3.0.3.3 AMPs That Are Not Consistent with or Not Addressed in the GALL Report

In LRA Appendix B, the applicant identified that the following AMPs were plant-specific:

For AMPs that are not consistent with or not addressed by the GALL Report, the staff performed a complete review of the AMPs to determine if they were adequate to monitor or manage aging. The staff's review of these plant-specific AMPs is documented in the following sections of this SER.

- Reactor Vessel and Internals Structural Integrity Program
- Systems Monitoring Program
- Preventive Maintenance Program
- Phase Bus Aging Management Program
- Fuel Pool Girder Tendon Inspection Program

3.0.3.3.1 Reactor Vessel and Internals Structural Integrity Program

Summary of Technical Information in the Application. This AMP is described in LRA Section B.2.28, "Reactor Vessel and Internals Structural Integrity Program." In the LRA, the applicant stated that this is an existing, plant-specific program. The applicant identified this program as a plant-specific AMP that incorporates both the required inservice inspection activities for Units 1 and 2 RV and RV internal components, as implemented in accordance of the applicant's ASME Section XI, Subsections IWB, IWC, and IWD Program, and the recommended inspection and flaw evaluation activities of the BWRVIP.

As a plant-specific AMP, the RV&ISIP includes a discussion on how the program meets the ten program elements required for AMPs, as defined and discussed in Branch Position RLSB-1 of SRP-LR, Appendix A, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants." The staff lists and evaluates the applicant's program elements for the RV&ISIP in the "Technical Evaluation" subsection.

The RV&ISIP also includes 10 tables which discuss how the applicant's AMP conforms to or deviates from the recommendations in pertinent BWRVIP inspection and flaw evaluation guidelines and pertinent NRC Applicant Action Items (AAIs) issued on these BWRVIP documents. The staff listed and evaluated the applicant's responses to the AAIs in the "Technical Evaluation" subsection.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section B.2.28 regarding the applicant's demonstration of the RV&ISIP to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation. The applicant stated that the RV&ISIP is an existing plant-specific AMP. Therefore, the applicant described the capabilities of this AMP in terms of how the program conforms to the 10 program elements for AMPs recommended in Branch Position RLSB-1 of the SRP-LR. Of these program elements, the staff evaluates the "corrective actions," "confirmation process," and "administrative controls" program elements for the RV&ISIP as part of the staff's evaluation of the applicant's Quality Assurance Program. The staff's evaluation of the Quality Assurance Program is given in SER Section 3.0.4. The staff's evaluation of the remaining seven program elements for the

RV&ISIP are given in subsections (1) through (7) below. In addition, subsection (8) to the staff evaluation for this AMP provides the staff's assessment of the applicant's responses to NRC applicant action items (AAIs) on applicable Topical Reports that were issued by Boiling Water Reactor Vessel and Internals Project (BWRVIP) for operating U.S. BWRs and that are within the scope of the RV&ISIP.

(1) Scope of Program

The applicant stated that the scope of the RV&ISIP is used to manage the effects of cracking, loss of material, flow blockage, loss of preload, and reduction in fracture toughness of the Units 1 and 2 RV and RV internal components. The applicant stated that EPRI Topical Report No. TR-113596, "BWRVIP-74-A: BWRVIP Vessel and Internals Project BWR Reactor Vessel Inspection and Flaw Evaluation Guidelines for License Renewal" (BWRVIP-74-A), dated June 2003, is the basis for the RV&ISIP. The applicant also stated that implementation of the guidelines in BWRVIP-74-A is performed in accordance with the implementation guidelines established in BWRVIP-94.

LRA Table 3.1.2-1 credits the RV&ISIP with aging management for the following RV and RV internal components:

- vessel shell attachment welds
- feedwater nozzles and their thermal sleeves
- vessel instrumentation penetrations
- standby liquid control penetrations
- flux monitor penetrations
- RV drain line penetration
- low pressure core spray line thermal sleeves
- core shroud shell (including upper, middle, and lower shell components)
- core shroud access hole covers
- core shroud repair hardware
- core plates and their bolts
- core plate plugs
- core shroud support structure
- top guide
- core spray line headers, nozzles, spargers, and spray-rings
- core spray line nozzle thermal sleeve
- jet pump instrument penetrations
- jet pump assembly components, including thermal sleeves, inlet headers, riser brace arms, hold down beams, inlet elbows, mixing assemblies, diffusers, castings, sensing lines, and fastener components (holddown beam keeper, lock plate, and bolts)
- fuel support and control rod drive (CRD) assembly components, including orifice fuel support and CRD housings
- flux monitor dry tubes, including those for the source range monitors, intermediate range monitors
- steam dryers (non-safety).

- shroud head and separators (non-safety)
- feedwater spargers (non-safety)
- RV surveillance capsule holder (non-safety)

BWRVIP-74-A provides recommended guidelines for inspection, assessment, mitigation, and repair/replacement strategies for the RV and RV internal components. The BWRVIP submitted BWRVIP-74 for NRC review and approval on September 21, 1999, and supplemented the report with additional information on March 7, 2000. The staff's approved BWRVIP-74 in an NRC letter and FSER, "Acceptance for Referencing EPRI Proprietary Report TR-113596, 'BWRVIP Vessel and Internals Project BWR Reactor Vessel Inspection and Flaw Evaluation Guidelines (BWRVIP-74)' and Appendix A, 'Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21),'" dated October 18, 2001. BWRVIP-74-A is the NRC-approved version of the report.

Table B.2.28-1 lists the topical reports relevant to the RV and RV internal components, along with the date and ADAMS accession numbers for any NRC FSERs issued in approval of these topical reports:

Table B.2.28-1

Component	Reference	SER Date	SER Accession Number
RV Components	BWRVIP-74-A	10/18/01	ML012920549
RV Shells	BWRVIP–05	03/07/00	ML003690281
Core Shroud Support and Attachments	BWRVIP-38	03/01/01	ML010600211
Core Shroud	BWRVIP-76	Under Review	N/A
Nozzle Safe Ends and Piping	BWRVIP-75	09/15/00	ML003751105
Core Support Plate	BWRVIP-25	12/07/00	ML003775989
Core ΔP/Standby Liquid Control (SLC) Line and Nozzle	BWRVIP-27	12/20/99	ML993630179
Core Spray, Jet Pump Riser Brace, and Other Attachments	BWRVIP-48	01/17/01	ML010180493
Core Spray Lines and Spargers	BWRVIP-18	12/07/00	ML003775973
Top Guide	BWRVIP-26	12/07/00	ML003776110
Jet Pump Assemblies	BWRVIP-41	06/05/01	ML011570460
RV Lower Plenum Components	BWRVIP-47	12/07/00	ML003775765
Instrument Penetrations	BWRVIP-49	03/13/02	Fiche A9153/241-253
Integrated RV Surveillance:	BWRVIP-78 (40-Yr.)	02/01/02	ML020380691

Component	Reference	SER Date	SER Accession Number
- Plan	BWRVIP-116 (60-Yr.)	Under Review	N/A
- Implementation	BWRVIP-86	02/01/02	ML020380691

The applicant's "scope of program" program element did not specify which RV and RV internal components were within the scope of the RV&ISIP or which additional BWRVIP guidelines (i.e., in addition to BWRVIP-74 and BWRVIP-94) were within the scope of the RV&ISIP relative to aging management of these components. The staff issued RAI B.2.28-1, Parts A, B, and C, dated May 18, 2005, to request clarification on which components and additional BWRVIP guideline documents are within the scope of the RV&ISIP and on the process to be taken if the applicant decides to deviate from the recommendations in pertinent NRC-approved BWRVIP topical reports.

The applicant provided its response to RAI B.2.28-1, Parts A, B, and C, by letter dated June 14, 2005. In its response to RAI B.2.28-1, Part A, the applicant confirmed that all of the components itemized in the bulleted list provided earlier in the section are within the scope of the RV&ISIP with the exception of the jet pump sensing lines.

The applicant also clarified that the CRD stub tube penetrations and incore flux monitor guide tubes were additional components that are within the scope of the RV&ISIP. For the jet pump sensing lines, the applicant originally took a position that the components, while within the scope of license renewal, do not require aging management because they are subject to daily surveillance requirements in accordance with the plant TS and because any potential failure of the lines would be detected as a result of the implementation of the TS surveillance requirements. The applicant added that the TS action statements would require that the facility be brought to Operating Mode 3 (hot standby) if one or more jet pump sensing lines were determined to be inoperable.

The applicant provided a supplemental response to RAIs B.2.28-1, Part A, by letter dated July 18, 2005, that clarified that the RV&ISIP will be credited, along with the Water Chemistry Program, as the basis for managing cracking due to SCC and loss of material due to pitting and crevice corrosion in the jet pump sensing lines. The staff has provided a comprehensive discussion and basis in SER Section 3.1.2.3 for approving the Water Chemistry Program and the RV&ISIP as the AMPs for managing cracking due to SCC and loss of material due to pitting and crevice corrosion in the jet pump sensing lines. The staff concluded that the applicant's initial and supplemental responses to RAI B.2.28-1, Part A are acceptable because the applicant clarified which RV internal components are within the scope of the RV&ISIP (including the jet pump sensing lines, CRD stub tubes penetrations, and incore flux monitor guide tubes) and has clarified how the RV&ISIP, along with the Water Chemistry Program, will be used to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in the jet pump sensing lines. Therefore, the staff's concern described in RAI B.2.28, Part A, is resolved.

In its response to RAI B.2.28-1, Part B, the applicant clarified that, in addition to BWRVIP-74-A and BWRVIP-94, the following BWRVIP reports were within the scope of RV&ISIP:

- BWRVIP-18, "Core Spray Internals Inspection and Flaw Evaluation Guidelines"

- BWRVIP-25, "Core Plate Inspection and Flaw Evaluation Guidelines"
- BWRVIP-26, "Top Guide Inspection and Flaw Evaluation Guidelines"
- BWRVIP-27, "Standby Liquid Control System/Core ΔP Inspection and Flaw Evaluation Guidelines"
- BWRVIP-38, "Shroud Support Inspection and Flaw Evaluation Guidelines"
- BWRVIP-41, "Jet Pump Assembly Inspection and Flaw Evaluation Guidelines"
- BWRVIP-47, "Lower Plenum Inspection and Flaw Evaluation Guidelines"
- BWRVIP-48, "Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines"
- BWRVIP-49, "Instrument Penetration Inspection and Flaw Evaluation Guidelines"
- BWRVIP-76 "Core Shroud Inspection and Flaw Evaluation Guidelines"

The applicant also clarified that the collective scope of these reports provides the "Inspection and Flaw Evaluation Guidelines" for the components that were confirmed to be within the scope of the RV&ISIP, as confirmed in the applicant's response to RAI B.2.28-1, Part A. The applicant also clarified that the scope of the RV&ISIP includes the following process for updating the scope of an AMP pending the staff's review of BWRVIP reports submitted for staff approval:

> The governing BSEP procedure for the Reactor Vessel and Internals Structural Integrity Program states:
>
> > Any required program changes (new or revised guidelines) should be incorporated into the program within 60 days of identification.

As indicated in SER Table B.2.28-1, with the exception of BWRVIP-76, these additional BWRVIP reports have been approved by the staff as being acceptable for implementation by BWR utilities, including BSEP. Therefore, it is acceptable to include them within the scope of the RV&ISIP. The applicant's commitment for the RV&ISIP includes a commitment to implement the NRC-approved version of BWRVIP-76 as part of the AMP once the report is finalized and approved by the staff (see Commitment Item #22). This is acceptable because the commitment is consistent with the BWRVIP implementation process for license renewal. The applicant's procedural step to incorporate any new or revised guidelines into the program confirms that the AMP includes measures to update the program for those unapproved BWRVIP reports that have been determined to be important to ensuring the integrity of a particular RV or RV internal component or commodity group of components and are pending NRC approval for implementation. This is acceptable to the staff.

In its supplemental response to RAI B.2.28-1, Part B, by letter dated July 18, 2005, the applicant added Topical Report BWRVIP-03, "BWR Vessel and Internals Project, Reactor Vessel and Internals Examination Guidelines," to the scope of the RV&ISIP because the report provides the basis for performing the UT examinations of the core plate rim hold-down bolts from the side of the core plates, which is an exception orientation of UT examinations recommended for these bolts in NRC-approved Topical Report BWRVIP-25. The staff's basis for accepting the recommended inspections in BWRVIP-03 for the examinations of the core plate rim hold-down bolts is given in the section titled "Technical Evaluation of the Applicant's Responses to AAIs on Applicable BWRVIP Topical Reports," subsection "Evaluation of the Applicant's Response to AAI 4 and 5 on BWRVIP-25."

The applicant also added Topical Report BWRVIP-139 to the scope of the RV&ISIP, because the report provides the applicant's augmented aging management strategy for the NSR steam dryers. This report is currently under review by the staff for acceptance. The staff's basis for accepting the recommended inspections in BWRVIP-139 for the examinations of the Units 1 and 2 steam dryers is given in the staff's evaluation of the "detection of aging effects" and "monitoring and trending" program elements for the RV&ISIP, subsection "Augmented Aging Management Activities for Non-Safety-Related RV Internal Components."

The list of BWRVIP topical reports that are within the scope of the RV&ISIP are either those that have been approved for implementation by the staff or those that are pending NRC acceptance through the BWRVIP report and BWR industry initiative acceptance process. The applicant clarified which additional BWRVIP topical reports are within the scope of the RV&ISIP. Based on the above, and the applicant's commitment regarding the BWRVIP topical reports, the staff found that RAI B.2.28-1, Part B, resolved and the program attribute acceptable.

The "scope of program" program element for the RV&ISIP states that the AMP is based on the BWRVIP's implementation guidelines in Topical Report BWRVIP-94. In RAI B.2.28-1, Part C, the staff requested confirmation that the scope of the RV&ISIP includes the following process for taking exceptions to NRC-approved BWRVIP recommendations:

> Each utility will inform the NRC of any decision to not fully implement a BWRVIP guideline approved by the NRC staff within 45 days of the report approval.
>
> The NRC should be notified if changes are made to the vessel and internals program that affect implementation of the BWRVIP guidelines.
>
> Flaw evaluations that deviate from guidance in BWRVIP reports shall be submitted to the NRC for approval.

The applicant provided the following response to RAI B.2.28-1, Part C, by letter dated June 14, 2005:

> The governing BSEP procedure for the Reactor Vessel and Internals Structural Integrity Program incorporates the recommendations from the best available guidance from the BWRVIP. These recommendations are within the scope of the BSEP responses to AAI No. 1 on Topical Report Numbers: BWRVIP-74-A, -18, -25, -26, -27, -38, -41, -47, -48, and -49.

Although the applicant did not confirm applicability of the information requested by the staff, the "scope of program" program element for the RV&ISIP clearly indicates the implementation guidelines of BWRVIP-94 are within the scope of the RV&ISIP. Since BWRVIP-94 includes the above reporting processes for deviating from, or making changes to, the BWRVIP inspection and evaluation guidelines that are within the scope of the RV&ISIP, the staff concluded that no additional confirmation of this is necessary, and RAI B.2.28-1, Part C, is resolved.

(2) Preventive Actions

The applicant stated that it implemented control of water chemistry to reduce the susceptibility of the RV and RV internal components to SCC (including IGSCC or irradiation assisted stress corrosion cracking (IASCC). The applicant stated that control of water chemistry is performed in accordance with the latest BWRVIP guidelines but did not specify which water chemistry guideline was being implemented for water chemistry control. In RAI B.2.28-2, dated May 18, 2005, the staff requested the applicant to clarify whether the Water Chemistry Program was also being used to mitigate the susceptibility of the RV and RV internal components to corrosive type of loss of material mechanisms, such as pitting corrosion or crevice corrosion. The staff also requested identification of the specific guideline document being used for water chemistry control.

By letter, dated June 14, 2005, the applicant clarified that TR-103515, Revision 2 is currently being implemented for water chemistry purity and control purposes and that the Water Chemistry Program is credited with the management of loss of material due to general, pitting, or crevice corrosion (in addition to management of flow blockage or cracking due to SCC, IGSCC, or IASCC). The applicant also clarified that the Water Chemistry Program will be supplemented to incorporate the recommendations in updated versions of this report as they are released by EPRI for implementation. Since the applicant has clarified which water chemistry guideline is being implemented for water chemistry control, RAI B.2.28-2 is resolved. The staff has evaluated the Water Chemistry program in Section 3.0.3.2.1 of this SER and has concluded that the applicant's Water Chemistry Program is an acceptable mitigative AMP for managing cracking and loss of material in BSEP components that are within the scope of license renewal. Based on this assessment, the staff concludes that the "preventive actions" program element is acceptable for implementation because the applicant will use the Water Chemistry Program to minimize the concentrations of impurities that, if left uncontrolled, could potentially induce these aging mechanisms in the RV internal components.

(3) Parameters Monitored or Inspected

The BWRVIP guideline documents address the intended functions of the RV and RV internal components, identify all aging effects that are applicable to these components, and propose recommended inspections for those components whose intended functions could be impacted by the aging effects applicable to the components. The applicant stated that the BWRVIP-developed inspection plans for the RV and RV internal components are based on the ability of the recommended inspection techniques to detect the aging mechanisms that are applicable to the components. The applicant's "parameters monitored or inspected" program element did not specify which aging effects/aging mechanisms are applicable to the RV and RV internal components within the scope of the RV&ISIP and are managed by the RV&ISIP. However, in the "scope of program" program element for this AMP, the applicant does identify that the RV&ISIP is used to manage the effects of cracking, loss of material, flow blockage, loss of pre-load, and reduction of fracture toughness in the RV and RV internal components. Since these aging effects have been identified in the "scope of program" program element, the staff has interpreted the RV&ISIP to also include these aging effects as being within the scope of the AMP's "parameters monitored/inspected" program element.

These aging effects are consistent with aging affects that are recommended for management in GALL AMP XI.M9, "BWR Internals Program," for RV and RV internal components and are consistent with the AERMs that been identified for the RV and RV internal components in LRA Table 3.1.2-1. Since these aging effects are consistent with the aging effects in GALL AMP XI.M9 and with the AERMs identified by the applicant in LRA Table 3.1.2-1, the staff concluded that the applicant has identified the applicable aging effects that are within the scope of, and are managed by, the applicant's RV&ISIP. Thermal fatigue of the RV and RV internal components is managed through the applicant's TLAA on Fatigue of ASME Code Class 1 and 2 components, which is discussed in LRA Section 4.3. The staff evaluated the TLAA on Fatigue of ASME Code Class 1 and 2 components in SER Section 4.3.

(4) and (5) Detection of Aging Effects and Monitoring and Trending

In the "detection of aging effects" and the "monitoring and trending" program elements, the applicant stated that the RV&ISIP uses a combination of ultrasonic, visual, and surface examinations to inspect the RV and RV internal components that are within the scope of the AMP. The applicant stated that the inspection methods and inspection frequencies used for the RV and RV internal components vary from component to component and will be consistent with the methods of examination and inspection frequencies specified in the applicable BWRVIP guidelines. The following subsections discuss the applicant's bases for performing augmented inspections of specific RV and RV internal components, as implemented in accordance with either (1) the BWRVIP topical reports that are within the scope of the RV&ISIP, (2) alternative inspection guidelines proposed by the Boiling Water Reactor Owners Group (BWROG) that have been approved by the NRC, or (3) other alternative bases for aging management that are evaluated in this section and approved for aging management.

- Augmented Inspections of the RV Feedwater Nozzles

The applicant stated that its inspections of the RV feedwater nozzles will be consistent with the methods of inspection and inspection frequencies specified in the BWROG, "Alternate BWR Feedwater Nozzle Inspection Requirements" report. This BWROG report provides the BWR industry's recommended guidelines for inspecting BWR feedwater nozzle components and was submitted for NRC approval on September 24, 1999. The staff approved the BWROG "Alternate BWR Feedwater Nozzle Inspection Requirements" report for implementation in its FSER to the BWROG dated March 10, 2000, (refer to ADAMS Accession Number ML003690673). Based on the staff's approval of the BWROG "Alternate BWR Feedwater Nozzle Inspection Requirements" report, the staff concluded that it is acceptable for the applicant to use the BWROG "Alternate BWR Feedwater Nozzle Inspection Requirements" report as the basis for managing cracking in the feedwater nozzles.

- Augmented Inspections of Top Guides

As an enhancement of the RV&ISIP, the applicant stated that BSEP will perform augmented inspections of the top guides (see Commitment Item #22). The applicant stated that the augmented inspections of the top guides will be performed using BWRVIP-26 and enhanced by VT-1 examination methods and that the sample sizes will be similar to those performed on the CRD guide tubes. The staff noted that the top guide in each unit is only a single component. In RAI B.2.28-3, dated May 18, 2005, the staff requested additional information on the criteria that will be used to define the sample size and inspection frequency for the inspections of the BSEP top guides and the criteria that will be used to select the top guide locations for inspection.

The applicant provided its response to RAI B.2.28-3 in Serial Letter 05-0071 dated June 14, 2005. The staff concluded that the response to RAI B.2.28-3 is acceptable because the applicant has clarified that inspections will be an enhanced VT-1 visual or a volumetric examination of those top guide locations in the areas that are expected to achieve the highest neutron fluence exposures and that the schedule and sample size will be 10% of the affected susceptible area within 12 years with 5% being completed within 6 years of the beginning of the period of extended operation. Since all of this is consistent with the inspection and flaw evaluation guidelines of BWRVIP-26, the staff concluded that the details of the proposed inspections for the top guides are acceptable. Therefore, the staff's concern described in RAI B.2.28-3 is resolved.

- Augmented Inspections of Core Shroud Repair Clamps

The applicant performs augmented inspections of the core shroud repair bracket assemblies (core shroud repair clamps). In a letter dated June 23, 2000, (BSEP 00-0069), the applicant indicated that it inspects 25 percent of the core shroud repair clamps during scheduled refueling outages (RFOs) for Units 1 and 2. This appears to differ from the sample size recommended in BWRVIP-76 for BWR core shroud repair hardware assemblies. In the "monitoring and trending" program element for the RV&ISIP, the applicant stated that the following type of augmented inspections would be used for the examinations of the core shroud repair clamps during the periods of extended operation for BSEP:

> The examination of the Core Shroud Repair Brackets should consist of a VT-3 inspection of the locking devices, contact areas, bolting, and the overall condition of the component. Bolt tightness should be verified by visually examining the repair assembly and verifying that the threaded components are seated and that there are no unintended gaps at the tensioned member contact points.

In RAI B.2.28-4, dated May 18,2005, the staff requested clarification on why the percentage of core shroud repairs clamps currently inspected during each RFO was different from the recommendations on inspection sample size for core shroud repair assemblies in BWRVIP-76. The staff also inquired whether the applicant would continue its practice of performing augmented inspections of the core shroud repair clamps in each unit during scheduled refueling outages in the periods of extended operation, and if so, asked for the applicant to identify the inspection method(s), sample size, and inspection frequency that it will use for the augmented inspections of the core shroud repair clamps.

The applicant provided its response to RAI B.2.28-4 in Serial Letter BSEP 05-0071, dated June 14, 2005 (see Commitment Item #22). The applicant's response clarified that it is performing its inspections of the core shroud repair hardware in conformance with the augmented inspection criteria of BWRVIP-76. BWRVIP-76 is still pending staff approval as an acceptable inspection and flaw evaluation guideline for core shroud components and their repair hardware designs. However, the applicant's response is acceptable because the applicant has modified its original commitment for the RV&ISIP to implement BWRVIP-76 according to the recommendations and criteria in the NRC-approved version of the report, once the staff's review of the report has been completed. Therefore, the staff concern described in RAI B.2.28-4 is resolved.

- Augmented Aging Management Activities for BSEP-2 Spring-Loaded Core Plate Plugs

LRA Section 4.2.8 provides the applicant's TLAA for analyzing stress relaxation in the Unit 2 spring-loaded core plate plugs. In this TLAA, the applicant dispositioned the TLAA as being in compliance with 10 CFR 54.21(c)(1)(iii), in that the applicant opted to credit the RV&ISIP with the management of stress relaxation in the Unit 2 spring-loaded core plate plugs. In SER Section 4.2.8, the staff concluded that the RV&ISIP can be used to satisfy the criterion for TLAAs in 10 CFR 54.21(c)(1)(iii) and to manage stress relaxation in the Unit 2 core plate plugs.

However, the applicant did not include any discussion in LRA Section B.2.28 on how the RV&ISIP will be used to manage stress relaxation in the Unit 2 spring-loaded core plate plugs during the period of extended operation for Unit 2. In RAI B.2.28-5, dated May 18,2005, the staff requested additional information on how the RV&ISIP would be used to manage stress relaxation in the Unit 2 spring-loaded core plate plugs.

In its response to RAI B.2.28-5, dated June 14, 2005, the applicant stated:

> In the response to RAI 4.2.8-1, Part A, and RAI 4.2.8-2 in BSEP letter to the NRC (Serial: BSEP 05-0050), dated May 4, 2005, BSEP stated that the Reactor Vessel and Internals Structural Integrity Program, discussed in BSEP LRA Section B.2.28, will manage loss of preload due to stress relaxation of the spring-loaded core plate plugs installed in Unit 2 by replacement.

The applicant provided additional information in its supplemental response to RAI B.2.28-5, by letter dated July 18, 2005:

> Based on current fluence projections, the replacement of the spring-loaded core plate plugs installed in Unit 2 will occur during the refueling outage that is currently scheduled for 2011. Any evaluation to extend the service life of the spring-loaded core plate plugs will be submitted to the NRC for review and approval.

The applicant's two responses to RAI B.2.28-5 clarify that the applicant's basis for managing stress relaxation in the Unit 2 spring-loaded core plate plugs will be to replace them and that the replacement of the plugs is scheduled to be performed in the Unit 2 2011 refueling outage. The applicant included its program to replace the Unit 2 spring-loaded core plate plugs for the RV&ISIP in Commitment Item #22. This is acceptable because the replacement activity will be performed prior to the period of extended operation for Unit 2 and because any decision to extend the life of the plugs will be evaluated by the applicant and the evaluation will be submitted to the NRC for review and approval. The staff's concern described in RAI B.2.28-5 is resolved.

- Augmented Inspections of the Welded Access Hole Covers

The AMR analysis in GALL Commodity Group item IV.B1.1-b, "Core Shroud and Core Plate," identified crack initiation and growth due to SCC, IASCC, or IGSCC as an AERM for welded access hole covers (AHCs). The AMR analysis recommends that GALL AMP XI.M1, "ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD," and GALL AMP XI.M2, "Water Chemistry," be used to manage these aging mechanisms in welded AHCs. In its discussion for the AMR, the staff emphasized that aging management strategies are to include augmented UT or other demonstrated acceptable examination methods of the AHC welds because cracking initiated in the crevice regions of the AHCs would not be amenable to visual inspection methods for BWR designs that include a creviced region in the AHCs. During the audit, the staff issued Audit Question 3.1-2 on aging management strategies for welded core plate AHCs:

> In LRA Table 3.1.2-1, Reactor Vessel and Internals, the cracking due to SCC in access hole cover (AHC) made out of nickel-based alloy and expose to reactor water is managed by the water chemistry program and the reactor vessel and internals structural integrity program. In the referenced LRA Table 1 item 3.1.1-32, the applicant also states that BSEP has only one welded AHC and cracking due to SCC in AHC will be managed by the ASME Section XI ISI program

and the water chemistry program, which is consistent with the GALL recommendations. Clarify the discrepancy in the AMPs stated in the LRA Table 3.1.2-1 for the AHC and the LRA Table 1 item 3.1.1-32.

The applicant provided its response to Audit Question 3.1-2 , by letter dated March 14, 2005. In this letter, the applicant clarified that the procedures that implement the RV&ISIP include enhanced inspections of the access hole covers and that the inspections will be performed using either a ultrasonic test (UT) or an enhanced visual test-1 (EVT-1) (see Commitment Item #22).

The staff determined that there were two aspects of the applicant's response to Audit Question 3.1-2 that needed additional resolution. In Item (b) of the applicant's response to the audit question, the applicant indicates that an enhanced VT-1 visual examination technique may be used detect and monitor for cracking in the creviced region of the welded AHC. Yet the staff's discussion in GALL Commodity Group Item IV.B1.1-b stated that visual inspection techniques are not capable of detecting cracks that could initiate in the creviced regions of the AHC. In Item (c) of the applicant's response to the audit question, the applicant indicates that the RV&ISIP and the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program are equivalent. While the staff would concur that the RV&ISIP incorporates all of the applicable ASME Section XI inspections for the RV and RV internal components, the RV&ISIP also incorporates additional augmented inspections that are recommended by the BWRVIP as industry initiatives and that actually go beyond those inspections that are required by the ASME Code, Section XI. In RAI B.2.28-6, Part A, dated May 18, 2005, the staff inquired, relative to the staff's position in GALL Commodity Group line item IV.B1.1-b, how an enhanced VT-1 visual examination of the weld would be capable of detecting cracking in the creviced region of a welded AHC. In RAI B.2.28-6, Part B, dated May 18, 2005, the staff requested confirmation that the RV&ISIP is considered to be a more comprehensive inspection program for the RV and RV internals than is the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program.

In its response RAI B.2.28-6 dated June 14, 2005 (Refer to Serial Letter BSEP 05-0071), the applicant provided information on how the augmented inspections of the welded AHCs would be performed. However, the applicant's response did not resolve the issue of how an enhanced VT-1 examination would be an acceptable examination technique for detecting cracks in the AHCs. To resolve this, the applicant supplemented its response to RAI B.2.28-6 with additional information in Serial Letter BSEP 05-0097, dated July 18, 2005. The applicant clarified that the augmented inspections of the welded AHCs will be performed using a volumetric examination method, either with or without an accompanying visual examination. The staff concludes that this is acceptable because the examination technique proposed by the applicant is consistent with the augmented inspection technique discussion in GALL Commodity Group line item IV.B1.1-b. RAI B.2.28-6 is resolved.

- Augmented Inspections of the Core Spray Sparger Nozzles to Monitor for Flow Blockage

The staff determined that the applicant's AMR for the core spray nozzles, as given in LRA Table 3.1.2-1, identified flow blockage as an AERM for the core spray nozzles and credited the RV&ISIP and the Water Chemistry Program with management of this aging effect. BWRVIP Topical Report BWRVIP-18-A, as approved in the NRC's FSER of December 7, 2000, provides the BWRVIP's recommended inspections and flaw evaluation methods for RV internal core spray lines and their components. The NRC-approved topical report focuses on the management of cracking and loss of material in these components but does not

appear to focus on how flow blockage of the core spray nozzles will be managed.
In RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Parts A and B, dated May 18, 2005, the staff requested clarification on how the RV&ISIP will be used to manage flow blockage in the core spray nozzles and possibly in the feedwater sparger nozzles.

In its response to RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A, by letter dated June 14, 2005, the applicant stated:

> Part A: Corrosion products associated with loss of material are considered capable of impeding the flow of emergency coolant through the core spray nozzles. As shown in Table 3.1.2-1, flow blockage due to fouling is managed with a combination of the Water Chemistry Program and the Reactor Vessel and Internals Structural Integrity Program. The Water Chemistry Program mitigates the formation of corrosion products by controlling oxygen, chlorides, sulfates, etc. The verification that the Water Chemistry Program is effective is through the use of the Reactor Vessel and Internals Structural Integrity Program. The inspection of the core spray components is through BWRVIP-18-A. The NRC has previously found that the use of inspections per the BWRVIP guidelines is adequate.
>
> Section 2.3.2.3 of NUREG-1803, "Safety Evaluation Report Related to the License Renewal of the Edwin I. Hatch Nuclear Plant, Units 1 and 2," states:
>
> > In the call made on June 26, 2000, the staff expressed concern that blockage of the spray holes of the core spray spargers through aging could keep the core spray system from performing its intended function of spraying the fuel bundles following a LOCA, and thus may fail to provide adequate core cooling for the short- and long-term following the LOCA. The applicant replied that, because the core spray piping is made of stainless steel, corrosion is not a credible aging mechanism to cause flow blockage. The applicant further stated that BWRVIP-18, "Core Spray Internals Inspection and Flaw Evaluation Guidelines," provides a means to inspect the core spray piping. The staff believes that adequate long-term core cooling can only be assured by maintaining the original core spray distribution that was assumed for the CLB. The staff, therefore, will rely on the BWRVIP inspection program to provide reasonable assurance that the original spray distribution will be maintained during the period of extended operation.
>
> Therefore, the combination of the Water Chemistry Program and the Reactor Vessel and Internals Structural Integrity Program will be effective in managing flow blockage due to fouling during the period of extended operation.

The applicant provided the following supplemental response to RAI B.2.28-7/RAI 3.1.2.3.1.2, Part A, by letter dated July 18, 2005, to clarify that the Water Chemistry Program was the AMP credited for aging management of flow blockage in core spray sparger nozzles and that the RV&ISIP was only being used to inspect for cracking or loss of material in the components (see Commitment Item #22):

> The BSEP Water Chemistry Program has been effective in mitigating loss of material and cracking. The Chemistry Performance Index (CPI) was developed by the Institute for Nuclear Power Operations (INPO) to provide a single performance indicator for plant chemistry performance. This formula compares three factors monitored in BWR Feedwater/Reactor Water. These three factors are Final Feedwater Iron, Reactor Pressure Vessel (RPV) Sulfates and RPV Chlorides. These results are compared to INPO-compiled Industry Mean Values from 1993 for all BWR plants.
>
> The BSEP CPI trend since 2002 has been:

	Unit 1	Unit 2
2002	1.049	1.036
2003	1.012	1.000

2004	1.169	1.000

Specific data on chemistry parameters follows:

Parameter	2002	2003	2004
RPV Chlorides			
Unit 1	0.504 ppb	0.301 ppb	0.351 ppb
Unit 2	0.499 ppb	0.331 ppb	0.236 ppb
FW Iron			
Unit 1	0.812 ppb	0.367 ppb	0.575 ppb
Unit 2	0.318 ppb	0.439 ppb	0.201 ppb
RPV SO_4			
Unit 1	2.046 ppb	1.686 ppb	1.990 ppb
Unit 2	1.779 ppb	0.891 ppb	0.469 ppb

In addition, the structural integrity of the core spray spargers will be verified by performing inspections so that the original core spray distribution will be preserved during the extended period of operation.

Therefore, the combination of the Water Chemistry Program and the Reactor Vessel and Internals Structural Integrity Program are effective in managing flow blockage due to fouling of the core spray nozzles.

The applicant's supplemental RAI response demonstrates that the applicant is controlling the concentrations of ionic impurities in the reactor coolant to concentrations of only 2 parts per billion (ppb) or less. These concentrations are lower than those for which EPRI recommends corrective action in Table 4-5a (no hydrogen water chemistry) or Table 4-5b (hydrogen water chemistry) of EPRI BWR water chemistry guidelines being implemented by the applicant (refer to the discussion of the "preventive actions" program element). Thus, the applicant is maintaining the Units 1 and 2 reactor coolant system water at a high purity level. Based on this analysis, the staff concludes that Water Chemistry Program will be sufficient by itself to manage flow blockage of the core spray sparger nozzles because, at these concentrations, the Water Chemistry Program will preclude the precipitation of corrosion products which otherwise could potentially lead to blockage of the core spray sparger nozzles orifices.

Currently, the RV&ISIP is not a sufficient AMP to credit with management of flow blockage in these nozzles because the inspections recommended in Topical Report BWRVIP-41 for the core spray sparger nozzles do not include visual inspections of the core spray sparger nozzle orifices to look for corrosion products that might be blocking the flow paths. However, the staff does conclude that the augmented inspections of the core spray sparger structural welds, as implemented in accordance with BWRVIP-41, will be sufficient to assure the structural integrity of the core spray sparger nozzles during the periods of extended operation for BSEP because the NRC has approved the augmented inspection recommendations in BWRVIP-41 in its SE to the BWRVIP dated May 1, 2001. Therefore, the staff's concern described in RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A is resolved.

In its response to RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part B, by letter dated June 14, 2005, the applicant clarified that the feedwater spargers are designed with flow holes in lieu of nozzles.

Therefore, the staff does not consider flow blockage to be a concern for the feedwater spargers. Based on this assessment, the staff agreed with the applicant and concluded that flow blockage is not an AERM of concern for the feedwater spargers. Therefore, the staff's concern described in RAI B.2.28-7/3.1.2.3.1.2-3, Part B, is resolved.

- Augmented Aging Management Activities for Non-Safety-Related RV Internal Components

The staff noted that, in LRA Table 3.1.2-1, the applicant identified that cracking due to SCC and/or IASCC and loss of material due to pitting or crevice corrosion are applicable AERMs for four NSR RV internal components: (1) the steam dryers, (2) the core shroud heads and separators, (3) the internal feedwater spargers, and (4) the RV surveillance capsule holders. The staff also determined that the applicant credited the RV&ISIP and the Water Chemistry Program with the management of these aging effects/aging mechanisms during the periods of extended operation. The staff determined that the current set of BWRVIP topical reports does not address aging management strategies and activities for these NSR RV internal components. In RAI B.2.8-8, Parts A and B, dated May 18, 2005, the staff requested that the applicant provide additional information on how the RV&ISIP would be used to manage cracking due to SCC or IASCC and loss of material due to pitting and crevice corrosion in the steam dryers, core shroud heads and separators, internal feedwater spargers, and RV surveillance capsule holders.

The applicant provided its response to RAI B.2.28-8 in Serial Letter BSEP 05-007, dated June 14, 2005, as supplemented its response with additional information in Serial Letter BSEP 05-0097, dated July 18, 2005. The applicant's response indicated that the Water Chemistry Program will be credited for aging management of the steam dryers, feedwater nozzle spargers, core shroud head and separators, and surveillance capsule holders. The staff evaluated the Water Chemistry Program in SER Section 3.0.3.1.

In the applicant's responses to RAI B.2.28-8, the applicant also credited the RV&ISIP for aging management regarding loss of material and cracking in the steam dryers and committed to implementing the recommendations of Topical Report BWRVIP-139 (the Inspection and Flaw Evaluation Guidelines for Steam Dryers) once the inspection guidelines are reviewed and approved by the NRC (see Commitment Item #22). The applicant intends to follow the recommended guidelines in topical report BWRVIP-139 for the RV&ISIP. The commitment was provided in the applicant's supplemental response to RAI B.2.28-15, Part B, dated July 18, 2005 (see Commitment Item #22). This is acceptable because the applicant's commitment will ensure that the inspections of the steam dryers will follow the augmented inspection guidelines of Topical Report BWRVIP-139, once the report is approved by the staff, and the FSER on the report is issued to the BWRVIP. Therefore, RAI B.2.28-8 is resolved with respect to performing augmented inspections of the stream dryers.

For the feedwater spargers, the applicant credited the RV&ISIP for aging management through use of the inspection guidelines that are established in the BWROG "Alternate BWR Feedwater Nozzle Inspection Requirements" report, which were issued by the BWROG and approved by the staff (refer to the NRC FSER of March 10, 2000, which may be accessed through ADAMS Accession Number ML003690673) to conform to the recommendations in NUREG-0619, "BWR Feedwater Nozzle and Control Rod Return Line Nozzle Cracking" (see Commitment Item #22). This is an NRC-recommended inspection program for BWR feedwater nozzle and spargers and is acceptable. RAI B.2.28-8 is resolved with respect to performing augmented inspections of the feedwater nozzles and spargers.

The applicant did not initially couple any inspection-based AMP with its proposal to credit the Water Chemistry Program with aging management of the NSR RV surveillance capsule holders and the core shroud heads and separators. To correct this, the applicant proposed in its supplemental response to RAI B.2.28-8 to credit a one-time inspection of these components. This is acceptable because these components are not highly loaded and because industry experience has not yet indicated that cracking due to SCC, IGSCC, or IASCC or that loss of material due to general, pitting, or crevice corrosion are AERMs for these components. The staff evaluates the One-time Inspection Program in SER Section 3.0.3.1 of this SER.

As indicated in the applicant's AMRs for RV attachment welds, aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in the structural welds attaching the surveillance capsule holders to the reactor vessel will be accomplished using the Water Chemistry Program and augmented inspections of BWRVIP-74-A, as invoked by the RV&ISIP and approved by the staff in its SE on BWRVIP-74. RAI B.2.28-8 is resolved with respect to performing augmented inspections of the NSR RV surveillance capsule holders and the core shroud heads and separators.

(6) Acceptance Criteria

The applicant stated that the acceptance criteria for the RV&ISIP are those that are specified in the specific BWRVIP inspection and flaw evaluation guidelines that are within the scope of the AMP. Progress Energy's commitment to participate and implement the recommend guidelines that are established by the BWRVIP is given the generic BWRVIP commitment letter of May 30 1997, from Mr. Carl Terry, Chairman of the BWRVIP to Dr. Brian Sheron, U.S. Nuclear Regulatory Commission. The letter commits Progress Energy to implementing those BWRVIP inspection and flaw evaluation guidelines that have been approved by the staff (see Commitment Item #22). The BWRVIP inspection and flaw evaluation guidelines that are within the scope of the RV&ISIP have been approved by the staff. These NRC-approved guidelines provide the flaw evaluation acceptance criteria for evaluating degradation that may be detected as a result of the applicant's implementation of these guidelines. For those BWRVIP inspection and flaw evaluation guidelines that are pending staff approval, the applicant has committed to implement the NRC-approved versions of the BWRVIP guidelines once they have been approved by the staff and the approved versions have been issued by the BWRVIP for implementation (see Commitment Item #22). Based on the applicant's commitments to implement the BWRVIP inspection and flaw evaluation guidelines that are within the scope of the RV&ISIP, the staff concluded that the "acceptance criteria" program element for the RV&ISIP is acceptable.

(7) Operating Experience

The applicant provided the following discussion in the "operating experience" program element for the RV&ISIP:

> The OE of BSEP mirrors that of the BWR fleet. The program guidelines outlined in applicable BWRVIP documents are based on evaluation of available OE information, including BWR inspection results and information on the elements that cause degradation. This information is used to determine which components may be susceptible to cracking and loss of material and to enhance

> inspection strategies, as applicable. Implementation of the Program provides reasonable assurance that the aging effects will be adequately managed so the intended functions of the reactor vessel and internals components will be maintained consistent with the CLB for the period of extended operation.

The BWRVIP's industry initiatives and topical reports for BWR RV and RV internal components were developed to summarize pertinent age-related degradation operating experience for BWR RV and RV internal components and to provide the BWR industry with a series of recommended augmented inspection and evaluation activities that would be equivalent to those required by the ASME Code, Section XI, or would go beyond the requirements of the ASME Code, Section XI. The staff's evaluation of the [Scope of Program] attribute for this AMP summarizes the BWRVIP Reports that are within the scope of the RV&ISIP. The BWRVIP Reports provide acceptable summaries and evaluations of the operating experience that is applicable to the BSEP RV internals. Therefore, the applicant's response is acceptable because BWRVIP reports address the relevant operating experience for BSEP RV internals.

In response to a recommendation that was raised in Advisory Committee on Reactor Safeguards (ACRS) Correspondence Letter ACRS-2091 to the Commission, dated September 14, 2004, the applicant included the steam dryers within the scope of license renewal. The applicant provided an AMR for the steam dryers in LRA Table 3.1.2-1 and credited the RV&ISIP and the Water Chemistry Program with the management of cracking and loss of material that could occur in the components during the periods of extended operation The staff's evaluation of the applicant's basis for managing cracking due to SCC and loss of material due to pitting and crevice corrosion of the steam dryers has been discussed in the staff evaluation of the "detection of aging effects" and "monitoring and trending" program elements for this AMP under the subsection titled, "Augmented Aging Management Activities for NSR RV Internal Components." The staff's evaluation includes the staff's basis for accepting resolution of RAI B.28-8 on aging management of the steam dryers.

Since the applicant addressed the operating experience that is relevant to BWRVIP augmented inspection recommendations and the BWR steam dryer experience and issue that was discussed in ACRS Correspondence Letter ACRS-2091, the staff concluded that the applicant's "operating experience" program element for the RV&ISIP is acceptable.

(8) Evaluation of the Applicant's Responses to AAIs on Applicable BWRVIP Topical Reports

The applicant also provided a number of tables in AMP B.2.28 that discuss the applicant's responses to the AAIs that are given in the staff's FSERs on specific BWRVIP Guideline Documents. These tables include:

- Table 1 - Responses to AAIs on BWRVIP-74-A, *BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal*
- Table 2 - Responses to AAIs on BWRVIP-18, *BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines*
- Table 3 - Responses to AAIs on BWRVIP-25, *BWR Core Plate Inspection and Flaw Evaluation Guidelines*
- Table 4 - Responses to AAIs on BWRVIP-26, *BWR Top Guide Inspection and Flaw Evaluation Guidelines*

- Table 5 - Responses to AAIs on BWRVIP-27, *BWR Standby Liquid Control System / Core Plate ΔP Inspection and Evaluation Guidelines*
- Table 6 - Responses to AAIs on BWRVIP -38, *BWR Shroud Support Inspection and Flaw Evaluation Guidelines*
- Table 7 - Responses to AAIs on BWRVIP-41, *BWR Jet Pump Assembly Inspection and Flaw Evaluation Guidelines*
- Table 8 - Responses to.AAIs on BWRVIP-47, *BWR Lower Plenum Inspection and Flaw Evaluation Guidelines*
- Table 9 - Responses to AAIs on BWRVIP-48, *BWR Vessel ID Attachment Weld Inspection and Flaw Evaluation Guidelines*
- Table 10 - Responses to AAIs on BWRVIP 49, *Instrument Penetration Inspection and Flaw Evaluation Guidelines*

The staff evaluated the applicant's responses to these AAIs. With respect to the applicant's responses to the AAIs, the staff found that the applicant had in all cases properly identified the AAIs and provided an acceptable bases for responding to and resolving the required renewal actions raised in the AAIs, with the following exceptions:

- AAI No. 1 on BWRVIP Topical Reports BWRVIP-74-A,-18, - 25, -26, -27, -38, -41, -47, -48, and -49: "The LR applicant is to verify that its plant is bounded by the topical report. Further, the renewal applicant is to commit to programs described as necessary in the BWRVIP report to manage the effects of aging on the functionality of the reactor vessel instrument penetrations during the period of extended operation. Applicants for license renewal will be responsible for describing any such commitments and identifying how such commitments will be controlled. Any deviations from the aging management programs within this BWRVIP report described as necessary to manage the effects of aging during the period of extended operation and to maintain the functionality of the reactor vessel components or other information presented in the report, such as materials of construction, will have to be identified by the renewal applicant and evaluated on a plant-specific basis in accordance with 10 CFR 54.21(a)(3) and (c)(1)."

  The applicant stated that BSEP participates in the BWRVIP activities and that, as such, the BWRVIP initiatives are applicable to BSEP. The applicant stated that, for current and future open issues between the BWRVIP and the NRC, BSEP will work as part of the BWRVIP to resolve these issues generically with the staff. The applicant stated that if it is determined that exceptions to full compliance with the recommended guidelines of a BWRVIP report is warranted, BSEP will notify the NRC of the exception(s) to the guidelines within 45 days of receipt of the NRC's FSER and approval of the applicable BWRVIP guideline report.

  The staff determined that the "scope of program" program element for the RV&ISIP states that Topical Report BWRVIP-94 is within the scope of the AMP.

  In RAI B.2.28-1, Part C, the staff requested confirmation that these BWRVIP-94 recommendations are within the scope of the RV&ISIP and the scope of the applicant's collective responses to Applicant AAI No. 1 on Topical Reports BWRVIP-74-A, -18, -25, -

26, -27, -38, -41, -46, -47, -48, and -49. The staff's evaluation of the "scope of program" program element for this AMP has included its basis for confirming that the RV&ISIP includes these processes and the basis for resolving RAI B.2.28-1, Part C. Since the staff has concluded that the RV&ISIP includes these processes, RAI B.2.28-1, Part C is resolved and the applicant's generic response to AAI No. 1 on BWRVIP Topical Reports BWRVIP-74-A, -18, - 25, -26, -27, -38, -41, -47, -48, and -49 is acceptable.

- AAI No. 2 on BWRVIP Topical Reports BWRVIP-74-A,-18, - 25, -26, -27, -38, -41, -47, -48, and -49 : "10 CFR 54.21(d) requires that the UFSAR supplement for the facility must contain a summary description of all programs and activities for managing the effects of aging and all evaluations of TLAAs for the period of extended operation. Applicants for license renewal referencing applicable BWRVIP topical reports are to ensure that the programs and activities specified as necessary in the reports are summarily described in the UFSAR supplement."

  The applicant's response to the AAI stated that the UFSAR supplement will include a summary description of the programs and activities specified as necessary in the BWRVIP reports.

  10 CFR 54.21(d) requires applicants to include an UFSAR supplement summary description only for each AMP and TLAA that is within the scope of an LRA but not necessarily for each topical report that is identified as being within the scope of an AMP or TLAA. In RAI B.2.28-9, dated May 18, 2005, the staff recommended that the applicant make the following revision to its generic response to AAI No. 2:

  > To satisfy the requirements of 10 CFR 54.21(d), the UFSAR Supplement for the BSEP-1/2 LRA includes a summary description for each AMP and TLAA that is within the scope of the LRA. Should the scope of a specific AMP or TLAA invoke a specific BWRVIP report as a subset of the AMP or TLAA, the summary description will state that CP&L is an active participant in the BWRVIP programs, and that CP&L will implement the guidelines of the applicable BWRVIP report, as approved in the NRC's final safety evaluation report on the specific BWRVIP guideline.

  In its response, dated June 14, 2005, the applicant stated :

  > BSEP will update its response to Applicant Action Item 2, for each of the applicable BWRVIP reports, based on the recommendations. Also see the response to RAI B.2.28-15 below.

  Since the applicant complied with the UFSAR supplement summary description requirement of 10 CFR 54.21(d) and has indicated that it would change its generic response to AAI No. 2 to reflect compliance with these requirements, the staff concluded that the applicant has satisfied generic AAI No. 2 on BWRVIP Topical Reports BWRVIP-74-A, -18, - 25, -26, -27, -38, -41, -47, -48, and -49 and RAI B.2.28-9 is resolved.

- AAI No. 6 on BWRVIP-74-A : "The staff believes inspection by itself is not sufficient to manage cracking. Cracking can be managed by a program that includes inspection and water chemistry. BWRVIP-29 describes a water chemistry program that contains monitoring and control guidelines for BWR water that is acceptable to the staff. BWRVIP-29 is not discussed in the BWRVIP-74 report. Therefore, in addition to the previously discussed BWRVIP reports, LR applications shall contain water chemistry programs based on monitoring and control guidelines for reactor water chemistry that are contained in BWRVIP-29."

The applicant stated that the BWR Stress Corrosion Cracking Program includes water chemistry control as a preventive measure and that the Water Chemistry Program is implemented in accordance with the latest guidelines of the BWRVIP. In RAI B.2.28-2, dated May 18, 2005, on the "preventive actions" program element for the RV&ISIP, the staff requested that the applicant identify by title and number which water chemistry guideline or guidelines were being implemented for water chemistry control. The staff identified that the RAI was also applicable to the applicant's response to AAI No. 6 on BWRVIP-74-A.

In its response to RAI B.2.28-2, by letter dated June 14, 2005 (Refer to Serial Letter BSEP 05-0071), the applicant confirmed that the Water Chemistry Program includes implementation of the EPRI BWR water chemistry guidelines in report TR-103515, Revision 2. These water chemistry guidelines are invoked in GALL AMP XI.M2, "Water Chemistry," as being acceptable for implementation. The staff's evaluation of the "preventive actions" program element for this AMP has included its basis for resolving RAI B.2.28-2 based on this confirmation. Since the applicant identified that an acceptable EPRI BWR water chemistry guideline report is being implemented as part of the Water Chemistry Program, the staff concluded that RAI B.2.28-2 is resolved with respect to the applicant's response to AAI No. 6 on BWRVIP Topical Report BWRVIP-74-A and the response to the AAI, as amended by the RAI response, is acceptable.

- AAI Nos. 4 and 5 on BWRVIP-25: In AAI No. 4 on BWRVIP-25, the staff stated that "due to susceptibility of the rim hold-down bolts to stress relaxation, applicants referencing the BWRVIP-25 report for license renewal should identify and evaluate the projected stress relaxation as a potential TLAA issue."

  In AAI No. 5 on BWRVIP-25, the staff stated that "until such time as an expanded technical basis for not inspecting the rim hold-down bolts is approved by the staff, applicants referencing the BWRVIP-25 report for license renewal should continue to perform inspections of the rim hold-down bolts."

  In its response to AAI No. 4 on BWRVIP-25, the applicant stated that the susceptibility of the core plate rim hold-down bolts was evaluated as a potential TLAA, but no TLAA was identified by the applicant for these components. In Section 3.5 of the staff's FSER on BWRVIP-25, dated December 7, 2000, the staff made the following determination with respect to potential TLAAs for core plate rim hold-down bolts:

  > The susceptibility of the rim hold-down bolts to stress relaxation results in a potential Time Limiting Analysis Aging (TLAA) issue. The rim hold-down bolts connect the core plate to the core shroud. The BWRVIP evaluated this issue under 10 CFR 54.21(c)(1)(ii) by projecting the analysis to the end of the period of extended operation. The stress state analyses, calculated for a 60-year plant

> life, indicated that all but two BWR/3s would undergo a five to 19 percent reduction in stress (e.g., loss of preload). However, two BWR/3s with core plate bolts positioned closer to the active fuel would show a 54 to 74 percent stress reduction. The staff agrees that stress relaxation in the rim hold-down bolts is a TLAA issue and must be identified and evaluated by individual applicants considering license renewal.

In RAI 4.2.8-1, Part B, dated April 8, 2005, the staff requested that the applicant provide its technical justification for concluding why management of stress relaxation in the core plate rim hold-down bolts was not identified as a TLAA for the facility. The applicant's response to RAI 4.2.8-1, Part B, is applicable to the evaluation of AAI No. 4 on BWRVIP-25. In the applicant's response to RAI 4.2.8-1, Part B, dated May 4, 2005), the applicant stated that the integrity of 48 intact but un-preloaded core plate rim hold-down bolts is necessary to maintain the lateral alignment of the core plate, but clarified that the integrity of the bolts does not require maintenance of an adequate preload on the bolts and therefore is not dependent on an evaluation of the impact of accumulated neutron fluence level on the preload level. Based on the staff's evaluation in SER Section 4.2.8 and the applicant's response to RAI 4.2.28-1, Part B, the staff has concluded that the applicant does not need to include a TLAA for the core plate rim hold-down bolts because the structural integrity of the bolts and the bolts' ability to maintain the lateral alignment of the core plates does not rely on maintenance of an adequate pre-load. Therefore, the staff concluded that the applicant's response to AAI No. 4 on BWRVIP-25, as amended by the response to RAI 4.2.28-1, Part B, is acceptable in that a TLAA is not necessary to manage stress relaxation in the core plate rim hold-down bolts.

In its response to AAI No. 5 on BWRVIP-25, the applicant stated that an analysis by BSEP determined that only 48 of the 72 rim hold-down bolts in each of the core plates were needed to maintain the lateral alignment of the plates. The applicant stated that it confirms the presence of an adequate number of bolts by performing a UT inspection of the outside diameter of the core support ring. The examination performed by BSEP to assure the lateral alignment of the core plates and the structural integrity of rim hold-down bolts is different from that recommended by the BWRVIP in Topical Report BWRVIP-25 because the examination is performed from an orientation different from that recommended in BWRVIP-25. In RAI B.2.28-11, Parts A and B, dated May 18, 2005, the staff inquired whether this alternative examination method has been identified as an exception to the recommendations of BWRVIP-25 and to request a basis that demonstrates that the UT of the outside diameter of the core plate support ring would be capable of detecting potential cracking and/or stress relaxation in the bolts.

In its response, dated June 14, 2005, the applicant clarified that the core plate rim hold-down bolts were not relied on for structural integrity of the core plates and that instead the core plate rim hold-down bolts were relied upon only to prevent lateral displacement. As indicated in the response to AAI No. 5 on BWRVIP-25, the applicant stated that a BSEP-specific mechanical engineering evaluation has determined that only 48 of 72 intact bolts are relied upon to maintain the position of the core plate against lateral displacement and, as discussed in the previous paragraphs, that the integrity of the BSEP core plates does not rely on maintenance of a preload on the bolts, thus eliminating the need for a TLAA on stress relaxation of the bolts.

In the applicant's supplemental response to RAI B.2.28-11, Parts A and B, dated July 18, 2005 (Refer to Serial Letter BSEP 05-0097), the applicant clarified that, contrary to the recommendations of BWRVIP-25, the UT inspections of the core plate rim hold-down bolts from the side of the core plates are justified because the bolts are only relied upon for maintaining the lateral position of the core plates and because maintenance of an adequate preload is not a prerequisite for accomplishing this. The applicant's supplemental response also clarifies that these UT examinations will be done in accordance Section 8.4.4 of Report BWRVIP-03, which was approved in the NRC's SE on BWRVIP-03 dated June 8, 1998, as amended in the NRC's supplemental SE on BWRVIP-03 dated July 15, 1999. The applicant's supplemental response to RAI B.2.28-1, Part B, has added Topical Report BWRVIP-03 to the list of BWRVIP reports that are within the scope of the RV&ISIP. The applicant's supplemental response to RAI B.2.28-15, Part A, dated July 18, 2005, has amended the UFSAR supplement summary description for the RV&ISIP (as provided in LRA Section A.1.1.30) to account for the inclusion of BWRVIP-03 within the scope of license renewal of the AMP.

The NRC's SE on BWRVIP-3 provides the basis for accepting the inspections of the core plates and its bolts from the outside surfaces of the core plates. Based on this assessment, the staff concluded that the UT inspections recommended in BWRVIP-03 for the BSEP core plate rim hold-down bolts are acceptable to confirm that the position of the bolts are sufficient to protect the core plates against lateral displacement. Based on this assessment, the UT examinations recommended in BWRVIP-03 for the core plate rim hold-down bolts are acceptable and the applicant's response and supplemental response to RAI B.2.28-11, Parts A and B, are resolved. The staff also concluded that the applicant's response to AAI No. 5 on BWRVIP-25, as amended by the RAI responses, is acceptable.

- AAI No. 4 on BWRVIP-26: "Due to IASCC susceptibility of the subject safety-related components, applicants referencing the BWRVIP-26 report for license renewal should identify and evaluate the projected accumulated neutron fluence as a potential TLAA issue."

In its response to AAI No. 4 on BWRVIP-26, the applicant stated that portions of the top guides at BSEP-Units 1 and 2 already exceed the BWRVIP's threshold for potential initiation of IASCC; therefore, these components are considered susceptible to IASCC. The applicant stated that no TLAA was identified for the top guides. In its response to this AAI item, the applicant also stated that BSEP will perform augmented inspections of the top guides, as defined in the applicant's enhancement of the RV&ISIP. The staff evaluated this enhancement in its evaluation of detection of the aging effects and "monitoring and trending" program elements for the RV&ISIP.

In Section 3.5 of the staff's FSER on BWRVIP-26, dated December 7, 2000, the staff made the following determination with respect to potential TLAAs for top guide assemblies:

> One of the mechanisms that can cause degradation of the top guide assembly design is IASCC, due to the high fluence that exists at the grid beam locations. The BWRVIP-26 report found that the projected minimum end-of-life fluence at the grid beam location after 48 EFPY of operation

(assuming 60 years at 80 percent capacity factor) is approximately 6×10^{21} n/cm^2 (E > 1 MeV), which surpasses the approximated threshold fluence level for IASCC of 5×10^{20} n/cm^2 (E > 1 MeV). The staff agrees that the accumulated neutron fluence is a TLAA issue and must be identified and evaluated by individual applicants considering license renewal.

Thus, in the staff's FSER on BWRVIP-26, dated December 7, 2000, the staff concluded that IASCC of the top guides, as impacted by the accumulated neutron fluence for the components, must be treated as a TLAA as defined in 10 CFR 54.3.

The applicant's response to AAI No. 4 on BWRVIP-26 indicates that the applicant has reviewed the CLBs and did not identify any safety analyses in the CLBs that are specifically related to management of IASCC in the BSEP top guides and that meet the definition of a TLAA, as defined in 10 CFR 54.3. Based on this determination, the staff concludes that any TLAA submitted by the applicant to respond to this AAI item (i.e., any submittal of a TLAA on management of IASCC in the top guides) would be beyond the CLBs (beyond-CLB) for the facilities.

In RAI B.2.28-3, dated May 18, 2005, the staff requested additional information on the criteria that will be used to define the sample size and inspection frequency for the inspections of the BSEP top guides and the criteria that will be used to select the top guide locations for inspection. In its response to RAI B.2.28-3 dated June 14, 2005 (Refer to Serial Letter BSEP 05-0071), the applicant indicated that it is committed to performing augmented inspections of the BSEP-top guides to monitor for cracking in the components and has committed to performing these inspections in accordance with the version of BWRVIP-26 that has been approved by the staff (refer to the staff's FSER on BWRVIP-26, dated December 7, 2000. This commitment is discussed as an enhancement to the RV&ISIP and was included in Enclosure 1 to CP&L Serial Letter No. BSEP 04-0006, dated October 18, 2004, as amended in the applicant's supplemental response to RAI B.2.28-15, Part B, dated July 18, 2004 (See Commitment Item #22). In its response to RAI B.2.28-3, the applicant also indicated that inspection frequencies and sample size for the top guide inspections will be in accordance with the NRC-approved version of BWRVIP-26 and that the selection of locations will be based on those locations in the top guides that are projected to have the highest neutron fluences (E > 1.0 MeV) at the expiration of the periods of extended operation. This strategy for managing IASCC in the top guides addresses the issue raised in AAI No. 4 on BWRVIP-26 and will ensure that the proposed inspections will monitor for cracking in those top guide locations that have the highest probability of initiating IASCC. The neutron fluence methodology for the RVs and RV internal components has been approved by the staff and is assessed in SER Section 4.2.1.

Based on this assessment, the staff concluded that the applicant has taken a conservative approach to manage IASCC of the top guides and concludes that the applicant's aging management strategy is an acceptable alternative to providing a beyond-CLB TLAA for the facilities, as it otherwise might have been done to satisfy AAI No. 4 on BWRVIP-26. AAI No. 4 on BWRVIP-26 is therefore considered resolved.

- AAI No. 4 on BWRVIP-27: "Due to the susceptibility of the subject components to fatigue, applicants referencing the BWRVIP-27 report for license renewal should identify and evaluate the projected fatigue cumulative usage factors as a potential TLAA issue."

  In its response to AAI No. 4 on BWRVIP-27, the applicant stated that fatigue of the shroud supports was included as a TLAA in LRA Section 4. The BWRVIP issued BWRVIP-27 to provide the U.S. BWR industry with recommended guidelines and flaw evaluation criteria for SLC/core ΔP line penetrations to BWR RVs. The scope of the topical report does not cover core shroud supports. Thus, any response by the applicant to AAI No. 4 on BWRVIP-27 should have referenced the need to assess whether a TLAA regarding fatigue usage is needed for the SLC/core ΔP line penetrations of the Units 1 and 2 RVs.

  Therefore, in RAI B.2.28-13/RAI 4.3-1, staff requested that the applicant provide its basis for concluding that a TLAA fatigue analysis would not be necessary for the SLC/core ΔP lines.

  In the applicant's response to RAI B.2.28-13/RAI 4.3-1 dated June 14, 2005 (Refer to Serial Letter BSEP 05-0071), the applicant clarified that the SLC/core ΔP nozzles and internal lines were determined to be exempt from a fatigue evaluation for the RV and RV internal components, and that the staff accepted this in its evaluation of the BSEP TLAA on metal fatigue and of the applicant's response to RAI 4.3-1. Based on this assessment, the staff concludes that a TLAA on metal fatigue of the SLC/core ΔP nozzles and internal lines does not need to be included within the scope of the LRA. The staff evaluates the TLAA on metal fatigue of RV, RV internal, and other ASME Code Class components in SER Section 4.3. Based on this assessment, RAI B.2.28-13/RAI 4.3-1 is resolved; and the applicant's response to AAI No. 4 on BWRVIP-27, as amended by the RAI response, is closed.

- AAI No. 4 on BWRVIP-47: "Due to fatigue of the subject safety-related components, applicants referencing the BWRVIP-47 report for LR should identify and evaluate the projected CUF [cumulative usage factor] as a potential TLAA issue."

  In its response to AAI No. 4 on BWRVIP-27, the applicant stated that the applicant did not identify any fatigue-related TLAAs for the RV internal lower plenum components. In Section 3.5 of the staff's license renewal FSER on BWRVIP-47, the staff made the following statement on whether a TLAA on fatigue of the RV internal lower plenum components would be needed in an LRA for a BWR:

  > The BWRVIP-47 report stated that some plants may have lower plenum pressure boundary component fatigue cumulative usage factors (CUF) greater than the 1.0 threshold specified in NUMARC 90-02 for the license renewal term. For these plants, a plant-specific description of how this issue will be addressed will be needed.
  >
  > The BWRVIP-47 report further stated that, based on the above criteria, there are no generic TLAA issues that require evaluation for the lower plenum components."

The staff needed to validate that a TLAA would not be needed for the RV internal lower plenum components. Therefore, in RAI B.2.28-14, dated May 18, 2005, the staff requested confirmation that the CUF for the RV internal lower plenum components was determined to be less than 1.0 for the design cycles assumed through 54 EFPY.

In its response to RAI B.2.28-14 dated June 14, 2005, the applicant clarified that the RV internal lower plenum components were determined to be exempt from a fatigue evaluation for the RV and RV internal components and that the staff accepted this in its evaluation of the BSEP TLAA on metal fatigue and of the applicant's response to RAI 4.3-1. Based on this assessment, the staff concludes that a TLAA on metal fatigue of the RV internal lower plenum components does not need to be included within the scope of the LRA. The staff evaluates the TLAA on metal fatigue of RV, RV internal, and other ASME Code Class components in Section 4.3 of this SER. Based on this assessment, RAI B.2.28-14 is resolved; and the applicant's response to AAI No. 4 on BWRVIP-47, as amended by the RAI response, is closed.

UFSAR Supplement. 10 CFR Part 54.21(d) requires that the UFSAR supplement for a facility LRA must contain a summary description for each AMP and TLAA that is proposed for aging management. The current UFSAR supplement summary description for the RV&ISIP, as identified in LRA Section A.1.1.30, is contained in the applicant's supplemental response to RAI B.2.28-15, Parts A and B, dated July 18, 2005 (Refer to Serial Letter BSEP 05-0097).

The updated UFSAR supplement summary description addresses the following additional descriptions that the staff concluded were necessary to ensure adequate aging management of the RV internals:

1. A statement that scope of the RV&ISIP includes conformance with and implementation of applicable BWRVIP Flaw and Inspection Guidelines, including BWRVIP-03, -18, -25, -26, -27, -38, -41, -47, -48, -49, -74-A, -76, -94, and -139 (when -139 is approved by the NRC).
2. A statement that the RV&ISIP will be used to manage loss of preload/stress relaxation in the BSEP-2 spring-loaded core plate plugs by replacing the BSEP-2 spring-loaded core plate plugs prior to entering the period of extended operation for BSEP-2. For the current UFSAR supplement summary description this is to be implemented during the 2011 refueling outage for BSEP-2 unless further justification is provided to defer the replacement activity.
3. A statement that the RV&ISIP will be used to manage loss of integrity due to cracking or loss of material and flow blockage of the core spray nozzles by implementing augmented inspections of the core spray nozzles during the periods of extended operation for Units 1 and 2 in conjunction with the Water Chemistry Program. To be consistent with the staff's evaluation of the "detection of aging effects" and "monitoring and trending" program attributes, management of flow blockage of the core spray sparger nozzles will be accomplished with the Water Chemistry Program and EPRI Report 103515, Revision 2, as invoked by the "preventive actions" program element for the RV&ISIP, and the integrity of the core spray sparger nozzles will be accomplished through implementation of the augmented inspections that are implemented in accordance with Topical Report BWRVIP-18, as approved by the staff.

4. A statement in the RV&ISIP, in conjunction with the Water Chemistry Program, will be used to manage cracking due to SCC and loss of material pitting and crevice corrosion in the NSR steam dryers and feedwater spargers, and a revision to the application to credit a one-time inspection, in conjunction with the Water Chemistry Program, will be used to manage these aging effects in the NSR core shroud heads and separators and RV surveillance capsule holders.

The applicant's supplemental response to RAI B.2.28-15, Part B, dated July 18, 2005, also revised the original commitment for the RV&ISIP that was initially provided in Enclosure 1 of CP&L Serial Letter No. BSEP 04-0006, dated October 18, 2004. The applicant's amended commitment for the RV&ISIP addressed five additional aspects that are necessary because the augmented activities were either contained in a BWRVIP report that is pending acceptance by the NRC or not included in an existing NRC-approved BWRVIP or BWROG report. The five modifications of the original commitment for the RV&ISIP are as follows:

1. A statement that scope of the RV&ISIP includes conformance with and implementation of applicable BWRVIP Flaw and Inspection Guidelines, including BWRVIP-03, -18, -25, -26, -27, -38, -41, -47, -48, -49, -74-A, -76, -94, and -139 (when reviewed and approved by the staff), as approved by the NRC.
2. A statement that the RV&ISIP, in conjunction with Water Chemistry Program, will be used to manage flow blockage of the core spray nozzles by implementing augmented inspections of the core spray nozzles during the periods of extended operation.
3. A statement that the RV&ISIP will be used to manage cracking and loss of material in the NSR steam dryers and feedwater spargers during the periods of extended operation.
4. A statement that the RV&ISIP will manage loss of preload due to stress relaxation of the Unit 2 spring-loaded core plate plugs by replacement of the plugs prior to entering the period of extended operation.
5. A statement that the RV&ISIP will manage cracking in the welded AHCs by performing either an ultrasonic examination of the AHCs with alone or with a visual examination until other specific guidance is provided by the BWRVIP.

Since the applicant has addressed these items in the revised UFSAR supplement summary description and revised commitment for the RV&ISIP (see Commitment Item #22), the staff concluded the revised UFSAR supplement summary description is acceptable in accordance with 10 CFR 54.21(d) and that the applicant's implementation of RV&ISIP, as modified by the commitments for the AMP, will be sufficient to manage aging in the RV internal components during the period of extended operation.

Conclusion. On the basis of its review of the applicant's program, the staff concluded that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concluded that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.2 Systems Monitoring Program

Summary of Technical Information in the Application. This AMP is described in LRA Section B.2.29, "Systems Monitoring Program." In the LRA, the applicant stated that this is an existing, plant-specific program.

The Systems Monitoring Program will manage aging effects such as loss of material and cracking for external surfaces of piping, heat exchangers, ductwork, tanks, and other mechanical components within the scope of license renewal. Specific guidelines for assessing the material condition of components during system engineer walkdowns will be provided prior to the period of extended operation. The aging effects will be managed through visual inspection and monitoring of external surfaces for component leakage, rust or corrosion products, cracking, peeling coatings, and corroded fasteners. These activities are conducted on a periodic basis to verify the continuing capability of in-scope components prior to the loss of component intended function. The Systems Monitoring Program is a plant-specific program and there is no comparable program in the GALL Report.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section B.2.29, regarding the applicant's demonstration of the Systems Monitoring Program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation.

In RAI B.2.29-1, dated March 17, 2005, the staff stated: "the applicant stated that the Systems Monitoring Program is an existing, plant-specific program and there is no comparable SRP-LR program in place. The applicant further stated that the implementation of the Systems Monitoring Program will be accomplished by a new procedure to be developed before the period of extended operation." Therefore, the staff requested that the applicant provide the following information:

(A) Since the Systems Monitoring Program is an existing program, what is the frequency of inspection, and what are the inspection criteria for the current program?

(B) Among the 10 program elements, many element descriptions rely on a new procedure to be developed prior to the period of extended operation. For example, the applicant stated, in "Monitoring and Trending," that the new procedure to be developed will include guidance on inspection frequency, inspection criteria that focus on detection of aging effects, and trending to provide predictability of component degradation. The applicant was requested to clarify the differences between those elements to be developed in the new procedure and those in the existing program.

In its March 31, 2005, response to RAI B.2.29-1, the applicant stated:

> The Systems Monitoring Program requires that systems crediting the program are inspected on a frequency sufficient to identify age-related degradation prior to loss of intended function. While license renewal systems are typically inspected on a quarterly basis, an extended frequency can be justified for some systems. In general, inspections are scheduled and performed so the entire system is fully walked down at least once per operating cycle. Portions of systems not accessible due to reactor operation are inspected during refueling outages.

The BSEP systems monitoring implementation procedure incorporates a checklist of inspection attributes associated with the item being inspected and potentially applicable degradation mechanisms. For example, piping and fittings are inspected for:

- Pinhole leaks or seepage,
- Exterior corrosion, scaling, or rust,
- Missing or not fully engaged flange nuts, studs, or bolts,
- Excessive sweating or condensation collecting on pipes,
- Leaking on threaded connections,
- Excessive pipe vibration or pipe movement, and
- No appreciable loss of material or cracking.

With respect to the difference between those elements to be developed in the new procedure and those in the existing program, the applicant stated that, since the LRA was submitted, BSEP has developed a new procedure directing activities of the Systems Monitoring Program. This procedure incorporates the enhancement attributes and provides more detailed guidance relative to the 10 program elements of an AMP.

The staff reviewed the Systems Monitoring Program against the AMP elements found in SRP-LR Section A.1.2.3 and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience).

The applicant indicated that the "corrective actions," "confirmation process," and "administrative controls" program elements are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is discussed in SER Section 3.0.4. The remaining seven elements are discussed below.

(1) Scope of Program - In LRA Section B2.29, the applicant stated that the scope of the Systems Monitoring Program activities will apply to indoor and outdoor areas of the plant that contain SSCs and/or commodities that are within the scope of license renewal. AMRs for affected systems credit the Systems Monitoring Program for managing the external surface aging effects of loss of material and cracking for components such as piping, valves, ductwork, pumps, tanks, filters, and heat exchangers. Walkdowns by system engineers will be an essential part of this program. The applicant also stated that the implementation of the Systems Monitoring Program will be accomplished by a new procedure. Before the period of extended operation, BSEP will develop a new procedure, and the administrative controls will be enhanced to provide inspection criteria that focus on visual detection of aging effects. The staff considered the scope of the program to be clearly defined and acceptable.

The staff confirmed that the "scope of program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1. The staff concluded that this program attribute is acceptable.

(2) Preventive Actions - The applicant stated, in LRA Section B2.29 that the Systems Monitoring Program is a condition monitoring program; thus, there is no preventive action. The staff agreed with the applicant's statements.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2. The staff concluded that this program attribute is acceptable.

(3) Parameters Monitored or Inspected - In LRA Section B2.29, the applicant stated that engineering and other plant personnel will continue to inspect the surface conditions of mechanical system components, including closure bolting, through visual inspection and examination for evidence of defects and age-related degradation. The parameters monitored or inspected are selected based on AMR results, including plant and industry operating experience, to ensure that aging degradation which could lead to loss of intended function will be identified and addressed. Inspections will detect aging effects/mechanisms and qualify degradations. Identified aging effects include loss of material and cracking. The applicant also stated that piping systems will be monitored through visual inspection for evidence of leaks. Flexible HVAC connections will be monitored for cracking or other changes in material properties (including wear). Inspections performed during system walkdowns include an evaluation of the pipe covering and environmental conditions to determine whether insulation should be removed to inspect the pipe. Insulation is not generally removed in support of system walkdowns unless there is reason to believe that the condition of the pipe is degraded. The applicant further stated that, before the period of extended operation, BSEP will develop a new procedure (1) identifying the specific parameters to be monitored or inspected and (2) providing inspection criteria that focus on detection of aging effects for the Systems Monitoring Program (see Commitment Item #23). Degradations discovered will be recorded, qualified, and dispositioned, as appropriate. Implementation of the Systems Monitoring Program with the new procedure provides a link between the inspection guidelines and the specific components and associated degradations. The new procedure provides reasonable assurance that the presence of aging effects will be detected and recorded.

The staff's review of LRA Section B.2.29 identified an area in which additional information was necessary to complete the review of the applicant's program elements. The applicant responded to the staff's RAI as discussed below.

In RAI B.2.29-2, dated March 17, 2005, the staff asked whether the applicant will inspect the surface condition of the closure bolting through visual examination for evidence of defects and age-related degradation. The applicant further stated that identified aging effects include loss of material and cracking. Therefore, the staff requested that the applicant provide justification for not identifying loss of preload as an aging effect for closure bolting in various plant systems.

In its response, by letter dated March 31, 2005, the applicant stated that the Bolting Integrity Program is being revised to address staff concerns raised during the audit. The revised program considers that loss of preload is applicable to bolting, and manages this aging effect by incorporating program elements consistent with those described in the GALL Report (i.e., torquing/installation guidance, materials control, ASME Section XI inspections, etc.). The staff found the applicant's response to be acceptable; therefore, the staff's concern described in RAI B.2.29-2 is resolved.

The staff confirmed that implementation of the "parameters monitored or inspected" program element is in accordance with general industry practice and that the program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3; therefore, the staff concluded that this program element is acceptable.

(4) Detection of Aging Effects - In LRA Section B2.29, the applicant stated that the external surface condition of systems and components will be determined by visual inspection. Before the period of extended operation, a new procedure will be developed focusing on detection of aging effects for the Systems Monitoring Program. Thus, the Systems Monitoring Program is intended to detect degradation prior to component failure. As indicated in the response to RAI B.2.29-1, the applicant stated that the BSEP systems monitoring implementation procedure incorporates a checklist of inspection attributes associated with the item being inspected and potentially applicable degradation mechanisms that address aging effects identified by the license renewal aging management reviews. The staff considered this approach of detecting the aging effects for external surfaces of selected systems and components to be acceptable.

The staff confirmed that the "detection of aging effects" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4. The staff concluded that this program attribute is acceptable.

(5) Monitoring and Trending - In LRA Section B2.29, the applicant stated that the new procedure to be developed will include guidance on inspection frequency, inspection criteria that focus on detection of aging effects, and trending to provide predictability of component degradation (see Commitment Item #23). This will ensure aging indicators are qualified so that trending continues to be done effectively. Data from detailed system and component material condition inspections will be trended and evaluated to identify and correct problems. The results of monitoring and trending activities will be documented. The staff agrees with the applicant's approach for the monitoring and trending of the component degradation.

The staff confirmed that the "monitoring and trending" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.5. The staff concluded that this program attribute is acceptable.

(6) Acceptance Criteria - In LRA Section B2.29, the applicant stated that the acceptance criterion for visual inspections is the absence of anomalous indications that are signs of degradation. Responsibility for the evaluation of visual indications is assigned to engineering personnel. Evaluations of anomalies found during inspections determine whether analysis, repair, or further inspection is required. The applicant further stated that the new procedure will require an inspection checklist for SSCs inspected during system walkdowns (see Commitment Item #23). Inspection checklists and procedure instructions will require inspection attributes to be qualified. The new procedure will define when corrective action is required. The staff found the acceptance criteria for the program to be acceptable.

The staff confirmed that the "acceptance criteria" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.6. The staff concluded that this program attribute is acceptable.

(10) Operating Experience - In LRA Section B2.29, the applicant stated that BSEP operating experience supports the fact that engineering personnel monitor and evaluate equipment and system performance through examination and trending of condition monitoring activities, reviewing equipment failure history, analyzing availability and reliability information, and performing system walkdowns. The applicant also stated that processes at BSEP are continually being upgraded based on industry operating experience and self-assessment. These processes will provide effective means of ensuring the system health for applicable license renewal systems.

The staff's review of LRA Section B.2.29 identified an area in which additional information was necessary to complete the review of the applicant's program elements. The applicant responded to the staff's RAI, as discussed below.

In RAI B.2.29-3, dated March 17, 2005, the applicant was requested to provide some examples of actual plant-specific operating experience of appropriate actions taken to demonstrate and ensure the effectiveness of the existing Systems Monitoring Program.

In its response, by letter dated March 31, 2005, the applicant stated:

> The World Association of Nuclear Operators (WANO) performed a peer review of BSEP in August, 2003. The peer review team observed the following strengths:
>
> > The system engineering organization has embraced a culture of identifying degrading system problems through system trending and monitoring. Problems are often identified before equipment failure through the use of advanced monitoring and trending software, process computer data and system engineering walkdowns. Trending successes are celebrated and rewarded to emphasize the culture. The use of advanced electronic system notebooks allows engineers to retrieve and store all trending and system information from many sources in one location, and provides a historical record for long-term monitoring.

An assessment of the Brunswick Engineering Support Section (BESS) at BSEP was performed on September 9 through September 20, 2002. The Brunswick Nuclear Assessment Section (BNAS) conducted an assessment of activities to determine the effectiveness of engineering personnel in support of BSEP and the performance monitoring of systems. This assessment was accomplished through performance-based, real-time observations, technical reviews, and interviews with personnel. As a basis for the assessment, the team used Institute for Nuclear Power Operations (INPO) 97-002, "Performance Objectives and Criteria for Operating and Near-Term Operating License Plants." The team's assessment concluded that BESS was effective in support of the operation of BSEP.

BNAS Report B-ES-02-01 provided the following details on the conduct of the BESS:

- Verified that engineering personnel monitor and evaluate equipment and system performance through examination and trending of condition monitoring activities,
- reviewing equipment failure history, analyzing availability and reliability information, and performing system walkdowns.
- Reviewed the process, status, and use of the Electronic System Notebook,
- Reviewed the age and number of work tickets on hold pending engineering resolution for timeliness and adequacy of engineering support, and
- Verified that engineering personnel support the effective maintenance of the plant, and that personnel are aware of, and proactively pursue, maintenance issues.

In a more recent self-assessment, BNAS Report B-ES-04-01 supports that BSEP System Engineering activities were effective in support of the operation of the BSEP, but noted several instances wherein walkdowns and trending were not properly performed and documented. The assessment identified the use of informal guidelines rather than procedural controls to ensure that system trending and monitoring is effectively implemented as a contributing factor in these findings. BSEP has addressed this issue by development of a formal site procedure for systems monitoring, including inspection frequency requirements, acceptance criteria, monitoring and trending, corrective actions, and documentation.

Based on the above descriptions, the staff's concern described in RAI B.2.29-3 is resolved, and the staff confirmed that the "operating experience" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.10; therefore, this program element is acceptable.

UFSAR Supplement. In LRA A.2.2.31, the applicant provided the UFSAR supplement for the Systems Monitoring Program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review and audit of the applicant's Systems Monitoring Program, the staff concluded that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concluded that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.3 Preventive Maintenance Program

Summary of Technical Information in the Application. This AMP is described in LRA, Section B.2.30, "Preventive Maintenance Program." In the LRA, the applicant stated that this is an existing, plant-specific program.

The Preventive Maintenance Program provides for inspections of structures and components, or their replacement/refurbishment, during the performance of preventive maintenance activities.

The program assures that various aging effects are managed for a wide range of components through scheduled inspections and predetermined criteria. The Preventive Maintenance Program includes inspections for blockage of flow, internal corrosion, fouling of heat exchangers, cracking, loss of material, loss of heat transfer, degradation of elastomers, and adverse impact on the function of nearby SR components. The components inspected or replaced as part of the Preventive Maintenance Program include heat exchanges, relief valves, strainers, filters, traps, sump pumps, rubber bladders, elastomer seals, and plate coils in containment penetrations.

The program administrative controls reference activities for monitoring SSCs to permit early detection of degradation. Data from walk-downs are trended and evaluated to identify and correct problems. In addition, the program includes periodic refurbishment or replacement of structures and components. The applicant credited the Preventive Maintenance Program for the aging management of selected components in the following systems: RHR system, HPCI system, SLC system, reactor building closed cooling water system, DG fuel oil system, DG lube oil system, DG jacket water system, DG starting air system, standby gas treatment system, HVAC DG building, HVAC reactor building, HVAC control building, service water intake structure, DG building, and control building.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section B.2.30 regarding the applicant's demonstration of the Preventive Maintenance Program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB throughout the period of extended operation.

The staff reviewed the Preventive Maintenance Program against the AMP elements found in SRP-LR Section A.1.2.3 and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience).

The applicant indicated that corrective actions, confirmation process, and administrative controls are part of the site-controlled quality assurance program. The staff's evaluation of the quality assurance program is discussed in SER Section 3.0.4. The remaining seven elements are discussed below.

(1) Scope of the Program - In LRA Section B.2.30, the applicant stated that this program is a plant-specific program that assures various aging effects are managed for a wide range of components, as specified by AMRs and credited in selected AMPs. In the LRA, the applicant provided a table that summarizes the activities for the systems that are within the scope of the Preventive Maintenance Program. The table includes the components that credit the Preventive Maintenance Program for management of specific aging effects. In particular, the program provides for periodic component replacement/refurbishment, inspection, and testing of components. The Preventive Maintenance Program may also be used to implement specific preventive maintenance activities required by other AMPs. The applicant will add or modify Preventive Maintenance Program activities, as necessary, to assure that age-related degradation will be managed for the systems/components for which the program is credited.

As documented in the BSEP Audit and Review Report, the applicant provided a list of the systems, component/commodity groups, intended functions, and aging effects/mechanisms managed by this program. The applicant also provided a list of the materials of construction for the component groups in the scope of the Preventive Maintenance Program and the environments to which the component groups are exposed.

The staff confirmed that the "scope of program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1. The staff concluded that this program attribute is acceptable.

(2) Preventive Actions - In LRA Section B.2.30, the applicant stated that this program includes periodic refurbishment or replacement of components specified at an interval that assures no loss of intended function. As documented in the BSEP Audit and Review Report, the staff confirms that, where appropriate, the Preventive Maintenance Program contains inspections and testing activities used to identify component aging degradation effects.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2. The staff concluded that this program attribute is acceptable.

(3) Parameters Monitored or Inspected - In LRA Section B.2.30, the applicant stated that this program consists of inspections, testing, and criteria used to identify component aging effects. Where necessary, activities are specified on a component-specific basis to ensure that appropriate parameters are monitored based on anticipated aging effects. In addition, the applicant identified the inspection activities that monitor various parameters, such as surface condition, loss of material, corrosion, cracking, elastomer degradation, loss of heat transfer effectiveness, and adverse impacts on nearby SR components. In addition, the aging effects and mechanisms to be managed by the Preventive Maintenance Program are documented in the BSEP Audit and Review Report.

During the audit, the staff noted that examples of aging effects monitored by the Preventive Maintenance Program include visual inspections of the interior of the SLC system accumulator shells to identify corrosion, measurements of flow in HPCI minimum flow bypass lines to identify clogging, and visual examinations of elastomers to identify aging degradations, such as cracking.

In LRA Section B.2.30, the applicant stated an enhancement to its existing program that will add or modify the Preventive Maintenance Program, as necessary, to assure that age-related degradation will be managed for the components that credit the program. The applicant will complete these additions and modifications prior to the period of extended operations (see Commitment Item #24). As documented in the BSEP Audit and Review Report, the applicant stated that the Preventive Maintenance Program will ensure structures and components will not adversely impact the function of nearby SR components.

The staff reviewed and confirmed that this program element satisfies the criteria defined in SRP-LR Section A.1.2.3.3. The staff determined that the parameters inspected by the

Preventive Maintenance Program for passive long-lived components are adequate to provide symptomatic evidence of potential degradation for timely replacement of components to prevent equipment failure. The staff also determined that the routinely scheduled replacement, or timely refurbishment of structures and components will maintain conditions such that their associated systems will be able to perform their intended functions during the period of intended operation. On this basis, the staff found that the applicant's "parameters monitored or inspected" program element is acceptable.

(4) Detection of Aging Effects - In LRA Section B.2.30, the applicant stated that this program provides inspection and test criteria identified during the AMRs that rely on the program for detection of the aging effects.

As documented in the BSEP Audit and Review Report, the applicant uses a database to identify the frequency of preventive maintenance, and to generate work orders. The work orders contain the component, the parameter monitored or inspected, the degradation being monitored, the procedure to conduct the inspection, and what data to collect. The work order also identifies the codes and standards, if any, that are associated with the activity, the techniques to be used, and the qualification requirements for the inspectors.

The staff also noted that the Preventive Maintenance Program activities include use of (1) ultrasonic flow meters to confirm that HPCI minimum-flow bypass valves are not excessively clogged; (2) visual inspections of elastomers to detect aging degradation effects, such as cracking; and (3) visual (VT-2) examinations of HPCI piping to identify corrosion.

In the LRA, the applicant stated that its Preventive Maintenance Program is a defined-scope program directed toward specified components. In systems where the scope is not defined at a component level (HVAC systems), inspection criteria will address representative or leading indicator conditions for the aging mechanism of concern. Degraded conditions would be addressed through the Corrective Action Program, including expansion of inspections and repairs, as necessary.

The staff reviewed and confirmed that this program element satisfies the criteria defined in SRP-LR Section A.1.2.3.4. The staff determined that the work orders provided links between the parameters and the aging effects being monitored. Also, the staff determined that the techniques used to detect aging effects are consistent with accepted engineering practice and, therefore, satisfy this program element. On this basis, the staff found that the applicant's "detection of aging effects" program element is acceptable.

(5) Monitoring and Trending - In LRA Section B.2.30, the applicant stated that this program's inspection intervals are specified, as necessary, to ensure that aging effects are detected prior to loss of intended functions. Condition monitoring is accomplished by generic procedural requirements, as well as by specific requirements contained in preventive maintenance activities.

As documented in the BSEP Audit and Review Report, the applicant uses the PassPort database to schedule and track preventive maintenance activities. Some work requests contain the acceptance criteria and the actions to be taken if the acceptance criteria are exceeded. In other cases, the work requests require the results of the monitoring or inspection activity to be forwarded to the system engineers for their review and action. The system engineers are responsible for reviewing and trending the results. The frequency of activities is adjusted by the system engineers on the basis of trending data from previous activities.

The staff confirmed that this program element satisfies the criteria defined in SRP-LR Section A.1.2.3.5. The overall monitoring and trending techniques proposed by the applicant are acceptable on the basis that the inspections, replacements, and sampling activities described by the applicant will effectively manage the applicable aging effects. On this basis, the staff found that the applicant's "monitoring and trending" program element is acceptable.

(6) Acceptance Criteria - In LRA Section B.2.30, the applicant stated that the acceptance criteria are specified based on generic requirements and application-specific considerations, and are intended to ensure that an acceptable level of performance is maintained at all times.

The staff confirmed that this program element satisfies the criteria defined in SRP-LR Section A.1.2.3.6. The plant design-basis includes Code-specified acceptance criteria for applicable systems. On this basis, the staff found that the applicant's "acceptance criteria" program element is acceptable.

(10) Operating Experience - In LRA Section B.2.30, the applicant stated that operating experience has demonstrated that the Preventive Maintenance Program has been effective in maintaining component performance and function. The program is subject to continual improvement under corporate procedures and initiatives.

The GALL Report is based on industry operating experience through April 2001. Recent industry operating experience has been reviewed for applicability, and subsequent operating experience will be captured through the normal operating experience review process. In addition, periodic surveillance and preventive maintenance activities have been in place at BSEP since the plant began operation. These activities have proven effective at maintaining the material condition of SSCs and detecting unsatisfactory conditions. The applicant has a demonstrated history of detecting damaged and degraded components and causing their repair or replacement in accordance with the site corrective action process.

Furthermore, the applicant stated that it has performed a review of corrective actions for a 10-year period to investigate site operating experience relative to various AMRs performed. These reviews revealed that the Corrective Action Program had a limited number of corrective action reports identifying age-related degradation and failures. For those failures, corrective actions were taken that resulted in improvements to maintenance and operating procedures/practices, and prevented recurrence of the failures.

Also, as documented in the Audit and Review Report, the staff reviewed the applicant's corrective action report, which addressed degradation of the SLC system accumulators. In 1988, during an annual SLC accumulator bladder inspection, the applicant found surface corrosion on the interior shell of an SLC accumulator, and set up six-month inspection intervals for the SLC accumulators. On the basis of inspection results, the applicant calculated a corrosion rate in 1990 and determined that the next surveillance of the accumulators would be due on Unit 1 prior to December 5, 1992, and on Unit 2 prior to March 31, 1993.

On the basis of its review of the above industry and plant-specific operating experience and discussions with the applicant's technical staff, the staff concluded that the applicant's Preventive Maintenance Program will adequately manage the aging effects that are identified in the LRA for which this AMP is credited.

The staff confirmed that the "operating experience" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.10. The staff concluded that this program attribute is acceptable.

UFSAR Supplement. In LRA Section A.1.1.32, the applicant provided the UFSAR supplement for the Preventive Maintenance Program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review and audit of the applicant's Preventive Maintenance Program, the staff concluded that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concluded that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.4 Phase Bus Aging Management Program

Summary of Technical Information in the Application. This AMP is described in LRA Section B.2.31, "Phase Bus Aging Management Program." In the LRA, the applicant stated that this is a new, plant-specific program.

In the LRA, the applicant stated that the materials of construction for the phase bus components are:

- Aluminum
- Bronze
- Copper
- Galvanized Metal
- Porcelain
- Polyester Fiberglass
- Silicone Caulk
- Steel

The phase bus components are exposed to heat and oxygen (including ohmic heating)

Aging Effects - In LRA Table 3.6.2-1, the applicant identified oxidation, loosening of bolted connections due to thermal cycling, and corrosion due to moisture as the aging effects associated with phase bus components that require management.

Aging Management Program - The applicant will credit the Phase Bus AMP to manage the potential aging effects for the phase bus components. The applicant stated that the structural supports of the phase bus housing containing the electrical buses and bus supports are addressed in LRA Section 2.4 as civil/structural commodities.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section B.2.31 regarding the applicant's demonstration of the Phase Bus AMP to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation.

The staff agreed that the applicant, in the LRA, correctly identified the aging effects associated with phase bus components. The staff also finds cracks, foreign debris, excessive dust built up, and evidence of water intrusion as additional aging effects addressed in the BSEP AMP.

The applicant will credit the Phase Bus AMP for aging management of in-scope iso-phase and non-segregated phase bus at BSEP. The program involves several activities conducted at least once every 10 years to identify the potential existence of aging degradation. Activities include sampling accessible bolted connections for adequate torque, visual inspections of the bus for signs of cracks, corrosion, or discoloration which may indicate overheating, and visual inspections of the bus enclosure for signs of corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion. The program applies to the iso-phase bus as well as nonsegregated 4.16KV and 480V phase bus within the scope of license renewal. The staff evaluated the aging management activity for the phase bus. The evaluation of the applicant's AMP focused on program elements rather than the details of specific plant procedures. To determine whether the applicant's AMPs are adequate to manage the effect of aging so that the intended function will be maintained consistent with the CLB for the period of extended operation, the staff evaluated the following seven program elements: (1) scope of program, (2) preventive actions, (3) parameter monitored or inspected, (4) detection of aging effects, (5) monitoring and trending, (6) acceptance criteria, and (10) operating experience. The staff's evaluation of the applicant's corrective action confirmation process, and administrative controls is provided separately in SER Section 3.0.4.

(1) Scope of Program - This Program applies to the iso-phase bus as well as non-segregated 4.16KV and 480V phase bus within the scope of License Renewal. This is acceptable to the staff since the program will include all bus ducts within the scope of license renewal.

(2) Preventive Actions - The Phase Bus AMP is a condition monitoring program. No actions are taken as part of this program to prevent or mitigate aging degradation. The staff did not identify the need for such actions.

(3) Parameters Monitored or Inspected - In the LRA, the applicant stated that a sample of accessible bolted connections will be checked for adequate torque. Bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., are inaccessible and are not covered by this activity. This Program will also inspect the bus enclosure for cracks, corrosion, foreign debris, excessive dust buildup, and evidence of water intrusion (see Commitment Item #25). The bus itself will be inspected for signs of cracks, corrosion, or discoloration which may indicate overheating. The internal bus supports will be inspected for structural integrity and signs of cracking.

The staff noted that vendors do not recommend the retorque of bolted connections unless the joint requires service or the bolted connections are clearly loose. The torque required to turn the fastener in the tightening direction (restart torque) is not a good indication of the preload once the fastener is in service. Due to relaxation of the parts of the joint, the final loads are likely to be lower than the installed loads.

In light of the above concern, in RAI 3.6.2.3-1, dated May 18, 2005, the staff requested that the applicant provide technical justification of how retorquing of bolted connections is a good indicator of the preload once the fastener is in service. In its response, by letter dated June 14, 2005, the applicant stated that the proposed activity to retorque bolted connections, even on a sample basis, is contrary to vendor recommendations and good bolting practices discussed in EPRI Technical Report 1003471, December 2002, and EPRI Technical Report 104213, December 1995. In lieu of this, the contact resistance across accessible bolted connections at sample locations will be measured using a low-range ohmmeter. The program element "acceptance criteria" will be modified accordingly. The staff found that the applicant's response addresses the staff's concern regarding retorquing.

In the LRA, the applicant stated that bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., are inaccessible and are not covered by this activity. In RAI 3.6.2.3-1, the staff also requested that the applicant provide a method for detecting inaccessible bolted connections loosening due to thermal cycling or provide a technical justification of why inaccessible bolted connections are not subject to thermal cycling. In its response by letter dated June 14, 2005, the applicant stated that visual inspection of the inaccessible bolted connection is an appropriate technique for determining the condition of the joint. Inaccessible bolted connections will be inspected for signs of embrittlement, cracking, melting, swelling, or discoloration, which may indicate overheating or aging degradation. The applicant proposed to visually inspect the inaccessible bolted connections (covered by heat shrink tape, sleeving, insulating boots, etc.). However, the applicant did not specify the frequency of this inspection nor the parameter monitored/inspected. The staff position is that bolted connections can be checked for loose connections by thermography or by measuring connection resistance using a low-range ohmmeter. Alternatively, bolted connections covered with heat shrink tape, sleeving, insulating boots, etc., can be visually inspected for insulation material surface anomalies, such as discoloration, cracking, chipping or surface contamination. If visual inspection is performed to check bolted connections, the inspection shall be performed every five years and the first inspection shall be completed before the period of extended operation. During discussions with the applicant, the staff requested that the applicant provide the frequency of visual inspection and the criteria for the visual inspection. In response to the staff's information request, the applicant stated, by letter dated July 18, 2005, that accessible and inaccessible phase bus bolted connections will be checked for loose connections by thermography or by measuring connection resistance using a low-range ohmmeter on a 10-year frequency (see Commitment Item #25). Thermography will be performed while the bus is energized and loaded. The staff found the applicant's response acceptable because using thermography or measuring connections resistance will detect loosening of bolted connections due to ohmic heating.

The staff found that the visual inspection of bus ducts, bus bar, and internal bus supports will provide indications of aging effects. Additionally, using thermography or checking resistance of a sample of a bolted joint will provide reasonable assurance that bolted connections are not loose due to ohmic heating. The staff also found that the 10-year inspection frequency is an adequate period to preclude failures of bus ducts since industry experience has shown that the aging degradation is a slow process.

(4) Detection of Aging Effects - Following issuance of a renewed operating license for BSEP, this program will be completed before the end of the initial 40-year license term of September 8, 2016, for Unit 1 and December 27, 2014, for Unit 2; and every 10 years thereafter. The staff found that the 10-year inspection frequency is an adequate period to preclude failures of bus ducts since industry experience has shown that the aging degradation is a slow process.

(5) Monitoring and Trending - Trending actions are not included as part of this program. Trending of discrepancies will be performed as required in accordance with the Corrective Action Program. Corrective action is part of the Quality Assurance Program. The staff found this to be acceptable since trending will be performed under a controlled administrative process.

(6) Acceptance Criteria - Initially, in the LRA, the applicant stated that accessible bolted connections must meet the minimum torque specification. Additional acceptance criteria include no unacceptable indications of cracks, corrosion, foreign debris, excessive dust buildup or discoloration which may indicate overheating or evidence of water intrusion. An unacceptable indication is defined as a noted condition or situation that, if left unmanaged, could lead to a loss of license renewal intended function. As discussed above, the staff expressed its concern about the retorquing of the bolted connections. The applicant revised the acceptance criteria to state that using thermography or checking resistance of a sample of bolted joint will provide reasonable assurance that bolted connections are not loose due to ohmic heating. The staff found the revised acceptance criteria to be acceptable.

(10) Operating Experience - This is a new AMP. There is no existing site-specific operating experience to validate the effectiveness of this program. Industry operating experience has shown that phase bus exposed to appreciable ohmic or ambient heating during operation may experience loosening of bolted connections related to the repeated cycling of connected loads or of the ambient temperature environment. This phenomenon can occur in heavily loaded circuits (i.e., those exposed to appreciable ohmic heating or ambient heating) that are routinely cycled. The staff found that the proposed program will provide reasonable assurance that bus ducts are not exposed to excessive ohmic or ambient heating.

UFSAR Supplement. In LRA Section B.2.31, the applicant provided the UFSAR supplement for the Phase Bus AMP. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

Conclusion. On the basis of its review and audit of the applicant's Phase Bus AMP, the staff concluded that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concluded that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.3.3.5 Fuel Pool Girder Tendon Inspection Program

Summary of Technical Information in the Application. This AMP is described in LRA Section B.2.32, "Fuel Pool Girder Tendon Inspection Program." In the LRA, the applicant stated that this is an existing, plant-specific program.

The Fuel Pool Girder Tendon Inspection Program is used to manage loss of prestress in the fuel pool girder tendons of each reactor building. The fuel pool girder tendons are not associated with the containment pressure boundary and are not within the scope of the ASME Section XI, Subsection IWL Program; however, the Fuel Pool Girder Tendon Inspection Program is conservatively based on guidance from the ASME Section XI, Subsection IWL Program. The program visually inspects and physically tests a representative sample of tendons. Inspection results are used to project an estimated loss of prestress through the next inspection period to ensure the tendon prestressing values do not fall below the minimum design requirements.

In describing the program, the applicant discussed the program in terms of the 10 elements described in SRP-LR. The applicant also plans to enhance the existing program during the period of extended operation.

On the basis of the program and its proposed enhancements, the applicant concluded that the Implementation of the program provides reasonable assurance that the loss of prestress will be adequately managed such that the fuel pool girder tendons will continue to perform their intended functions consistent with the CLB for the period of extended operation.

The program elements and the enhancements are discussed in LRA B.2.32.2.

Staff Evaluation. In accordance with 10 CFR 54.21(a)(3), the staff reviewed the information included in LRA Section B.2.32, regarding the applicant's demonstration of the Fuel Pool Girder Tendon Inspection Program to ensure that the effects of aging, as discussed above, will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation.

The staff reviewed the Fuel Pool Girder Tendon Inspection Program against the AMP elements found in SRP-LR Section A.1.2.3, and SRP-LR Table A.1-1 and focused on how the program manages aging effects through the effective incorporation of 10 elements (i.e., program scope, preventive actions, parameters monitored or inspected, detection of aging effects, monitoring and trending, acceptance criteria, corrective actions, confirmation process, administrative controls, and operating experience). These elements are discussed below.

(1) Scope of Program - In LRA Section B.2.32, the applicant stated that the Fuel Pool Girder Tendon Inspection Program applies to the BSEP fuel pool girder tendons and manages them for a loss of prestress (see Commitment Item #26).

The staff initially had some reservation regarding the scope of program coverage. However, after reviewing the parameters monitored, the staff confirmed that the program includes periodic inspection of the tendon hardware components. The staff found this program element acceptable, as it will monitor the condition of BSEP fuel pool girder tendon hardware, and will monitor and trend the prestressing forces in the tendons.

The staff confirmed that the "scope of the program" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.1. The staff concluded that this program attribute is acceptable.

(2) Preventive Actions - In LRA Section B.2.32, the applicant stated that the Fuel Pool Girder Tendon Inspection Program is a condition monitoring program; thus preventive actions are not applicable.

The staff considers the implementation of the program as a preventive measure against significant degradation of tendon hardware components. Therefore, the staff found the element description acceptable.

The staff confirmed that the "preventive actions" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.2. The staff concluded that this program attribute is acceptable.

(3) Parameters Monitored or Inspected - In LRA Section B.2.32, the applicant stated that the Fuel Pool Girder Tendon Inspection Program monitors/inspects the fuel pool tendons for loss of prestress. The monitored/inspected parameters include visual examination for corrosion, pitting, or deleterious conditions, physical testing of tendon lift-off values, filler grease, and destructive testing of a tendon wire for an ultimate strength determination (see Commitment Item #26).

The staff found the "parameters monitored or inspected" acceptable, as the monitoring of the essential parameters will manage the aging of the hardware components of the BSEP fuel pool girder tendons.

The staff confirmed that the "parameters monitored or inspected" program element satisfies the criterion defined in SRP-LR Section A.1.2.3.3. The staff concluded that this program attribute is acceptable.

(4) Detection of Aging Effects - In LRA Section B.2.32, the applicant stated that detection of aging effects is performed by the Fuel Pool Girder Tendon Inspection Program by both visual inspection and physical testing performed on a frequency commensurate with ASME Code, Section XI, Subsection IWL.

The staff believes that the implementation of the program commensurate with that for the post-tensioning tendons in ASME Code Subsection IWL of Section XI will detect defects in the tendons' hardware components and corrosion protection medium. Therefore, the staff found the element description acceptable.

The staff confirmed that the detection of aging effects program element satisfies the criterion defined in SRP-LR Section A.1.2.3.4. The staff concluded that this program attribute is acceptable.

(5) Monitoring and Trending - In LRA Section B.2.32, the applicant stated that the Fuel Pool Girder Tendon Inspection Program will require the loss of prestress to be trended to ensure the actual prestress does not fall below the minimum design allowable prior to the next inspection period.

The staff found the description in this element acceptable. In conjunction with the parameters monitored, keeping track of the trend in prestressing forces will help alert the applicant about the unusual behavior of the trend during the period of extended operation.

The staff confirmed that the "monitoring and trending" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.5. The staff concluded that this program attribute is acceptable.

(6) Acceptance Criteria - In LRA Section B.2.32, the applicant stated that the acceptance criteria for tested tendons is that the prestress values be above the minimum design requirements and are projected to be above the minimum design requirements through the next inspection period (see Commitment Item #26).

The staff's review of LRA Section B.2.32 identified an area in which additional information was necessary to complete the review of the applicant's program elements. The applicant responded to the staff's RAI as discussed below.

In RAI B.2.32-1, dated March 17, 2005, the staff's request to the applicant is as follows:

> This inspection program includes monitoring parameters (as described in element Parameters Monitored) as well as monitoring prestressing force levels in the girders. The applicant is requested to provide its justification as to why the element Acceptance Criteria does not incorporate the acceptance criteria related to the tendon hardware components and corrosion

In its response, by letter dated March 31, 2005, the applicant stated that the subject tendons are not associated with the containment structure and do not support any pressure boundary intended function; as such, ASME Code Section XI, Subsection IWL, is not applicable. However, previous inspections of the tendons were performed using criteria based on ASME Code, Section XI, Subsection IWL, and inspections performed in accordance with the BSEP AMP will continue to use guidance based on ASME Code, Section XI, Subsection IWL.

The staff found the response acceptable, as the applicant will utilize the applicable provisions of Subsection IWL of Section XI of the ASME Code for acceptance criteria related to tendon hardware and corrosion protection medium. Therefore, the staff's concern described in RAI B.2.32-1 is resolved.

The staff confirmed that the "acceptance criteria" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.6. The staff concluded that this program attribute is acceptable.

(7) Corrective Actions - In LRA Section B.2.32, the applicant stated that the corrective actions associated with a deficient inspection finding shall either re-tension the tendon, replace and tension the tendon, or perform an engineering evaluation. Corrective actions including root cause determinations and prevention of recurrence are done in accordance with the Corrective Action Program. Timeliness is monitored and is commensurate with the level of significance. Where evaluations are performed without repair or replacement, engineering analysis reasonably assures that the SSC intended function is maintained consistent with the CLB.

The applicant has provided adequate description of corrective actions, and with the enhancement to be implemented during the period of extended operation, the staff found the actions proposed in this element acceptable.

The staff confirmed that the "corrective actions" program element satisfies the criteria defined in SRP-LR Section A.1.2.3.7. The staff concluded that this program attribute is acceptable.

(8) Confirmation Process - In LRA Section B.2.32, the applicant stated that confirmation of the effectiveness of this program is accomplished in accordance with the Corrective Action Program and Corporate Quality Assurance Procedures, review and approval processes, and administrative controls implemented in accordance with the requirements of 10 CFR Part 50, Appendix B.

The adequacy of this element is discussed in SER Section 3.0.4.

(9) Administrative Controls - In LRA Section B.2.32, the applicant stated that BSEP quality assurance (QA) procedures, review and approval processes, and administrative controls implemented in accordance with the requirements of 10 CFR Part 50, Appendix B and will continue to be adequate for the period of extended operation.

The adequacy of this element is discussed in SER Section 3.0.4.

(10) Operating Experience - In LRA Section B.2.32, the applicant stated that the Fuel Pool Girder Tendon Inspection Program is an existing program; two inspections have been performed: one in 1995 and another in 2000, based on guidance from ASME Code, Section XI, Subsection IWL. The staff reviewed the tendon inspection in 1995 and found the program to be "conservative, technically sound, and thorough." Program improvements have been implemented as a result of past inspections. Industry issues associated with the management of prestressed tendon systems are reviewed and considered for applicability to the BSEP tendon system.

The staff's review of LRA Section B.2.32 identified an area in which additional information was necessary to complete the review of the applicant's program elements. The applicant responded to the staff's RAI, as discussed below.

In RAI B.2.32-2, dated March 17, 2005, the staff requested that the applicant provide a summary of the results of the last two inspections for Unit 1 and Unit 2 girders. The staff indicated that, as a minimum, the summary should include (1) the minimum required prestressing forces, (2) the sample size of the tendons inspected, (3) a table of measured prestressing forces, (4) chemical composition of grease (CPM) and free water in the grease, (5) strength values of the wires tested during inspections, and (6) condition of anchorages and the concrete around the anchorages.

In its response, by letter dated March 31, 2005, the applicant stated:

> The tendon surveillance consists of an inspection of the physical condition of a selected sample of in-place tendons. Physical tendon surveillance consists of sheathing filler inspection, anchorage inspection, tendon lift-off, inspection and tensile testing of removed wire samples, and tendon retensioning with the tendons being resealed after completion of all inspections. The applicant stated that two surveillances have been performed on the tendons; the twenty-year surveillance performed in 1995, and the twenty-five year surveillance performed in 2000.

(1) Three values are provided for the minimum required prestressing forces based on the three stages of tendons used for each girder. The prestressing forces are Stage I: 582 kips, Stage II: 595 kips, and Stage III: 602 kips.

(2) The 1995 tendon inspection selected six tendons on each of the two girders per unit for visual examination. Three of the six tendons per girder were selected for lift-off. One of the lift-off tendons was de-tensioned for wire removal, visual examination, and tensile testing. Provisions for sample expansion were included based on BSEP 05-0044 inspection results (see Commitment Item #26). The 2000 tendon inspection sampled three tendons on each unit for physical inspection and three tendons for visual inspection. One tendon was selected for detensioning and wire removal.

(3)

Summary of Tendon Inspection Average Prestressing Values (kips)						
	Stage I		Stage II		Stage III	
	1995	2000	1995	2000	1995	2000
Unit 1	658	664	645.5	659	661.2	673
	648.1		655.5		660.7	
			646.6			

	Stage I		Stage II		Stage III	
	1995	2000	1995	2000	1995	2000
Unit 2	642.9	651	671.6	701	652.1	660
	710.9		682.5		666.7	
	647.9		706.5			
	610.8		681.4			
	641.6		666.4			
			656.4			

(4) Chemical Composition - 1995 inspection

The sheathing filler grease samples tested for water soluble ions showed acceptable levels of chloride, nitrate, and sulfide ions. Water content of grease in all tendons, except one tendon, was found to be acceptable. The old grease in the unacceptable tendon was replaced by pumping through with new Visconorust 2090 P4 grease.

Chemical Composition - 2000 Inspection

The sheathing filler grease samples tested for water soluble ions showed acceptable levels of chloride, nitrate, and sulfide ions and water content.

(5) The tensile tests of both the 1995 and 2000 inspections found the wire samples exhibited acceptable yield strength, ultimate strength, and elongation. All samples exceeded the yield and ultimate strength minimum values of 192,000 psi and 240,000 psi, respectively.

(6) Physical Condition - 1995 Inspection

For Unit 1, no sign of significant corrosion was found in the anchorheads, shims, or bearing plates of any of the tendon samples inspected. Concrete adjacent to the bearing plates was found covered with a steel plate and could not be inspected. For Unit 2, data gathered during this in-service inspection supports the conclusion that no abnormal degradation of the Unit 2 post-tensioning system affecting the structural integrity of the Unit 2 fuel pool girders has occurred during the first twenty years of service. Structural integrity has been maintained despite visual indications at the anchorage of grease leakage from defective grease cans and visual indications of corrosion on some of the anchorage components and surveillance wires.

Physical Condition - 2000 Inspection

Acceptable corrosion levels were found on all the tendon ends except for the buttonheads on one tendon. No cracks were found on any anchorage components. Concrete surrounding the bearing plates was covered with a steel plate and could not be inspected for cracks.

Based on these responses, the staff found that the applicant is appropriately monitoring the condition of post-tensioning system hardware and corrosion protection medium. The applicant plans to continue with monitoring of prestressing tendon forces, and condition monitoring of the post-tensioning system hardware during the period of extended operation. Therefore, the staff found the applicant's response acceptable for this element of the program, and the concern described in RAI B.2.32-2 is resolved.

Enhancements. The applicant plans to enhance the program prior to the period of extended operation in the areas of (1) Parameters Monitored or Inspected, (2) Detection of Aging Effects, (3) Monitoring and Trending, (4) Acceptance Criteria, and (5) Corrective Action.

The staff review of the enhancements indicates that the enhancements are in the right direction, and the implementation of the program with the enhanced elements will ensure that the prestressing tendons of the fuel pool girders will perform their intended function during the period of extended operation.

UFSAR Supplement. In LRA Section A.1.1.34, the applicant provided the UFSAR supplement for the Fuel Pool Girder Tendon Inspection Program. The staff reviewed this section and determined that the information in the UFSAR supplement provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

In RAI B.2.32-4, the staff noted that in LRA Section A.1.1.34, the applicant provided a summary of the inspection program. The summary, in part, stated: "Inspection results are used to ensure that the tendon prestressing values do not fall below the minimum design requirements." The staff requested that the applicant provide the present projected values at 40 and 60 years (based on the two inspections), and the minimum required value that is required for the girders to perform their intended functions.

In response, the applicant explained that the loss of prestress is relatively steep from the initial loading to the first surveillance at 20 years and then levels off between the 20-year surveillance and the 25-year surveillance. The applicant further noted that no meaningful information could be derived for a 60-year prestress value from two data points taken less than half-way through the 60-year period. The 40- and 60-year values have been determined analytically, and the following table provides those values compared to the minimum required.

	Minimum Required Prestress	Initial Prestress	Predicted 40 year Prestress	Predicted 60 year Prestress
Stage I Tendons	581.6 kips	776.9 kips	616 kips	568 kips
Stage II Tendons	595.2 kips	783 kips	635.7 kips	587.7 kips
Stage III Tendons	602.2 kips	780 kips	639.7 kips	591.7 kips

In LRA Section 4.7.2, TLAA "Fuel Pool Girder Tendon Loss of Prestress," the applicant indicated that it has analytically predicted the tendon forces for 40 and 60 years, as shown in the above table. In making a prediction for 60 years, the applicant increased the 40-year losses assumed due to concrete creep and shrinkage by 25 percent, and that due to relaxation of steel by 50 percent. Based on these estimates, as seen in the table above, the 60-year prestressing forces in all tendons are likely to be less than the minimum required prestressing force. The applicant plans to monitor the forces, and plans to take appropriate actions, when the forces are found to be below the minimum required forces. The staff found the approach taken by the applicant acceptable.

Conclusion. On the basis of its review and audit of the applicant's Fuel Pool Girder Tendon Inspection Program, the staff concluded that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the UFSAR supplement for this AMP and concluded that it provides an adequate summary description of the program, as required by 10 CFR 54.21(d).

3.0.4 Quality Assurance Program Attributes Integral to Aging Management Programs

Pursuant to 10 CFR 54.21(a)(3), a license renewal applicant is required to demonstrate that the effects of aging on SCs subject to an AMR will be adequately managed so that their intended functions will be maintained consistent with the CLB for the period of extended operation. Three of these 10 attributes are associated with the QA activities of corrective action, confirmation process, and administrative control. 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 (see Commitment Item #1):

- 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 quality of SR SSCs are subject to the QA requirements of 10 CFR Part 50, Appendix B. Additionally, for 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, confirmation process, and administrative control. Branch Technical Position IQMB-1 provides the following guidance with regard to the QA attributes of AMPs:

- SR 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 action, confirmation process, and administrative control for aging management during the period of extended operation. In this case, the applicant should document such a commitment in the UFSAR 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 period of extended operation. 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, enhanced, and new AMPs.

In LRA Section A.1.1, "Aging Management Programs and Activities," the applicant discussed that the QA program implements the requirements of 10 CFR Part 50, Appendix B, and that the program elements of "corrective action," "confirmation process," and "administrative controls" apply to both SR and NSR SSCs that are within the scope of license renewal. In LRA Section B.1.3, "Quality Assurance Program and Administrative Controls," the applicant discussed the implementation of its 10 CFR Part 50, Appendix B, QA program, which includes the program elements of "corrective action," "confirmation process," and "administrative control," and is applicable to the SR and NSR SSCs that are subject to AMR.

Corrective Action. Corrective actions are implemented through the initiation of an Action Request (AR) in accordance with plant procedures established to implement the Corrective Action Management Policy and requirements of 10 CFR 50, Appendix B, Criterion XVI. 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 prevent 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. The focus of the confirmation process is on the follow-up actions that must be taken to verify effective implementation of corrective actions and preclude repetition of significant conditions adverse to quality. The Corrective Action Program includes the requirement that measures be taken to preclude repetition of significant conditions adverse to quality. These measures will include actions to verify effective implementation of proposed corrective actions. The confirmation process is part of the Corrective Action Program and, for significant conditions adverse to quality, includes:

- reviews to assure proposed actions are adequate
- tracking and reporting of open corrective actions
- root cause determinations
- reviews of corrective action effectiveness

The AR process is also monitored for potentially adverse trends. The existence of an adverse trend due to recurring or repetitive adverse conditions will result in the initiation of a follow-up AR.

Administrative Control. Administrative controls that govern aging management activities are established within the document control procedures that implement (1) industry standards related to administrative controls and quality assurance for the operational phase of nuclear power plants, and (2) the requirements of 10 CFR 50, Appendix B, Criterion VI.

3.0.4.2 Staff Evaluation

The staff reviewed LRA Appendices, Sections A.1.1 and B.1.3. The purpose of this review was to assure that the SRP-LR Section A.2, "Quality Assurance for Aging Management Programs (Branch Technical Position IQMB-1)," regarding QA attributes of AMPs. Based on the staff's evaluation, the descriptions and applicability of the plant-specific AMPs and their associated quality attributes provided in LRA Sections A.1.1 and B.1.3; the staff concluded that the program descriptions are consistent with the staff's position and the Branch Technical Position discussed in IQMB-1.

3.0.4.3 Conclusion

The staff found 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 provides the elements of corrective action, confirmation process, and administrative control. Therefore, the applicant's QA description for its AMPs is acceptable.

3.1 Aging Management of Reactor Vessel, Internals, and Reactor Coolant System

This section of the SER documents the staff's review of the applicant's AMR results for the reactor vessel, internals, and reactor coolant system (RCS) components and component groups associated with the following systems:

- reactor vessel and internals
- neutron monitoring system
- reactor manual control system
- CRD hydraulic system
- reactor coolant recirculation system

3.1.1 Summary of Technical Information in the Application

In LRA Section 3.1, the applicant provided AMR results for components. In LRA Table 3.1.1, "Summary of Aging Management Evaluations in Chapter IV of NUREG-1801 for Reactor Vessel, Internals, and Reactor Coolant System," the applicant provided a summary comparison of its AMRs with the AMRs evaluated in the GALL Report for the reactor vessel, internals, and RCS components and component groups.

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 condition reports 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 Staff Evaluation

The staff reviewed LRA Section 3.1 to determine if the applicant provided sufficient information to demonstrate that the effects of aging for the reactor vessel, internals, and RCS components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff performed an onsite audit of AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL AMRs. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. Detail of the staff's audit evaluation are documented in the Audit and Review Report and are summarized in SER Section 3.1.2.1.

During the audit, the staff reviewed the AMRs that were consistent with the GALL Report and for which further evaluation is recommended. The staff confirmed that the applicant's further evaluations were consistent with the acceptance criteria in SRP-LR Section 3.1.2.2. The staff's audit evaluations are documented in the Audit and Review Report and are summarized in SER Section 3.1.2.2.

During the audit, the staff also conducted a technical review of the remaining AMRs that were not consistent with, or not addressed in, the GALL Report. The audit and technical review included evaluating (1) whether all plausible aging effects were identified, and (2) whether the aging effects listed were appropriate for the combination of materials and environments specified. The staff's audit evaluations are documented in the Audit and Review Report and are summarized in SER Section 3.1.2.3. The staff's evaluation of its technical review is also documented in SER Section 3.1.2.3.

Finally, the staff 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 reactor vessel, internals, and RCS components.

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

Table 3.1-1 Staff Evaluation for Reactor Vessel, Internals, and Reactor Coolant System Components in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor coolant pressure boundary components (Item 3.1.1-01)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	This TLAA is evaluated in Section 4.3, Metal Fatigue
Steam generator shell assembly (Item 3.1.1-02)	Loss of material due to pitting and crevice corrosion	Inservice inspection; water chemistry		Not applicable, PWR only
Isolation condenser (Item 3.1.1-03)	Loss of material due to general, pitting, and crevice corrosion	Inservice inspection; water chemistry		Not applicable (See Section 3.1.2.2)
Pressure vessel ferritic materials that have a neutron fluence greater than 10^{17} n/cm^2 (E > 1 MeV) (Item 3.1.1-04)	Loss of fracture toughness due to neutron irradiation embrittlement	TLAA, evaluated in accordance with Appendix G of 10 CFR 50 and RG 1.99	TLAA	This TLAA is evaluated in Section 4.2, Reactor Vessel Neutron Embrittlement
Reactor vessel beltline shell and welds (Item 3.1.1-05)	Loss of fracture toughness due to neutron irradiation embrittlement	Reactor vessel surveillance	Reactor Vessel Surveillance Program (B.2.14), TLAA	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2)
Westinghouse and B&W baffle/former bolts (Item 3.1.1-06)	Loss of fracture toughness due to neutron irradiation embrittlement and void swelling	Plant specific		Not applicable, PWR only
Small-bore RCS and connected systems piping (Item 3.1.1-07)	Crack initiation and growth due to SCC, intergranular SCC, and thermal and mechanical loading	Inservice inspection; water chemistry; one-time inspection	ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program (B.2.1) Water Chemistry Program (B.2.2)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2)
Jet pump sensing line, and reactor vessel flange leak detection line (Item 3.1.1-08)	Crack initiation and growth due to SCC, intergranular stress corrosion cracking (IGSCC), or cyclic loading	Plant specific	Water Chemistry Program (B.2.2) One-Time Inspection Program (B.2.15)	Consistent with GALL, which recommends further evaluation (See Section 3.1.2.2)
Isolation condenser (Item 3.1.1-09)	Crack initiation and growth due to stress corrosion cracking (SCC) or cyclic loading	Inservice inspection; water chemistry		Not applicable (See Section 3.1.2.2)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Vessel shell (Item 3.1.1-10)	Crack growth due to cyclic loading	TLAA		Not applicable, PWR only
Reactor internals (Item 3.1.1-11)	Changes in dimension due to void swelling	Plant specific		Not applicable, PWR only
PWR core support pads, instrument tubes (bottom head penetrations), pressurizer spray heads, and nozzles for the steam generator instruments and drains (Item 3.1.1-12)	Crack initiation and growth due to SCC and/or primary water stress corrosion cracking (PWSCC)	Plant specific		Not applicable, PWR only
Cast austenitic stainless steel (CASS) reactor coolant system *piping* (Item 3.1.1-13)	Crack initiation and growth due to SCC	Plant specific		Not applicable, PWR only
Pressurizer instrumentation penetrations and heater sheaths and sleeves made of Ni-alloys (Item 3.1.1-14)	Crack initiation and growth due to PWSCC	Inservice inspection; water chemistry		Not applicable, PWR only
Westinghouse and B&W baffle former bolts (Item 3.1.1-15)	Crack initiation and growth due to SCC and IASCC	Plant specific		Not applicable, PWR only
Westinghouse and B&W baffle former bolts (Item 3.1.1-16)	Loss of preload due to stress relaxation	Plant specific		Not applicable, PWR only
Steam generator feedwater impingement plate and support (Item 3.1.1-17)	Loss of section thickness due to erosion	Plant specific		Not applicable, PWR only

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
(Alloy 600) Steam generator tubes, repair sleeves, and plugs (Item 3.1.1-18)	Crack initiation and growth due to PWSCC, ODSCC, and/or IGA or loss of material due to wastage and pitting corrosion, and fretting and wear; or deformation due to corrosion at tube support plate intersections	Steam generator tubing integrity; water chemistry		Not applicable, PWR only
Tube support lattice bars made of carbon steel (Item 3.1.1-19)	Loss of section thickness due to FAC	Plant specific		Not applicable, PWR only
Carbon steel tube support plate (Item 3.1.1-20)	Ligament cracking due to corrosion	Plant specific		Not applicable, PWR only
Steam generator feedwater inlet ring and supports (Item 3.1.1-21)	Loss of material due to flow-corrosion	Combustion engineering (CE) steam generator feedwater ring inspection		Not applicable, PWR only
Reactor vessel closure studs and stud assembly (Item 3.1.1-22)	Crack initiation and growth due to SCC and/or IGSCC	Reactor head closure studs	Reactor Head Closure Studs Program (B.2.3)	Consistent with GALL, which recommends no further evaluation (Section 3.1.2.1)
CASS pump casing and valve body (Item 3.1.1-23)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection	ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program (B.2.1)	Consistent with GALL, which recommends no further evaluation (Section 3.1.2.1)
CASS piping (Item 3.1.1-24)	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS		Not applicable (See Section 3.1.2.1)
BWR piping and fittings; steam generator components (Item 3.1.1-25)	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	Flow-Accelerated Corrosion Program (B.2.5)	Consistent with GALL, which recommends no further evaluation (Section 3.1.2.1)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
RCPB valve closure bolting, manway and holding bolting, and closure bolting in high pressure and high temperature systems (Item 3.1.1-26)	Loss of material due to wear; loss of preload due to stress relaxation; crack initiation and growth due to cyclic loading and/or SCC	Bolting integrity	Reactor Head Closure Studs Program (B.2.3), Bolting Integrity Program (B.2.6)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.1)
Feedwater and control rod drive (CRD) return line nozzles (Item 3.1.1-27)	Crack initiation and growth due to cyclic loading	Feedwater nozzle; CRD return line nozzle	Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Not consistent with GALL (See Section 3.1.2.2)
Vessel shell attachment welds (Item 3.1.1-28)	Crack initiation and growth due to SCC, IGSCC	BWR vessel ID attachment welds; water chemistry	Water Chemistry Program (B.2.2), Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Not consistent with GALL (See Section 3.1.2.2)
Nozzle safe ends, recirculation pump casing, connected systems piping and fittings, body and bonnet of valves (Item 3.1.1-29)	Crack initiation and growth due to SCC, IGSCC	BWR stress corrosion cracking; water chemistry	Water Chemistry Program (B.2.2), BWR Stress Corrosion Cracking Program (B.2.4)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.2)
Penetrations (Item 3.1.1-30)	Crack initiation and growth due to SCC, IGSCC, cyclic loading	BWR penetrations; water chemistry	Water Chemistry Program (B.2.2), Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Not consistent with GALL (See Section 3.1.2.2)
Core shroud and core plate, support structure, top guide, core spray lines and spargers, jet pump assemblies, CRD housing, nuclear instrumentation guide tubes (Item 3.1.1-31)	Crack initiation and growth due to SCC, IGSCC, IASCC	BWR vessel internals; water chemistry	Water Chemistry Program (B.2.2), Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.2)
Core shroud and core plate access hole cover (welded and mechanical covers) (Item 3.1.1-32)	Crack initiation and growth due to SCC, IGSCC, IASCC	ASME Section XI inservice inspection; water chemistry	Water Chemistry Program (B.2.2), Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Not consistent with GALL (See Section 3.1.2.2)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Jet pump assembly castings; orificed fuel support (Item 3.1.1-33)	Loss of fracture toughness due to thermal aging and neutron embrittlement	Thermal aging and neutron irradiation embrittlement	Reactor Vessel and Internals Structural Integrity Program (B.2.28)	Not consistent with GALL (See Section 3.1.2.2)
Unclad top head and nozzles (Item 3.1.1-34)	Loss of material due to general, pitting, and crevice corrosion	Inservice inspection; water chemistry	ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program (B.2.1); Water Chemistry Program (B.2.2)	Consistent with GALL, which recommends no further evaluation (See Section 3.1.2.2)
CRD nozzle (Item 3.1.1-35)	Crack initiation and growth due to PWSCC	Ni-alloy nozzles and penetrations; water chemistry		Not applicable, PWR only
Reactor vessel nozzles safe ends and CRD housing; RCS components (except CASS and bolting) (Item 3.1.1-36)	Crack initiation and growth due to cyclic loading, and/or SCC and PWSCC	Inservice inspection; water chemistry		Not applicable, PWR only
Reactor vessel internals CASS components (Item 3.1.1-37)	Loss of fracture toughness due to thermal aging, neutron irradiation embrittlement, and void swelling	Thermal aging and neutron irradiation embrittlement		Not applicable, PWR only
External surfaces of carbon steel components in RCS pressure boundary (Item 3.1.1-38)	Loss of material due to boric acid corrosion	Boric acid corrosion		Not applicable, PWR only
Steam generator secondary manways and handholds (Item 3.1.1-39)	Loss of material due to erosion	Inservice inspection		Not applicable, PWR only
Reactor internals, reactor vessel closure studs, and core support pads (Item 3.1.1-40)	Loss of material due to wear	Inservice inspection		Not applicable, PWR only
Pressurizer integral support (Item 3.1.1-41)	Crack initiation and growth due to cyclic loading	Inservice inspection		Not applicable, PWR only
Upper and lower internals assembly (Westinghouse) (Item 3.1.1-42)	Loss of preload due to stress relaxation	Inservice inspection; loose part and/or neutron noise monitoring		Not applicable, PWR only

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Reactor vessel internals in fuel zone region (except Westinghouse and B&W baffle bolts) (Item 3.1.1-43)	Loss of fracture toughness due to neutron irradiation embrittlement, and void swelling	PWR vessel internals; water chemistry		Not applicable, PWR only
Steam generator upper and lower heads; tubesheets; primary nozzles and safe ends (Item 3.1.1-44)	Crack initiation and growth due to SCC, PWSCC, IASCC	Inservice inspection; water chemistry		Not applicable, PWR only
Vessel internals (except B&W and Westinghouse baffle former bolts) (Item 3.1.1-45)	Crack initiation and growth due to SCC and IASCC	PWR vessel internals; water chemistry		Not applicable, PWR only
Reactor internals (B&W screws and bolts) (Item 3.1.1-46)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring		Not applicable, PWR only
Reactor vessel closure studs and stud assembly (Item 3.1.1-47)	Loss of material due to wear	Reactor head closure studs		Not applicable, PWR only
Reactor internals (Westinghouse upper and lower internal assemblies; CE bolts and tie rods) (Item 3.1.1-48)	Loss of preload due to stress relaxation	Inservice inspection; loose part monitoring		Not applicable, PWR only

The staff's review of the BSEP component groups followed one of three approaches depending on the group's consistency with the GALL Report. SER Section 3.1.2.1 discusses the staff's review and documentation of the AMR results for components in the reactor vessel, internals, and RCS that the applicant indicated are consistent with the GALL Report and do not require further evaluation; SER Section 3.1.2.2 discusses the staff's review and documentation of the AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended; and, SER Section 3.1.2.3 discusses the staff's review and documentation of the AMR results for components that the applicant indicated are not consistent with, or not addressed in, the GALL Report. The staff's review of BSEP AMPs that are credited to manage or monitor aging effects of the reactor vessel, internals, and RCS components is documented in SER Section 3.0.3.

3.1.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Technical Information in the Application. In 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 reactor vessel, internals, and RCS components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Corrosion Program
- One-Time Inspection Program
- Reactor Head Closure Studs Program
- Reactor Vessel and Internals Structural Integrity Program
- Reactor Vessel Surveillance Program
- Systems Monitoring Program
- Water Chemistry Program
- Closed-Cycle Cooling Water Program
- Bolting Integrity Program

Staff Evaluation. In LRA Tables 3.1.2-1 through 3.1.2-5, the applicant provided a summary of AMRs related to the reactor vessel, internals, and RCS components, and identified which AMRs it considered to be consistent with the GALL Report.

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 staff 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 staff 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 staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report. The staff 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 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 staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item 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 staff audited these line items to verify consistency with the GALL Report. The staff verified whether the AMR line item of the different component was applicable to the component under review. The staff verified whether 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 E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different AMP is credited. The staff audited these line items to verify consistency with the GALL Report. 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's review of the LRA, as documented in the Audit and Review Report, dated June 21, 2005, did not repeat 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.

In LRA Section 3.1, the applicant provided the results of its AMRs for the reactor vessel, internals, and RCS.

In LRA Tables 3.1.2-1 through 3.1.2-5, the applicant provided a summary of the AMR results for component types associated with (1) reactor vessel and internals; (2) neutron monitoring system; (3) reactor manual control system; (4) control rod drive hydraulic system; and, (5) reactor coolant recirculation system. The summary information for each component type included: intended function; material; environment; aging effect requiring management; AMPs; the GALL Report Volume 2 item; cross reference to the LRA Table 3.1.1 (Table 1); and generic and plant-specific notes related to consistency with the GALL Report.

Also, for each component type in LRA Table 3.1.1, the applicant identified those components that are consistent with the GALL Report for which no further evaluation is required; those components consistent with the GALL Report for which further evaluation is recommended; and components that are not addressed in the GALL Report, together with the basis for their exclusion.

For AMRs that the applicant stated are consistent with the GALL Report and for which no further evaluation is recommended, the staff conducted its audit to determine if the applicant's reference to the GALL Report in the LRA is acceptable.

The staff compared the applicable AMR line items in LRA Tables 3.1.2-1 through 3.1.2-5 to the referenced GALL Report, Volume 2, items to confirm consistency with the GALL Report.

SER Sections 3.1.2.1.1 through 3.1.2.3, below, document the resolution of discrepancies identified by the staff during its audit of those AMRs that the applicant claimed are consistent with the GALL Report and for which no further evaluation is recommended in the GALL Report.

3.1.2.1.1 Crack Initiation and Growth in the Core Shroud and Core Plate (Welded and Mechanical Covers) in the Reactor Vessel

LRA Table 3.1.2-1 includes AMR results line items for core shroud and core plate access hole covers (AHCs) that are constructed of nickel-based alloys and exposed to treated water on their external surface. The Reactor Vessel and Internals Structural Integrity Program and Water Chemistry Program are specified to manage cracking due to SCC for these components; however, GALL Report line item IV.B1.1-d recommends ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program for Class 1 components, along with the Water Chemistry Program to manage this aging effect. In addition, since cracking initiated in crevice regions of AHC welds is not amenable to visual inspection under the ASME Section XI inservice inspection program, an augmented inspection, including UT or other demonstrated acceptable inspection, is also recommended in the GALL Report for AHC welds containing crevices. This augmented inspection is not addressed in the applicant's AMR.

The staff requested that the applicant clarify the discrepancy between the AMPs specified in the LRA and the AMPs recommended in the GALL Report for managing crack initiation due to SCC for the core shroud and core plate access hole covers and to state why the augmented inspection program for the AHCs, which covers welded components, is not discussed in the LRA. As documented in the BSEP Audit and Review Report, the applicant stated that the ASME Section XI inservice inspection requirements are captured as part of the Reactor Vessel and Internals Structural Integrity Program in LRA Section B.2.28.

In addition, the applicant stated that the procedures that implement the Reactor Vessel and Internals Structural Integrity Program include enhanced inspections of the AHCs. Specifically, the inspections performed may be either a UT or an EVT-1 (enhanced VT-1). However, EVT-1 is not consistent with the discussion in the AMR line for core shroud/core plate AHC, which states that the examination should be a UT examination method. This issue is investigated in RAI B.2.28-6, Parts A and B, and is dispositioned by staff in SER Section 3.0.3.3.1.

On the basis of its review, with the exception of RAI B.2.28-6, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

3.1.2.1.2 Reduction of Fracture Toughness for Cast Austenitic Stainless Steel Piping in the Reactor Coolant Recirculation System

LRA Table 3.1.2-5 includes an AMR line item for piping and fittings in the reactor coolant recirculation system that are constructed of CASS and exposed to treated water. The One-Time Inspection Program is specified to manage reduction of fracture toughness due to thermal aging embrittlement for these components; however, GALL Report line item IV.C1.1-g recommends the Thermal Aging Embrittlement of CASS Program (GALL AMP XI.M12) to manage this aging effect. LRA Table 3.1.1, Item 3.1.1, is also referenced for this AMR, which states that BSEP does not have CASS piping in the RCS, except for the main steam line flow limiters and the reactor coolant recirculation pump discharge flow elements. These components are assumed to be susceptible to thermal embrittlement; however, an AMP may not be needed based on a formal screening for susceptibility. The description of the One-Time Inspection Program in LRA Section B.2.15 also states that managing reduction of fracture toughness due to thermal aging embrittlement for CASS components may not be necessary based on the outcome of a review of material susceptibility.

The staff noted that the LRA does not address when this screening will be completed. During the audit, the staff asked the applicant to provide clarification as to when the screening of CASS components for material susceptibility to thermal embrittlement will be completed, and how the One-Time Inspection Program compares to GALL AMP XI.M12, which is recommended for managing reduction of fracture toughness for susceptible CASS components. Also, the applicant was asked to explain why the One-Time Inspection Program is used to manage thermal embrittlement in CASS components instead of the Reactor Vessel and Internals Structural Integrity Program, since LRA Table B-1, "Correlation of the NUREG-1801and BSEP Aging Management Programs," indicates that GALL AMP XI.M12 is part of the RV&ISIP.

As documented in the staff's Audit and Review Report, the applicant stated that the initial screening for material susceptibility to thermal embrittlement of the main steam line flow limiters and reactor coolant recirculation pump discharge flow elements has been completed. The staff determined that these components are not susceptible to reduction of fracture toughness due to thermal aging embrittlement. Therefore, the affected AMR results will be updated to reflect this, and the One-Time Inspection Program will be updated to remove these components from the program.

The staff reviewed the applicant's response and determined that it is acceptable on the basis that the applicant completed its screening for material susceptibility and determined that there are no CASS piping and fittings that are susceptible to thermal embrittlement. Therefore, the aging effect identified in the AMR for recirculation system piping and fittings is no longer applicable as stated by the applicant, in its letter dated March 14, 2005, (ML050810493), The applicant will delete the reference in the AMR table to update the affected AMRs to reflect the results of the screening for susceptibility of CASS components to thermal embrittlement. and to update the One-Time Inspection Program to remove these components.

On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report..

3.1.2.1.3 Loss of Material, Loss of Preload, and Crack Initiation and Growth of Pressure-Retaining Bolting in High Pressure and High Temperature Systems

LRA Table 3.1.2-5 includes AMR line items for recirculation pump closure bolting that is constructed of low-alloy steel and exposed to indoor air. The Bolting Integrity Program is specified to manage loss of material and loss of pre-load for these components. GALL Report line items IV.C1.2-d and IV.C1.2-e, respectively, are referenced, and both recommend the Bolting Integrity Program to manage this aging effect. Generic Note B is listed for these AMRs indicating consistency with the GALL Report, with the exception that the AMP takes exceptions to the AMP recommended in the GALL Report.

The staff compared the Bolting Integrity Program to the AMP recommended in the GALL Report and determined that the exceptions stated for the BSEP AMP effectively remove the ASME inservice inspection requirements from this AMP. Therefore, the staff reviewed and determined that the Bolting Integrity Program alone is not sufficient to manage aging for the AMRs in question since it does not include the ASME ISI requirements.

As part of its audit of the AMRs for the ESF systems in delineated LRA Section 3.2, the staff asked for clarification on the Bolting Integrity Program as it relates to pressure-retaining bolting. In its response, as documented in the Audit and Review Report, the applicant committed, by letter dated March 14, 2005, (ML050810493), to revising the Bolting Integrity Program to include the ASME inservice inspection requirements, along with monitoring and trending activities for pressure-retaining bolting (see Commitment Item #3). The revised AMP that includes the ASME ISI requirements resolves the discrepancy noted above.

On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

Conclusion. The staff evaluated the applicant's claim of consistency with the GALL Report. The staff also reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the staff concluded that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report. Therefore, the staff concluded that the applicant demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.2 AMR Review Results For Which Further Evaluation is Recommended By the GALL Report

Summary of Technical Information in the Application. In LRA Section 3.1.2.2, the applicant provided further evaluation of aging management as recommended by the GALL Report for the reactor vessel, internals, and RCS components. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage (BWR/PWR)
- loss of material due to crevice and pitting corrosion (BWR/PWR)
- loss of fracture toughness due to neutron irradiation embrittlement (BWR/PWR)
- crack initiation and growth due to thermal and mechanical loading or stress corrosion cracking (BWR/PWR)

Staff Evaluation. For some line items assigned to the staff in LRA Tables 3.1.2-1 through 3.1.2-5, the GALL Report recommends further evaluation. When further evaluation is recommended, the staff reviewed these further evaluations provided in LRA Section 3.1.2.2 against the criteria provided in the SRP-LR Section 3.1.3.2. The staff's assessments of these evaluations is documented in this section. These assessments are applicable to each Table 2 line item in Section 3.1 that cites the item in Table 1.

3.1.2.2.1 Cumulative Fatigue Damage (BWR/PWR)

Cumulative fatigue is a TLAA, as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is performed and addressed in SER Section 4.3.

3.1.2.2.2 Loss of Material Due to Crevice and Pitting Corrosion (BWR/PWR)

Steam Generator Shell Crevice and Pitting Corrosion (LRA Section 3.1.2.2.2.1). Loss of material for a steam generator shell assembly is applicable to PWRs only.

Isolation Condenser Crevice and Pitting Corrosion (LRA Section 3.1.2.2.2.2). BSEP does not have an isolation condenser.

3.1.2.2.3 Loss of Fracture Toughness Due to Neutron Irradiation Embrittlement (BWR/PWR)

Neutron Irradiation Embrittlement TLAA (LRA Section 3.1.2.2.3.1). Neutron irradiation embrittlement is a TLAA, as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed in SER Section 4.2.

Reactor Vessel Embrittlement (LRA Section 3.1.2.2.3.2). In the LRA Section 3.1.2.2.3.2, the applicant stated that loss of fracture toughness due to neutron irradiation embrittlement could occur in the reactor vessel. A materials surveillance program monitors neutron irradiation embrittlement of the reactor vessel. The BSEP Reactor Vessel Surveillance Program, and the results of its evaluation for license renewal, are presented in Section 3.0.3.2.10.

Reactor vessel embrittlement is reviewed and addressed in SER Section 3.0.3.3.1.

3.1.2.2.4 Crack Initiation and Growth Due to Thermal and Mechanical Loading or Stress Corrosion Cracking (BWR/PWR)

The staff reviewed LRA Section 3.1.2.2.4 against the criteria in SRP-LR Section 3.1.2.2.4.

Small-Bore Reactor Coolant System and Connected System Piping (LRA Section 3.1.2.2.4.1). The staff reviewed LRA Section 3.1.2.2.4.1 against the criteria in SRP-LR Section 3.1.2.2.4.

As documented in the staff's BSEP Audit and Review Report, in LRA Section 3.1.2.2.4.1, the applicant requested and received approval from the NRC to use RI-ISI in 2001. In support of the request, evaluations of degradation mechanisms were performed, and they demonstrated that no locations had a high failure potential on small bore pipe due to TASCS and TTs. The RI-ISI evaluations considered lines greater than 1-inch in diameter. For lines 1-inch and smaller, cracking due to thermal loadings was evaluated and dispositioned as not applicable. Cracking due to mechanical loadings was evaluated by a review of plant-specific operating experience; no relevant operating experience was found. The risk associated with cracking due to SSC of these lines is bounded by those components selected for inservice inspection as part of RI-ISI program. Therefore, the current inspection methods, as detailed in the ASME Section XI, Subsection IWB, IWC and IWD Program, supplemented by the Water Chemistry Program, will manage cracking of small bore piping systems.

The staff noted that an RI-ISI evaluation is not an acceptable technical basis for excluding small-bore Class 1 piping from one-time inspection, as recommended by the SRP-LR. Staff approval of an RI-ISI program is only for the current inspection interval and does not cover the extended period of operation. Therefore, during its review of the One-Time Inspection Program, the staff rejected the applicant's technical basis for not including inspections of small bore Class 1 piping in the scope of the BSEP AMP.

Consequently, the applicant stated, as documented in the BSEP Audit and Review Report, that it will revise the One-Time Inspection Program to be consistent with GALL Report AMP XI.M32. On the basis of its review, the staff found the One-Time Inspection Program to be acceptable.

Additionally, as requested by staff and documented in the Audit and Review Report, the applicant identified, and committed, by letter dated, May 4, 2005, (ML051330020), to make all required revisions to the LRA in order to include small bore Class 1 piping in the scope of the One-Time Inspection Program (see Commitment Item #11). The LRA will no longer reference or credit RI-ISI for aging management. BSEP credits the ASME Section XI, Inservice Inspection, Subsections IWB, IWC and IWD Program and the Water Chemistry Program for aging management, and will use the One-Time Inspection Program for verification of program effectiveness, consistent with the recommendations of the GALL Report.

Based on the applicant's new commitment to include small bore Class 1 piping in the scope of the One-Time Inspection Program and to revise the LRA as identified above and in the Audit and Review Report, the staff reviewed the applicant's commitment and determined that the applicant has met the criteria of SRP-LR Section 3.1.2.2.4 for further evaluation. For those AMRs whose further evaluation is provided in LRA Section 3.1.2.2.4.1, the staff concluded that the AMRs are consistent with the GALL Report and are acceptable.

Reactor Vessel Flange Leak Detection Line and Jet Pump Sensing Line. In LRA Section 3.1.2.2.4.2, as discussed in the Audit and Review Report, the applicant stated that the reactor vessel flange leak detection line is a Class 2 line that is normally dry. The BSEP AMR methodology assumed that this stainless steel line is exposed to treated water and, therefore, is susceptible to SCC. This aging effect will be managed with a combination of the Water Chemistry Program and the One-Time Inspection Program.

The staff reviewed LRA Section 3.1.2.2.4.2 and determined that cracking due to SCC in the reactor vessel flange leak detection line is possible since the stainless steel lines are exposed to treated water at high temperature. However, these lines normally remain dry during reactor operation, unless a leak develops between the closure head and vessel head flanges. The Water Chemistry Program would minimize susceptibility to SCC if a leak develops in the system. A one-time inspection of this small bore piping would provide reasonable assurance that cracking due to SCC is not occurring. If degradation is detected, then appropriate action would be taken to mitigate the aging effect. Therefore, the staff determined that the applicant's approach to manage cracking due to SCC in vessel flange leak detection lines is acceptable on the basis that it provides reasonable assurance that the effects of aging will be adequately managed.

In LRA Section 3.1.2.2.4.2, the applicant also stated that the jet pump sensing lines were evaluated for flow-induced vibration as part of the extended power uprate (EPU). This evaluation determined that the sensing line natural frequency of interest is well separated from the vane passing frequency of the recirculation pumps at EPU conditions. The failure of a sensing line at any location would be detected during jet pump surveillance, which is performed at least daily. Failure of a sensing line does not affect the pressure measurement taken for post-accident water level monitoring. If one or more jet pumps are inoperable, the plant must be brought to mode 3 within 12 hours. Therefore, the applicant claims that no AMP is required.

As documented in the Audit and Review Report, the staff agreed with the applicant's claim that there is no resonance between the vane passing frequency of the recirculation pump and the natural frequency of the jet pump sensing lines.

The staff noted that LRA Table 2.3.1-1, "Component/Commodity Groups Requiring Aging Management Review and Their Intended Functions: Reactor Vessel and Internals," identifies —4 (provides structural support/seismic integrity) as the only intended function for these lines. The intended function —1 (provides pressure-retaining boundary), which the staff expected for the portion of the jet pump sensing line external to the reactor vessel, was not identified. During the audit, the staff requested that the applicant provide clarification on how aging management of the jet pump sensing line external to the reactor vessel is addressed.

In its response, the applicant stated that the jet pump sensing lines that are external to the reactor vessel are evaluated as part of the component/commodity group "piping and fittings (small bore piping less than NPS 4)." This component/commodity group is evaluated in LRA Table 3.1.2-1. The applicant also noted that the AMR for this line item will be revised to add the One-Time Inspection Program.

The staff reviewed the applicant's response and determined that it was acceptable on the basis that the portion of the jet pump sensing line external to the reactor vessel is included in the commodity group for small bore piping, which is addressed in LRA Table 3.1.2-1. The portion of the jet pump sensing line internal to the reactor vessel is submerged in reactor coolant and its failure would not have any consequence in terms of a reactor coolant leak. Therefore, the portion of the jet pump sensing line internal to the reactor vessel does not have an intended pressure-retaining boundary function, and the applicant's identification of the structural support/seismic integrity intended function (—4 in LRA Table 2.0-1), is appropriate.

The staff reviewed the applicant's response and determined that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.1.2.2.4 for further evaluation. For those AMRs whose further evaluation is provided in LRA Section 3.1.2.2.4.2, the staff concluded that the applicant is consistent with the GALL Report and the AMRs are acceptable.

<u>Isolation Condenser Components</u>. LRA Section 3.1.2.2.4.3 states that BSEP does not have an isolation condenser.

On the basis that BSEP does not have any components from this group, the staff agreed with the applicant's determination that this aging effect is not applicable.

<u>Conclusion</u>. On the basis of its review, 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 recommends further evaluation, the staff determined that: (1) those attributes or features for which the applicant claimed consistency with the GALL Report were indeed consistent; and, (2) the applicant adequately addressed the issues that were further evaluated. The staff found

that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3 AMR Results That Are Not Consistent with the GALL Report or Not Addressed in the GALL Report

Summary of Technical Information in the Application. In LRA Tables 3.1.2-1 through 3.1.2-5, the staff reviewed additional details of the results of the AMRs for material, environment, aging effect requiring management, and AMP combinations that are not consistent with the GALL Report, or that are not addressed in the GALL Report.

In LRA Tables 3.1.2-1 through 3.1.2-5, the applicant indicated, via Notes F through J, that neither the identified component nor the material and environment combination is evaluated in the GALL Report and provided information concerning how the aging effect will be managed. Specifically, Note F indicated that the material for the AMR line-item component is not evaluated in the GALL Report. Note G indicated that the environment for the AMR line-item component and material is not evaluated in the GALL Report. Note H indicated that the aging effect for the AMR line-item component, material, and environment combination is not evaluated in the GALL Report. Note I indicated that the aging effect identified in the GALL Report for the line-item component, material, and environment combination is not applicable. Note J indicated that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

Staff Evaluation. For component type, material, and environment combinations that are not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.1.2.3.1 Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Vessel and Internals – Table 3.1.2-1

The staff reviewed LRA Table 3.1.2-1, which summarizes the results of AMR evaluations for the reactor vessel and internals component groups.

Reactor Vessel Components. The RVs are located within the drywell structures. The RVs are fabricated from low-alloy steel plates and welds and are clad internally with stainless steel. The RV shells are fabricated from four shell courses: (1) upper RV shell, (2) intermediate RV shell, (3) intermediate beltline RV shell, and (4) lower RV shell. Two of these RV shell courses, the intermediate beltline RV shell and lower RV shell, are located in the beltline region of the RV that immediately surrounds the RV core. The beltline region of the RV is the region of the RV that receives the greatest amount of irradiation by high-energy neutrons ($E \geq 1.0$ MeV). The RV top head flanges are bolted to the RV shell flanges using studs and nuts.

The applicant's plant-specific AMRs for the RV components are given in LRA Table 3.1.2-1. The specific RV components that are within the scope of LRA Table 3.1.2-1 include:

- RV top head assembly (including the RV top head enclosure, the RV top head flange, the RV top head nozzles, and the RV top head closure studs and nuts)
- RV shell courses (including the upper RV shell course and the RV flange, intermediate RV shell course, lower intermediate beltline RV shell course, and lower RV shell course; the RV welds, and the RV attachment welds)
- RV nozzles (including main steam nozzles, feedwater nozzles and their thermal sleeves, CRD return nozzles, recirculation inlet and outlet nozzles, low pressure core spray nozzles and their thermal sleeves, and shell flange nozzles).
- RV bottom heads and the RV support skirt attachment welds
- RV drain line penetrations
- RV interior attachment welds

The applicant identified that the materials of fabrication for the RV components include carbon steel, low-alloy steel, stainless steel, and nickel-based alloys. The applicant identified that the applicable environments for the RV components include the containment and indoor air environments and the treated water (including steam) environment.

The RV interior attachment welds are managed by the applicant's RV&ISIP and are, therefore, treated in this SER as Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Vessel and Internals – Table 3.1.2-1. The staff's assessments of the plant-specific AMRs for RV interior attachment welds are given in SER Section 3.1.2.3.1, "Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Vessel and Internals – Table 3.1.2-1."

The applicant also credited the RV&ISIP with the management of cracking due to cyclical loading in the low-alloy steel RV feedwater nozzles and low-alloy RV drain line penetrations. The applicant's AMR for assessing cracking due to cyclical loading of the low-alloy steel RV feedwater nozzles has been identified by the applicant as an AMR that is consistent with GALL Report, Volume 2, as modified by the applicant in Footnote E of LRA Tables 3.1.2-1 through Table 3.1.2-4, in which the applicant credits an alternative program to that recommended in the GALL Report. The staff evaluated the AMR on cracking due to cyclical loading of the RV feedwater nozzles in SER Section 3.1.2.1. The applicant's AMR for assessing cracking due to cyclical loading of the low-alloy steel RV drain line penetrations has been identified by the applicant as a plant-specific AMR. The staff deferred its assessment of the AMR on cracking due to cyclical loading of the RV drain line penetrations to SER Section 3.1.2.3.1, "Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Vessel and Internals – Table 3.1.2-1," because the applicant opted to credit the RV&ISIP with management of this aging effect.

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Crack Initiation Due to Thermal Fatigue

<u>Identification of Aging Effects</u> - The applicant identified cracking due to thermal fatigue as an applicable aging effect for all RV components and their supports. This is consistent with the SRP-LR and is, therefore, acceptable. In addition, although not requested to do so, the applicant

provided, in its response to RAI No. 3.1.2.3.1.1-1, Part B, dated June14, 2005, the following supplemental information:

> Part B: Reduction of fracture toughness due to neutron irradiation embrittlement is an applicable aging effect for all the components in the commodity groups described in Part A.
>
> Note that the AMR line items for cracking due to thermal fatigue in LRA Tables 3.1.2-1, 3.2.2-1, 3.3.2-1, and 3.4.2-1 refer to "Table 1" items 3.1.1-01, 3.2.1-01, 3.3.1-01, and 3.4.1-01, respectively. This "Table 1" item addresses cumulative fatigue damage. Cumulative fatigue damage is addressed topically in Section 4.3 of the LRA. Cracking due to thermal fatigue is the aging effect/mechanism combination that is addressed by the time-limited aging analyses (TLAAs) when calculating cumulative fatigue damage.

The applicant's supplemental response to RAI 3.1.2.3.1.1-1, Part B, clarified that the phrase "cracking due to thermal fatigue," as defined in the applicable AMR line items for "Table 2" in LRA Sections 3.1, 3.2, 3.3, 3.4, and 3.5, corresponds to the definition "cumulative fatigue damage" in the applicant AMR line items for "Table 1" in LRA Sections 3.1, 3.2, 3.3, 3.4, and 3.5. The applicant changed the terminology because it recognized that 10 CFR 54.21(a) requires that aging effects be managed for the period of extended operation and because the term "cumulative fatigue damage" referred to a parameter that is used to assess the aging effect of cracking due to thermal fatigue and was not referring to the aging effect itself. Based on this assessment, the change in the terminology from "cumulative fatigue damage" in the "Table 1" to "cracking due to thermal fatigue" in the "Table 2" was done to satisfy the provision and criteria of 10 CFR 54.21(a). This meets the provisions in SRP-LR Sections 3.1, 3.2, 3.3, 3.4, and 3.5 for assessing cracking due to thermal fatigue/cumulative fatigue damage in ASME Code Class 1, 2, and 3 components and any applicable NSR components that are required to have thermal fatigue assessments for license renewal and, therefore, is acceptable. Refer to SER Section 4.3 for the staff's assessment of those plant components that are required to have thermal fatigue analyses for the LRA.

Aging Management - The applicant proposed to manage cracking due to thermal fatigue using the TLAA for assessing thermal fatigue/cumulative fatigue damage of ASME Code Class 1 components, which is given in LRA Section 4.3. This is consistent with the SRP-LR and is, therefore, acceptable. The staff evaluated the applicant's TLAA on thermal fatigue of ASME Code Class 1 components in SER Section 4.3.

Evaluation - Reduction of Fracture Toughness Properties in the RV Shell Courses Due to Neutron Irradiation Embrittlement

Identification of Aging Effects - The shells and heads of the RVs are fabricated from low-alloy steel plates and weld materials. The applicant identified reduction of fracture toughness as a result of neutron irradiation embrittlement as an applicable aging effect for those low-alloy steel plates and welds that are used to fabricate the intermediate beltline RV shell and lower RV shell courses of the RVs.

Considerable fracture toughness data compiled by the Oak Ridge National Laboratory demonstrated that prolonged irradiation of RV low-alloy steel materials by high-energy neutrons

(E ≥1.0 MeV) reduces the fracture toughness properties of the materials over time. The NRC established a threshold in 10 CFR Part 50, Appendix H, of 1 x 10^{17} neutrons per square centimeter (n/cm^2, E ≥1.0 MeV) for neutron irradiation embrittlement of low-alloy steel materials in the RCPB. Neutron irradiation embrittlement/reduction of fracture toughness properties is a concern for only those low-alloy steel RV shell and weld materials located in the beltline region of the RVs, where the 54 EFPY neutron fluence values have been projected to exceed the NRC's threshold for neutron irradiation.

In RAI 3.1.2.3.1.1-1, Part A, by letter dated May 18, 2005, the staff noted that the applicant appeared to have used two different terminologies for the RV intermediate beltline shell in the LRA. In LRA Table 3.1.2-1, the applicant defined the beltline shell course as the "RV Shell (intermediate beltline shell)." In contrast, in LRA Tables 4.2.5 and 4.2.6, which are associated with TLAAs in LRA Section 4.2, "Reactor Vessel Neutron Embrittlement," the applicant refers to two RV shell courses in the beltline region of the RVs: (1) the "RV Lower Intermediate Shell" and (2) the "RV Lower Shell." The staff also noted that reduction of fracture toughness due to neutron irradiation embrittlement was not identified in Table 3.1.2-1 as an applicable aging effect for the "RV Shell (Lower Shell)" plates, even though it had been identified and analyzed as an aging effect in LRA Tables 4.2-5 and 4.2-6. Therefore, the staff inquired about these inconsistencies in the application.

In its response, by letter dated June 14, 2005, the applicant stated:

> Part A: The terminology used in LRA Tables 4.2-5 and 4.2-6 is consistent with the submittals BSEP has previously made in relation to Generic Letter 92-01, "Reactor Vessel Structural Integrity." The terminology used in LRA Section 3.1 is in the form of "commodity groups."
>
> The "Vessel Shell (Intermediate Beltline Shell)" is a commodity group name derived from NUREG-1801, "Generic Aging Lessons Learned (GALL) Report." It is not meant to describe particular shell courses of the reactor vessel (RV). However, this commodity group does include the following items from Tables 4.2-5 and 4.2-6:
>
> - Plates: Lower Shell,
> - Plates: Lower Intermediate Shell, and
> - Nozzles: N16A, N16B (i.e., forgings).
>
> The "Vessel Shell (Beltline Welds)" is another commodity group name derived from GALL. This commodity group does include the following items from Tables 4.2-5 and 4.2-6:
>
> - Welds: Vertical (i.e., G1, G2, F1, and F2) and
> - Welds: Girth (i.e., EF and FG).

The applicant's response to RAI 3.1.2.3.1.1-1, Part A, clarified that the AMR line item on reduction of fracture toughness properties for the "intermediate beltline shell" course covers the following components: lower shell plates, lower intermediate shell plates, N16-A and -B instrumentation nozzle forgings, and associated welds. This is consistent with components analyzed in Section 4.2 of the application and resolves the apparent discrepancy that was thought to exist between the AMR lines item and the TLAA analyses. The response also agreed that reduction of fracture toughness is an applicable aging effect for all of these components. Therefore, the applicant's response to RAI 3.1.2.3.1.1-1, Part A, is acceptable because it clarified that the RV shell plate and weld components in the applicant's AMR analysis is consistent with those analyzed for neutron irradiation embrittlement in Chapter 4.2 of the application.

Based on this assessment, the staff concluded that the applicant performed an acceptable identification of those RV beltline plate and weld components that are subject to neutron irradiation embrittlement/reduction of fracture toughness properties. Therefore, the staff's concern described in RAI 3.1.2.3.1.1-1 is resolved.

Aging Management - The applicant proposed to manage this reduction of fracture toughness using a number of TLAAs on neutron irradiation embrittlement of these components, which are defined and discussed in LRA Sections 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.2.6, 4.2.7, 4.2.8, and 4.2.9 and in the applicant's response and supplemental response to RAI 4.2-2, which provided a supplemental TLAA on the RV reflood thermal shock analysis. This is consistent with the SRP-LR and acceptable. The staff evaluated these TLAAs in SER Sections 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.2.5, 4.2.6, 4.2.7, 4.2.8, and 4.2.9. SER Section 4.2.10, added in response to RAI 4.2-2, dated April 8, 2005, provides the staff's basis for accepting the TLAA on RV Reflood Thermal Shock Analysis under the acceptance criterion of 10 CFR 54.21(c)(1)(ii).

RV Components that are Exposed to the Indoor Air/Containment Air Environments

Identification of Aging Effects - With the exception of the RV top head studs and nuts, the applicant did not identify any AERMs for the RV components that are exposed externally to the indoor air environment, including those RV components that are fabricated from either carbon steel, low-alloy steel, stainless steel, or nickel-based alloy materials. The applicant's external indoor air environment for the RV is subdivided into one of two types of atmospheric environments: (1) indoor air during refueling outages or (2) containment air during plant operations. In LRA Table 3.0-2, the applicant provided the following definition of the indoor air environment:

> Atmospheric air, specific temperature range/humidity dependent upon building/room/area. Typically, temperature is 104 °F maximum in most areas and radiation dose levels are negligible. Potentially wetted.

The applicant also provides the following definition of the containment air environment:

> Nitrogen atmosphere (atmospheric air during refueling outages). Specific temperature range dependent upon area. Bulk average temperature 150 °F maximum. Relative humidity 40 - 90%. Pressure +2.5/-0.5 psig. Gamma radiation dose level: maximum 60-year total integrated dose (TID) 1.25 x 10^8 rad gamma (1.32 x 10^{10} rad gamma (54 EFPY) at inside face of sacrificial shield wall). Maximum neutron fluence (54 EFPY) of 4.03 x 10^{17} n/cm^2 (E>1 Mev) inside face of the sacrificial shield wall.

The predominant external environment for the RV components is containment air because the indoor air environment only occurs infrequently: during scheduled refueling outages for the plants, normally 6 to12 percent of the time, depending on the length of the refueling outages.

The applicant included plant-specific Footnote 101 in LRA Table 3.1.2-1 through 3.1.2-5, as its basis for establishing its position that cracking or loss of material would not occur in stainless steel or nickel-based alloy RV components under the indoor/containment air environments. In this footnote, the applicant stated that stainless steel and nickel-based alloy components do not have any applicable aging effects in non-aggressive indoor air environments (i.e., indoor air environments that do not contain significant aggressive chemical species). The staff agreed with this assessment because stainless steel and nickel-based alloy materials are generally designed to be corrosion resistant in indoor air environments that do not contain aggressive chemical species (e.g., halides or sulfates) that, if present, might otherwise lead to corrosion-induced loss of material or cracking in the materials. Since the indoor/containment air environments do not normally contain aggressive chemical species, the staff agreed that aging effects do not need to be identified for the stainless steel and nickel-based alloy RV components that are exposed to indoor/containment air environments and concluded that the applicant's assessment is acceptable.

The applicant included plant-specific Footnote 109 in LRA Table 3.1.2-1 through 3.1.2-5 as its basis for establishing its position that loss of material would not occur in carbon steel or low-alloy steel RV components under the indoor/containment air environments. In this footnote, the applicant stated that general corrosion is not a concern for the carbon steel/low-alloy steel RV components that are exposed to these environments because the components operate at temperatures equal to or above 212°F. The maximum bulk average temperature of the indoor/containment air environments is identified in the application as 150°F. Since the carbon steel/low-alloy steel RV components operate at temperatures above the maximum bulk average temperature for the indoor/containment air environments, the staff concluded that loss of material/general corrosion induced by the precipitation of water will not be an issue for the carbon steel/low-alloy steel RV components that are exposed to these environments. Furthermore, industry operating experience has not yet identified that SCC is an AERM for carbon steel/low-alloy steel components that are exposed to indoor air environments, in the absence of aggressive chemical species. Since the indoor/containment air environments do not normally contain aggressive chemical species, the staff agreed that SCC is not an AERM for the carbon steel/low-alloy steel RV components that are exposed to the indoor/containment air environments. Based on this assessment, the staff agreed that neither loss fo material due to general corrosion nor cracking due to SCC need to be identified as AERMs for the carbon steel/low-alloy steel RV components that are exposed to indoor/containment air environments and concluded that the applicant's assessment is acceptable.

For the RV top head closure studs and nuts, the applicant identified that cracking due to SCC and loss of material due to general corrosion, pitting corrosion, or crevice corrosion were applicable AERMs. The applicant's identification that SCC is an applicable AERM for these components is consistent with the staff's AMR in the GALL Report, Volume 2, commodity group line item IV.A1.1-c, and is, therefore, acceptable. GALL Report, Volume 2, does not identify the loss of material due to general corrosion, pitting corrosion, or crevice corrosion as an AERM for RV top head closure studs and nuts. Therefore, the applicant's identification of loss of material due to general corrosion, pitting corrosion, or crevice corrosion as an applicable AERM for the RV top head closure studs and nuts is conservative relative to the recommended AMRs and AERMs for BWR RV components in the GALL Report, Volume 2, and is acceptable.

Cracking by thermal fatigue is not an issue for the RV components exposed to the indoor/containment air environments, but has been included as a separate AMR entry for the surfaces that are exposed to and loaded under the treated water environment of the reactor coolant. The staff evaluated thermal fatigue of these RV components in SER Section 3.1.2.3.1.

Aging Management Programs - With the exception of the applicant's AMRs for the RV top head closure studs and nuts, the applicant did not identify any AERMs for the RV components that are exposed to the indoor/containment air environments and therefore did not credit any AMPs with aging management. In the Identification of Aging Effects section, the staff provided its bases for concluding that there were not any AERMs for the RV components that are exposed to these environments, with the exception of those for the RV top head closure studs and nuts. Therefore the staff concluded that, with the exception of the AERMs for the RV top head closure studs and nuts, AMPs do not need to be credited for aging management of the RV components that are exposed to indoor/containment air environments.

The applicant credits the Reactor Head Closure Studs Program with aging management of cracking due to SCC in the RV top head closure studs and nuts. Crediting the Reactor Head Closure Studs Program for management of SCC in the RV top head closure studs and nuts is consistent with the staff's recommended AMR in the commodity group line item IV.A1.1-c of GALL, Volume 2, and is, therefore, acceptable. The applicant's Reactor Head Closure Studs Program is an existing AMP that is entirely consistent with GALL AMP XI.M3.

The applicant also credited the Reactor Head Closure Studs Program with the management of loss of material due to general corrosion, pitting corrosion, and crevice corrosion in these components. GALL AMP XI.M3 indicates that the program can be used to detect loss of material due to corrosion or wear in the RV top head closure studs and nuts. There the staff concluded that crediting the Reactor Head Closure Studs Program with management of loss of material in the RV top head closure studs and nuts is also consistent with GALL AMP XI.M3 and is acceptable.

The staff evaluated the ability of the Reactor Head Closure Studs Program to manage cracking and loss of material in the RV top head closure studs and nuts in SER Section 3.0.3.1.

Stainless Steel and Nickel-based Alloy RV Components that are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - The applicant identified cracking induced by SCC and loss of material due to pitting and crevice corrosion as applicable aging effects for stainless steel and nickel-based alloy RV components exposed internally to the treated water environment. For these components, which include any low-alloy steel RV components clad internally with stainless steel, the treated water environment is reactor coolant or its steam environment. In LRA Table 3.0–1, the applicant provided the following definition of the treated water (including steam) environment:

> Treated water is demineralized water and is the base water for all clean, closed loop systems. Depending on the system, treated water may require additional processing. Treated water can be deaerated, include corrosion inhibitors, biocides, or include a combination of these treatments. Steam generated from treated water is included in this environment category. Typical treated water categories include:
>
> Reactor Water: BSEP water quality parameters for use in the reactor coolant system.

The NRC-approved Topical Report BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," provides the BWRVIP's recommended inspection strategies and flaw evaluation recommendations for BWR RV components. The staff approved this report in an FSER to the BWRVIP, dated October 18, 2001. In this report, the BWRVIP indicates that cracking induced by SCC can be an AERM for stainless steel RV components that are exposed to a BWR reactor coolant environment, including cracking induced by IGSCC and IASCC, which are forms of SCC. BWRVIP-74-A also indicates that SCC can be an AERM for nickel-based alloy RV components that are exposed to a BWR reactor coolant environment, particularly in nickel-based alloy weld filler metals that are fabricated from Alloy 182 or Alloy 82.

The applicant's identification of cracking due to SCC as an AERM for these components under internal exposure to the reactor coolant is consistent with the age-related degradation analysis provided in BWRVIP-74-A and is, therefore, acceptable.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion or pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive ionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components that are located in creviced areas or areas of restricted access, where the exposure of the components to a particular coolant may be prone to stagnant conditions. Neither GALL Report, Volume 2, nor Topical Report BWRVIP-74-A identify that loss of material due to general, pitting, or crevice corrosion is an applicable AERM for the stainless steel and nickel-based alloy RV components (including those low-alloy steel RV components that are designed with internal stainless steel cladding) that are exposed to the reactor coolant (or its steam) environment. In contrast, the applicant identified that loss of material due to pitting and crevice corrosion is an applicable AERM for these components exposed to these environments. The staff concluded that this is acceptable because it is conservative relative to the aging-effect analysis approved in BWRVIP-74-A or the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel or nickel-based alloy RV components in the reactor coolant pressure boundary.

Aging Management Programs - The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program and the Water Chemistry Program with aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in the stainless steel and nickel-based alloy RV components that are exposed to the reactor coolant (or its steam) environment. The applicable ISI examinations for these RV components are required by 10 CFR 50.55a and are defined in applicable inspection categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1 of Topical Report BWRVIP-74-A provides a summary of the ISI inspections that are required for RV components. The staff concluded that crediting the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for aging management of cracking due to SCC and loss of material due to pitting corrosion is acceptable because the applicant will apply the required ISI examinations as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.1.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize the concentrations of the dissolved oxygen and ionic impurities in the reactor coolant. The applicant's Water Chemistry Program is implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting of the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the ERPI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. The staff evaluated the ability of the Water Chemistry Program to minimize the concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment in SER Section 3.0.3.1.

Carbon Steel and Low Alloy Steel RV Components that are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - Not all of the low-alloy steel RV components are clad with austenitic stainless steel. Therefore, the applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for those carbon steel/low-alloy steel RV components whose surfaces are exposed internally to the treated water environment. The treated water environment has been described in the previous subsection and, for these RV components, is reactor coolant or its steam.

Topical Report BWRVIP-74-A indicates loss of material due general corrosion as an AERM for carbon steel/low-alloy steel RV components exposed to a BWR reactor coolant environment, even though the BWRVIP states that the amount of general corrosion in the components is expected to be small. The report, as approved by NRC, does not indicate cracking due to SCC (including IASCC or IGSCC) as an applicable aging effect for the carbon steel/low-alloy steel components exposed to the reactor coolant. The applicant identified loss of material due to general corrosion as an AERM for these components and included pitting corrosion and crevice corrosion within the scope of the mechanisms that could lead to this aging effect. This is acceptable to the staff because it adds pitting corrosion and crevice corrosion (in addition to general corrosion) as the mechanisms that can lead to loss of material in these components and is, therefore, more conservative than the corresponding age-related degradation analysis provided in NRC-approved Topical Report BWRVIP-74-A.

The applicant also identified cracking due to cyclical loading as an applicable aging effect for low-alloy steel RV drain line penetrations. The staff opted to evaluate the AMR on cracking due to cyclical loading of the RV drain line penetrations in SER Section 3.1.2.3.1, "Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Vessel and Internals – Table 3.1.2-1," because the applicant opted to credit the Reactor Vessel and Internals Structural Integrity Program for management of the aging effect.

Aging Management Programs. The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program and the Water Chemistry Program with aging management of loss of material due to general, pitting, and crevice corrosion in the carbon steel/low-alloy steel RV components that are exposed to the reactor coolant (or its steam) environment. The applicable ISI examinations for these RV components are required by 10 CFR 50.55a and are defined in applicable ISI categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1 of Topical Report BWRVIP-74-A provides a summary of the inspections that are required for RV components. The staff concluded that crediting the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for the management of loss of material due to general, pitting, and crevice corrosion is acceptable because the applicant will apply the required ISI examinations as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage this aging effect and mechanisms in SER Section 3.0.3.1.

The applicant credited the Water Chemistry Program for aging management used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to cracking due to SCC and loss of material due to general, pitting and crevice corrosion of low-alloy steel/carbon steel reactor coolant pressure boundary components, including those for the RV. The staff concluded that this is an acceptable AMP for aging management because it will be used to control the concentration of dissolved oxygen and ionic water impurities to acceptable levels, as recommended in the EPRI/BWRVIP water chemistry guidelines. In SER Section 3.0.3.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentration of dissolved oxygen and ionic water impurities in reactor coolant.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the RV components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

RV Internal Components. The applicant's plant-specific AMRs for the RV internal components are given in LRA Table 3.1.2-1. The specific RV internal components within the scope of LRA Table 3.1.2-1 include:

- RV internal penetrations (including CRD stub tube penetrations, reactor instrumentation penetrations, jet pump instrumentation penetrations, SLC/core ΔP penetrations, flux monitor penetrations, and RV drain line penetrations).
- RV core shrouds (including the flange, upper, central, and lower shell courses and the core shroud access hole cover)
- Core shroud repair hardware (core shroud repair clamps) and the core shroud support structure
- Core plates, the core plate bolts, and the core plate plugs
- Top guides
- Core spray lines and their subcomponents (including their thermal sleeves, headers, spargers, and sparger nozzles).
- Jet pump assemblies and their subcomponents (including their thermal sleeves, inlet headers, riser brace arms, holddown beams, inlet elbows, mixing assemblies, diffusers, castings, jet pump sensing lines, jet pump holddown beam keepers, lock plates, and bolts)
- Fuel support and CRD assemblies and their subcomponents (including the orificed support plates and the CRD housings)

- RV incore flux instrumentation (including those for the source range monitors and the intermediate range monitors)
- NSR RV internal components (including the steam dryers, core shroud head and separators, feedwater spargers, and the RV surveillance capsule holders)

This section provides the staff's evaluation of the plant-specific AMRs for the RV internal components. The evaluations in this section also include an evaluation of those AMRs for the RV drain line penetration and RV interior attachment welds that credit the RV&ISIP for aging management.

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Crack Initiation Due to Thermal Fatigue

Identification of Aging Effects - The applicant identified cracking due to thermal fatigue as an applicable aging effect for all RV internal components, including the RV penetrations and the RV interior attachment welds, which are RV components within the scope of the RV&ISIP. GALL Report, Volume 2, provides the following AMR commodity group line items on cracking due to thermal fatigue/cumulative fatigue damage of RV internal components:

- AMR Commodity Group IV.A1.5-b, RV penetration components
- AMR Commodity Group IV.B1.1-c, core plate
- AMR Commodity Group IV.B1.2-b, top guide
- AMR Commodity Group IV.B1.3-b, core spray components, including spray lines, spray header, spray rings, and spray nozzles
- AMR Commodity Group IV. B1.4-b. -c. and -d, jet pump assembly components, including castings, sensing lines, mixing assemblies, inlet headers and elbows, hold-down beam, and riser brace arms
- AMR Commodity Group IV.B1.5-b, fuel support - orifice support plate
- AMR Commodity Group IV.B1.6-b, intermediate range monitor and source range monitor dry tubes

The applicant's identification of cracking due to thermal fatigue/cumulative fatigue damage as an applicable aging effect for the RV internal components is consistent and goes beyond the number of AMR commodity group line items for cumulative fatigue damage identified in the SRP-LR and in GALL Report, Volume 2, for RV internal components. The staff concluded that this is acceptable because the AMRs on cracking due to thermal fatigue of the RV internal components is both consistent with and more conservative than those identified in GALL Report, Volume 2.

Aging Management - The applicant credits its TLAA on thermal fatigue of ASME Code Class components with the management of cracking due to thermal fatigue/cumulative fatigue damage in the RV internal components. This TLAA is discussed in LRA Section 4.3. The applicant's determination is consistent with the SRP-LR and is, therefore, acceptable. The staff evaluated the applicant's TLAA on thermal fatigue of ASME Code Class 1 components in SER Section 4.3.

Evaluation - Loss of Preload in the Unit 2 Spring-Loaded Core Plate Plugs

Identification of Aging Effects. In RAI 3.1.2.3.1.2-1, dated May 18, 2005, the staff stated that the applicant identified loss of preload due to stress relaxation as an AERM for spring-loaded, nickel-based alloy core plate plugs at Unit 2. Therefore, the staff requested that the applicant confirm that the applicant's AMR on loss of preload due to stress relaxation of the nickel-based alloy core plate plugs is applicable to the only spring-loaded core plate plugs at Unit 2, and that the core plate plugs at Unit 1 are fabricated from stainless steel and involve a welded design.

In its response, by letter dated June 14, 2005, the applicant stated:

> The Unit 2 plug is constructed from stainless steel for the latch, body, shaft, and pin. The spring for the Unit 2 plug is fabricated from a nickel-based alloy.
>
> The nickel-based alloy material associated with the core plate plugs in Table 3.1.2-1 refers to the Alloy X-750 spring that provides preload to the core plate plug. This mechanical core plate plug design is applicable to BSEP Unit 2 only.
>
> BSEP Unit 1 does not have the mechanical plugs, but has welded plugs fabricated from stainless steel.

Stress relaxation is a time-dependent aging phenomenon in which the imparted stresses or loads used to secure bolted, fastened, keyed, or spring-loaded connections reduces over time and loosens the components. The applicant's response to RAI 3.1.2.3.1.2-1 confirmed that the core plate plugs at Unit 2 are spring loaded. Therefore, the staff concluded that loss of preload due to stress relaxation is an applicable aging effect for the Unit 2 spring-loaded core plate plugs. In contrast, the applicant's response to RAI 3.1.2.3.1.2-1 confirmed that the core plate plugs at Unit 1 are of a welded configuration and not subject to stress relaxation in the manner of the spring-loaded core plate plugs at Unit 2. Based on these analyses, the staff concluded that the applicant's identification of loss of preload/stress relaxation of the Unit 2 spring-loaded core plate plugs is conservative and acceptable, and that stress relaxation at Unit 1 is not an applicable aging effect for the core plate plugs because they are of a welded design; therefore, the staff's concern described in RAI 3.1.2.3.1.2-1 is resolved.

Aging Management - Although not specifically stated in the AMR line item, the applicant identified, treated, discussed, and assessed loss of preload due to stress relaxation in the Unit 2 spring-loaded core plate plugs as a TLAA in LRA Section 4.2.8. The applicant dispositioned the TLAA on the Unit 2 spring-loaded core plate plugs in accordance with 10 CFR 54.21(c)(1)(iii) in that the applicant proposed to credit the Reactor Vessel and Internals Structural Integrity Program (RV&ISIP) with the management of loss of preload due to stress relaxation in the Unit 2 spring-loaded core plate plugs. The applicant's AMR is therefore consistent with the manner the applicant dispositioned the TLAA for the Unit 2 spring-loaded core plate plugs and is acceptable. Based on this analysis, the staff concluded that the RV&ISIP is an appropriate AMP to credit for aging management of the Unit 2 spring-loaded core plate plugs.

The staff evaluated the TLAA on stress relaxation of the Unit 2 spring-loaded core plate plugs in SER Section 4.2.8. The staff evaluated the RV&ISIP in SER Section 3.0.3.3.1. The staff's evaluation of the RV&ISIP includes an assessment of the applicant's response to RAI B.2.28-5, which was issued to request specific details on how the RV&ISIP would be used to manage loss of preload due to stress relaxation of the Unit 2 spring-loaded core plate plugs.

Loss of Material and Cracking in Stainless Steel and Nickel-based Alloy RV Internal Components that are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - The applicant identified all of the RV internal components (including RV penetrations and interior RV attachment welds) exposed to the treated water (and its steam) environment. For these components, the treated water (and its steam) environment is that of the reactor coolant environment.

The applicant identified cracking due to SCC as an AERM for all stainless steel and nickel-based alloy RV internal components (including RV attachment welds) that are exposed to the reactor coolant (or its steam) environment and have corresponding AMR commodity group line items in GALL Report, Volume 2. The applicant also identified that cracking due to cyclical loading is an AERM for a number of stainless steel or nickel-based alloy RV internal components that are exposed to the reactor coolant (or its steam) environment and have corresponding AMR commodity group line items in GALL Report, Volume 2. The staff evaluated these "consistent-with-GALL" AMR line items in either SER Section 3.1.2.1 or 3.1.2.2.

The applicant also included a number of plant-specific AMR line items for the RV internal components. For these plant-specific AMRs, the applicant identified cracking due to SCC (including IASCC for those RV internal components in high neutron fluence areas) as an AERM for the following stainless steel and nickel-based alloy RV internal components that are exposed to the reactor coolant (or its steam) environment (including carbon steel or low-alloy steel components clad with stainless steel):

- core shroud repair hardware (core shroud repair clamps)
- nickel alloy (Unit 1) and stainless steel (Unit 2) core plate plugs
- jet pump assembly components, including the jet pump sensing lines, jet pump holddown beams, jet pump keepers, jet pump lock plates, and jet pump bolts
- orificed fuel support plates
- NSR steam dryers
- NSR core shroud heads and separators
- NSR feedwater spargers
- NSR RV surveillance capsule holders

The applicant clarified that GALL Report, Volume 2, does not address SCC or IASCC as an AERM for these RV internal components. However, since these components are made from materials that are identical to those for the stainless steel or nickel-alloy RV internal components that have AMR commodity group line items on SCC/IASCC in GALL Report, Volume 2, and since the applicant conservatively identified that cracking due to SCC/IASCC is an applicable aging effect for these components, the staff concluded that the applicant's determination is consistent with similar AMR commodity group line items in GALL Report, Volume 2, for other RV internal components that are made from stainless steel or nickel-based alloy materials. Based on this analysis, the staff concluded that the applicant's determination is acceptable.

The staff has emphasized that GALL Report, Volume 2, does not identify cracking due to SCC or cyclical loading as an AERM for BWR steam dryers. However, the applicant did identify cracking due to SCC and cyclical loading as an applicable AERM for the NSR steam dryers. This determination is consistent with an applicant action item identified in ACRS Correspondence Letter ACRSR-2091, dated September 14, 2004, to the Commission. In this letter, the ACRS stated that cracking of BWR steam dryers as a result of either cyclical loading or SCC should be managed for BWR LRAs. Thus, the applicant's AMR for the steam dryers is consistent with the ACRS determination and is acceptable.

The applicant identified that loss of material due to pitting and crevice corrosion are applicable aging effects for stainless steel and nickel-based alloy RV internal components that are exposed to the reactor coolant (or its steam) environment. These components include any low-alloy steel RV penetrations that are clad internally with stainless steel and interior stainless RV attachment welds. Stainless steel components are normally designed to be resistant to pitting and crevice corrosion in the absence of significant concentrations of dissolved oxygen or anionic impurities. GALL Report, Volume 2, does not indicate that loss of material due to general, pitting, or crevice corrosion is an AERM for the RV internal components fabricated from stainless steel or nickel-based alloys. The applicant credits and implements its Water Chemistry Program for the purpose of controlling the chemistry of the reactor coolant to within acceptable levels in accordance with the BWRVIP/EPRI water chemistry guidelines. This is conservative to the AMR commodity group line items that are listed in GALL Report, Volume 2, for stainless steel and nickel-based alloy RV internal components and, therefore, is acceptable.

<u>Aging Management Programs</u> - The applicant credits the RV&ISIP with the management of cracking due to either cyclical loading or SCC (including IASCC for RV internal components in high neutron fluence areas) and loss of material due to pitting or crevice corrosion for stainless steel and nickel-based alloy RV internal components having plant-specific AMRs. This program is defined in LRA Section B.2.28 and is an acceptable plant-specific AMP that is described in terms how the RV&ISIP conforms to the 10 program attributes recommended for AMPs in Agreed Branch Position RLEP-001. The program discussion includes the ability of the RV&ISIP to manage aging in the RV internal components. The staff confirmed that loss of material due to pitting and crevice corrosion and cracking due to SCC/IASCC and cyclical loading are aging effects that are within the scope of the AMP. Based on this assessment, the staff concluded that the RV&ISIP is an acceptable AMP to credit for management of these aging effects in the stainless steel and nickel-based alloy RV internal components. The staff evaluated the ability of the RV&ISIP to manage loss of material and cracking of the stainless steel RV internal components in SER Section 3.0.3.3.1.

The applicant also credits the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in the stainless steel and nickel-based alloy RV internal components. The staff concluded that this is an acceptable AMP for aging management because it will be used to control the concentrations of dissolved oxygen and ionic water impurities that, if left uncontrolled, could potentially lead to corrosion-induced cracking or loss of material aging mechanisms in the components. The applicant controls the concentrations of dissolved oxygen and ionic water impurities to acceptable levels as recommended in the EPRI/BWRVIP water chemistry guidelines. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentration of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

The applicant did include a plant-specific AMR line item for the jet pump sensing lines that identified cracking due to SCC and loss of material due to pitting and crevice corrosion as applicable AERMs for the components. However, the corresponding AMR line item on cracking due to SCC and loss of materials due to pitting and crevice corrosion of the jet pump sensing lines did not credit any AMP with management of the aging effects. To correct this, the applicant provided a supplemental response to RAI B.2.28-1, by letter dated July 18, 2005, and amended its AMR on loss of material due to pitting and crevice corrosion of the jet pump sensing lines. In this response, the applicant credited the RV&ISIP and Water Chemistry Program with management of loss of material due to pitting and crevice corrosion of the jet pump sensing lines.

For the jet pump sensing lines, the RV&ISIP references the management strategy in agreed-approved Topical Report BWRVIP-41-A as the basis for managing aging in the jet pump assembly components, including the jet pump sensing lines. In BWRVIP-41-A, the BWRVIP stated that augmented inspection activities of the jet pump sensing lines were not necessary because potential failures of the components are adequately addressed by the limiting conditions for operation (LCOs) and surveillance requirements for the jet pumps in the BWR TS. The BWRVIP clarified that any failure of a jet pump sensing line would result in an inoperability determination for the jet pumps and that this would lead to a plant operating mode change from operations at critical conditions.

For BSEP, the applicable TS requirements for the jet pumps are LCO 3.4.2 and Surveillance Requirement 3.4.2.1. Surveillance Requirement 3.4.2.1 requires surveillance monitoring of the jet pumps once every 24 hours to verify either that the recirculation pump-flow-to-speed ratio differs only by 5 percent or less from established patterns, or that the jet pump diffuser-to-lower-plenum differential pressure varies by 10 percent or less from that of the jet pump's established pattern. The action statement in LCO 3.4.2 requires the respective BSEP unit to be in hot standby (Mode 3) within 12 hours of an inoperability determination of a jet pump, including that which would be made following a failure of a jet pump sensing line. Although fulfillment of the TS requirements does not by itself constitute an adequate basis for aging management under 10 CFR Part 54, when coupled with the crediting the Water Chemistry Program for aging management the staff concluded that the applicant established a conservative aging management strategy for the jet pump sensing lines, as based on the following:

(1) The applicant conservatively included the jet pump sensing lines within the scope of license renewal and the scope of an AMR analysis.

(2) The Water Chemistry Program will be used to mitigate the probability that loss of material due to pitting or crevice corrosion or cracking due to SCC will occur in the jet pump sensing lines, and to minimize the concentrations of dissolved oxygen and ionic impurities in the reactor coolant that could, if left uncontrolled, lead to these aging effects. As demonstrated by its supplemental response to RAI B.2.28/ RAI 3.1.2.3.1.2-3, dated July 18, 2005, the applicant maintains the concentrations of impurities in the reactor coolant to extremely low concentrations, on the order of a few tenths of a percent parts per billion, and, therefore, is maintaining the reactor coolant at a high purity level.

(3) Should the Water Chemistry Program fail to achieve its purpose for mitigating corrosive aging mechanisms, and should a BSEP jet pump sensing lines fail as a result of loss of material due to pitting, crevice corrosion, or cracking due to SCC, the implementation of the applicable BSEP TS will place the effected unit on "hot standby" within 12 hours of the jet pump inoperability determination, including a jet pump sensing line failure. The daily

surveillance requirements for monitoring jet pump differential pressure and/or recirculation pump flow-to-speed ratio will indicate that the jet pump sensing lines are achieving their intended functions.

Based on this determination, the staff concluded that it is acceptable to credit the Water Chemistry Program and the required TS 3.4.2 action statement, as invoked through the RV&ISIP and BWRVIP-41-A, as the basis for aging management of loss of material due to pitting or crevice corrosion or cracking due to SCC in the jet pump sensing lines because the applicant has credited an acceptable AMP for aging management and because the TS process will be used as a basis for confirming that the Water Chemistry Program is achieving its function of mitigating corrosion effects in the components.

Cracking due to Cyclical Loading in the Low Alloy Steel RV Drain Lines

Identification of Aging Effects. - The applicant identified cracking due to cyclical loading as an AERM for the RV drain line penetrations exposed to the treated water (including steam) environment. For this component, the treated water environment is reactor coolant, or its steam. The applicant's AMR did not identify that the RV drain line penetrations were clad with stainless steel and therefore identified that this AMR was plant-specific because the material for these components is not addressed in any corresponding AMR commodity group line item in GALL Report, Volume 2. In contrast, AMR commodity group line item IV.A1.5-a of GALL Report, Volume 2, does identify that cracking due to SCC, IGSCC, or cyclical loading is an AERM for stainless steel (SB-167) RV drain lines. Cracking due to cyclical loading is a mechanical type of aging mechanism that results from the loading and unloading of an applied stress on a component. The isolation valves in the RV drain lines are only opened periodically at the times the applicant wants to use the drain lines to send and purify the reactor coolant through the reactor water cleanup system. Thus, the RV drain lines are subject to only infrequent cycling. In spite of this, the applicant identified cracking due to cyclical loading as an AERM for these components. Since this is conservative, the staff concluded that the applicant's identification of cracking due to cyclical loading as an AERM for the low-alloy steel RV drain line penetrations is acceptable.

In RAI 3.1.2.3.1.2-2, dated May 18, 2005, the staff stated that industry experience has not yet demonstrated that SCC and IGSCC are AERMs for RV penetrations that are fabricated from unclad low-alloy steel. However, industry experience demonstrated the cracking of nickel-based alloy weld filler metals may be an AERM for the industry. Thus, cracking due to SCC or IGSCC could occur in the low-alloy steel RV drain line penetrations if the structural welds that are used to join the drain lines to the RVs are fabricated from nickel-based alloy weld filler metals. Therefore, the staff requested that the applicant clarify whether the structural welds for the RV drain line penetrations are fabricated from nickel-based alloy weld filler metals, and if so, to explain the basis for omitting cracking due to SCC or IGSCC as an applicable AERM for these components.

In its response, dated June 14, 2005, the applicant stated:

> Nickel-based alloys were not used in the fabrication of the drain nozzle. The low-alloy steel nozzle was joined to the low-alloy steel reactor vessel using low-alloy steel weld material. Therefore, cracking due to SCC, including IGSCC, is not an applicable aging effect.

The applicant's response to RAI 3.1.2.3.1.2-2 confirms that the low-alloy steel RV drain line penetrations were adjoined to the lower RV heads (which were also made from low-alloy steel) using a low-alloy steel weld metal. Since the applicant confirmed that the structural welds for the drain line penetrations were made from low-alloy steel weld material and not nickel alloy weld material, the staff agreed that SCC does not need to be identified as an AERM in the LRA for the RV drain line penetrations and that cyclical loading is the only mechanism for cracking that needs to be managed for the RV drain line penetrations during the extended period of operation. Therefore, the staff's concern described in RAI 3.1.2.3.1.2-2 is resolved.

Aging Management Programs - The applicant credits the RV&ISIP with the management of cracking due to cyclical loading in the low-alloy steel RV drain line penetrations. The scope of the applicant's RV&ISIP includes recommended inspection and flaw evaluation guidelines of Agreed-approved Topical Report BWRVIP-74-A. The staff-approved guidelines of BWRVIP-74-A include recommended inspections for RV penetration nozzles. The staff therefore concludes that it is acceptable to credit the RV&ISIP as the basis for managing cracking due to cyclical loading of the RV drain line penetrations. The staff assesses the ability of the RV&ISIP to manage cracking due to cyclical loading of the RV drain line penetrations in SER Section 3.0.3.3.1.

Flow Blockage of Stainless Steel RV Internal Spray Nozzles as a Result of Fouling

Identification of Aging Effects. In RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A, dated May 18, 2005, the staff stated that the applicant identified flow blockage due to fouling as an additional AERM for the stainless steel core spray nozzles. Therefore, the staff requested that the applicant identify what type of fouling mechanisms could impede emergency coolant flow through the core spray nozzles if the core spray system was required to initiate in response to a design-basis accident or operational transient. In its response, by letter dated June 14, 2005, the applicant stated:

> Corrosion products associated with loss of material are considered capable of impeding the flow of emergency coolant through the core spray nozzles. As shown in Table 3.1.2-1, flow blockage due to fouling is managed with a combination of the Water Chemistry Program and the Reactor Vessel and Internals Structural Integrity Program. The Water Chemistry Program mitigates the formation of corrosion products by controlling oxygen, chlorides, sulfates, etc. The verification that the Water Chemistry Program is effective is through the use of the Reactor Vessel and Internals Structural Integrity Program. The inspection of the core spray components is through BWRVIP-18-A. The NRC has previously found that the use of inspections per the BWRVIP guidelines is adequate.

The applicant's response to RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A addressed the potential cause of flow blockage in the core spray sparger nozzles and identified precipitation of corrosion products resulting from potential impurities in the reactor coolant as the mechanism that could potentially induce flow blockage in the core spray sparger nozzles. RAI B.2.28/RAI 3.1.2.3.1.2-3, with respect to identifying the mechanism that could potentially induce flow blockage in the core spray sparger nozzles, is therefore resolved.

In RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part B, dated May 18, 2005, the staff stated that LRA Table 3.1.2-1 includes an AMR line entry for the internal feedwater spargers. Therefore, the staff requested that the applicant clarify whether the feedwater nozzles were designed with spray nozzles, and, if so, whether flow blockage due to fouling should be identified as an applicable aging effect for the feedwater sparger nozzles.

In its response, by letter dated June 14, 2005, the applicant stated:

> The feedwater spargers do not have spray nozzles but have flow holes. The non-safety related feedwater spargers have been included within the scope of license renewal because of the potential for affecting safety related subcomponents of the reactor vessel and internals. The intended function of the feedwater spargers is M-4; i.e., provide structural support/seismic integrity. The feedwater spargers are managed to ensure gross structural integrity to prevent the formation of loose parts.

The applicant's response to RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part B, clarified that the feedwater spargers are designed with flow holes in lieu of nozzles. Therefore, the staff concluded that flow blockage is not an AERM of concern for the feedwater spargers, and the staff's concern described in RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part B, is resolved.

<u>Aging Management Programs</u> - The applicant credits the Water Chemistry Program and the RV&ISIP with the management of flow blockage in the core spray nozzles as a result of fouling. The Water Chemistry Program is an appropriate AMP to credit with aging management because the program is designed to minimize the concentrations of ionic impurities in the reactor coolant and secondary coolants which, if left uncontrolled, could potentially lead to corrosion products in the coolant. The staff evaluated the Water Chemistry Program in SER Section 3.0.3.2.1.

The RV&ISIP is an inspection-based AMP for the RV internal components but is not an appropriate inspection-based program to credit for flow blockage in the core spray sparger nozzles. The staff issued RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A, in order to request additional information on how the RV&ISIP would be capable of managing flow blockage in these components during the extended period of operation. The staff evaluated the RV&ISIP in SER Section 3.0.3.3.1. The staff's evaluation of the RV&ISIP included an evaluation of the applicant's response to RAI B.2.28-7/RAI 3.1.2.3.1.2-3, Part A, as relevant to the ability of the AMP to inspect and monitor for potential flow blockage of the core spray sparger nozzles. The resolution of this RAI is addressed in SER Section 3.0.3.3.1.

Based on this assessment, the staff concluded that the applicant has credited an appropriate AMP (the Water Chemistry Program) to manage potential flow blockage of the core spray sparger nozzles.

<u>Conclusion</u>. The staff reviewed the applicant's plant-specific AMRs and RAI responses for evaluating the RV internal components (including the RV drain line penetrations and RV interior attachment welds) that are exposed to the treated water (including steam) environment. For these AMRs, the staff determined that the applicant identified the aging effects that are applicable to the RV internal components exposed to these environments. The staff also determined that the applicant has credited either an appropriate inspection-based AMP, an appropriate mitigative-based AMP, a TLAA, or a combination of these management strategies to manage the aging effects that are applicable to the RV internal components. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects of aging associated RV internal components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

Reactor Vessel (RV) and Internals - Piping, Fitting and Valve Components. The components subjected to this review include nozzle safe ends in the low pressure core spray (LPCS) system, recirculating water (inlet and outlet), feedwater, and instrumentation. The components also include piping, fitting and valve bodies in main steam, feedwater, and RV head vent.

The applicant's plant-specific AMRs for the RV piping, fitting and valve components are given in LRA Table 3.1.2-1. The specific components that are within the scope of LRA Table 3.1.2-1 include:

- Nozzle safe ends in LPCS, recirculating water (inlet and outlet), feedwater and instrumentation.
- Piping, fittings and valve bodies in main steam, feedwater, and RV head vent.

The applicant identified that the materials of fabrication for the components include carbon steel, stainless steel, and nickel-based alloys. The applicant identified that the applicable environments for these components include the indoor air environment (external) and the treated water (including steam) environment (internal).

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Crack Initiation due to Thermal Fatigue

Identification of Aging Effects - The applicant identified cracking due to thermal fatigue as an applicable aging effect for all RV piping, fitting and valve components and their supports. This is consistent with SRP-LR; therefore, the staff concluded that the applicant's identification of RV piping, fitting and valve components that are subject to thermal fatigue is acceptable.

Aging Management - The applicant proposed to manage cracking due to thermal fatigue using TLAA for assessing thermal fatigue/cumulative fatigue damage of ASME Code Class 1 components, which is given in LRA Section 4.3. This is consistent with the SRP-LR and is, therefore acceptable. The staff evaluated the applicant's TLAA on thermal fatigue of ASME Code Class 1 components in SER Section 4.3.

RV Piping, Fitting and Valve Components that Are Exposed to the Indoor Air/Containment Air Environments

Identification of Aging Effects - For the RV piping, fitting and valve components, including components that are fabricated from either carbon steel, stainless steel, or nickel-based alloy materials, and including valves made of aluminum alloys or copper alloys, the applicant did not identify any AERMs that are exposed externally to the indoor air environment. The applicant's external indoor air environment for the RCS is divided into two types of atmospheric environments: (1) indoor air during refueling outages or (2) containment air during plant operations. The applicant provided the following definition of the indoor air environment:

> Atmospheric air, specific temperature range/humidity dependent upon building/room/area. Typically, temperature is 104 °F maximum in most areas and radiation dose levels are negligible. Potentially wetted.

The applicant also provides the following definition of the containment air environment:

Nitrogen atmosphere (atmospheric air during refueling outages). Specific temperature range dependent upon area. Bulk average temperature 150 °F maximum. Relative humidity 40 - 90%. Pressure +2.5/-0.5 psig. Gamma radiation dose level: maximum 60-year total integrated dose (TID) 1.25×10^8 rad gamma (1.32×10^{10} rad gamma (54 EFPY) at inside face of sacrificial shield wall). Maximum neutron fluence (54 EFPY) of 4.03×10^{17} n/cm^2 (E>1 Mev) inside face of the sacrificial shield wall.

The predominant external environment for the RV piping, fitting and valve components is containment air because the indoor air environment only occurs during scheduled refueling outages for the plants, normally 6 to 12 percent of the time, depending on the length of the refueling outages.

The applicant included plant-specific Footnote 101 in LRA Table 3.1.2-1 through 3.1.2-5 as its basis for establishing its position that cracking or loss of material would not occur in stainless steel or nickel-based alloy components under the indoor/containment air environments. In this footnote, the applicant stated that stainless steel and nickel-based alloy components do not have any applicable aging effects in non-aggressive indoor air environments; that is, indoor air environments that do not contain significant aggressive chemical species. Since the indoor/containment air environments do not normally contain aggressive chemical species, the staff agreed that aging effects do not need to be identified for the stainless steel and nickel-based alloy components that are exposed to indoor/containment air environments and concluded that the applicant's assessment is acceptable.

The applicant included plant-specific Footnote 109 in LRA Table 3.1.2-1 through 3.1.2-5 as its basis for establishing its position that loss of material would not occur in carbon steel or low-alloy steel components under the indoor/containment air environments. In this footnote, the applicant stated that general corrosion is not a concern for the carbon steel/low-alloy steel components that are exposed to these environments because the components operate at temperatures equal to or above 212 °F. The maximum bulk average temperature of the indoor/containment air environments is identified in the application as 150 °F in LRA Table 3.0-2. Since the carbon steel/low-alloy steel components operate at temperatures above the maximum bulk average temperature for the indoor/containment air environments, the staff concluded that loss of material/general corrosion induced by the precipitation of water will not be an issue for the carbon steel/low-alloy steel components that are exposed to these environments. Furthermore, industry operating experience has not yet identified that SCC is an AERM for carbon steel/low-alloy steel components that are exposed to indoor air environments, in the absence of aggressive chemical species. Since the indoor/containment air environments do not normally contain aggressive chemical species, the staff agreed that SCC is not an AERM for the carbon steel/low-alloy steel components that are exposed to the indoor/containment air environments. Based on this assessment, the staff agreed that neither loss of material due to general corrosion nor cracking due to SCC need to be identified as AERMs for the carbon steel/low-alloy steel components that are exposed to indoor/containment air environments and concludes that the applicant's assessment is acceptable.

Aging Management Programs - The applicant did not identify any AERMs for the RV piping, fitting and valve components that are exposed to the indoor/containment air environments and therefore did not credit any AMPs with aging management. In the previous section, the staff provided its bases for concluding that there were no AERMs for the RV piping, fitting and valve components that are exposed to these environments. Therefore the staff concluded that, AMPs do not need to be credited for aging management of the RV piping, fitting and valve components that are exposed to indoor/containment air environments.

Stainless Steel and Nickel-based Alloy RV Piping, Fitting and Valve Components that Are Exposed to the Treated Water (Including Steam) Environment

The applicant identified that cracking induced by SCC and loss of material due to pitting and crevice corrosion are applicable aging effects for the stainless steel and nickel-based alloy components that are exposed internally to the treated water environment. For these components, which include low-alloy steel components that are clad internally with stainless steel, the treated water environment is reactor coolant or its steam. The applicant provided the following definition of the treated water (including steam) environment:

> Treated water is demineralized water and is the base water for all clean, closed loop systems. Depending on the system, treated water may require additional processing. Treated water can be deaerated, include corrosion inhibitors, biocides, or include a combination of these treatments. Steam generated from treated water is included in this environment category.
>
> Reactor Water: BSEP water quality parameters for use in the reactor coolant system.

The NRC has approved Topical Report BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," which provides the BWRVIP's recommended inspection strategies and flaw evaluation recommendations for BWR RV piping components. The staff approved this report in an FSER to the BWRVIP, dated October 18, 2001. In this report, the BWRVIP indicated that cracking induced by SCC (and IGSCC and IASCC, which are forms of SCC) can be an AERM for stainless steel RV piping, fitting and valve components that are exposed to a BWR reactor coolant environment. BWRVIP-74-A also indicates that SCC can be an AERM for nickel-based alloy RV piping components exposed to a BWR reactor coolant environment, particularly in nickel-based alloy weld filler metals fabricated from Alloy 182 or Alloy 82. The applicant's identification of cracking due to SCC as an AERM for these components under internal exposure to reactor coolant is consistent with the age-related degradation analysis provided in BWRVIP-74-A and is, therefore, acceptable.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion and pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive anionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components that are located in crevice areas, where the exposure of the components to a particular coolant may be prolonged due to stagnant conditions. Neither GALL Report, Volume 2, nor Topical Report BWRVIP-74-A identified loss of material due to general, pitting, or crevice corrosion as an applicable AERM for stainless steel and nickel-based alloy RV piping, fitting and valve components (including low-alloy steel RV components designed with internal stainless steel cladding) that are exposed to the reactor coolant (or its steam) environment. In contrast, the applicant identified loss of material due to pitting and crevice corrosion as an applicable AERM for these components exposed to these environments. The staff concluded that this is acceptable because it is conservative relative to the aging-effect analysis approved in BWRVIP-74-A or the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel or nickel-based alloy RV piping, fitting and valve components in the reactor coolant pressure boundary.

Aging Management Programs - The applicant credited the BWR Stress Corrosion Cracking Program and the Water Chemistry Program with aging management of cracking due to SCC in stainless steel or nickel alloy RV piping, pump, and valve components that are exposed to the reactor coolant or its steam environment. The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program and the Water Chemistry Program with aging management of loss of material due to pitting and crevice corrosion in stainless steel and nickel-based alloy RV piping, fitting and valve components that are exposed to the reactor coolant (or its steam) environment. The applicable ISI examinations for these components are required by 10 CFR 50.55a and are defined in applicable inspection categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1 of Topical Report BWRVIP-74-A provides a summary of the ISI inspections or NRC-approved alternative, augmented inspections for RV piping, fitting and valve components. The staff concluded that crediting the BWR Stress Corrosion Cracking or the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for aging management of cracking due to SCC or loss of material due to pitting corrosion is acceptable because the applicant will apply either the required ISI examinations or NRC-approved alternative, augmented inspections as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.2.1. The staff evaluated the ability of the BWR Stress Corrosion Cracking Program to manage cracking due to SCC in SER Section 3.0.3.1.3.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize the concentrations of the dissolved oxygen and anionic impurities in the reactor coolant. The applicant's Water Chemistry Program has been implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting of the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the EPRI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

Carbon Steel and Low Alloy Steel RV Piping, Fitting and Valve Components that Are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - Not all of the low-alloy steel RV piping, fitting and valve components are cladded with austenitic stainless steel. Therefore, the applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for those carbon steel/low-alloy steel components whose surfaces are exposed internally to the treated water environment. The treated water environment has been described in the previous subsection and, for these components, is either reactor coolant or its steam.

Topical Report BWRVIP-74-A indicates that loss of material due to general corrosion is an AERM for carbon steel/low-alloy steel RV components exposed to a BWR reactor coolant environment, even though the BWRVIP states that the amount of general corrosion in the components is expected to be small. The report, as approved by the NRC, does not indicate that cracking due to SCC (including IASCC or IGSCC) is an applicable aging effect for the carbon steel/low-alloy steel components that are exposed to the reactor coolant (or its steam) environment. The applicant identified loss of material due to general corrosion as an AERM for these components and included pitting corrosion and crevice corrosion within the scope of the mechanisms that could lead to this aging effect. This is acceptable to the staff because it adds pitting corrosion and crevice corrosion to general corrosion as mechanisms that can lead to loss of material in these components and is, therefore, consistent with, or more conservative than, the corresponding age-related degradation analysis provided in NRC-approved Topical Report BWRVIP-74-A.

Aging Management Programs - The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program and the Water Chemistry Program with aging management of loss of material due to general, pitting, and crevice corrosion in the carbon steel/low-alloy steel RV piping, fitting and valve components that are exposed to the reactor coolant (or its steam) environment. The applicable ISI examinations for these components are required by 10 CFR 50.55a and are defined in applicable ISI categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1 of BWRVIP-74-A provides a summary of the inspections that are required for RV piping, fitting and valve components. The staff concluded that crediting the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for the management of loss of material due to general, pitting, and crevice corrosion is acceptable because the applicant will apply the required ISI examinations as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage this aging effect and mechanisms in SER Section 3.0.3.1.

The applicant credited the Water Chemistry Program for aging management to minimize the concentrations of dissolved oxygen and ionic water impurities that, in elevated concentrations, could potentially lead to cracking due to SCC and loss of material due to general, pitting and crevice corrosion of low-alloy steel/carbon steel in reactor coolant pressure boundary components. The staff concluded that this is an acceptable AMP for aging management because it will be used to control the concentration of dissolved oxygen and ionic water impurities to acceptable levels, as recommended in the EPRI/BWRVIP water chemistry guidelines. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentration of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the RV piping components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.2 Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Neutron Monitoring System (NMS) – Table 3.1.2-2

The staff reviewed LRA Table 3.1.2-2, which summarizes the results of AMR evaluations for the NMS component groups.

The applicant's plant-specific AMRs for piping, fitting and valve components in the NMS are given in LRA Table 3.1.2-2. The specific components that are within the scope of LRA Table 3.1.2-2 include:

- piping, fittings and valve bodies included in the RCS but outside of the reactor coolant pressure boundary.
- incore neutron flux monitor guide tubes

The applicant identified that these components are made of stainless steels. For the guide tubes, the applicant identified that the applicable environments include the indoor air environment (external) and the treated water (including steam) environment (internal). For the rest of the components, the applicant identified that the applicable environments are the indoor air environment (external) and dry air/gas environment (internal).

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Crack Initiation due to Thermal Fatigue

Identification of Aging Effects - The applicant identified cracking due to thermal fatigue as an applicable aging effect for all NMS piping, fitting and valve components and their supports. This is consistent with SRP-LR; therefore, the staff concluded that the applicant's identification of the NMS piping, fitting and valve components that are subject to thermal fatigue is acceptable.

Aging Management - The applicant proposed to manage cracking due to thermal fatigue using TLAA for assessing thermal fatigue/cumulative fatigue damage of ASME Code Class 1 components, which is given in LRA Section 4.3. This is consistent with the SRP-LR and is, therefore, acceptable. The staff evaluated the applicant's TLAA on thermal fatigue of ASME Code Class 1 components in SER Section 4.3.

Stainless Steel Components that Are Exposed to the Treated Water Environment

The applicant identified cracking induced by SCC and loss of material due to pitting and crevice corrosion as applicable aging effects for the stainless steel and nickel-based alloy piping, fitting and valve components in the NMS that are exposed internally to the treated water environment. For these components, the applicant provided the following definition of the treated water environment:

> Treated water is demineralized water and is the base water for all clean, closed loop systems. Depending on the system, treated water may require additional processing. Treated water can be deaerated, include corrosion inhibitors, biocides, or include a combination of these treatments. Steam generated from treated water is included in this environment category.
>
> Reactor Water: BSEP water quality parameters for use in the reactor coolant system.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion or pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive anionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components located in crevice areas, where the exposure of the components to a particular coolant may be prolonged due to stagnant conditions. The GALL Report, Volume 2, did not identify loss of material due to general, pitting, or crevice corrosion as an applicable AERM for stainless steel components exposed to the treated water environment. In contrast, the applicant identified that loss of material due to pitting and crevice corrosion is an applicable AERM for these components exposed to the environment. The staff concluded that this is acceptable because it is conservative relative to the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel components.

Aging Management Programs - The applicant credited the Water Chemistry Program and the Reactor Vessel and Internal Structural Integrity Program with aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in stainless steel components that are exposed to the reactor coolant (or its steam) environment. The staff concluded that crediting the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for aging management of cracking due to SCC and loss of material due to pitting corrosion is acceptable because the applicant will apply the programs as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the Reactor Vessel and Internal Structural Integrity Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.3.1.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize the concentrations of the dissolved oxygen and anionic impurities in the reactor coolant. The applicant's Water Chemistry Program is implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting of the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the EPRI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the NMS components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.3 Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Manual Control System – Table 3.1.2-3

The staff reviewed LRA Table 3.1.2-3, which summarizes the results of AMR evaluations for the reactor manual control system component groups.

The applicant's plant-specific AMRs for piping and fittings in the reactor manual control system are given in LRA Table 3.1.2-3. The specific components that are within the scope of LRA Table 3.1.2-3 include piping and fittings in the RCS but outside of the RCPB.

The applicant identified that these components are made of stainless steels and that the applicable environments include the indoor air environment (external) and the treated water (including steam) environment (internal).

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Stainless Steel Components that Are Exposed to the Treated Water Environment

The applicant identified cracking induced by SCC and loss of material due to pitting and crevice corrosion as applicable aging effects for stainless steel components exposed internally to treated water.

The NRC has approved Topical Report BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," which provides the BWRVIP's recommended inspection strategies and flaw evaluation recommendations for BWR RV components. The staff approved this report in an FSER to BWRVIP, dated October 18, 2001. In this report, the BWRVIP indicated that cracking induced by SCC (including IGSCC and IASCC, which are forms of SCC) can be an AERM for stainless steel RV components that are exposed to a BWR reactor coolant environment. BWRVIP-74-A also indicates that SCC can be an AERM for nickel-based alloy RV components that are exposed to a BWR reactor coolant environment, particularly in nickel-based alloy weld filler metals that are fabricated from Alloy 182 or Alloy 82. The applicant's identification that cracking due to SCC is an AERM for these components under internal exposure to the reactor coolant is consistent with the age-related degradation analysis provided in BWRVIP-74-A and is, therefore, acceptable.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion or pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive anionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components that are located in crevice areas, where exposure of the components to a particular coolant may be prolonged due to stagnant conditions. GALL Report, Volume 2, did not identify loss of material due to general, pitting, or crevice corrosion as an applicable AERM for stainless steel components exposed to treated water. In contrast, the applicant identified loss of material due to pitting and crevice corrosion as an applicable AERM for these components exposed to this environment. The staff concluded that this is acceptable because it is more conservative relative to the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel components.

Aging Management Programs - The applicant credited the Water Chemistry Program and the One-Time Inspection Program with aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in stainless steel components that are exposed to treated water. The staff concluded that crediting the One-Time Inspection Program for aging management of cracking due to SCC and loss of material due to pitting corrosion is acceptable because the applicant will apply the programs as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the One-Time

Inspection Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.2.11.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize concentrations of dissolved oxygen and anionic impurities in the reactor coolant. The applicant's Water Chemistry Program is implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting of the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the EPRI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the reactor manual control system components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.4 Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Control Rod Drive (CRD) Hydraulic System – Table 3.1.2-4

The staff reviewed LRA Table 3.1.2-4, which summarizes the results of AMR evaluations for the CRD hydraulic system component groups.

The applicant's plant-specific AMRs for the RCS control rod drive hydraulic system components are given in LRA Table 3.1.2-4. The specific components within the scope of LRA Table 3.1.2-4 include:

- piping, fittings and valve bodies
- tanks
- rupture disks and filters
- control rod drive housing (CRDH) pump casing and gearbox coolers

The applicant identified that the materials of fabrication for the piping, fittings, valve bodies, tanks, rupture disks, filters, pump casing and gearbox coolers include carbon steel, stainless steel, copper alloys and nickel-based alloys. The applicant identified that the applicable environments for these components include the indoor air environment (external), dry air/gas environment (internal), lube oil (internal) environment, and the treated water environment (internal).

Management of Specific Aging Effects Using TLAAs - Carbon Steel Components Exposed to Indoor Air that are Operated at below 212°F

The applicant identified loss of material due to general corrosion as an applicable aging effect for the carbon steel components exposed to moist air and humidity. The staff found this identification consistent with GALL Report, Volume 2, Item VII.I.1-b. Therefore, the staff concluded that the applicant's identification of the control rod drive hydraulic system (CRDHS) carbon steel components that are subject to loss of material in an indoor environment is acceptable.

Stainless Steel Components that Are Exposed to the Treated Water Environment

<u>Identification of Aging Effects</u> - The applicant identified cracking induced by SCC and loss of material due to pitting and crevice corrosion as applicable aging effects for the stainless steel components exposed internally to the treated water environment.

The NRC has approved Topical Report BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," which provides the BWRVIP's recommended inspection strategies and flaw evaluation recommendations for BWR RV components. The staff approved this report in an FSER to the BWRVIP, dated October 18, 2001. In this report, the BWRVIP indicated that cracking induced by SCC (including IGSCC and IASCC, which are forms of SCC) can be an AERM for stainless steel RV components that are exposed to a BWR reactor coolant environment. BWRVIP-74-A also indicates that SCC can be an AERM for nickel-based alloy components that are exposed to a BWR reactor coolant environment.

The applicant's identification that cracking due to SCC is an AERM for the CRDHS piping fitting and valve components under internal exposure to the reactor coolant is consistent with the age-related degradation analysis provided in BWRVIP-74-A and is, therefore, acceptable.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion or pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive anionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components that are located in crevice areas, where exposure of the components to a particular coolant may be prolonged due to stagnant conditions. GALL Report, Volume 2, did not identify loss of material due to general, pitting, or crevice corrosion as an applicable AERM for the stainless steel components that are exposed to the treated water environment. In contrast, the applicant identified loss of material due to pitting and crevice corrosion as an applicable AERM for these components exposed to these environments. The staff concluded that this is acceptable, because it is more conservative relative to the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel components.

<u>Aging Management Programs</u> - The applicant credited the Water Chemistry Program and the One-Time Inspection Program with aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion in stainless steel components that are exposed to the treated water environment. The staff concluded that crediting the One-Time Inspection Program for aging management of cracking due to SCC and loss of material due to pitting corrosion is acceptable because the applicant will apply the programs as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the One-Time Inspection Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.2.11.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize the concentrations of the dissolved oxygen and anionic impurities in the reactor coolant. The applicant's Water Chemistry Program is implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the EPRI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

Carbon Steel Components that Are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - Not all of the low-alloy steel CRDHS components are clad with austenitic stainless steel. Therefore, the applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for those carbon steel/low-alloy steel components whose surfaces are exposed internally to the treated water environment.

Topical Report BWRVIP-74-A indicates that loss of material due general corrosion is an AERM for carbon steel/low-alloy steel RV components that are exposed to a BWR reactor coolant environment, even though the BWRVIP states that the amount of general corrosion in the components is expected to be small. The report, as approved by the NRC, does not indicate that cracking due to SCC (including IASCC or IGSCC) is an applicable aging effect for carbon steel/low-alloy steel components exposed to the reactor coolant (or its steam) environment. The applicant identified that loss of material due to general corrosion is an AERM for these components and included pitting corrosion and crevice corrosion within the scope of the mechanisms that could lead to this aging effect. This is acceptable to the staff because it adds pitting corrosion and crevice corrosion (in addition to general corrosion) as mechanisms that can lead to loss of material in these components and is, therefore, more conservative than the corresponding age-related degradation analysis provided in NRC-approved Topical Report BWRVIP-74-A.

Aging Management Programs. With the exception of the CRDH gearbox coolers, the applicant credited the One-Time Inspection Program and the Water Chemistry Program with aging management of loss of material due to general, pitting, and crevice corrosion in the carbon steel/low-alloy steel components in the CRDHS that are exposed to the treated water environment. The applicant credited the Closed-Cycle Cooling Water System Program with aging management of general, pitting, and crevice corrosion in the CRDH gear box coolers.

The staff concluded that crediting the One-Time Inspection Program for aging management of cracking due to SCC and loss of material due to pitting corrosion is acceptable because the applicant will apply the programs as the basis for managing these aging effects during the period of extended operation. In SER Section 3.0.3.2.11, the staff evaluated the ability of the One-Time Inspection Program to manage cracking due to loss of material due to general, pitting, and crevice corrosion.

The applicant credited the Water Chemistry Program for aging management to minimize concentrations of dissolved oxygen and ionic water impurities that if present in elevated concentrations, could potentially lead to cracking due to SCC and loss of material due to general, pitting and crevice corrosion of low-alloy steel/carbon steel RCPB components. The staff concluded that this is an acceptable AMP for aging management because it will be used to control the concentration of dissolved oxygen and ionic water impurities to acceptable levels, as recommended in the EPRI/BWRVIP water chemistry guidelines. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentration of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

With respect to management of loss of material due to general, pitting, and crevice corrosion in the CRDH gear box coolers, the Closed-Cycle Cooling Water System Program manages the aging effect by adding corrosion inhibitors into the closed-cycle cooling water. These corrosion inhibitors are used to lower the potential of the carbon steel CRDH gear box coolers to corrode when exposed to the closed-cycle cooling water. In SER Section 3.0.3.2.5, the staff evaluated the ability of the Closed-Cycle Cooling Water System Program to manage loss of material due to general, pitting, and crevice corrosion.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the CRDHS components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.2.3.5 Reactor Vessel, Internals, and Reactor Coolant System – Summary of Aging Management Evaluation – Reactor Coolant Recirculation System – Table 3.1.2-5

The staff reviewed LRA Table 3.1.2-5, which summarizes the results of AMR evaluations for the reactor coolant recirculation system component groups.

The applicant's plant-specific AMRs for the RCS reactor coolant recirculation system components are given in LRA Table 3.1.2-5. This section also evaluated other Class 1 piping components that the applicant listed in LRA Tables 3.3.2-1, 3.3.2-2, and 3.3.2-3. The specific components that are within the scope of license renewal include:

- piping, fittings and valves (body)
- pump casing, cover, flange and closure bolting

The applicant identified that the materials of fabrication for the piping, fittings, valves (body), pump casing, cover, flange and closure bolting include carbon steel, low-alloy steel, stainless steel, and copper alloys. The applicant identified that the applicable environments for these components include the indoor air environment (external), dry air/gas environment (internal), and treated water environment (internal).

Management of Specific Aging Effects Using Time Limited Aging Analyses (TLAAs) - Cracking due to Thermal Fatigue

Identification of Aging Effects - The applicant identified cracking due to thermal fatigue as an applicable aging effect for all reactor coolant recirculation system (RCRS) components and their supports. This is consistent with SRP-LR; therefore, the staff concluded that the applicant's identification of piping, fitting, valve, and pump components subject to thermal fatigue is acceptable.

Aging Management - The applicant proposed to manage cracking due to thermal fatigue using the TLAA for assessing thermal fatigue/cumulative fatigue damage of ASME Code Class 1 components, which is given in LRA Section 4.3. This is consistent with the SRP-LR and is, therefore, acceptable. The staff evaluated the applicant's TLAA on thermal fatigue of ASME Code Class 1 components in SER Section 4.3.

Low Alloy Steel Loss of Materials due to Wear, Loss of Pre-load due to Relaxation, Bolting Integrity Program

Identification of Aging Effects - The applicant identified loss of materials due to wear and loss of pre-load due to relaxation as applicable aging effects for the pump closure bolting. This is consistent with GALL Report Item IV.C1.2-d and Item IV.C1.2-e. Therefore, the staff concluded that the applicant's identification of pump closure bolting components that are subject to loss of materials due to wear, loss of preload due to relaxation is acceptable.

Aging Management. The applicant proposed to manage loss of materials due to wear and loss of pre-load due to relaxation using its Bolting Integrity Program. The staff evaluated the SER Section 3.0.3.2.3.

Carbon Steel Components Exposed to Indoor Air that Are Operated at below 212°F

The applicant identified loss of material due to general corrosion as an applicable aging effect for the carbon steel components exposed to moist air and humidity. The staff found that this identification is consistent with GALL Report, Volume 2. Therefore, the staff concluded that the applicant's identification of CRDHS carbon steel components that are subject to loss of material in an indoor environment is acceptable.

Stainless Steel and Nickel-based Alloy RCRS Components that Are Exposed to Treated Water (Including Steam) Environment

The applicant identified that cracking induced by SCC and loss of material due to pitting and crevice corrosion are applicable aging effects for the stainless steel and nickel-based alloy components that are exposed internally to the treated water environment. For these components, which include low-alloy steel RCRS components that are clad internally with stainless steel, the treated water environment is reactor coolant. The applicant provides the following definition of the treated water (including steam) environment:

> Treated water is demineralized water and is the base water for all clean, closed loop systems. Depending on the system, treated water may require additional processing. Treated water can be deaerated, include corrosion inhibitors, biocides, or include a combination of these treatments. Steam generated from treated water is included in this environment category.
>
> Reactor Water: BSEP water quality parameters for use in the reactor coolant system.

The NRC has approved Topical Report BWRVIP-74-A, "BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal," which provides the BWRVIP's recommended inspection strategies and flaw evaluation recommendations for BWR RV components. The staff approved this report in an FSER to the BWRVIP, dated October 18, 2001. In this report, the BWRVIP identified cracking induced by SCC (including IGSCC and IASCC, which are forms of SCC) as an AERM for stainless steel RV components exposed to a BWR reactor coolant environment. BWRVIP-74-A also indicates that SCC can be an AERM for nickel-based alloy components exposed to a BWR reactor coolant environment, particularly in nickel-based alloy weld filler metals that are fabricated from Alloy 182 or Alloy 82. The applicant's identification of cracking due to SCC as an AERM for these components under internal exposure to reactor coolant is analogous with the age-related degradation analysis provided in BWRVIP-74-A and is, therefore, acceptable.

Stainless steels and nickel-based alloys are normally designed to be resistant to general corrosion. In addition, crevice corrosion or pitting corrosion are not expected to be aging mechanisms of concern in the absence of elevated concentrations of dissolved oxygen or dissolved corrosive anionic impurities (such as sulfates or halide impurities) in the reactor coolant. Crevice and pitting corrosion are localized mechanisms that can induce loss of material in components that are located in crevice areas, where exposure of the components to a particular coolant may be prolonged due to stagnant conditions. Neither GALL Report, Volume 2, nor BWRVIP-74-A, identify loss of material due to general, pitting, or crevice corrosion as an applicable AERM for stainless steel and nickel-based alloy components (including those low-alloy steel RV components designed with internal stainless steel cladding) exposed to the reactor coolant environment. In contrast, the applicant identified loss of material due to pitting and crevice corrosion as an applicable AERM for these components exposed to this environment. The staff concluded that this is acceptable because it is conservative relative to the aging-effect analysis approved in BWRVIP-74-A or the staff's recommended AMR commodity group line items identified in GALL Report, Volume 2, for stainless steel or nickel-based alloy components in the RCPB.

Aging Management Programs. The applicant credited the BWR Stress Corrosion Cracking Program and the Water Chemistry Program with aging management of cracking due to SCC in stainless steel or nickel alloy RCRS piping, pump, and valve components that are exposed to the reactor coolant or its steam environment. The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program and the Water Chemistry Program with aging management of loss of material due to pitting and crevice corrosion in stainless steel and nickel-based alloy RCRS piping, fitting and valve components that are exposed to the reactor coolant (or its steam) environment. The applicable ISI examinations for these components are required by 10 CFR 50.55a and are defined in applicable inspection categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1 of Topical Report BWRVIP-74-A provides a summary of the ISI inspections or NRC-approved alternative, augmented inspections for RCRS piping, fitting and valve components. The staff concluded that crediting the BWR Stress Corrosion Cracking or the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for aging management of cracking due to SCC or loss of material due to pitting corrosion is acceptable because the applicant will apply either the required ISI examinations or NRC-approved alternative, augmented inspections as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage cracking due to SCC and loss of material due to pitting and crevice corrosion in SER Section 3.0.3.2.1. The staff evaluated the ability of the BWR Stress Corrosion Cracking Program to manage cracking due to SCC in SER Section 3.0.3.1.3.

U.S. owners of BWRs implement comprehensive water chemistry control programs to minimize the concentrations of the dissolved oxygen and anionic impurities in the reactor coolant. The applicant's Water Chemistry Program is implemented to satisfy the recommended concentrations for impurities in the EPRI/BWRVIP BWR water chemistry guidelines. Therefore, crediting of the Water Chemistry Program for aging management of cracking due to SCC and loss of material due to pitting and crevice corrosion is acceptable because implementation of the AMP will be in accordance with the EPRI/BWRVIP water chemistry guidelines and will be used to minimize the concentrations of dissolved oxygen and ionic water impurities, that if present in elevated concentrations, could potentially lead to these aging mechanisms. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize concentrations of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

During its review, the staff determined that it needed additional information. The specific RAI and the applicant's response are discussed below.

In RAI 3.2-4, dated April 8, 2005, The staff stated that in LRA Tables 3.1.2-5 and 3.3.2-1, carbon and stainless steel small-bore piping and fittings less than NPS 4 in treated water (includes steam)(internal) environments, are subject to cracking due to thermal and mechanical loading. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the identified aging effect. In the subject tables, stainless steel small-bore piping less than NPS 4, in the same treated water (includes steam) (internal) environment, are also subject to cracking due to SCC. The same AMPs are credited to manage the aging effect. Therefore, the staff requested that the applicant (1) provide the basis for the statement made under Note 226 that "cracking due to thermal and mechanical loadings was evaluated and dispositioned as not applicable," and (2) clarify the statement made under Note 226 that "The risk associated with cracking due to SCC is bounded by those components selected for inservice inspection as part of the Risk-Informed ISI Program." Therefore, the staff requested the applicant to provide the technical basis for not including these components in the One-Time Inspection Program, as the staff questioned the effectiveness of the ASME Section XI inspection Program on this small bore piping.

In its response to RAI 3.2-4, by letter dated May 4, 2005, the applicant stated that these components are included in its revised One-Time Inspection Program, which satisfactorily answers the staff's concerns expressed in RAI 3.1.2.3.3-3.

The applicant further stated that susceptibility to cracking due to thermal and mechanical loading has been previously evaluated on a component-specific basis, in support of the BSEP RI-ISI submittal in Process Energy Carolinas (PEC) letter to the NRC dated April 20, 2001 (BSEP 01-0013). However, the applicant also stated that BSEP revised its comments during an audit of AMPs, and no longer credits RI-ISI in aging management. The applicant credits the Water Chemistry Program and ASME Section XI Subsection IWB, IWC and IWD Program for aging management of cracking, including SCC, in less than NPS 4 Class 1 piping components. The applicant stated that, consistent with the GALL Report, the One-Time Inspection Program will be used to verify the effectiveness of these programs. SER Section 3.0.3.2.11 provides the staff's discussion of the applicant's One-Time Inspection Program. It is noted that in its response to Audit Question B.2.15-1a, the applicant stated that in AMR Tables 3.1.2-5 and 3.3.2-1, the AMR line items addressing small-bore Class 1 piping will be revised to reflect Water Chemistry, ASME Section XI Subsection IWB, IWC and IWD, and One-Time Inspection Programs for aging management of cracking due to thermal and mechanical loading and SCC. In addition, the applicant noted that Note 226 is no longer applicable.

Based on the above information provided by the applicant, the staff considered that the applicant adequately clarified the aging management for small-bore Class 1 piping components, which are susceptible to cracking due to thermal and mechanical loading and SCC. Therefore, the staff's concerns described RAI 3.2-4 and RAI 3.1.2.3.3-3 are resolved.

Carbon Steel and Low Alloy Steel RCRS Components that Are Exposed to the Treated Water (Including Steam) Environment

Identification of Aging Effects - Not all of the low-alloy steel components in the RCRS and other Class 1 components identified in LRA Tables 3.3.2-1, 3.3.2-2, and 3.3.2-3, are clad with austenitic stainless steel. Therefore, the applicant identified loss of material due to general, pitting, and crevice corrosion as an applicable aging effect for those carbon steel/low-alloy steel components whose surfaces are exposed internally to the treated water environment. The treated water environment has been described in the previous subsection and, for these components, is either the reactor coolant or its steam.

Topical Report BWRVIP-74-A indicates that loss of material due general corrosion is an AERM for carbon steel/low-alloy steel components that are exposed to a BWR reactor coolant environment, even though the BWRVIP states that the amount of general corrosion in the components is expected to be small. The report, as approved by the NRC, does not indicate that cracking due to SCC (including IASCC or IGSCC) is an applicable aging effect for the carbon steel/low-alloy steel components that are exposed to the reactor coolant (or its steam) environment. The applicant identified loss of material due to general corrosion as an AERM for these components and included pitting corrosion and crevice corrosion within the scope of the mechanisms that could lead to this aging effect. This is acceptable to the staff because it adds pitting corrosion and crevice corrosion to general corrosion as mechanisms that can lead to loss of material in these components and is, therefore, more conservative than the corresponding age-related degradation analysis provided in NRC-approved Topical Report BWRVIP-74-A.

Aging Management Programs - The applicant credited the Water Chemistry Program for aging management to minimize the concentrations of dissolved oxygen and ionic water impurities that, if present in elevated concentrations, could potentially lead to cracking due to SCC and loss of material due to general, pitting and crevice corrosion of low-alloy steel/carbon steel RCPB components. The staff concluded that this is an acceptable AMP for aging management because it will be used to control the concentration of dissolved oxygen and ionic water impurities to acceptable levels, as recommended in the EPRI/BWRVIP water chemistry guidelines. In SER Section 3.0.3.2.1, the staff evaluated the ability of the Water Chemistry Program to minimize the concentration of dissolved oxygen and ionic water impurities in the reactor coolant (or its steam) environment.

The applicant credited the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program and the Water Chemistry Program with aging management of loss of material due to general, pitting, and crevice corrosion in Class 1 carbon steel/low-alloy steel components exposed to reactor coolant. The applicable ISI examinations for these components are required by 10 CFR 50.55a and are defined in applicable ISI categories of Table IWB-2500-1 to Section XI of the ASME Code. Table 4-1of BWRVIP-74-A provides a summary of the inspections that are required for RV components. The staff concluded that crediting the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program for the management of loss of material due to general, pitting, and crevice corrosion is acceptable, because the applicant will apply the required ISI examinations as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program to manage this aging effect and mechanisms in SER Section 3.0.3.1.

The applicant will include non-Class 1 carbon steel components exposed to a reactor coolant or its steam environment, in the One-Time Inspection Program, in addition to the Water Chemistry Program, for aging management of loss of material due to general, pitting, and crevice corrosion, as the basis for managing these aging effects during the period of extended operation. The staff evaluated the ability of the One-Time Inspection Program to manage this aging effect and mechanisms in SER Section 3.0.3.1.

Conclusion. On the basis of its review, as discussed above, the staff concluded that the applicant has demonstrated that the aging effects associated with the RCRS components will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.1.3 Conclusion

The staff concluded that the applicant provided sufficient information to demonstrate that the effects of aging of the reactor vessel, internals, and RCS 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 period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff also reviewed the applicable UFSAR supplement program summaries and concluded that they adequately describe the AMPs credited for managing aging the reactor vessel, internals, and RCS, as required by 10 CFR 54.21(d).

3.2 Aging Management of Engineered Safety Features

This section of the SER documents the staff's review of the applicant's AMR results for the ESF systems components and component groups associated with the following systems:

- residual heat removal system
- containment isolation system
- containment atmosphere control system
- high pressure coolant injection system
- automatic depressurization system
- core spray system
- standby gas treatment system
- standby liquid control system
- HVAC control building system
- reactor protection system

3.2.1 Summary of Technical Information in the Application

In LRA Section 3.2, the applicant provided AMR results for components. In LRA Table 3.2.1, "Summary of Aging Management Evaluations in Chapter V of NUREG-1801 for Engineered

Safety Features," the applicant provided a summary comparison of its AMRs with the AMRs evaluated in the GALL Report for the ESF systems components and component groups.

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 condition reports 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.

3.2.2 Staff Evaluation

The staff reviewed LRA Section 3.2 to determine whether the applicant provided sufficient information to demonstrate that the effects of aging for the ESF systems components that are within the scope of license renewal and subject to an AMR will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

The staff performed an onsite audit of AMRs to confirm the applicant's claim that certain identified AMRs were consistent with the GALL Report. The staff did not repeat its review of the matters described in the GALL Report; however, the staff did verify that the material presented in the LRA was applicable and that the applicant had identified the appropriate GALL AMRs. The staff's evaluations of the AMPs are documented in SER Section 3.0.3. Detailed results of the staff's onsite audits are documented in the Audit and Review Report, dated June 21, 2005, and are summarized in SER Section 3.2.2.1.

During the audit, the staff reviewed the AMRs that were consistent with the GALL Report and for which further evaluation is recommended. The staff confirmed that the applicant's further evaluations were consistent with the acceptance criteria in SRP-LR Section 3.2.2.2. The staff's audit evaluations are documented in the Audit and Review Report and are summarized in SER Section 3.2.2.2.

During the audit, the staff also conducted a technical review of the remaining AMRs that were not consistent with, or not addressed in, the GALL Report. The audit and technical review included evaluating (1) whether all plausible aging effects were identified, and (2) whether the aging effects listed were appropriate for the combination of materials and environments specified. The staff's audit evaluations are documented in the Audit and Review Report and are summarized in SER Section 3.2.2.3. The staff's evaluation of its technical review is also documented in SER Section 3.2.2.3.

Finally, the staff 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 systems components, as required by 10 CFR 54.21(d).

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

Table 3.2-1 Staff Evaluation for Engineered Safety Features System Components in the GALL Report

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Piping, fittings, and valves in emergency core cooling system (Item Number 3.2.1-01)	Cumulative fatigue damage	TLAA, evaluated in accordance with 10 CFR 54.21(c)	TLAA	This TLAA is evaluated in Section 4.3, Metal Fatigue
Piping, fittings, pumps, and valves in emergency core cooling system (Item Number 3.2.1-02)	Loss of material due to general corrosion	Water chemistry and one-time inspection	Water Chemistry Program (B.2.2), One-Time Inspection Program (B.2.15)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems (Item Number 3.2.1-03)	Loss of material due to general corrosion	Plant specific	Systems Monitoring Program (B.2.29), Preventive Maintenance Program (B.2.30)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
Piping, fittings, pumps, and valves in emergency core cooling system (Item Number 3.2.1-04)	Loss of material due to pitting and crevice corrosion	Water chemistry and one-time inspection	Water Chemistry Program (B.2.2); One-Time Inspection Program (B.2.15)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
Components in containment spray (PWR only), standby gas treatment (BWR only), containment isolation, and emergency core cooling systems (Item Number 3.2.1-05)	Loss of material due to pitting and crevice corrosion	Plant specific	Systems Monitoring Program (B.2.29), Preventive Maintenance Program (B.2.30)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
Containment isolation valves and associated piping (Item Number 3.2.1-06)	Loss of material due to microbiologically influenced corrosion	Plant specific	Water Chemistry Program (B.2.2), One-Time Inspection Program (B.2.15), Systems Monitoring Program (B.2.29)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Seals in standby gas treatment system (Item Number 3.2.1-07)	Changes in properties due to elastomer degradation	Plant specific	Systems Monitoring Program (B.2.29), Preventive Maintenance Program (B.2.30)	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
High pressure safety injection (charging) pump miniflow orifice (Item Number 3.2.1-08)	Loss of material due to erosion	Plant specific		Not applicable, PWR only
Drywell and suppression chamber spray system nozzles and flow orifices (Item Number 3.2.1-09)	Plugging of nozzles and flow orifices due to general corrosion	Plant specific	Protective Coatings Monitoring and Maintenance Program	Not consistent with GALL (See Section 3.2.2.2)
External surface of carbon steel components (Item Number 3.2.1-09)	Loss of material due to general corrosion	Plant specific	Systems Monitoring Program	Consistent with GALL, which recommends further evaluation (See Section 3.2.2.2)
Piping and fittings of CASS in emergency core cooling system (Item Number 3.2.1-11)	Loss of fracture toughness due to thermal aging embrittlement	Thermal aging embrittlement of CASS		Not applicable
Components serviced by open-cycle cooling system (Item Number 3.2.1-12)	Local loss of material due to corrosion and/or buildup of deposit due to biofouling	Open-cycle cooling water system	Open-Cycle Cooling Water System Program (B.2.7)	Consistent with GALL, which recommends no further evaluation (See Section 3.2.2.2)
Components serviced by closed-cycle cooling system (Item Number 3.2.1-13)	Loss of material due to general, pitting, and crevice corrosion	Closed-cycle cooling water system		Not applicable
Emergency core cooling system valves and lines to and from HPCI and RCIC pump turbines (Item Number 3.2.1-14)	Wall thinning due to flow-accelerated corrosion	Flow-accelerated corrosion	Flow-Accelerated Corrosion Program (B.2.5)	Consistent with GALL, which recommends no further evaluation (See Section 3.2.2.1)

Component Group	Aging Effect/ Mechanism	AMP in GALL Report	AMP in LRA	Staff Evaluation
Pumps, valves, piping, and fittings in containment spray and emergency core cooling systems (Item Number 3.2.1-15)	Crack initiation and growth due to SCC	Water chemistry		Not applicable, PWR only
Pumps, valves, piping, and fittings in emergency core cooling systems (Item Number 3.2.1-16)	Crack initiation and growth due to SCC and IGSCC	Water chemistry and BWR stress corrosion cracking	Water Chemistry Program (B.2.2), BWR Stress Corrosion Cracking Program (B.2.4)	Consistent with GALL, which recommends no further evaluation (See Section 3.2.2.2)
Carbon steel components (Item Number 3.2.1-17)	Loss of material due to boric acid corrosion	Boric acid corrosion		Not applicable, PWR only
Closure bolting in high pressure or high temperature systems (Item Number 3.2.1-18)	Loss of material due to general corrosion, loss of preload due to stress relaxation, and crack initiation and growth due to cyclic loading or SCC	Bolting integrity		Not applicable (See Section 3.2.2.2)

The staff's review of the BSEP component groups followed one of three approaches depending on the group's consistency with the GALL Report. SER Section 3.2.2.1 discusses the staff's review and documentation of the AMR results for components in the ESF systems that the applicant indicated are consistent with the GALL Report and do not require further evaluation; SER Section 3.2.2.2 discusses the staff's review and documentation of the AMR results for components that the applicant indicated are consistent with the GALL Report and for which further evaluation is recommended; and SER Section 3.2.2.3 discusses the staff's review and documentation of the AMR results for components that the applicant indicated are not consistent with, or not addressed in, the GALL Report. The staff's review of AMPs that are credited to manage or monitor aging effects of the ESF systems components is documented in SER Section 3.0.3.

3.2.2.1 AMR Results That Are Consistent with the GALL Report

Summary of Technical Information in the Application. In LRA Section 3.2.2.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the aging effects related to the ESF systems components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- BWR Stress Corrosion Cracking Program
- One-Time Inspection Program

- Open-Cycle Cooling Water System Program
- Preventive Maintenance Program
- Protective Coating Monitoring and Maintenance Program
- Selective Leaching of Materials Program
- Systems Monitoring Program
- Water Chemistry Program
- Flow-Accelerated Corrosion Program
- Buried Piping and Tanks Inspection Program

Staff Evaluation. In LRA Tables 3.2.2-1 through 3.2.2-9, the applicant provided a summary of AMRs for the ESF systems components, and identified which AMRs it considered to be consistent with the GALL Report.

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 staff 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 staff 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 staff audited these line items to verify consistency with the GALL Report and the validity of the AMR for the site-specific conditions.

Note B indicates that the AMR line item is consistent with the GALL Report for component, material, environment, and aging effect. In addition, the AMP takes some exceptions to the AMP identified in the GALL Report. The staff audited these line items to verify consistency with the GALL Report. The staff 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 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 staff audited these line items to verify consistency with the GALL Report. The staff also determined whether the AMR line item of the different component was applicable to the component under review and whether the AMR was valid for the site-specific conditions.

Note D indicates that the component for the AMR line item 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 staff audited these line items to verify consistency with the GALL Report. The staff verified whether the AMR line item of the different component was applicable to the component under review. The staff verified whether 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 E indicates that the AMR line item is consistent with the GALL Report for material, environment, and aging effect, but a different aging management program 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 of the information provided in the LRA, as documented in the BSEP 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.

In the LRA Section 3.2, the applicant provided the results of its AMRs for the engineered safety features systems.

In the LRA Tables 3.2.2-1 through 3.2.2-9, the applicant provided a summary of the AMRs for components/commodities in the (1) RHR system; (2) containment atmospheric control (CAC) system; (3) HPCI system; (4) automatic depressurization system (ADS); (5) core spray (CS) system; (6) standby gas treatment system (SGTS); (7) SLC system; (8) HVAC control building system; and (9) reactor protection system.

Also, for each component type in LRA Table 3.2.1, the applicant identified those components that are consistent with the GALL Report where no further evaluation is required, those that are consistent with the GALL Report for which further evaluation is recommended, and those that are not addressed in the GALL Report together with the basis for their exclusion.

For AMRs that the applicant stated are consistent with the GALL Report and for which no further evaluation is recommended, the staff conducted its audit to determine whether the applicant's references to the GALL Report in the LRA are acceptable.

The staff reviewed its assigned LRA line-items to determine that the applicant (1) provided a brief description of the system, components, materials, and environment; (2) stated that the applicable aging effects have been reviewed and are evaluated in the GALL Report; and (3) identified those aging effects for the RHR, CAC, HPCI, ADS, CS, SGTS, SLC, HVAC control building, and reactor protection systems components that are subject to an AMR.

SER Sections 3.2.2.1.1 through 3.2.2.1.4, below, document the resolution of discrepancies identified by the staff during its audit of those AMRs that the applicant claimed are consistent with the GALL Report, and for which no further evaluation is recommended in the GALL Report.

3.2.2.1.1 Loss of Material and Crack Initiation and Growth in Closure Bolting in High Pressure and High Temperature Systems

In the discussion of LRA Table 3.2.1, item number 3.2.1-18, the applicant addressed aging management of closure bolting in the ESF systems. The applicant stated that the Bolting Integrity Program is not applicable since this system does not use high-strength pressure-boundary bolting. For non-Class 1 closure bolting, the applicant considers bolting to be a subcomponent of the associated component; therefore, bolting materials are not itemized as a separate component and the Bolting Integrity Program is not needed for aging management.

The staff reviewed LRA Tables 3.2.2-1 through 3.2.2-9 and noted that the applicant specified the Systems Monitoring Program for visual inspection of the external surfaces of components in the ESF systems, including any bolting associated with the component, to identify general corrosion. However, this AMP does not address the crack initiation and growth aging effect for pressure-retaining bolting. GALL AMP XI.M18 is recommended to manage loss of material due to general corrosion, and crack initiation and growth due to cyclic loading and/or SCC for all closure bolting in high-pressure or high-temperature systems that are within the scope of license renewal. The AMP recommended in the GALL Report does not exclude non-Class 1 bolting.

The staff reviewed the applicant's Bolting Integrity Program, and its evaluation is documented in SER Section 3.0.3.2.3. The applicant claims that this program is consistent with GALL AMP XI.M18. However, the Bolting Integrity Program has several major exceptions. For non-Class 1 pressure-retaining bolting, the Bolting Integrity Program excludes the ASME Section XI inservice inspection activities, along with monitoring and trending under the Systems Monitoring Program. Therefore, the staff determined that the Bolting Integrity Program, as presented in the LRA, would not be adequate to manage all of the aging effects identified for the non-Class 1 pressure-retaining bolting.

The staff requested the applicant to clarify how aging management of pressure-retaining bolting in the ESF systems would be managed during the extended period of operation.

As documented in the Audit and Review Report, the applicant provided the following response:

> The Bolting Integrity Program will be revised to include ASME, Section XI, activities identified in GALL, as well as aspects of monitoring and trending under Systems Monitoring for bolted connections outside of ASME, Section XI, boundaries. Subsequent to these revisions, the Bolting Integrity Program will be consistent with GALL with the exception that structural bolting is not addressed.
>
> Additionally, aging management review summaries in Sections 3.1, 3.2, 3.3, and 3.4 will be revised to address aging management requirements for each of the aging effects identified in GALL AMR line items pertaining to closure bolting in high pressure or high temperature systems. The following information will be included in these aging management reviews:
>
> 1) In general, BSEP treats bolting as a subcomponent of the parent component; and bolting does not have a separate line item in system level aging management reviews.
>
> 2) GALL identifies loss of material, loss of preload and cracking as applicable aging effects for high temperature, high pressure bolting.

3) The Bolting Integrity Program, updated as described above, is specified to manage these aging effects.

During the audit, the staff determined that, upon completion of the revisions noted in the applicant's response, above, the Bolting Integrity Program will be consistent with the GALL Report for all pressure-retaining bolting. Structural bolting will not be addressed. Since BSEP treats bolting as a subcomponent of the pressure-retaining components, there are no separate AMRs in the LRA for bolting in the ESF system. However, the applicant's commitment to specify the Bolting Integrity Program to manage all aging effects identified in the GALL Report for components containing Class 1 and non-Class 1 pressure-retaining bolting will resolve this discrepancy.

Since the revised Bolting Integrity Program will be consistent with the recommendation of GALL AMP XI.M18, the staff concluded that aging of pressure-retaining bolting in the ESF systems will be adequately managed. On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

3.2.2.1.2 Loss of Material for Valve Bodies in the Residual Heat Removal System

In the discussion section of LRA Table 3.2.2-1, the applicant stated that it includes AMR line items for valve bodies and bonnets in the residual heat removal system that are constructed of copper alloys and stainless steel, and exposed to raw water internally. The Open-Cycle Cooling Water System Program is specified to manage loss of material due to various corrosion mechanisms, and flow blockage due to fouling for these components. In addition, the Selective Leaching of Materials Program is specified to manage loss of material due to selective leaching for the copper-alloy components. GALL Report line item VII.C1.2-a is referenced, which also recommends the Open-Cycle Cooling Water System Program and the Selective Leaching of Materials Program. However, the AMRs identify generic Note E, indicating they are consistent with GALL with the exception of the AMP. The staff noted that other AMRs in Table 3.2.2-1 for piping and heat exchangers with similar materials and environments in this system identify generic Notes A or B, indicating that the AMPs are consistent with the GALL Report. During the audit, the staff asked the applicant to clarify this apparent inconsistency in the generic notes.

As documented in the Audit and Review Report, the applicant stated that the AMR line items for valves should be consistent with comparable line items for piping and heat exchanger components. Specifically, the line item for valves (body and bonnet) in LRA Table 3.2.2-1 associated with flow blockage due to fouling, loss of material due to crevice corrosion, loss of material due to MIC, and loss of material due to pitting corrosion should appropriately include generic Note A; selective leaching should include generic Note B.

On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

3.2.2.1.3 Loss of Material for Carbon Steel Piping and Fittings in the HVAC Control Building System

In the discussion section of LRA Table 3.2.2-8, the applicant stated that it includes an AMR line item for piping and fittings in the HVAC control building system that are constructed of carbon steel and exposed to indoor air on the internal surfaces. The Preventive Maintenance Program is specified to manage loss of material due to general corrosion for these components; however, GALL Report line item VII.D.1-a recommends the Compressed Air Monitoring Program to manage this aging effect. During the audit, the staff requested clarification on what preventive maintenance is performed on these components and how their interior surfaces are inspected for general corrosion by the Preventive Maintenance Program.

In its response, the applicant stated that this AMR line item represents one pipe nipple with a threaded connection to one drain trap from each of two instrument air receivers. The Preventive Maintenance Program will be enhanced to include activities to inspect the drain traps and the pipe nipple for the extended period of operation.

The staff determined that the enhancement to the Preventive Maintenance Program to include inspection of the drain trap and pipe nipple will provide an acceptable means of managing loss of material due to general corrosion for the carbon steel piping and fittings addressed in this AMR line item.

With regard to the Compressed Air Monitoring Program, the applicant stated that this program is not used at BSEP. The applicant's justification and the staff's evaluation are documented in the Audit and Review Report.

On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

3.2.2.1.4 Loss of Material for Carbon Steel Air Receivers in the HVAC Control Building System

In the discussion section of LRA Table 3.2.2-8, the applicant stated that it includes an AMR line item for air receivers (shell and access cover) in the HVAC control building system that are constructed of carbon steel and exposed to indoor air on their internal surfaces. The One-Time Inspection Program is specified to manage loss of material due to general corrosion for these components; however, GALL Report line item VII.D.3-a recommends the Compressed Air Monitoring Program to manage this aging effect. The staff asked the applicant to provide justification for using the One-Time Inspection Program to manage general corrosion on the interior surfaces of the air receivers instead of the Compressed Air Monitoring Program.

In its response, the applicant stated that this line item represents two air receivers in the HVAC control building system which receive dry, compressed air. Even though the inlet air is dried using an air dryer, any condensation is removed from the bottom of the tank through a piping and trap arrangement. The expectation is that these air receivers will not exhibit loss of material due to general corrosion. However, because the potential for condensation exists in the bottom of the tank, the two air receivers were conservatively assigned the aging effect of loss of material due to general corrosion.

The applicant also stated that the One-Time Inspection Program in the GALL Report is appropriate for the subject air receivers. The staff has accepted that a one-time inspection may be used to provide additional assurance that aging is not occurring or is so insignificant that an aging management program is not warranted. A one-time inspection may also trigger development of a program necessary to assure component intended functions through the period of extended operation. However, there may be locations that are isolated from the flow stream for extended periods and are susceptible to the gradual accumulation or concentration of agents that promote certain aging effects. This program provides inspections that either verify that unacceptable degradation is not occurring, or trigger additional actions that will assure the intended function of affected components will be maintained during the period of extended operation.

For aging management of the subject components, the One-Time Inspection Program will verify that the expectation is correct, or it will determine the extent of the degradation present so that corrective actions can be taken. The applicant stated that this is the approach used at BSEP and, based on the program description in the GALL Report, it is consistent with GALL Report recommendations. Since the piping components have a threaded connection, the air receiver inspections will likely be performed with the use of a boroscope or a volumetric examination, or a combination of the two techniques.

With regard to the Compressed Air Monitoring Program recommended in the GALL Report, the applicant stated in its response to the audit question that this AMP is not used at BSEP. The supply of dry instrument air to pneumatic controllers, dampers, and other pneumatic controls is provided by an air dryer located upstream of the devices served. The instrument air dryer is located downstream of the instrument air compressors. The compressed air is dried and cooled by a refrigerant type dryer. As documented in the Audit and Review Report, the applicant periodically tests the quality of the instrument air. This procedure is a result of the applicant's response to GL 88-14, in which the applicant stated that they will maintain instrument air quality and to establish a program to include periodic sampling of the air quality of the instrument air system. Locations tested are monitored for dew point (each quarter), entrained particulates exceeding 3 microns (every 18 months), and hydrocarbon contaminates (every 18 months). The selected test locations provide a representative sample of the instrument air system, DG starting air system, and the HVAC control building system.

The applicant further stated in its response that, for the majority of the HVAC control building system instrument air components, loss of material was not identified as an aging effect for instrument air components subject to aging management based on the dry air delivered by the air dryer. Dry air is provided by system design, and is maintained by system operation and testing requirements as discussed above. Moisture downstream of the air dryer is controlled. BSEP currently uses procedures to test air quality periodically using representative samples, review trend data, and initiate corrective actions as appropriate for the instrument air system. BSEP has completed steps to test air quality periodically, review trend data, and initiate corrective actions as appropriate for the instrument air system and has met the intent of GL 88-14.

The applicant also provided copies of its bases documents as documented in the Audit and Review Report. The staff reviewed these documents and confirmed that, for the majority of the HVAC control building system instrument air components, dry air is provided by system design and is maintained by system operation and testing requirements to meet the intent of the compressed air monitoring system AMP recommended in the GALL Report.

The staff determined that, although the applicant has not credited an AMP consistent with the GALL Report, BSEP has procedures and programs in place that perform the activities included in the Compressed Air Monitoring Program recommended in the GALL Report. Therefore, the One-Time Inspection Program, together with the existing plant programs and procedures, meet the intent of the Compressed Air Monitoring Program. On the basis of its review, the staff found that the applicant appropriately addressed the aging mechanism, as recommended by the GALL Report.

Conclusion. The staff evaluated the applicant's claim of consistency with the GALL Report. The staff also reviewed information pertaining to the applicant's consideration of recent operating experience and proposals for managing associated aging effects. On the basis of its review, the staff concluded that the AMR results, which the applicant claimed to be consistent with the GALL Report, are consistent with the AMRs in the GALL Report. Therefore, the staff concluded that the applicant demonstrated that the effects of aging for these components will be adequately managed so that their intended function(s) will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2 AMR Results That Are Consistent with the GALL Report, for Which Further Evaluation is Recommended

Summary of Technical Information in the Application. In LRA Section 3.2.2.2, the applicant provided further evaluation of aging management as recommended by the GALL Report for the ESF systems. The applicant provided information concerning how it will manage the following aging effects:

- cumulative fatigue damage
- loss of material due to general corrosion
- local loss of material due to pitting and crevice corrosion
- local loss of material due to microbiologically influenced corrosion
- changes in properties due to elastomer degradation
- loss of material due to erosion of charging pump flow orifices
- buildup of deposits due to corrosion in drywell and torus spray nozzles and flow orifices

Staff 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 recommends further evaluation, the staff audited the applicant's evaluation to determine whether it adequately addressed the issues that were further evaluated. In addition, the staff reviewed the applicant's further evaluations against the criteria contained in SRP-LR Section 3.2.2.2. Details of the staff's audit are documented in the staff's Audit and Review Report. The staff's evaluation of the aging effects is discussed in the following sections.

For some line-items assigned to the staff in LRA Tables 3.2.2-1 through 3.2.2-9, the GALL Report recommends further evaluation. When further evaluation is recommended, the staff reviewed these further evaluations provided in LRA Section 3.2.2.2 against the criteria provided in the SRP-LR Section 3.2.3.2. The staff's assessments of these evaluations is documented in this section. These assessments are applicable to each Table 2 line-item in Section 3.2 that cite the item in Table 1.

3.2.2.2.1 Cumulative Fatigue Damage

Cumulative fatigue is a TLAA, as defined in 10 CFR 54.3. TLAAs are required to be evaluated in accordance with 10 CFR 54.21(c)(1). The evaluation of this TLAA is addressed in SER Section 4.3.

3.2.2.2.2 Loss of Material Due to General Corrosion

Areas with Stagnant Flow Conditions. The staff reviewed LRA Section 3.2.2.2.2.1 against the criteria in SRP-LR Section 3.2.2.2.2, which states:

> The management of loss of material due to general corrosion of pumps, valves, piping, and fittings associated with some of the BWR emergency core cooling systems [high pressure coolant injection, reactor core isolation cooling, high pressure core spray, low pressure core spray, low pressure coolant injection (residual heat removal)] and with lines to the suppression chamber and to the drywell and suppression chamber spray system should be further evaluated. The existing aging management program relies on monitoring and control of primary water chemistry based on BWRVIP 29 (EPRI TR-103515) for BWRs to mitigate degradation. However, control of primary water chemistry does not preclude loss of material due to general corrosion at locations of stagnant flow conditions. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage loss of material due to general corrosion to verify the effectiveness of the chemistry control program. A one-time inspection 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 period of extended operation.

In LRA Section 3.2.2.2.2.1, the applicant stated that loss of material due to general corrosion is predicted for carbon steel components exposed to treated water in the ECCS, and is managed by the Water Chemistry Program and the One-Time Inspection Program. The Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. Since control of water chemistry does not preclude corrosion at locations with stagnant flow conditions, the One-Time Inspection Program will provide a verification of the effectiveness of the Water Chemistry Program to manage loss of material due to general corrosion through examination of carbon steel ECCS components.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.2 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Interior and Exterior Surfaces of Carbon Steel Components. The staff reviewed LRA Section 3.2.2.2.2.2 against the criteria in SRP-LR Section 3.2.2.2.2, which states:

> Loss of material due to general corrosion could occur in the drywell and suppression chamber spray (BWR) systems header and spray nozzle components, standby gas treatment system components (BWR), containment isolation valves and associated piping, the automatic depressurization system piping and fittings (BWR), emergency core cooling system header piping and fittings and spray nozzles (BWR), and the external surfaces of BWR carbon steel components. The GALL Report recommends further evaluation on a plant specific basis to ensure that the aging effect is adequately managed.

In LRA Section 3.2.2.2.2, the applicant stated that the Preventive Maintenance Program is used to manage loss of material due to general corrosion on interior surfaces of filter housings and ductwork in the standby gas treatment system. Loss of material due to external corrosion of carbon steel components is predicted by BSEP for components in air/gas environments exposed to moisture. To manage this aging effect/mechanism, the Systems Monitoring Program will be used. This program provides for scheduled visual inspections to ensure that aging degradation that might lead to loss of intended functions will be detected.

The staff noted that SRP-LR Section 3.2.2.2.2 requires aging management of several other components in the ESF systems, including the drywell and suppression chamber spray systems header and spray nozzle components, containment isolation valves and associated piping, and the automatic depressurization system piping and fittings and spray nozzles. These components are not addressed in the LRA.

The staff requested that the applicant explain how loss of material due to general corrosion on the interior surfaces of the aforementioned components would be managed.

As documented in the Audit and Review Report, the applicant provided the following further evaluations for each of the components identified:

> Drywell and suppression chamber spray systems header: The SRP-LR identifies loss of material due to general corrosion as a potentially applicable aging effect for the drywell and suppression chamber spray systems header. Aging management reviews have identified that carbon steel piping in normally wetted portions of these subsystems is susceptible to general corrosion, managed by the water chemistry program with a verification of program effectiveness using the One-Time Inspection Program. Regarding the portion of the Suppression Pool (Torus) Spray subsystem downstream of the isolation valves, this piping is normally not wetted or pressurized, but rather exposed to the primary containment environment. Since the primary containment is inerted with nitrogen during operation, no significant corrosion of this piping is expected as a result. Similarly, drywell spray is considered an SR function, but is not expected to be used except in post accident conditions and the drywell spray headers are not subject to alternate wetting. This piping is assumed to be dry and normally exposed to the inerted drywell environment, and significant corrosion is not expected. Hence general corrosion of drywell and suppression chamber spray is not considered to be an aging mechanism requiring aging management.

The staff determined that the applicant's evaluation for the drywell and suppression chamber spray systems header is acceptable on the basis that the wetted portion of the drywell and suppression chamber spray system header would be subject to loss of material due to general corrosion, and the Water Chemistry Program and One-Time Inspection Program specified by the applicant will adequately manage this aging effect. Further, the dry portion of the piping will not experience corrosion, and the applicant appropriately concluded that these components do not require aging management.

> Drywell and suppression chamber spray systems spray nozzle components: As noted above, the suppression spray function is not safety-related at BSEP, hence, the suppression spray nozzles do not perform an intended function. Drywell spray is a safety-related function. The drywell spray nozzles are constructed of brass and installed in a

normally dry, inerted environment. As such, they are not subject to general corrosion and aging management is not required.

The staff determined that the applicant's justification for the drywell and suppression chamber spray nozzle components not being subject to general corrosion is acceptable on the basis that the brass components will not experience any corrosion in a dry environment.

> Containment isolation valves and associated piping: BSEP has not performed a separate aging management review of containment isolation valves and associated piping, but rather addressed aging management reviews of these components within the aging management reviews of the systems in which they occur. The BSEP methodology used for system aging management reviews conservatively predicts general corrosion in those applications where it might be applicable. Additional information regarding the aging management programs applied to manage general corrosion of containment isolation valves and associated piping is provided in line items for "Valves (including check valves and containment isolation) (body and bonnet)" in System AMR Tables 3.1.2, 3.2.2, 3.3.2 and 3.4.2.

The staff determined that the applicant's approach for managing loss of material due to general corrosion in containment isolation valves and associated piping is acceptable on the basis that these components are addressed as part of the aging management review of the systems in which they are contained.

> Automatic depressurization system piping and fittings and spray nozzles: BSEP includes the automatic depressurization system piping (S/RV downcomers) as part of the reactor vessel and internals system. Aging management review of these components are addressed in Section 3.1 of the LRA. These components are managed for general corrosion using the systems monitoring, water chemistry and one time inspection programs.

The staff determined that the applicant's approach for managing loss of material due to general corrosion in automatic depressurization system piping and fittings, and spray nozzles is acceptable on the basis that these components are addressed as part of the reactor vessel and internals system, and their aging management review is included in LRA Section 3.1.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.2 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.3 Local Loss of Material Due to Pitting and Crevice Corrosion

Areas with Stagnant Flow Conditions. The staff reviewed LRA Section 3.2.2.2.3.1 against the criteria in SRP-LR Section 3.2.2.2.3, which states:

> The management of local loss of material due to pitting and crevice corrosion of pumps, valves, piping, and fittings associated with some of the BWR emergency core cooling system piping and fittings [high pressure coolant injection, reactor core isolation cooling, high pressure core spray, low pressure core spray, low

pressure coolant injection (residual heat removal)] and with lines to the suppression chamber and to the drywell and suppression chamber spray system should be evaluated further. The existing aging management program relies on monitoring and control of primary water chemistry based on EPRI guidelines of TR-105714 for PWRs and BWRVIP 29 (EPRI TR-103515) for BWRs to mitigate degradation. However, control of coolant water chemistry does not preclude loss of material due to crevice and pitting corrosion at locations of stagnant flow conditions. Therefore, verification of the effectiveness of the chemistry control program should be performed to ensure that corrosion is not occurring. The GALL Report recommends further evaluation of programs to manage the loss of material due to pitting and crevice corrosion to verify the effectiveness of the chemistry control program). A onetime inspection 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 so that the component's intended function will be maintained during the period of extended operation.

In LRA Section 3.2.2.2.3.1, the applicant stated that loss of material due to pitting and crevice corrosion is predicted for carbon steel components exposed to treated water in ECCS systems, and is managed by the Water Chemistry Program and the One-Time Inspection Program. The Water Chemistry Program manages aging effects through periodic monitoring and control of contaminants. Since control of water chemistry does not preclude corrosion at locations with stagnant flow conditions, the One-Time Inspection Program will provide a verification of the effectiveness of the Water Chemistry Program to manage loss of material due to pitting and crevice corrosion through examination of carbon steel ECCS components.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.3 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

<u>Interior and Exterior Surfaces of Carbon and Stainless Steel Components</u>. The staff reviewed LRA Section 3.2.2.2.3.2 against the criteria in SRP-LR Section 3.2.2.2.3, which states:

> Local loss of material from pitting and crevice corrosion could occur in the containment isolation valves and associated piping, and automatic depressurization system piping and fittings (BWR). The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed.

In LRA Section 3.2.2.2.3.2, the applicant stated that the Preventive Maintenance Program is used to manage loss of material in filter housings and duct work in the standby gas treatment system. BSEP has addressed aging management of containment isolation valves and associated piping as a part of the system in which they reside. Generally, this entails use of the Systems Monitoring Program for exterior surfaces, and use of the Water Chemistry Program in conjunction with the One-Time Inspection Program on the internal surfaces.

The staff noted that LRA Section 3.2.2.2.3.2 does not address aging management of the ADS piping and fitting, as recommended by SRP-LR Section 3.2.2.2.3. The staff asked the applicant to explain how loss of material due to pitting and crevice corrosion in the ADS piping and fittings will be managed for the extended period of operation.

As documented in the Audit and Review Report, the applicant stated that BSEP includes the ADS piping (S/RV downcomers) as part of the reactor vessel and internals system. AMRs of these components are summarized LRA Section 3.1, and have identified pitting and crevice corrosion as being applicable to wetted portions of these components. These AMRs have specified the Water Chemistry Program for aging management, with program effectiveness verification performed under the One-Time Inspection Program.

The staff determined that the applicant's approach for managing loss of material due to pitting and crevice corrosion in the ADS piping and fittings is acceptable on the basis that these components are included in the reactor vessel and internals system and their aging management is addressed as part of that system.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.3 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.4 Local Loss of Material Due to Microbiologically Influenced Corrosion

The staff reviewed LRA Section 3.2.2.2.4 against the criteria in SRP-LR Section 3.2.2.2.4, which states:

> Local loss of material due to microbiologically influenced corrosion (MIC) could occur in BWR and PWR containment isolation valves and associated piping in systems that are not addressed in other chapters of the GALL Report. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed.

In LRA Section 3.2.2.2.4, the applicant stated that BSEP has addressed aging management of containment isolation valves and associated piping as a part of the system in which they reside. Generally, this entails use of the Systems Monitoring Program for the external surfaces, and use of the Water Chemistry Program in conjunction with the One-Time Inspection Program on the internal surfaces. BSEP has no service water lines inside the primary containment and MIC is not a significant liability for containment isolation components.

During the audit, the staff also interviewed the technical staff to determine which ESF components use service water for cooling and why MIC is not an issue for the containment isolation components. Based on the interview, it was determined that the RHR heat exchangers, ECCS pump coolers, and the RHR pump seals are among the ESF components that are cooled by service water. However, the containment isolation valves do not use service water for cooling; therefore, they are not subject to MIC. Based on the information provided, the staff determined that the applicant's further evaluation is acceptable since service water is not used to cool the containment isolation valves.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.4 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.5 Changes in Properties Due to Elastomer Degradation

The staff reviewed LRA Section 3.2.2.2.5 against the criteria in SRP-LR Section 3.2.2.2.5, which states:

> Changes in properties due to elastomer degradation could occur in seals associated with the standby gas treatment system ductwork and filters. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed.

In LRA Section 3.2.2.2.5, the applicant stated that change in material properties (hardening, cracking) is predicted by the BSEP AMR methodology for elastomeric seals in the standby gas treatment system. The Preventive Maintenance Program will be used to manage aging of the internal surfaces of these seals; whereas, the Systems Monitoring Program will be used to manage aging of visible external surfaces.

The staff determined that the applicant's use of the Preventive Maintenance Program and Systems Monitoring Program are acceptable since they will periodically verify the condition of the elastomers and provide reasonable assurance that hardening and cracking are not occurring.

The staff 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. The staff also found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.2.6 Loss of Material Due to Erosion of Charging Pump Flow Orifices

This issue is applicable only to charging pumps in the chemical and volume control systems of PWRs.

3.2.2.2.7 Buildup of Deposits Due to Corrosion in Drywell and Torus Spray Nozzles and Flow Orifices

The staff reviewed LRA Section 3.2.2.2.7 against the criteria in SRP-LR Section 3.2.2.2.7, which states:

> The plugging of components due to general corrosion could occur in the spray nozzles and flow orifices of the drywell and suppression chamber spray system. This aging mechanism and effect will apply since the spray nozzles and flow orifices are occasionally wetted, even though the majority of the time this system is on standby. The wetting and drying of these components can aid in the acceleration of this particular corrosion. The GALL Report recommends further evaluation to ensure that the aging effect is adequately managed.

In LRA Section 3.2.2.2.7, the applicant stated that suppression pool (torus) spray is not required for design-basis accidents at BSEP, and is not considered an SR function. Drywell spray is required but not used in normal operation, and it is maintained isolated. Therefore, plugging or fouling of drywell spray components is not considered an applicable aging effect. Fouling of the ECCS strainers is managed by the Protective Coatings Monitoring and Maintenance Program, which ensures that failed coatings in the primary containment will not degrade the capability of ECCS systems, including RHR and drywell spray, below design requirements.

The staff noted that SRP-LR Section 3.2.2.2.7 states that wetting and drying of components due to their occasional use can aid in the acceleration of general corrosion, which may result in plugging of components in the drywell spray system. The staff asked the applicant to clarify why plugging of drywell spray components is not an applicable aging effect.

As documented in the Audit and Review Report, the applicant stated that drywell spray is an SR function, but this post-accident subsystem is not subject to alternate wetting either from normal operation or periodic flow testing. Moreover, the portion of the drywell spray subsystem downstream of isolation valves is normally exposed to the inerted primary containment environment. Therefore, significant accumulation of corrosion is not expected in the drywell spray header, and plugging or fouling of spray components is not considered to be an aging effect requiring aging management.

The staff determined that the applicant's justification for concluding that plugging is not an applicable aging effect for drywell spray nozzles and orifices is acceptable on the basis that these components are not subjected to alternate wetting and drying; therefore, they are not susceptible to corrosion product buildup, which could cause plugging.

The staff found that, based on the programs identified above, the applicant has met the criteria of SRP-LR Section 3.2.2.2.7 for further evaluation. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained during the period of extended operation, as required by 10 CFR 54.21(a)(3).

Conclusion. On the basis of its review, 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 recommends further evaluation, the staff determined that (1) those attributes or features for which the applicant claimed consistency with the GALL Report were indeed consistent, and (2) the applicant adequately addressed the issues that were further evaluated. The staff found that the applicant demonstrated that the effects of aging will be adequately managed so that the intended functions will be maintained consistent with the CLB for the period of extended operation, as required by 10 CFR 54.21(a)(3).

3.2.2.3 AMR Results That Are Not Consistent with or Are Not Addressed in the GALL Report

Summary of Technical Information in the Application. In LRA Tables 3.2.2-1 through 3.2.2-10, the staff reviewed additional details of the results of the AMRs for material, environment, AERMs, and AMP combinations that are not consistent with the GALL Report, or that are not addressed in the GALL Report.

In LRA Tables 3.2.2-1 through 3.2.2-10, the applicant indicated, via Notes F through J, that neither the identified component nor the material and environment combination is evaluated in the GALL Report and provided information concerning how the aging effect will be managed. Specifically, Note F indicated that the material for the AMR line-item component is not evaluated in the GALL Report. Note G indicated that the environment for the AMR line-item component and material is not evaluated in the GALL Report. Note H indicated that the aging effect for the AMR line-item component, material, and environment combination is not evaluated in the GALL Report. Note I indicated that the aging effect identified in the GALL Report for the line-item component, material, and environment combination is not applicable. Note J indicated that neither the component nor the material and environment combination for the line item is evaluated in the GALL Report.

Staff Evaluation. For the component type, material, and environment combinations that are not evaluated in the GALL Report, the staff reviewed the applicant's evaluation to determine whether the applicant had demonstrated that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB during the period of extended operation. The staff's evaluation is discussed in the following sections.

3.2.2.3.1 Engineered Safety Features – Summary of Aging Management Evaluation – Residual Heat Removal (RHR) System – Table 3.2.2-1

The staff reviewed LRA Table 3.2.2-1, which summarizes the results of AMR evaluations for the RHR system component groups.

In LRA Section 3.2.2.1.1, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the RHR system components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- Open-Cycle Cooling Water System Program
- One-Time Inspection Program
- Selective Leaching of Materials Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program
- Preventive Maintenance Program

The staff reviewed the applicant's AMR of the RHR system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-1. The staff also reviewed those combinations in Table 3.2.2-1, with Notes A through E, for which issues were identified. The staff determined that the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-1 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for aging management review include piping and fitting, valves, pumps, heat exchangers, drywell and suppression chamber spray system, and pump suction strainers.

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in treated water (includes steam)(internal) environments are subject to loss of material due to general, crevice, and pitting corrosion.
- Carbon steel components in treated water (internal) environments are subject to loss of material due to crevice, galvanic, general, and pitting corrosion.
- Carbon steel components in treated water (internal) environments are subject to flow blockage due to fouling, or loss of material due to erosion.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to loss of material due to crevice and pitting corrosion, and/or cracking due to SCC.
- Stainless steel components in treated water (internal) environments are subject to flow blockage due to fouling, and loss of material due to crevice and pitting corrosion and MIC.
- Stainless steel components in treated water (external) environments are subject to loss of material due to crevice and pitting corrosion.
- Stainless steel components in raw water (internal) environments are subject to loss of material due to crevice corrosion, pitting corrosion, and MIC, as well as loss of heat transfer effectiveness due to fouling of heat transfer surface. These components are also subject to flow blockage due to fouling.
- Copper-alloy components in treated water (external) or raw water environments are subject to loss of heat transfer effectiveness due to fouling of heat transfer surfaces.
- Copper-alloy components in treated water (external) environments are subject to loss of material due to crevice and pitting corrosion, or loss of material due to selective leaching.
- Copper-alloy components in raw water (internal) environments are subject to loss of material due to erosion and/or galvanic corrosion.
- Copper-alloy components in raw water (internal) environments are subject to loss of material due to erosion and MIC.
- Copper-alloy components in indoor air (external) environments are subject to loss of heat transfer effectiveness due to fouling of heat transfer surfaces.
- Grey cast iron components in treated water (internal) environments are subject to loss of material due to galvanic corrosion, loss of material due to selective leaching, or loss of material due to crevice, general, and pitting corrosion.
- Stainless steel components in indoor air (external) environments are not identified with any aging effects.
- Thermal insulation (such as glass fiber or calcium silicate) in indoor (external) environments are not identified with any aging effects.
- Carbon steel components in dry air/gas (internal) environments are not identified with any aging effects.

During its review, the staff determined that it needed additional information to complete its review. The specific RAI and the applicant's response are discussed below.

In LRA Tables 3.2.2-1, 3.2.2-3, 3.2.2-5, and 3.2.2-7, carbon steel and stainless steel piping/fittings, valves, and small-bore piping in treated water (includes steam) (internal) environments are subject to loss of material due to crevice, general, and pitting corrosion. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the aging effect. In draft RAI 3.2-8, dated February 2, 2005, the staff requested the applicant to explain how the Section XI ISI Program will be used to manage the above identified aging effect of loss of material in the specified internal environment, noting that the ISI program is primarily credited for managing the aging effect of cracking. During a teleconference held on June 29, 2005, the applicant responded by stating that portions of the systems involved are included in Section XI ISI Class 1 boundaries, and that the piping represented by the respective AMR line items are subject to Section XI ISI Class 1 examination requirements. The examination includes volumetric examinations, which would be effective in detecting the loss of material due to crevice, general, and pitting corrosion. The staff considered the applicant's response to be insufficient in demonstrating the effectiveness of the ISI program in managing loss of material due to crevice, general, and pitting corrosion, for the inside surfaces of piping components. The staff requested the applicant to address five follow-up questions:

(1) Provide the basis for concluding that the potential for internal corrosion is the greatest at Class 1 ISI welds due to sensitization and geometric changes associated with the weldment.

(2) The GALL ISI Program does not specifically call for inspections at other susceptible internal surfaces of piping and fittings.

(3) The ability of volumetric examination methods (UT and radiographic testing (RT)) to detect loss of material for internal surfaces needs to be assured for the system components in question.

(4) An augmented inspection program should be required to verify the effectiveness of the Water Chemistry Program and ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program.

(5) Both Class 1 boundaries and those outside of Class 1 boundaries need to be addressed.

By letter dated July 18, 2005, in the supplemental response to RAI 3.3.2-1-2, the applicant provided its responses to the above follow-up questions.

Regarding Follow-up Question 1, the applicant stated that the scope of Section XI ISI is not limited to weldments; rather, weldments are generally specified as inspection locations on the basis of susceptibility. Welds are typically specified for inspection because the assessment of degradation mechanisms identifies them as the areas of most concern. This increased susceptibility at welds is attributed to metallurgical changes and surface imperfections associated with the welding process. The applicant provided a detailed discussion, contained in the American Society for Metals Handbook, Volume 13, pertaining to crevice and pitting corrosion of the heat-affected zone of weldments. The applicant also stated that the handbook contains a similar discussion of the potential for sensitization at weldments of stainless steels and nickel-based alloys. While measures can be specified to minimize the potential for corrosion in welds, the applicant stated that the variables associated with welding activities introduce a set of liabilities to welds not applicable to the balance of piping base metal. The staff determined that the applicant adequately explained the basis of increased susceptibility at welds, and assured an inspection scope of Section XI ISI Program beyond weldments. Follow-up Question 1 is, therefore, closed.

Regarding Follow-up Question 2, the applicant stated that the current approved version of GALL Report, Section XI ISI Program does not specifically address crevice, pitting, and general corrosion of other susceptible internal surfaces of Class 1 piping. This is because the industry has been effective in mitigating these aging mechanisms with water chemistry. These mechanisms, where applicable, were being included in the LRA due to the conservative, deterministic methods being used in AMRs; namely, assuming no water chemistry controls. The staff found the applicant's explanation to be acceptable, and Follow-up Question 2 is closed.

Regarding Follow-up Question 3, the applicant stated that, consistent with EPRI guidance, and as approved by the staff, the RI-ISI methodology includes: (1) identification and evaluation of potentially active degradation mechanisms, (2) selection of inspection locations in which the impact of each degradation mechanism is most severe, and (3) implementation of appropriate inspection methods, such as UT or RT, with qualified inspectors. The applicant stated that the assessment of applicable degradation mechanisms is piping/component-specific, and includes consideration of a range of factors including materials, pipe size/schedule, component type, geometry/configuration, fabrication methods, operating conditions, and service experience. The type of inspections, area to be examined, and qualification requirements for inspection personnel are specific to the degradation mechanism of concern.

In addition, the applicant stated that the types of flaws required to be detected under Section XI, Subsection IWB, are not limited to cracks, but include other types of imperfections and inclusions meeting the flaw-size criteria of IWB-3500. Qualification requirements for personnel performing volumetric examinations are intended to assure the inspection would find minor surface imperfections on the inside of piping geometries, consistent with the flaw-size requirements and acceptance criteria of the ASME Code. The staff found the applicant's response to have adequately addressed its concern regarding the ability of volumetric examination methods in detecting loss of material at the inside surface of piping components. Follow-up Question 3 is, therefore, closed.

Regarding Follow-up Question 4, the applicant stated that an augmented inspection is not needed to address the potential for loss of material due to crevice, pitting, or general corrosion of Class 1 piping. As prescribed by 10 CFR 50.55a, Section XI ISI requirements, and NRC-approved alternatives such as RI-ISI, are not limited to detection of cracking, but also include detection of loss of material due to crevice, pitting, and general corrosion. The applicant stated that the same Section XI ISI program that ensures an acceptable level of quality and safety during the current licensing period will continue in that role during the period of extended operation. The staff found the applicant's response to be adequate to assure that an augmented inspection program, other than the Section XI ISI Program, will not be needed for the verification of the effectiveness of the Water Chemistry Program. Follow-up Question 4 is, therefore, closed.

Regarding Follow-up Question 5, the applicant stated that the line items addressed in this discussion pertain only to NPS-4 Class 1 piping and larger. Components outside of Class 1 boundaries which credit the Water Chemistry Program for aging management are subject to the One-Time Inspection Program for verification of program effectiveness, consistent with GALL. It is noted that GALL does not specify one-time inspections for Class 1 piping that is NPS-4 and larger, because it is subject to volumetric examination. Less than NPS-4 Class 1 piping is not subject to volumetric examination, and has been included in the One-Time Inspection Program. The staff found the applicant's response to have adequately delineated the AMRs for both Class

1 boundaries and those outside of Class 1 boundaries, including pipes of different sizes. Follow-up Question 5 is, therefore, closed.

Based on the applicant's satisfactory responses to the staff follow-up questions, as discussed above, RAI 3.2-8 is resolved.

In RAI 3.2-1, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-1, carbon steel spray nozzles in the drywell and suppression chamber spray system, in a dry air/gas (internal) environment, are not identified with any aging effects. The applicant stated that the basis is that "Suppression pool spray is not required for design basis events. Drywell spray nozzles/piping is required but is normally isolated and not subject to plugging or fouling." Therefore, the staff requested that the applicant explain why the suppression pool spray is not required for design-basis events (DBEs). Noting that industry operating experience has revealed that plugging or fouling of carbon steel spray nozzles could occur if not properly prevented or managed, the staff also requested the applicant to provide the necessary procedure to ensure that drywell spray nozzles/piping will be free from plugging. In its response, by letter dated May 4, 2005, the applicant stated that the drywell and suppression pool spray subsystems are provided to condense steam and cool non-condensable gases in reducing containment pressure and temperature after a loss of coolant accident (LOCA). Analyses performed in support of the BSEP EPU submittal credit containment (i.e., drywell) spray with maintaining the drywell temperature profile within EQ requirements subsequent to small steamline breaks. The applicant stated that, otherwise, neither drywell nor suppression pool spray is needed to maintain post-accident primary containment P-T parameters within acceptable values.

The applicant further stated that the assumption that drywell spray nozzle and piping are free from plugging is not based on procedural requirements, but rather on consideration that drywell spray components are not intermittently wetted, that the drywell is inerted with nitrogen during operation, and that the spray nozzles themselves are constructed of corrosion-resistant material (brass). The applicant stated that the industry operating experience discussed in SRP-LR Section 3.2.2.7, pertains to spray piping that is subject to alternate wetting, and is not applicable to drywell spray components at BSEP. Drywell spray is a post-accident function at BSEP. It is not actuated during the course of normal plant operations, and UFSAR 5.4.7.4 notes that operation of valves to the containment spray headers is checked by operating the upstream and downstream valves individually, thereby avoiding initiating spray during routine testing.

The staff found the above responses provided by the applicant to be adequate in explaining why the carbon steel spray nozzles in the drywell and suppression chamber spray system are not identified with any aging effects. Therefore, the staff's concern described in RAI 3.2-1 is resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's responses to the above RAIs, the staff found that the aging effects of the RHR system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant identified the appropriate aging effects for the materials and environments associated with the components in the RHR system.

<u>Aging Management Programs</u>. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are

appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-1 identifies the following AMPs for managing the aging effects described above for the RHR system:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- Open-Cycle Cooling Water System Program
- One-Time Inspection Program
- Selective Leaching of Materials Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program
- Preventive Maintenance Program

SER Sections 3.0.3.1.1, 3.0.3.2.1, 3.0.3.1.3, 3.0.3.2.4, 3.0.3.2.11, 3.0.3.2.12, 3.0.3.2.18, 3.0.3.1.2, and 3.0.3.3.3, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant described appropriate AMPs for managing the aging effects of the RHR system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.2 Engineered Safety Features – Summary of Aging Management Evaluation – Containment Atmosphere Control (CAC) System – Table 3.2.2-2

The staff reviewed LRA Table 3.2.2-2, which summarizes the results of AMR evaluations for the CAC system component groups.

In LRA Section 3.2.2.1.2, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the CAC system components:

- Water Chemistry Program
- One-Time Inspection Program
- Systems Monitoring Program

The technical staff reviewed the applicant's AMR of the CAC system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-2. The staff also reviewed those combinations in LRA Table 3.2.2-2, with Notes A through E, for which issues were identified. The staff determined that the applicant identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

<u>Aging Effects</u>. LRA Table 2.3.2-2 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for aging management review include: piping and fitting, valves, tanks, pumps, and heat exchangers.

- For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in indoor air (internal) environments are subject to loss of material due to general corrosion.
- Stainless steel components in treated water (internal or external) environments are subject to loss of material due to crevice and pitting corrosion.
- Carbon steel components in dry air/gas (internal) environments are not identified with any aging effects.
- Stainless steel components in dry air/gas (internal) or indoor air (external) environments are not identified with any aging effects.
- Copper-alloy components in dry air/gas (internal) or indoor air (internal or external) environments are not identified with any aging effects.
- Glass components in indoor air (external) or treated water (internal) environments are not identified with any aging effects.

During its review, the staff determined that it needed additional information to complete its review. The specific RAIs and the applicant's responses are discussed below.

In RAI 3.2-2, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-2, no aging effects are identified for glass components in a treated water (internal) environment. Therefore, the staff requested that the applicant provide the basis for such determination. In its response, by letter dated May 4, 2005, the applicant stated that because most silicate glasses have a high resistance to corrosion in normal environments, glass *per se* is frequently considered to be an inert substance. Silica is almost insoluble in an aqueous environment, except at temperatures above 482°F. Acid attack of soda-lime and boronsilicate glass compositions is minimal due to the formation of a protective, highly siliceous surface layer, except for hydrofluoric and phosphoric (i.e., at high temperatures) acids. The applicant stated that indoor and outdoor environments do not typically contain contaminants that could concentrate and chemically attack glass. Based on this information, and the fact that no definitive instances of glass failure due to aging have been identified in industry operating experience searches, the staff considered the applicant's basis for concluding that no aging effects are predicted for glass components in the CAC system to be acceptable. Therefore, the staff's concern described in RAI 3.2-2 is resolved.

In RAI 3.2-3, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-2, for the stainless steel heat exchangers in dry air/gas (internal) environments, the applicant stated under Note 208 that "Heat exchangers in this category are in scope for spatial interaction with SR components. Therefore, only the external surfaces require aging management review." Therefore, the staff requested that the applicant clarify the meaning of this statement, and explain how the aging management for the "spatial interaction" of the stainless steel components is to be performed. In its response, by letter dated May 4, 2005, the applicant stated that "spatial interaction" in the context of Note 208 means the potential to spray, wet, or otherwise adversely affect the function of SR equipment. In this instance, the heat exchangers are sample precoolers, which are literally coils in an air environment. The applicant stated that since the application does not involve liquid-filled components, Note 208 was misapplied. Instead, Notes 221 and 215 are applicable, and no aging effects are predicted. The staff found the applicant's resolution of the above misapplication to be acceptable. Therefore, the staff's concern described in RAI 3.2-3 is resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's responses to the above RAIs, the staff found that the aging effects of the CAC system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the CAC system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program, in accordance with 10 CFR 54.21(d)

LRA Table 3.2.2-2 identifies the following AMPs for managing the aging effects described above for the CAC system:

- Water Chemistry Program
- One-Time Inspection Program
- Systems Monitoring Program

SER Sections 3.0.3.2.1, 3.0.3.2.11, and 3.0.3.3.2, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant described the appropriate AMPs for managing the aging effects of the CAC system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.3 Engineered Safety Features – Summary of Aging Management Evaluation – High Pressure Coolant Injection (HPCI) System – Table 3.2.2-3

The staff reviewed LRA Table 3.2.2-3, which summarizes the results of AMR evaluations for the HPCI system component groups.

In LRA Section 3.2.2.1.3, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the HPCI system components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Control Program
- One-Time Inspection Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program

- Preventive Maintenance Program

The technical staff reviewed the applicant's AMR of the HPCI system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-3. The staff also reviewed those combinations in Table 3.2.2-3, with Notes A through E, for which issues were identified. The staff determined that the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-3 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include: piping and fittings, pumps, valves, tanks, steam turbines, strainer elements, and heat exchangers.

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in treated water (includes steam)(internal), or treated water (internal) environments are subject to loss of material due to general, crevice, and pitting corrosion.
- Carbon steel components in treated water (internal) environments are subject to general, crevice, pitting, and galvanic corrosion.
- Carbon steel components in treated water (internal) are subject to flow blockage due to fouling.
- Carbon steel components in treated water (includes steam)(internal) environments are subject to cracking due to thermal and mechanical loadings.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to cracking due to SCC, and loss of material due to crevice and pitting corrosion.
- Stainless steel components in treated water (includes steam)(internal), or treated water (internal) environments are subject to loss of material due to crevice and pitting corrosion.
- Stainless steel components in treated water (internal) are subject to flow blockage due to fouling.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to cracking due to thermal and mechanical loadings.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to loss of material due to flow-accelerated corrosion.
- Strainer elements in lube oil (internal) or treated water (internal) environments are subject to flow blockage due to fouling.
- Carbon steel components in indoor air (external) or lube oil (internal) environments are not identified with any AERMs.
- Stainless steel components in indoor air (external), dry air/gas (internal), or lube oil (internal) environments are not identified with any AERMs.

- Insulation material in indoor air (external) environments are not identified with any AERMs.
- Copper-alloy components in lube oil (internal or external) environments are not identified with any AERMs.

During its review, the staff determined that it needed additional information to complete its review. The specific RAI and the applicant's response are discussed below.

In LRA Table 3.2.2-3, carbon steel piping/fittings, valves, and small-bore piping in treated water (includes steam) (internal) environments are subject to loss of material due to crevice, general, and pitting corrosion. The Section XI ISI and Water Chemistry Programs are credited to manage the aging effect. In RAI 3.2-8, the staff requested the applicant to explain how the Section XI ISI program will be used to manage the above identified aging effect of loss of material in the specified internal environment, noting that the ISI program is primarily credited for managing the aging effect of cracking. The staff's discussion of this RAI and its resolution by the applicant are provided in SER Section 3.2.2.3.1.

In RAI 3.2-4, dated, April 8, 2005, the staff stated that in LRA Tables 3.2.2-3, 3.2.2-5, and 3.2.2-7, carbon and stainless steel small-bore piping and fittings less than NPS-4, in treated water (includes steam)(internal) environments, are subject to cracking due to thermal and mechanical loading. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the identified aging effect. In the subject tables, stainless steel small-bore piping less than NPS-4, in the same treated water (includes steam)(internal) environment, are also subject to cracking due to SCC. The same AMPs are credited to manage the aging effect. Therefore, the staff requested that the applicant (1) provide the basis for the statement made under Note 226 that "cracking due to thermal and mechanical loadings was evaluated and dispositioned as not applicable," and (2) clarify the statement made under Note 226 that "The risk associated with cracking due to SCC is bounded by those components selected for inservice inspection as part of the Risk-Informed ISI Program..."

In its response, by letter dated May 4, 2005, the applicant stated that susceptibility to cracking due to thermal and mechanical loading has been previously evaluated on a component-specific basis, in support of the BSEP RI-ISI submittal in PEC letter to the NRC (serial: BSEP 01-0013) dated April 20, 2001. However, the applicant also stated that BSEP has revised its aging management strategy for small-bore piping to include a one-time inspection in response to NRC comments during an audit of AMPs, and it no longer credits RI-ISI in aging management. The applicant credits the Water Chemistry Program and ASME Section XI Subsection IWB, IWC and IWD Program for aging management of cracking, including SCC, in less than NPS-4 Class 1 piping components. The applicant stated that, consistent with the GALL Report, the One-Time Inspection Program will be used to verify the effectiveness of these programs. SER Section 3.0.3.2.11 provides the staff's discussion of the applicant's One-Time Inspection Program. It is noted that in its response to Audit Question B.2.15-1a, the applicant stated that in LRA Tables 3.2.2-3, 3.2.2-5, and 3.2.2-7, the AMR line items addressing small-bore Class 1 piping will be revised to reflect Water Chemistry, ASME Section XI Subsection IWB, IWC and IWD, and One-Time Inspection Programs for aging management of cracking due to thermal and mechanical loading and SCC. In addition, the applicant noted that Note 226 is no longer applicable.

Based on the above information provided by the applicant, the staff considered that the applicant adequately clarified the aging management for small-bore Class 1 piping components, which are susceptible to cracking due to thermal and mechanical loading and SCC. Therefore, the staff's concem described in RAI 3.2-4 is resolved.

In RAI 3.2-5, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-3, stainless steel piping and fittings (HPCI) in treated water (includes steam)(internal) environments are subject to cracking due to SCC. The Water Chemistry and One-Time Inspection Programs are credited to manage the aging effect. The staff noted the statement made in LRA Section B.2.15 by the applicant that "BSEP does not utilize the One-Time Inspection Program activity specified in the GALL Report, for detection of cracking in small-bore Class 1 piping. Cracking of this piping will be detected and managed by the combination of the ASME Section XI, Subsection IWB, IWC, and IWD Program supplemented by the Water Chemistry Program..." Therefore, the staff requested that the applicant clarify the discrepancy found between the above statement and the LRA Table 3.2.2-3 . In its response, by letter dated May 4, 2005, the applicant stated that BSEP has revised its aging management strategy for small-bore piping for consistency with the GALL Report. The applicant credits a combination of the Water Chemistry Program, ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program, and the One-Time Inspection Program for managing cracking of small-bore piping, consistent with the recommendations of GALL IV.C1.1.13. See the staff's discussion on the applicant's responses to RAI 3.2-4 and Audit Question B.2.15-1a for additional information. The staff found the applicant's responses to be acceptable, and RAI 3.2-5 is, therefore, resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's responses to the above RAIs, the staff found that the aging effects of the HPCI system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant identified the appropriate aging effects for the materials and environments associated with the components in the HPCI system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-3 identifies the following AMPs for managing the aging effects described above for the HPCI system:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- Flow-Accelerated Control Program
- One-Time Inspection Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program
- Preventive Maintenance Program

Sections 3.0.3.1.1, 3.0.3.2.1, 3.0.3.1.3, 3.0.3.2.2, 3.0.3.2.11, 3.0.3.2.18, 3.0.3.3.2, and 3.0.3.3.3 of this SER, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant has described appropriate AMPs for managing the aging effect of the HPCI system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.4 Engineered Safety Features – Summary of Aging Management Evaluation – Automatic Depressurization System (ADS) – Table 3.2.2-4

The staff reviewed LRA Table 3.2.2-4, which summarizes the results of AMR evaluations for the ADS component groups.

In LRA Section 3.2.2.1.4, the applicant identified the materials and environments for the components in the ADS, and identified no AERMs. No AMPs were, therefore, required for the ADS system components.

The technical staff reviewed the applicant's AMR of the ADS system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-4. The staff also reviewed those combinations in Table 3.2.2-4, with Notes A through E, for which issues were identified. The staff determined whether the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs, if credited, to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-4 lists individual system components within the scope of license renewal and subject to an AMR. Valves are the only components that do not rely on the GALL Report for AMR.

For this component type, the applicant identified the materials, environments, and AERMs, as specified below:

- Stainless steel components in dry air/gas (internal) environments are not identified with any AERMs.
- Stainless steel components in indoor air (external) environments are not identified with any AERMs.

On the basis of its review of the information provided in the LRA, the staff found that the absence of aging effects for the ADS system component type not addressed by the GALL Report is consistent with industry experience for these combinations of material and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant adequately concluded that there are no AERMs for the materials and environments associated with the components in the ADS system.

Aging Management Programs. Because there are no AERMs, no AMPs are required for the ADS system.

3.2.2.3.5 Engineered Safety Features – Summary of Aging Management Evaluation – Core Spray (CS) System – Table 3.2.2-5

The staff reviewed LRA Table 3.2.2-5, which summarizes the results of AMR evaluations for the CS system component groups.

In LRA Section 3.2.2.1.5, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the CS system components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- One-Time Inspection Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program

In LRA Table 3.2.2-5, the applicant provided a summary of the AMRs for the CS system components and identified which AMRs it considered to be consistent with the GALL Report.

The technical staff reviewed the applicant's AMR of the CS system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-5. The staff also reviewed those combinations in Table 3.2.2-5, with Notes A through E, for which issues were identified. The staff determined that the applicant identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-5 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include: piping and fitting, valves, pumps, and pump suction strainers

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in treated water (includes steam)(internal) or treated water (internal) environments are subject to loss of material due to general, crevice, and pitting corrosion.
- Carbon steel components in treated water (internal) environments are subject to loss of material due to crevice, galvanic, general, and pitting corrosion.
- Carbon steel components in treated water (internal) environments are subject to flow blockage due to fouling.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to loss of material due to crevice and pitting corrosion, or cracking due to thermal and mechanical loading.
- Stainless steel components in treated water (internal) environments are subject to flow blockage due to fouling, and loss of material due to crevice and pitting corrosion.

- Carbon steel components (external surfaces) in indoor air (external) environments are subject to loss of material due to general corrosion.
- Stainless steel components in indoor air (external) environments are not identified with any AERMs.

During its review, the staff determined that it needed additional information to complete its review. The specific RAIs and the applicant's responses are discussed below.

In LRA Table 3.2.2-5, carbon steel piping/fittings, valves, and small-bore piping in treated water (includes steam) (internal) environments are subject to loss of material due to crevice, general, and pitting corrosion. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the aging effect. In RAI 3.2-8, the staff requested the applicant to explain how the Section XI ISI Program will be used to manage the above identified aging effect of loss of material in the specified internal environment, noting that the ISI Program is primarily credited for managing the aging effect of cracking. The staff's discussion of this RAI and its resolution by the applicant are provided in SER Section 3.2.2.3.1.

In LRA Table 3.2.2-5, carbon and stainless steel small-bore piping and fittings less than NPS-4 in treated water (includes steam)(internal) environments, are subject to cracking due to thermal and mechanical loading. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the identified aging effect. In the subject tables, stainless steel small-bore piping less than NPS-4, in the same treated water (includes steam)(internal) environment, are also subject to cracking due to SCC. The same AMPs are credited to manage the aging effect. In RAI 3.2-4, the staff requested the applicant to (1) provide the basis for the statement made under Note 226 that "cracking due to thermal and mechanical loadings was evaluated and dispositioned as not applicable," and (2) clarify the statement made under Note 226 that "The risk associated with cracking due to SCC is bounded by those components selected for inservice inspection as part of the Risk-Informed ISI Program..." SER Section 3.2.2.3.3 provides the staff's discussion of this RAI and its resolution by the applicant.

In RAI 3.2-6, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-5, carbon steel piping and fittings (misc. auxiliary and drain piping and valves) in treated water (internal) environments are subject to loss of material due to crevice, general, and pitting corrosion. The One-Time Inspection Program is credited to manage the aging effects. The applicant's Note 205 states that "The One-Time Inspection Program will include elements to verify the integrity of spatial interaction piping." Therefore, the staff requested that the applicant explain how this note is applicable to the aging effects identified. The applicant was also requested to provide the basis of using the One-Time Inspection Program alone to manage the identified aging effects without the use of the Water Chemistry Program. In its response, by letter dated May 4, 2005, the applicant stated that the subject line item should reflect Water Chemistry and One-Time Inspection Programs for aging Management. The applicant stated that the AMR is being revised to apply these two programs consistent with comparable line items in the RHR, HPCI, and RCIC systems. This is acceptable to the staff, and the concern described in RAI 3.2-6 is resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's responses to the above RAIs, the staff found that the aging effects of the CS system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the CS system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-5 identifies the following AMPs for managing the aging effects described above for the CS system:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- One-Time Inspection Program
- Protective Coating Monitoring and Maintenance Program
- Systems Monitoring Program

SER Sections 3.0.3.1.1, 3.0.3.2.1, 3.0.3.1.3, 3.0.3.2.11, 3.0.3.2.18, and 3.0.3.3.2, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant has described appropriate AMPs for managing the aging effect of the CS system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.6 Engineered Safety Features – Summary of Aging Management Evaluation - Standby Gas Treatment System (SGTS) – Table 3.2.2-6

The staff reviewed LRA Table 3.2.2-6, which summarizes the results of AMR evaluations for the SGTS component groups.

In LRA Section 3.2.2.1.6, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the SGTS components:

- One-Time Inspection Program
- Buried Piping and Tanks Inspection Program
- Systems Monitoring Program
- Preventive Maintenance Program

The technical staff reviewed the applicant's AMR of the SGTS system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-6. The staff also reviewed those combinations in Table 3.2.2-6, with Notes A through E, for which issues were identified. The staff determined that the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-6 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include piping specialties and instrument tubing.

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in indoor air (internal) environments are subject to loss of material due to general corrosion.
- Carbon steel components in buried (external) environments are subject to loss of material due to crevice, general, and pitting corrosion, as well as MIC.
- Elastomer components in indoor air (internal or external) environments are subject to loss of material due to wear.
- Stainless steel components in indoor air (internal or external) environments are not identified with any AERMs.

On the basis of its review of the information provided in the LRA, the staff found that the aging effects of the SGTS component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant identified the appropriate aging effects for the materials and environments associated with the components in the SGTS system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-6 identifies the following AMPs for managing the aging effects described above for the SGTS system:

- One-Time Inspection Program
- Buried Piping and Tanks Inspection Program
- Systems Monitoring Program
- Preventive Maintenance Program

SER Sections 3.0.3.2.11, 3.0.3.2.13, 3.0.3.3.2, and 3.0.3.3.3, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant has described appropriate AMPs for managing the aging effect of the SGTS system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.7 Engineered Safety Features – Summary of Aging Management Evaluation – Standby Liquid Control (SLC) System – Table 3.2.2-7

The staff reviewed LRA Table 3.2.2-7, which summarizes the results of AMR evaluations for the SLC system component groups.

In LRA Section 3.2.2.1.7, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the SLC system components:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- One-Time Inspection Program
- Systems Monitoring Program
- Preventive Maintenance Program

The technical staff reviewed the applicant's AMR of the SLC system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-7. The staff also reviewed those combinations in Table 3.2.2-7, with Notes A through E, for which issues were identified. The staff determined that the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-7 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include: piping and fitting, valves, tanks, and pumps.

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel components in treated water (internal) environments are subject to loss of material due to crevice, galvanic, general, and pitting corrosion.
- Stainless steel components in treated water (includes steam)(internal) environments are subject to loss of material due to crevice and pitting corrosion, or cracking due to thermal and mechanical loading.
- Stainless steel components in treated water (internal) environments are subject to loss of material due to crevice and pitting corrosion.
- Plastics/polymer components in indoor air (internal) environments are subject to cracking due to various degradation mechanisms.
- Plastics/polymer components in treated water (external) environments are subject to change in material properties due to various degradation mechanisms.
- Stainless steel components in indoor air (external) environments are not identified with any AERMs.
- Glass components in indoor air (external) or treated water (internal) environments are not identified with any AERMs.

During its review, the staff determined that it needed additional information to complete its review. The specific RAIs and the applicant's responses are discussed below.

In LRA Table 3.2.2-7, stainless steel piping/fittings, valves, and small-bore piping in treated water (includes steam) (internal) environments are subject to loss of material due to crevice and pitting corrosion. The Section XI Inservice Inspection and Water Chemistry Programs are credited to manage the aging effect. In RAI 3.2-8, the staff requested the applicant to explain how the Section XI ISI program will be used to manage the above identified aging effect of loss of material in the specified internal environment, noting that the ISI program is primarily credited for managing the aging effect of cracking. The staff's discussion of this RAI and its resolution by the applicant are provided in SER Section 3.2.2.3.1.

In LRA Table 3.2.2-7, no aging effects are identified for glass components in a treated water (internal) environment. In RAI 3.2-2, the staff requested the applicant to provide the basis for such determination. SER Section 3.2.2.3.2 provides the staff's discussion of this RAI and its resolution by the applicant.

In RAI 3.2-7, dated April 8, 2005, the staff stated that in LRA Table 3.2.2-7, carbon steel components in treated water (internal) environments is subject to loss of material due to crevice, general, and pitting corrosion. The Preventive Maintenance Program is credited to manage the aging effects. The applicant's Note 206 to LRA Tables 3.2.2-1 through 3.2.2-9, states that "Internal inspection of the phenolic-lined carbon steel accumulator tank is performed under the Preventive Maintenance Program." Therefore, the staff requested that the applicant provide the basis for crediting the Preventive Maintenance Program to manage the identified aging effects, in lieu of the Water Chemistry and One-Time Inspection Programs. In its response, by letter dated May 4, 2005, the applicant stated that the Preventive Maintenance Program is directed at defined inspections of specific components. The SLC hydraulic accumulators are carbon steel tanks lined internally with a phenolic coating, containing a rubber bladder charged with nitrogen. BSEP has existing preventive maintenance routes to internally inspect these accumulators to verify the integrity of the rubber bladder, the condition of the phenolic coating, and any corrosion occurring on the interior surfaces of the carbon steel tanks. The applicant stated that these activities provide direct verification on an ongoing basis that aging effects are not occurring. The staff found the applicant's response to be adequate in explaining how the interior surfaces of the SLC hydraulic accumulator tanks are inspected, using the existing Preventive Maintenance Program, to preclude corrosion from occurring. Therefore, the staff's concern described in RAI 3.2-7 is, resolved.

On the basis of its review of the information provided in the LRA and the additional information included in the applicant's responses to the above RAIs, the staff found that the aging effects of the SLC system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant has identified the appropriate aging effects for the materials and environments associated with the components in the SLC system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-7 identifies the following AMPs for managing the aging effects described above for the SLC system:

- ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program
- Water Chemistry Program
- BWR Stress Corrosion Cracking Program
- One-Time Inspection Program
- Systems Monitoring Program
- Preventive Maintenance Program

Sections 3.0.3.1.1, 3.0.3.2.1, 3.0.3.1.3, 3.0.3.2.11, 3.0.3.3.2, and 3.0.3.3.3 of this SER, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant described appropriate AMPs for managing the aging effect of the SLC system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable, in accordance with 10 CFR 54.21(d).

3.2.2.3.8 Engineered Safety Features – Summary of Aging Management Evaluation – HVAC Control Building System – Table 3.2.2-8

The staff reviewed LRA Table 3.2.2-8, which summarizes the results of AMR evaluations for the HVAC control building system component groups.

In LRA Section 3.2.2.1.8, the applicant identified the materials, environments, and AERMs. The applicant identified the following programs that manage the AERMs for the HVAC control building system components:

- One-Time Inspection Program
- Systems Monitoring Program
- Preventive Maintenance Program

In LRA Table 3.2.2-8, the applicant provided a summary of the AMRs for the HVAC control building system components and identified which AMRs it considered to be consistent with the GALL Report.

The technical staff reviewed the applicant's AMR of the HVAC control building system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-8. The staff also reviewed those combinations in Table 3.2.2-8, with Notes A through E, for which issues were identified. The staff determined that the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-8 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include piping and fittings, valves, air receivers, filters, dryers, ducts, and heating/cooling coils.

For these component types, the applicant identified the materials, environments, and AERMs, as specified below:

- Carbon steel and carbon steel - galvanized components in indoor air (internal) environments are subject to loss of material due to general corrosion.
- Carbon steel components in outdoor air (internal or external) environments are subject to loss of material due to general corrosion.
- Carbon steel - galvanized components in outdoor air (internal) environments are subject to loss of material due to aggressive chemical attack and loss of material due to general corrosion.
- Stainless steel components in indoor air (internal) environments are subject to loss of material due to crevice and pitting corrosion.
- Plastics/polymer components in indoor air (internal or external) environments are subject to cracking due to various degradation mechanisms.
- Elastomer components in indoor air (internal) environments are subject to cracking due to various degradation mechanisms and/or loss of material due to wear.
- Copper-alloy components in indoor air (external) environments are subject to loss of material due to crevice and pitting corrosion.
- Copper-alloy and aluminum-alloy components in indoor air (external) or outdoor air (external) are subject to loss of heat transfer effectiveness due to fouling of heat transfer surfaces.
- Stainless steel, copper-alloy, glass, and aluminum-alloy components in dry air/gas (internal) environments are not identified with any aging effects.
- Stainless steel, carbon steel - galvanized, and copper-alloy components in indoor air (internal) environments are not identified with any AERMs.
- Stainless steel, carbon steel - galvanized, copper-alloy, glass, insulation, and aluminum-alloy components in indoor air (external) environments are not identified with any AERMs.

On the basis of its review of the information provided in the LRA, the staff found that the aging effects of the HVAC control building system component types not addressed by the GALL Report are consistent with industry experience for these combinations of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant identified the appropriate aging effects for the materials and environments associated with the components in the HVAC control building system.

Aging Management Programs. After evaluating the applicant's identification of aging effects for each of the above components, the staff evaluated the AMPs to determine whether they are appropriate for managing the identified aging effects. The staff also determined that the UFSAR supplement contains an adequate description of the program.

LRA Table 3.2.2-8 identifies the following AMPs for managing the aging effects described above for the HVAC control building system:

- One-Time Inspection Program

- Systems Monitoring Program
- Preventive Maintenance Program

SER Sections 3.0.3.2.11, 3.0.3.3.2, and 3.0.3.3.3, respectively, present the staff's detailed review of these AMPs.

On the basis of its review of the information provided in the LRA, the staff found that the applicant described appropriate AMPs for managing the aging effect of the HVAC control building system component types not addressed by the GALL Report. In addition, the staff found the program descriptions in the UFSAR supplement acceptable.

3.2.2.3.9 Engineered Safety Features – Summary of Aging Management Evaluation – Reactor Protection System – Table 3.2.2-9

The staff reviewed LRA Table 3.2.2-9, which summarizes the results of AMR evaluations for the reactor protection system component groups.

In LRA Section 3.2.2.1.9, the applicant identified the materials and environments for the components in the reactor protection system, and identified no AERMs. Therefore, no AMPs were required for the reactor protection system components.

The technical staff reviewed the applicant's AMR of the reactor protection system component-material-environment-AERM combinations that are not addressed in the GALL Report. These combinations are identified by Notes F through J in LRA Table 3.2.2-9. The staff also reviewed those combinations in LRA Table 3.2.2-9, with Notes A through E, for which issues were identified. The staff determined whether the applicant has identified all applicable AERMs and credited appropriate AMPs for managing them. The staff also reviewed the applicable UFSAR supplements for the AMPs, if credited, to ensure that the program descriptions are adequate.

Aging Effects. LRA Table 2.3.2-9 lists individual system components within the scope of license renewal and subject to an AMR. The component types that do not rely on the GALL Report for AMR include miscellaneous components in ESFs.

For this component type, the applicant identified the material, environment, and AERM, as specified below:

- Stainless steel components in indoor air (internal or external) environments are not identified with any AERMs.

On the basis of its review of the information provided in the LRA, the staff found the absence of aging effects for the reactor protection system component type not addressed by the GALL Report consistent with industry experience for this combination of materials and environments. The staff did not identify any omitted aging effects. Therefore, the staff found that the applicant adequately concluded that there are no AERMs for the material and environment associated with the components in the reactor protection system.

Aging Management Programs. Because there are no AERMs, no AMPs are required for the reactor protection system.

3.2.3 Conclusion

The staff concluded that the applicant provided sufficient information to demonstrate that the effects of aging for the ESF 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 period of extended operation, as required by 10 CFR 54.21(a)(3). The staff also reviewed the applicable UFSAR supplement program summaries and concludes that they adequately describe the AMPs credited for managing aging of the ESF systems, as required by 10 CFR 54.21(d).

3.3 Aging Management of Auxiliary Systems

This section of the SER documents the staff's review of the AMR results for the auxiliary systems components and component groups associated with the following systems:

- reactor water cleanup system
- reactor core isolation cooling system
- reactor building sampling system
- post accident sampling system
- circulating water system*
- screen wash water system
- service water system
- reactor building closed cooling water system
- turbine building closed cooling water system*
- diesel generator system
- heat tracing system
- instrument air system
- service air system*
- pneumatic nitrogen system
- fire protection system
- fuel oil system
- radioactive floor drains system
- radioactive equipment drains system
- makeup water treatment system
- chlorination system*
- potable water system
- process radiation monitoring system
- area radiation monitoring system*
- liquid waste processing system
- spent fuel system*
- fuel pool cooling and cleanup system
- HVAC diesel generator building
- HVAC reactor building
- HVAC service water intake structure*
- HVAC turbine building*
- HVAC radwaste building*
- torus drain system
- civil structure auxiliary systems
- non-contaminated water drainage system (NCWDS)