CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) Set #6 RESPONSES

RAI B1.4-1

Background:

Pursuant to Title 10 of the *Code of Federal Regulations* Part 54.21(a)(3) [10 CFR 54.21(a)(3)], a license renewal applicant is required to demonstrate that the effects of aging on structures and components subject to an aging management review (AMR) are adequately managed so that their intended functions will be maintained consistent with the current licensing basis (CLB) for the period of extended operation. Section 3.0.1 of NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants," Revision 2 (SRP-LR), defines an AMR as the identification of the materials, environments, aging effects, and aging management programs (AMPs) credited for managing the aging effects. SRP-LR Section A.1.2.3 defines an acceptable AMP as consisting of 10 elements, including Element 10, "operating experience," which is described in SRP-LR Section A.1.2.3.10, Paragraph 1 (in part), as follows:

> Consideration of future plant-specific and industry operating experience relating to aging management programs should be discussed. Reviews of operating experience by the applicant in the future may identify areas where aging management programs should be enhanced or new programs developed. An applicant should commit to a future review of plant-specific and industry operating experience to confirm the effectiveness of its aging management programs or indicate a need to develop new aging management programs (emphasis added). This information should provide objective evidence to support the conclusion that the effects of aging will be managed adequately so that the structure and component intended function(s) will be maintained during the period of extended operation.

In addition, 10 CFR 54.21(d) requires the application to contain a Final Safety Analysis Report (FSAR) supplement. This supplement must contain a summary description of the programs and activities for managing the effects of aging and the evaluation of time-limited aging analyses (TLAAs) for the period of extended operation.

The U.S. Nuclear Regulatory Commission (NRC or the staff) issued License Renewal Interim Staff Guidance (ISG) LR-ISG-2011-05, "Ongoing Review of Operating Experience," dated March 16, 2012, to clarify the staff's position that license renewal AMPs should be informed, and enhanced when necessary, based on the ongoing review of both plant-specific and industry operating experience.

Based on its review of the Callaway, Unit 1, license renewal application (LRA), the staff determined that LRA Section B1.4, "Operating Experience," provides a general description of how the applicant gathered and considered operating experience in preparing its LRA, and LRA Sections B2.1.1 through B2.1.39 and B3.1 through B3.3 summarize the specific operating experience considered for each AMP.

Issue:

LRA Sections B1.4, B2.1.1 through B2.1.39, and B3.1 through B3.3 describe how the applicant incorporated operating experience into its AMPs and will monitor internal and external operating experience on an ongoing basis. The applicant states that the Operating Experience program and the Corrective Action Program (CAP) are used to evaluate operating experience to enhance AMPs and ensure the effectiveness of AMPs. However, the LRA does not provide specific details to describe the Operating Experience program and CAP and how they are used to

monitor operating experience on an ongoing basis and ensure the continued effectiveness of AMPs.

Request:

a) Describe the programmatic activities that will be used to continually identify aging issues, evaluate them and, as necessary, enhance the AMPs or develop new AMPs for license renewal. Indicate whether these activities and programs will be consistent with guidance described in LR-ISG-2011-05. If not consistent, provide the basis for the conclusion that the programmatic activities will ensure operating experience will be reviewed on an ongoing basis to address age-related degradation and aging management during the term of the renewed license.

b) Consistent with the response to Request (a) above, provide a summary description in the FSAR supplement of how operating experience will be reviewed on an ongoing basis to address age-related degradation and aging management during the term of the renewed license.

Callaway Response

a) Callaway has an established, mature plant Operating Experience Program that has its roots in the Institute of Nuclear Power Operations (INPO) Significant Event Evaluation and Information Network (SEE-IN) Program that was implemented to address Item I.C.5 of NUREG-0737 and was endorsed by the NRC in Generic Letter 82-04. This program, which has undergone numerous improvements over the years, has provided an effective process for Callaway to learn from and make improvements to address operating experience, including aging-related degradation. The Callaway Corrective Action Program (CAP) is used with the Operating Experience Program to evaluate and address degraded conditions including plant specific (internal) and industry (external) operating experience. Moving forward, these programs will provide assurance that the license renewal aging management programs (AMPs) are and will continue to be effective in managing the aging effects for which they are credited, and the AMPs will be enhanced or new AMPs will be developed when the review of operating experience indicates that the AMPs may not be fully effective.

   As part of the Aging Management Review (AMR) portion of the License Renewal Application (LRA) preparation process, the Callaway LR team performed extensive reviews of internal operating experience to determine the breadth of aging effects potentially impacting SSCs in the scope of license renewal at Callaway. These reviews did not identify any aging effects that had not been accounted for in previous industry LRAs. In addition, the Callaway LRA was prepared in accordance with Revision 2 of the GALL report (NUREG-1801), which has incorporated industry-wide operating experience into the guidance for establishing effective AMPs. These factors provide confidence that lessons learned from many years of aging-related operating experience have already been captured, such that the AMPs specified in Callaway's LRA to manage aging during the period of extended operation (PEO) are designed to address reasonably expected aging effects.

   In addition, to ensure that the programmatic activities for the ongoing review of operating experience are adequate for license renewal, the following recommendations of LR-ISG-2011-05 for the SRP-LR new Appendix A.4, "Operating Experience for Aging Management Programs," are addressed.

1. Consideration of operating experience in the 10 CFR Part 50 Appendix B program

   Although the existing Operating Experience and Corrective Action Programs already consider and address operating experience related to aging, the programs will be enhanced to provide specific direction to identify, evaluate and communicate operating experience related to aging. This will ensure that consideration of such aging-related operating experience is not precluded. In addition as noted in LRA Section B1.3, the elements of corrective actions, confirmation process, and administrative controls of the Callaway Plant Quality Assurance (QA) program will be enhanced to include nonsafety-related structures and components within the scope of license renewal.

2. Sources of Operating Experience

   Additional documents, largely already included in the scope of the Callaway Operating Experience review process, will be based on those document categories defined in the INPO "Guidelines for Use of Operating Experience" document, which defines "Sources of Operating Experience." Included are a broad set of sources beyond specific internal and external plant operating experience items. These include INPO Event Report (IER) operating experience documents, NRC Bulletins, Generic Letters, Information Notices and Regulatory Issue Summaries, as well as Topical Reports and vendor correspondence (including 10 CFR Part 21 information). Callaway is also adding License Renewal Interim Staff Guidance (LR-ISG) documents to the scope of documents reviewed under its Operating Experience Program because they are issued on an ongoing basis, capturing new insights or addressing issues that emerge from license renewal reviews. Periodic (e.g., every five years) updates to NUREG-1801 (the GALL) will not be explicitly reviewed under the Program since these updates, as they relate to operating experience, will lag real-time plant operating experience and LR-ISGs. Should the NRC determine that it is valuable for plants with renewed licenses to review the periodic updates to NUREG-1801, an accompanying Regulatory Issue Summary (RIS) or other generic communication for the periodic update to NUREG-1801 would be reviewed in accordance with the Operating Experience Program.

3. Consideration of incoming plant-specific and industry operating experience

   <u>Internal Operating Experience</u>
   Internal operating experience evaluations involving degraded conditions, including those related to aging, are performed in accordance with the existing Callaway Corrective Action Program and procedures. The scope of what is considered and recorded relative to aging depends upon the nature of the degradation identified, whether the inspection was driven by aging management program activities that contain specific inspection criteria and other factors. Evaluations of internal operating experience involving a degraded condition are documented in the Corrective Action Program making them auditable, searchable, and retrievable.

   <u>External Operating Experience</u>
   Evaluation of external operating experience, including that related to aging management, is performed in accordance with the Callaway Operating Experience Program. Among other things, the issue or event is evaluated to determine its applicability to Callaway, whether similar conditions or deficiencies have occurred and whether Callaway is vulnerable to a similar issue. If the evaluation identifies an adverse condition, the issue is entered into the Corrective Action Program and addressed as appropriate. Although external aging-related issues have been captured and evaluated in the past, the

Operating Experience Program procedures will be enhanced to clearly state that aging related issues within the scope of operating experience be considered. Documentation associated with the initial evaluation of external operating experience is retained in accordance with the Operating Experience Program. As noted above, documentation entered into the Corrective Action Program is auditable and retrievable.

4. Identification of operating experience related to aging

   Assignment of identification codes will be established within the Corrective Action Program to assist in the identification and trending of aging-related degradation, such that in addition to addressing the specific issue, the adequacy of existing aging management programs can be assessed and adjustments can be made. Callaway is working with industry and INPO to determine coding that can be used for identification and sharing of industry level operating experience related to age-related degradation and aging management. The precise definition of this coding is not known at this time, since these activities are currently in progress. Upon implementation, Callaway personnel are also required to periodically assess the performance of the aging management programs, including insights obtained through operating experience. This could lead to AMP revisions or the establishment of new AMPs, as appropriate. In addition, existing procedures for engineering programs require performance trending.

5. Information considered in operating experience evaluations

   Evaluation of operating experience that relates to aging management will consider, as appropriate:

   - Systems, structures or components that are similar or identical to those involved with the identified operating experience issue, to gain relevant lessons learned
   - Materials of construction, operating environment and aging effects associated with the identified aging issue so that lessons learned can be applied to susceptible SSCs within the scope of license renewal
   - Aging mechanisms associated with the operating experience to confirm that Callaway has appropriate AMPs in place to manage aging that could be caused by these mechanisms.
   - AMPs associated with this operating experience so that if the AMPs have been demonstrated to be ineffective, similar AMPs in place at Callaway can be evaluated to determine if AMP changes are appropriate, or if a new AMP is needed.

   If the operating experience issue reveals site-specific vulnerabilities, the Callaway process directs that the vulnerability be documented in the Corrective Action Program where the issue is then further evaluated for appropriate action. The evaluation considers extent of condition and applicability to other systems, structures and components, as directed by the corrective action procedures.

6. Consideration of AMP implementation results as operating experience

   The results of AMP inspections, tests, analyses, etc. are documented and captured within Callaway work management system records, whether or not they meet the applicable acceptance criteria. If the results do not meet the acceptance criteria, the results are documented in the Corrective Action Program for further review and action, such as correcting the specific condition and evaluating the adequacy of existing AMPs. If the results of the AMP activity are satisfactory, the results are documented and captured so they are available for trending and future reference.

An evaluation as to whether AMPs should be modified or new AMPs created would be conducted within the Corrective Action Program if a deficient condition related to aging is identified and determined to be applicable to SSCs in the scope of license renewal for Callaway. This would occur directly as part of the evaluation activities that stem from the Corrective Action Program once a degraded condition is identified (e.g., acceptance criterion associated with an aging management activity is exceeded).

7. Training

Callaway has an established Operating Experience Program with individuals that are assigned and trained in the functions of screening, assigning, evaluating and submitting plant-specific (internal) or industry (external) operating experience. The Callaway Operating Experience Program Coordinators are the central input for all operating experience for Callaway. The Callaway Operating Experience Program Coordinators, among other things, are responsible for processing internal operating experience and outgoing operating experience notifications to the industry.

Recognizing the increased emphasis on aging management with license renewal, Callaway will enhance the existing Operating Experience Program procedures, and the Operating Experience Program Coordinator training will be updated to ensure that both internal and external aging-related operating experience is properly reviewed and disseminated for evaluation.

Callaway will assign responsibilities of an Aging Management Coordinator (AMC) as part of license renewal implementation. Throughout the period of extended operation, the individual(s) with these responsibilities will oversee the effective implementation of activities related to license renewal. Among the responsibilities of the AMC will be the review of internal and external operating experience for lessons learned applicable to Callaway as well as aging-related OE that should be shared external to Callaway. These responsibilities will be captured in a Callaway Aging Management Program implementation procedure. The Callaway AMC will be trained in the concepts of license renewal for proficiency in screening and evaluating aging-related OE.

The Callaway AMP owners for existing and new AMPs are selected based upon having appropriate educational background, work experience or duties. The AMP owners are involved with development, review and approval of the aging management programs credited for aging management in the Callaway License Renewal Application, and are therefore familiar with the aging management approach for their AMPs. Currently, the AMP owners have received classroom training that includes information on component aging. Training enhancements will be made to periodically include information related to aging management. Documentation showing that these individuals have been trained is retrievable.

Callaway provides appropriate training for those personnel performing key license renewal roles, including AMP owners, to provide greater assurance that they are effectively fulfilling their license renewal related duties. With regard to personnel turnover, personnel assigned to these roles are evaluated for inclusion in the Engineering Support Personnel (ESP) population and receive training as required by that accredited program. Furthermore, existing procedural guidance for ‘Transitioning of Engineering Programs and/or Personnel’ is used to ensure that turnovers are effective,

comprehensive, and that the new assignee understands their responsibilities. Associated records will be retained, making them auditable and retrievable.

8. Reporting operating experience to industry

   Callaway Operating Experience Program procedures will be enhanced to include direction and criteria for reporting Callaway plant-specific operating experience on aging-related degradation to the industry. It is expected that the criteria will include:

   - Observation of aging-related degradation significantly beyond what was expected, based upon an existing AMP inspection frequency, methodology, etc.
   - Aging effects or mechanisms not previously seen or accounted for in Callaway AMPs
   - Significant changes required or being made to AMPs that may be of interest to the industry

9. Implementation schedule

   Implementation of the above enhancements will be implemented at Callaway no later than the issue date of the renewed operating license.

b) LRA Appendix A1, Table A4-1 Item 2, and Appendix B1.4 have been revised, as shown in Amendment 8 in Enclosure 2, to describe how internal and external operating experience will be reviewed on an ongoing basis to address age-related degradation and aging management during the period of the renewed operating license.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, "Amendment 8, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI 3.2.2.2.4-1

Background:

SRP-LR Section 3.2.2.2.4 associated with SRP-LR Table 3.2-1, item 5, addresses loss of material due to erosion of the stainless steel minimum flow orifices for high-pressure safety injection pumps exposed to treated borated water. The associated item in NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 2, refers to Licensee Event Report 50-275/94-023 and notes that extended use of the high-pressure safety injection (HPSI) pumps for normal charging can cause this aging effect. The GALL Report recommends that a plant-specific AMP be evaluated to ensure that the aging effect is adequately managed.

LRA Table 3.2.2-5, "High Pressure Coolant Injection System," includes an AMR item for a flow orifice that references LRA Section 3.2.2.2.4 and LRA item 3.2.1.005, and states that the Water Chemistry and One-Time Inspection programs are the plant-specific AMPs used to manage aging for this item.

Issue:

The staff noted that the GALL Report credits the Water Chemistry program with managing loss of material due to corrosion in stainless steel components exposed to treated borated water; however, the Water Chemistry program is not credited with managing loss of material due to erosion. The staff also noted that the associated erosion issue was based on the length of time that the orifice experiences flow and was not based on any chemistry control concern. Since the One-Time Inspection program verifies the system-wide effectiveness of the Water Chemistry program, it was not clear to the staff how the combination of the Water Chemistry and One-Time Inspection programs will effectively manage aging of the minimum flow orifice in the high pressure coolant injection system.

Request:

Provide information regarding how the Water Chemistry program manages loss of material due to erosion of the minimum flow orifices for the high pressure coolant injection pumps. In addition, describe how verification of the Water Chemistry program through the One-Time Inspection program will effectively manage aging of these components. Otherwise, provide an enhancement to an existing AMP or information regarding a plant-specific AMP that will effectively manage loss of material due to erosion of the minimum flow orifices for the high pressure coolant injection pumps.

Callaway Response

As stated in the GALL Report, the aging effect of erosion applies to miniflow recirculation orifices associated with centrifugal HPSI pumps which experience extended use for normal charging. At Callaway, the centrifugal HPSI pumps are not used for normal charging, but are operated infrequently. Normal charging is provided by the normal charging pump. Check valves prevent flow from the normal charging pump from going through the centrifugal HPSI pump miniflow recirculation orifices. Therefore, erosion is not an applicable aging effect for these miniflow recirculation orifices. The Water Chemistry program (B2.1.2) manages loss of material due to pitting and crevice corrosion in the stainless steel HPSI miniflow recirculation orifices, and the One-Time Inspection program (B2.1.18) is used to verify the effectiveness of the Water Chemistry program.

LRA Section 3.2.2.4 and Table 3.2-1, item 3.2.1.005 have been revised, as shown in Amendment 8 in Enclosure 2, to state that erosion of the miniflow recirculation orifices is not applicable to Callaway because the centrifugal HPSI pumps are not used for normal charging, and are operated infrequently. LRA Table 3.2.2-5 has been revised, as shown in Amendment 8 in Enclosure 2, to remove the AMR line referring to Table 3.2-1 item 3.2.1.005.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, “Amendment 8, LRA Changes from RAI Responses,” for a description of LRA changes with this response.

RAI 3.3.2.28-1

Background:

SRP-LR Table 3.3-1 item 82 states that external surfaces of elastomeric seals and components exposed to uncontrolled indoor air should be managed for loss of material due to wear by AMP XI.M36, "External Surfaces Monitoring of Mechanical Components." SRP-LR Table 3.3-1 item 76 states that external and internal surfaces of elastomeric seals and components exposed to uncontrolled indoor air will be managed for hardening and loss of strength due to elastomer degradation. The GALL Report recommends GALL Report AMP XI.M36, "External Surfaces Monitoring of Mechanical Components," to ensure that these aging effects are adequately managed.

For the below elastomeric components, the LRA states:

LRA Table	Component	Environment	AERM	AMP
3.3.2-23	Expansion Joint	Fuel Oil (Int.)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
3.3.2-23	Expansion Joint	Plant Indoor Air (Ext.)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components
3.3.2-23	Flexible Hoses	Fuel Oil (Int.)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
3.3.2-23	Flexible Hoses	Plant Indoor Air (Ext.)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components
3.3.2-28	Flexible Hoses	Demineralized Water (Int.)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
3.3.2-28	Flexible Hoses	Plant Indoor Air (Ext.)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components
3.4.2-5	Flexible Hoses	Condensation (Int.)	Loss of Material	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components
3.4.2-5	Flexible Hoses	Plant Indoor Air (Ext.)	Hardening and Loss of Strength	External Surfaces Monitoring of Mechanical Components

GALL Report Section IX.F defines wear "as the removal of surface layers due to relative motion between two surfaces or under the influence of hard, abrasive particles. Wear occurs in parts that experience intermittent relative motion, frequent manipulation, or in clamped joints where relative motion is not intended, but may occur due to a loss of the clamping force."

Issue:

It is unclear to the staff why the expansion joints and flexible hoses in LRA Tables 3.3.2-23 and 3.3.2-28, and the external surface of the flexible hoses in LRA Table 3.4.2-5, are not being managed for loss of material due to wear due to possible relative motion, frequent manipulation, or loss of the clamping force over time. The staff does not have a concern with wear due to hard abrasive particles for the fuel oil, plant indoor air, demineralized water, and condensation environments.

The flexible hoses in LRA Table 3.4.2-5 are being managed for the hardening and loss of strength by only the External Surfaces Monitoring of Mechanical Components program.

The staff does not know if these hoses are sufficiently flexible such that manipulation of the external surface will result in inspection results which are representative of internal conditions. In addition, the staff lacks sufficient information on the utilization of the flexible hoses to be able to conclude that there are no contaminants that could be present which could result in degradation on the internal surfaces of the hose that would not be detected by an external examination.

Request:

a) State the basis for why the expansion joints and flexible hoses in LRA Tables 3.3.2-23 and 3.3.2-28, and the external surface of the flexible hoses in LRA Table 3.4.2-5, are not being managed for loss of material due to wear or propose how the aging effect will be managed.

b) State whether the flexible hoses in LRA Table 3.4.2-5 are sufficiently flexible such that an external inspection would yield representative results of potential degradation of the internal surfaces. If they are not; state how hardening and loss of strength of the internal surfaces will be managed.

c) State whether there are contaminants which could result in internal degradation of the flexible hoses in LRA Table 3.4.2-5, and if so, state how aging will be managed.

Callaway Response

a) The following LRA Tables have been revised to include the aging effect of loss of material due to wear on the external surfaces of elastomeric flexible hoses and expansion joints exposed to plant indoor air:

   Table 3.3.2-23 EOF and TSC Diesels, Security Building System
   Table 3.3.2-28 Miscellaneous Systems in scope ONLY for Criterion 10 CFR 54.4(a)(2)
   Table 3.4.2-5 Auxiliary Feedwater System

   The aging effect of loss of material due to wear on the external surfaces of these elastomeric flexible hoses and expansion joints will be managed by Aging Management Program XI.M36 External Surfaces Monitoring.

b) LRA Table 3.4.2-5 has also been revised to include the aging effect of hardening and loss of strength due to elastomeric degradation on the internal surfaces of elastomeric flexible hoses exposed to condensation. This aging effect will be managed by Aging Management Program XI.M38 Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components.

c) The elastomeric flexible hoses in the auxiliary feedwater system have an internal environment of condensation. There has been no plant operating experience at Callaway which would indicate that there are contaminants present for an internal environment of condensation. The staff notes that in the description of the issue above, that "The staff does not have a concern with wear issue due to hard abrasive particles for the fuel oil, plant indoor air, demineralized water and condensation environments." The presence of contaminants or hard abrasive particles in the auxiliary feedwater system is extremely unlikely. Aging effects of the elastomeric flexible hoses in the auxiliary feedwater system are adequately managed through the External Surfaces Monitoring of Mechanical Components program and the Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components program.

   LRA Tables 3.3.2-23, 3.3.2-28 and 3.4.2-5 have been revised as shown on LRA Amendment 8, in Enclosure 2 to include the aging effects of loss of material due to wear on the external surfaces of elastomeric flexible hose and expansion joints. LRA Table 3.4.2-5 has been revised as shown on LRA Amendment 8, in Enclosure 2 to include the aging effect of hardening and loss of strength due to elastomeric degradation on the internal surfaces of elastomeric flexible hoses.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, “Amendment 8, LRA Changes from RAI Responses,” for a description of LRA changes with this response.

RAI 3.5.1.25-1

Background:

SRP-LR Table 3.5-1, ID 25, addresses inaccessible containment concrete exposed to air, being managed for cracking, loss of bond, and loss of material due to corrosion of embedded steel. The corresponding item in the LRA states that this item is not applicable because Callaway has no inaccessible containment concrete exposed to an environment of air-indoor or air-outdoor.

Issue:

The staff does not agree that all containment concrete exposed to air is accessible for inspection. During an audit walkdown on May 2, 2012, the staff observed external containment concrete that appeared to be obstructed by the containment vent duct. In addition, other areas of containment concrete may not be accessible for inspection due to equipment placement or other obstructions. It is also not clear to the staff how inaccessible containment concrete exposed to other environments (e.g., groundwater, soil) will be managed during the period of extended operation. SRP-LR Table 3.5-1, ID 65, addresses this aging effect for inaccessible concrete exposed to groundwater or soil; however, this item is not used in LRA Table 3.5.2-1, which identifies the AMR items for the containment.

Request:

a) Verify that no containment concrete exposed to an air environment is inaccessible or revise the LRA accordingly. Reference the response to American Society of Mechanical Engineers (ASME) Section XI, Subsection IWL AMP RAI 8.1.27-3 as necessary.

b) Explain how inaccessible containment concrete exposed to environments other than air will be managed for cracking, loss of bond, and loss of material due to corrosion of embedded steel during the period of extended operation.

Callaway Response

a) LRA Table 3.5.2-1 and Table 3.5-1 item 25 have been revised as shown on Amendment 8 in Enclosure 2 to add II.A1.CP-97 as an applicable aging evaluation line for inaccessible concrete and to show that Table 3.5-1, Item 25 is consistent with NUREG-1801. See response to RAI B2.1.27-3 (refer to Ameren submittal letter ULNRC-05891 dated August 9, 2012) for discussion of inaccessible containment concrete, and see response part (b) below for discussion of opportunistic inspections.

b) LRA Table 3.5.2-1 has been revised as shown on Amendment 8 in Enclosure 2 to add III.A1.TP-212 as an applicable aging evaluation line for inaccessible below grade concrete. The Structures Monitoring program manages the aging effects of cracking, loss of bond, and loss of material due to corrosion of embedded steel for the inaccessible containment concrete and will continue to do so during the period of extended operation. As discussed in Element 4 of the Structures Monitoring program basis document, normally inaccessible structural components are examined when scheduled maintenance work and planned plant modifications permit access. Existing plant programs that could impact structures include measures to alert the assigned engineer when normally inaccessible areas are to be made accessible for walkdown and evaluation.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, “Amendment 8, LRA Changes from RAI Responses,” for a description of LRA changes with this response.

RAI 3.5.2.2.2.2-1

Background:

SRP-LR Section 3.5.2.2.2.2 recommends further evaluation for any concrete elements that exceed temperature limits of 66°C (150°F) for general areas and 93°C (200°F) for local areas. The SRP-LR also states that higher temperatures may be allowed if tests or calculations are provided to evaluate the reduction in strength and modulus of elasticity and these reductions are applied to the design calculations.

Issue:

The corresponding sections of the LRA state that an engineering evaluation was performed to ensure that the elevated temperature in the seal ring support concrete would not be detrimental to the ability of the concrete to perform its intended functions. The staff reviewed the FSAR-SP, specifically Section 3.8.3.4.2, and did not find any discussion of an engineering evaluation that accounted for possible reductions in concrete strength or modulus of elasticity due to elevated temperatures.

Request:

Provide a discussion of the engineering evaluation that was conducted to demonstrate that the concrete would be able to perform its intended functions while being exposed to temperatures above the GALL Report recommended limits. Include any reductions in strength or modulus of elasticity that were applied to the design calculations.

Callaway Response

An engineering calculation was performed to address the effects of elevated temperature on the seal ring support concrete. This calculation shows, based on industry research, that a temperature of 300°F can reduce the compressive strength of the concrete support to 2400 psi, which is 60% of the original design strength. Using this reduced strength to calculate new allowable stresses for compression and shear, and comparing these allowables to the maximum stresses under design basis loading, the calculation concludes that the concrete is acceptable and meets the applicable design codes. Therefore, the concrete is still capable of performing its intended function.

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 3.5.1.90-1

Background:

Item III.B1.1.TP-10 in the GALL Report recommends that steel and stainless steel support members exposed to treated water (< 60°C) should be managed for loss of material due to general (steel only), pitting, and crevice corrosion. This item rolls-up to Table 3.5-1, ID 90 in the SRP-LR, which indicates the item applies to both PWR and BWRs and recommends the Water Chemistry program to manage this aging effect for BWRs, and the ASME Section XI, Subsection IWF program to manage this aging effect for both reactor designs.

Issue:

LRA Table 3.5.1, item 3.5.1.090 states that this item only applies to BWRs and is not applicable; no further explanation is provided.

Request:

State whether there are any steel or stainless steel ASME Class 1 support members exposed to treated water (< 60°C), or treated borated water (< 60°C), and if there are, propose how they will be managed for loss of material.

Callaway Response

LRA Table 3.5-1 has been revised as shown on Amendment 8 in Enclosure 2 to state that Item 90 is not applicable because Callaway has no steel or stainless steel ASME Class 1 support members submerged in treated water, so the applicable NUREG-1801 lines were not used.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, “Amendment 8, LRA Changes from RAI Responses,” for a description of LRA changes with this response.

RAI 4.7.2-1

Background:

LRA Section 4.7.2 indicates that for the cold leg elbow-to-safe-end weld flaw indications, a fatigue crack growth analysis was performed. The LRA describes that the design numbers of transients assumed to occur over the plant life are consistent with those of FSAR Table 3.9(N)-1 SP. The TLAA is dis positioned in accordance with 10 CFR 54.21 (c)(1)(i) which states that the analyses are valid through the period of extended operation.

Issue:

LRA Section 4.7.2 did not specifically identify the transients that were used in the fatigue crack growth analysis. Therefore, the staff cannot verify the adequacy of the disposition of the TLAA in accordance with 10 CFR 54.21 (c)(1)(i).

Request:

Identify all the transients and associated number of cycles that were used in the fatigue crack growth analysis and confirm that these transients are included in LRA Table 4.3-1.

Callaway Response

Table 1 (refer to Pages 24 and 25 of this enclosure) identifies all transients and associated number of cycles used in the fatigue crack growth analysis of the cold leg elbow-to-safe-end weld flaw indications. All transients are included in LRA Table 4.3-2.

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 4.7.2-2

Background:

LRA Section 4.7.2 indicates that for the cold leg elbow-to-safe-end weld flaw indications, a fracture mechanics analysis was performed. The LRA describes that continued operation with a crack is acceptable with respect to unstable ductile tearing mechanism if the applied J-integral remains below the plastic-elastic fracture toughness, $J_{1C.}$ The LRA also states that "[t]he gas tungsten arc welds are subject to thermal aging, but the effects are considered negligible." The LRA indicates that the elbow is statically cast stainless steel (SA-351, CF8A). The LRA concluded that the "fracture mechanics analysis does not consider aging effects and is not a TLAA' by 10 CFR 54.3(a), Criterion 2."

Issue:

LRA Section 4.7.2 did not justify why the gas tungsten arc welds are subject to thermal aging but the effect is considered negligible. The applicant also has not indicated whether the statically cast stainless steel elbow is susceptible to thermal aging and has not justified why such fracture mechanics analysis is not a TLAA by 10 CFR 54.3.

Request:

a) Justify why the effect of thermal aging on the welds is considered negligible.

b) Discuss whether the elbow material is susceptible to thermal aging and justify why the fracture mechanics analysis did not consider thermal aging

Callaway Response

a) The methodology considers two possible modes of failure, plastic collapse and unstable ductile tearing. Plastic collapse is the dominant mode of failure unless the applied J-integral exceeds the J_{1C} fracture toughness. This is only expected for submerged arc and shielded metal arc welds, which were not used in the Callaway cold leg elbow-to-safe-end weld. Because of the high fracture toughness properties for GTAW welds, and per ASME Code Section XI, Appendix C, Paragraph C-4210, GTAW welds only need to consider plastic collapse. Plastic collapse is prevented by satisfying the IWB-3640 requirements, which include a fatigue crack growth analysis. The changes in the fracture toughness properties (J_{1C} and tearing modulus) from thermal aging do not affect the IWB-3640 fatigue crack growth analysis. Since thermal aging will not affect the analysis of the dominant failure mode, thermal aging is neglected.

b) The elbow is cast austenitic stainless steel, but is not susceptible to thermal aging as described in LRA Section 3.1.2.2.6.2. The molybdenum (<0.5%) and ferrite (<20%) content of these fittings and piping pieces are below the industry accepted thermal aging significance threshold from NEI 95-10 (ADAMS Access No. ML051860406), Appendix C, Reference 13, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components."

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 4.7.2-3

Background:

LRA Section 4.7.2 indicates that the pressurizer nozzle structural weld overlays (SWOLs), performed in 2007, depend on 40-year fatigue crack growth analyses which will remain valid until 2047 as long as the assumed numbers of cycles are not exceeded. The applicant stated that the projected transient accumulations in LRA Table 4.3-2 shows that the numbers of transient cycles are expected to remain within the assumed numbers and therefore the analyses are valid through the period of extended operation. The TLAAs are dispositioned in accordance with 10 CFR 54.21 (c)(1)(i).

Issue:

The applicant has not provided the list of transients and associated limits for each of the transients for the fatigue crack growth analyses. The staff noted that the baseline number of occurrences for each transient in LRA Table 4.3-2 is from 1983 to January 2011 and the applicant has not explained why the occurrences between 1983 to January 2011 is a conservative representation of the number of occurrences between 2007 to January 2011. Alternatively, the applicant has not identified the baseline number of occurrences for each transient from 2007 to January 2011 and provided the projected occurrences for each transient from January 2011 to 2043, which is the end of the period of extended operation. Without this information, the staff cannot verify the TLAAs disposition, in accordance with 10 CFR 54.21 (c)(1)(i), that fatigue crack growth analyses would remain valid for the period of extended operation.

Request:

a) Identify all the transients and associated number of cycles that were used in the fatigue crack growth analyses and confirm that these transients are included in LRA Table 4.3-1.

b) Identify the baseline number of occurrences for each transient from 2007 to January 2011. In addition, provide and justify the projected occurrences for each transient from January 2011 to 2043 to support the TLAAs disposition, in accordance with 10 CFR 54.21 (c)(1)(i). Alternatively, justify that the number of occurrences between 1983 to January 2011 is a conservative representation of the number of occurrences between 2007 to January 2011.

Callaway Response

a) Table 1, “Transients Used in the Fatigue Crack Growth Analyses,” (refer to pages 24 and 25 of this enclosure) identifies all the transients and associated number of cycles used in the fatigue crack growth analyses supporting the Callaway pressurizer structural weld overlay repairs. All the transients are included in LRA Table 4.3-2.

b) Table 1 (refer to pages 24 and 25 of this enclosure) provides the baseline and projected numbers for all transients included in the fatigue crack growth analyses supporting the Callaway pressurizer structural weld overlay repairs. The transients will not exceed the design numbers; therefore, the analyses will remain valid through the period of extended operation and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(i). This conclusion will be verified by counting the transients using the Fatigue Management program (B3.1). The requested period of extended operation is October 2024 through October 2044.

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 4.7.7-1

Background:

LRA Section 4.7.7 indicates that for the accumulator (ACC) and residual heat removal (RHR) lines, a fatigue crack growth assessment was performed. The LRA describes that normal operating and upset thermal transients were selected from the design specification and system design criteria. The TLAA is dispositioned in accordance with 10 CFR 54.21(c)(1)(i) which states that the analyses are valid through the period of extended operation.

Issue:

LRA Section 4.7.7 did not specifically identify the selected transients that were used for the fatigue crack growth analyses; therefore, the staff cannot verify the adequacy of the disposition of the TLAA in accordance with 10 CFR 54.21 (c)(1)(i).

Request:

Identify all the transients and associated number of cycles that were used in the fatigue crack growth analyses for the ACC and RHR lines and confirm that these transients are included in LRA Table 4.3-1.

Callaway Response

Table 1 (refer to pages 26 and 27 of this enclosure) identifies all transients and associated number of cycles used in the Leak Before Break fatigue crack growth analyses for the Accumulator lines and Residual Heat Removal lines. All transients are included in LRA Table 4.3-2. The transients will not exceed the design numbers; therefore, the analyses will remain valid through the period of extended operation and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(i). This conclusion will be verified by counting the transients using the Fatigue Management program (B3.1).

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 4.7.7-2

Background:

LRA Section 4.7.7 indicates that the reactor coolant loop (RCL) leak-before-break (LBB) analysis included a fracture mechanics analysis, which accounts for reduction in fracture toughness of the cast austenitic stainless steel (CASS) in the primary loops from thermal aging. The LRA also indicates that the fracture mechanics analysis in support of the LBB submittal was performed for a reference material with fully-aged fracture toughness material properties. Since the fracture toughness material properties used in the analysis are not time-dependent, this analysis is not a TLAA by 10 CFR 54.3(a), criterion 3.

Issue:

The applicant has not indicated whether the RCL piping are susceptible to thermal aging and the applicant has not justified why such fracture mechanics analysis, performed for a reference material with fully-aged fracture toughness material properties, is not a TLAA by 10 CFR 54.3. The staff noted that the fracture toughness property of the CASS material may not be time dependent because the analysis assumed a lower-bound fracture toughness that bounded the fracture toughness of the CASS material under assumed saturated thermal aging conditions. However, the staff also noted that the applicant's basis may be predicated on thermal aging data that are not up to date or conservative when compared to the most recent data for the industry. Based on the information provided in the LRA, the staff could not determine whether the assumption, that the lower bound of J_{1C} fracture toughness that bounds the saturated fracture toughness of the applicant's materials, remains valid. The staff's concern is that the applicant's basis may be predicated on Charpy or thermal aging data that are not up-to-date or conservative when compared to the most recent data for the state of the industry.

Request:

a) Discuss whether the RCL piping material is susceptible to thermal aging and justify why the fracture toughness material properties used in the LBB analysis are not time-dependent.

b) If the justification for Part (a) involves assumption of referenced fracture toughness values, justify that the thermal aging data used are up-to-date or conservative when compared to the most recent data for the state of the industry.

Callaway Response

a) The reactor coolant loop (RCL) piping material and elbow fittings are both SA351 Grade CF8A cast stainless steel, which at PWR operating temperatures can be subject to thermal aging. The molybdenum (<0.5%) and ferrite (<20%) content of these fittings and piping pieces are below the industry accepted thermal aging significance threshold from NEI 95-10 (ADAMS Access No. ML051860406), Appendix C, Reference 13, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components." Also, previous inspections of weld regions adjacent to the CASS fittings have not revealed any indications of damage. Therefore, thermal aging of Callaway's cast austenitic stainless steel reactor coolant loop piping and fittings is not a concern as described in LRA Section 3.1.2.2.6.2.

   Although Callaway determined that the RCL was not susceptible to thermal aging, the fracture mechanics calculation does consider aging of the material property; however the aging is not based on the plant life. The aging is based on the minimum material properties

possible and the fracture toughness material properties used by the calculation are the same whether the plant life is 40 years or 60 years. Therefore, the fracture mechanics calculation is not a TLAA by 10 CFR 54.3(a), Criterion 3.

b) The RCL leak-before-break facture mechanics analysis for Callaway is performed with the fracture toughness properties (J_{1C} , T_{mat} and J_{max}) from a reference material. The values were shown to bound the fully-aged fracture toughness properties of the Callaway reactor coolant pressure boundary cast stainless steel by comparing the Callaway fracture toughness properties and chemistry data from the certified material test reports (CMTRs) to that of the reference material.

   The fracture toughness values for J_{1C} and T_{mat} were compared to the most recent data for the state of the industry and found to be conservative. The gas tungsten arc welds (GTAW) prepared with Types 308 stainless steel filler material were compared against the results of NUREG/CR–6428, "Effects of Thermal Aging on Fracture Toughness and Charpy–Impact Strength of Stainless Steel Pipe Welds." The SA-351 Grade CF8A base metal was compared against the results of NUREG/CR-4513, "Estimation of Fracture Toughness of Cast Stainless Steels During Thermal Aging in LWR Systems." The straight pipe segments are centrifugal castings and the elbows static castings; therefore the material was conservatively assumed to be static-cast CF-8 steel with ferrite content greater than 15%. J_{max} defines the range of applicability of the data used and is not affect by the updated data.

Corresponding Amendment Changes

No changes to the License Renewal Application (LRA) are needed as a result of this response.

RAI 4.7.2-1 and RAI 4.7.2-3

Table 1

Transients Used in the Fatigue Crack Growth Analyses

Transient Description (Trans. # corresponds to the # in LRA Table 4.3-2	**RAI 4.7.2-1: RV Inlet Nozzle Flaw**	**RAI 4.7.2-3: SWOL Repairs**			**From LRA Table 4.3-2**		
		Spray Nozzle	**Safety/Relief Nozzles**	**Surge Nozzle**	**Limiting Value**	**Baseline**	**Projection**
Normal							
1a. Plant heatup at 100ºF/hr Pressurizer Heatup at 100°F/hr	200	200	200	200	200	29	65
1b. Plant cooldown at 100ºF/hr Pressurizer Cooldown at 200°F/hr		200	200	200	200	29	65
2a. Unit loading at 5% of full power per min	13,200	18,300	13,200	13,200	11,200	178	251
2b. Unit unloading at 5% of full power per min		18,300	13,200	13,200	13,200	184	276
3a. Step increase 10% of full power	2,000	2,000	-	2,000	2,000	24	61
3b. Step decrease 10% of full power		2,000	-	2,000	2,000	20	48
4. Large step decrease with steam dump	200	200	6,350	200	200	6	13
5a. Steady state fluctuations, Initial fluctuations	1.5E5	3.15E6	-	-	1E6	Transient does not result in the accumulation of fatigue usage.	
5b. Steady state fluctuations, Random fluctuations	3.00E6						
6. Feedwater cycling at hot shutdown (SG A / B / C / D)	2,000	2,000	-	4,000	2,000	134 / 132 / 134 / 134	186 / 175 / 183 / 180
7a. Loop out of service, Normal loop shutdown	-	80	-	-	80	0	0
7b. Loop out of service, Normal loop startup	-	70	-	-	70	0	0
9. Boron concentration equalization	26,400	26,400	-	-	26,400	This is a load following transient, so the design number will not be approached in 60 yrs.	
12. Refueling	80	-	-	-	80	17	39
13. Turbine roll test	20	20	-	20	10	7	7
14. Primary side leak test	200	200	200	200	50	8	10
15. Secondary side leak test	-	200	80	80	80	1	4

Transient Description (Trans. # corresponds to the # in LRA Table 4.3-2	RAI 4.7.2-1: RV Inlet Nozzle Flaw	RAI 4.7.2-3: SWOL Repairs			From LRA Table 4.3-2		
		Spray Nozzle	Safety/Relief Nozzles	Surge Nozzle	Limiting Value	Baseline	Projection
Upset							
1. Loss of load (without immediate reactor trip)	80	80	6,130	80	80	0	1
2. Loss of Power (with natural circulation in the RCS)	40	40	2,050	40	40	1	1
3. Partial loss of flow (loss of one pump)	80	80	80	80	80	0	1
4a. Reactor trip from full power, Without cooldown.	230	230	-	230	230	66	92
4b. Reactor trip from full power, With cooldown, without safety injection	160	160	-	160	160	0	1
4c. Reactor trip from full power, With cooldown, with safety injection	10	10	-	10	10	0	1
5. Inadvertent RCS depressurization	20	-	-	20	20	2	5
5a. Inadvertent RCS depressurization due to inadvertent auxiliary spray	-	10	570	-	10	0	1
6. Inadvertent startup of an inactive RCS loop	-	10	-	10	10	0	1
7. Control rod drop	80	80	-	80	80	0	1
8. Inadvertent safety injection actuation	60	80	-	60	60	2	2
9. Operating Basis Earthquake (20 earthquakes of 10 cycles each)	-	400 cycles	400 cycles	400 cycles	20 events	0 events	1 event
10. Excessive Feedwater Flow	30	-	-	30	30	0	1
Test							
1. Primary side hydrostatic test	10	10	-	10	5	1	1
Auxiliary							
26. Zero Load	-	200	-	-	200	29*	65*

* Value set equal to the number of cooldowns.

RAI 4.7.7-1

Table 1

Transient Description (Tran. # corresponds to the # in LRA Table 4.3-2.	**Accumulator Lines**	**Residual Heat Removal Lines**	**LRA Table 4.3-2**		
			Limiting Value	**Baseline**	**Projection**
Normal					
2a. Unit loading at 5% of full power per min	13,200	13,200	11,200	178	251
2b. Unit unloading at 5% of full power per min	13,200	13,200	13,200	184	276
3a. Step increase 10% of full power	2,000	2,000	2,000	24	61
3b. Step decrease 10% of full power	2,000	2,000	2,000	20	48
4. Large step decrease with steam dump	-	200	200	6	13
5a. Steady state fluctuations, Initial fluctuations	3.2E6	3.2E6	1E6	Transient does not result in the accumulation of fatigue usage.	
5b. Steady state fluctuations, Random fluctuations					
6. Feedwater cycling at hot shutdown (SG A / B / C / D)	2,000	2,000	2,000	134 / 132 / 134 / 134	186 / 175 / 183 / 180
8a. Unit loading between 0-15% of full power	-	500	500	93	176
8b. Unit unloading between 0-15% of full power	-	500	500	92	175
12. Refueling	80	-	80	17	39
13. Turbine roll test	20	20	10	7	7
Upset					
1. Loss of load (without immediate reactor trip)	-	80	80	0	1
2. Loss of Power (with natural circulation in the RCS)	-	40	40	1	1
3. Partial loss of flow (loss of one pump)	-	160*	80	0	1
4a. Reactor trip from full power, without cooldown.	-	230	230	66	92

Transient Description (Tran. # corresponds to the # in LRA Table 4.3-2.	**Accumulator Lines**	**Residual Heat Removal Lines**	**LRA Table 4.3-2**		
			Limiting Value	**Baseline**	**Projection**
4b. Reactor trip from full power, with cooldown, without safety injection	160	160	160	0	1
4c. Reactor trip from full power, with cooldown, with safety injection	-	10	10	0	1
5. Inadvertent RCS depressurization	20	20	20	2	5
7. Control rod drop	80	80	80	0	1
8. Inadvertent safety injection actuation	-	60	60	2	2
Auxiliary Trans					
11. Accumulator actuation, accident operation	21	-	21	0	1
12. Inadvertent accumulator blowdown	4	-	4	0	1
13. RHR operation - plant cooldown	200	-	200	29	62
14. High head safety injection (Loop A / B / C / D)	110	-	110	3 / 0 / 0 / 0	4 / 1 / 1 / 1

* 80 cycles from dead loop and 80 cycles from active loop

Amendment 8, LRA Changes from RAI Responses

Enclosure 2 Summary Table

Affected LRA Section	LRA Page
Section 3.2.2.2.4	3.2-9
Table 3.2-1	3.2-13
Table 3.2.2-5	3.2-56 and 3.2-66
Table 3.3.2-23	3.3-241
Table 3.3.2-28	3.3-272
Table 3.4.2-5	3.4-51, 3.4-60
Table 3.5-1	3.5-34
Table 3.5-1	3.5-51
Table 3.5.2-1	3.5-56
Appendix A, Section A1	A-2
Table A4-1, item 2	A-36 and A-37
Appendix B, Section B1.4	B-4 and B-5

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LRA Section 3.2.2.2.4 was revised. This LRA Section is for loss of material due to erosion of the orifices in the centrifugal HPSI pump miniflow recirculation lines. This aging effect is not applicable to Callaway because the HPSI pumps are infrequently operated.

LRA Section 3.2.2.2.4, Loss of Material due to Erosion (page 3.2-9) is revised as follows (deleted text shown in strikethrough and new text underlined):

3.2.2.2.4 Loss of Material due to Erosion

~~Loss of material due to erosion could occur in the stainless steel high pressure coolant injection (HPCI) pump miniflow recirculation orifice exposed to treated borated water. The plant-specific aging management programs used to manage the aging include Water Chemistry program (B2.1.2) and One-Time Inspection program (B2.1.18).~~

Not applicable. The centrifugal HPSI pumps at Callaway are not used for normal charging and are operated infrequently. Therefore, erosion is not an aging effect for the miniflow recirculation orifices.

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Changed the Discussion column of Table 3.2-1, item number 3.2.1.005, to indicate that loss of material due to erosion is not an applicable aging effect for the stainless steel orifices in the centrifugal HPSI pump miniflow recirculation lines because the pumps are operated infrequently.

Table 3.2-1, Summary of Aging Management Programs in Chapter V of NUREG-1801 for Engineered Safety Features (page 3.2-13) is revised as follows (deleted text shown in strikethrough and new text underlined):

Table 3.2-1 Summary of Aging Management Programs in Chapter V of NUREG-1801 for Engineered Safety Features

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.2.1.005	Stainless steel Orifice (miniflow recirculation) exposed to Treated water (borated)	Loss of material due to erosion	A plant-specific aging management program is to be evaluated for erosion of the orifice due to extended use of the centrifugal HPSI pump for normal charging. See LER 50-275/94-023 for evidence of erosion.	Yes, plant-specific	~~Consistent with NUREG-1801. The plant-specific aging management program(s) used to manage the aging include: Water Chemistry (B2.1.2) and One-Time Inspection (B2.1.18).~~ Not applicable. The centrifugal HPSI pumps at Callaway are not used for normal charging and are operated infrequently. Therefore, erosion is not an aging effect for the miniflow recirculation orifices. See further evaluation in Section 3.2.2.2.4.

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Deleted the line referring to NUREG-1801 item V.D1.E-24. This item is for loss of material due to erosion of the orifices in the centrifugal HPSI pump miniflow recirculation lines. This aging effect is not applicable to Callaway because the HPSI pumps are infrequently operated. No new Plant Notes are added.

Table 3.2.2-5, High Pressure Coolant Injection (pages 3.2-56 and 3.2-66) are revised as follows (deleted text shown in strikethrough):

Table 3.2.2-5 Engineered Safety Features – Summary of Aging Management Evaluation – High Pressure Coolant Injection System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
~~Flow Orifice~~	~~PB, TH~~	~~Stainless Steel~~	~~Treated Borated Water (Int)~~	~~Loss of material~~	~~Water Chemistry (B2.1.2) and One-Time Inspection (B2.1.18)~~	~~V.D1.E-24~~	~~3.2.1.005~~	~~E, 3~~

Plant Specific Notes:

1 The One-Time Inspection program (B2.1.18) is used to verify the effectiveness of the Water Chemistry program (B2.1.2) to manage these aging effects.

2 The bottom of this tank rests on a concrete foundation. Therefore, the Aboveground Metallic Tanks program (B2.1.15) is credited.

~~3 The plant-specific aging management programs used to manage loss of material due to erosion in the miniflow orifices are Water Chemistry (B2.1.2) and One-Time Inspection (B2.1.18).~~

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Revise to add aging effect of "Loss of material" to elastomeric flexible hoses and expansion joints with an external environment of Plant Indoor Air within the scope of license renewal. Table 3.4.2-5 only is being revised to include the aging effect of "Hardening and loss of strength" for elastomeric flexible hoses with an internal environment of condensation and to delete the aging effect of "Loss of material" for elastomeric flexible hoses with an internal environment of condensation.

Table 3.3.2-23 (page 3.3-241) is revised as follows (new text underlined):

Table 3.3.2-23 Auxiliary Systems – Summary of Aging Management Evaluation –EOF and TSC Diesels, Security Building System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Expansion Joint	PB	Elastomer	Plant Indoor Air (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.F4.AP-113	3.3.1.082	A
Flexible Hoses	PB	Elastomer	Plant Indoor Air (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.F4.AP-113	3.3.1.082	A

Table 3.3.2-28 (page 3.3-272) is revised as follows (new text underlined):

Table 3.3.2-28 Auxiliary Systems – Summary of Aging Management Evaluation –Miscellaneous Systems in scope ONLY for Criterion 10 CFR 54.4(a)(2)

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Flexible Hoses	LBS	Elastomer	Plant Indoor Air (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.F4.AP-113	3.3.1.082	A

Table 3.4.2-5 (pages 3.4-51 and 3.4-60) is revised as follows (new text underlined and deleted text shown in strikethrough):

Table 3.4.2-5 Steam and Power Conversion System – Summary of Aging Management Evaluation – Auxiliary Feedwater System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
~~Flexible Hoses~~	~~LBS~~	~~Elastomer~~	~~Condensation (Int)~~	~~Loss of material~~	~~Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)~~	~~VII.F2.AP-103~~	~~3.3.1.096~~	~~B~~
Flexible Hoses	LBS	Elastomer	Condensation (Int)	Hardening and loss of strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)	None	None	G
Flexible Hoses	LBS	Elastomer	Plant Indoor Air (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.F2.AP-113	3.3.1.082	A

Notes for Table 3.4.2-5:
Standard Notes:

A Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.

B Consistent with NUREG-1801 item for component, material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP.

C Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP is consistent with NUREG-1801 AMP.

D Component is different, but consistent with NUREG-1801 item for material, environment, and aging effect. AMP takes some exceptions to NUREG-1801 AMP

G Environment not in NUREG-1801 for this component and material.

J Neither the component nor the material and environment combination is evaluated in NUREG-1801.

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Revision to Table 3.5-1 to show item 25 is consistent with NUREG-1801.

Table 3.5-1 (page 3.5-34) is revised as follows (deleted text shown in strikethrough and new text is shown underlined):

Table 3.5-1 Summary of Aging Management Programs in Chapters II and III of NUREG-1801 for Containments, Structures, and Component Supports (Continued)

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1.025	Concrete (inaccessible areas): dome; wall; basemat; ring girders; buttresses; reinforcing steel	Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	ASME Section XI, Subsection IWL (B2.1.27) or Structures Monitoring (B2.1.31)	No	Consistent with NUREG-1801.~~Not applicable. Callaway has no inaccessible concrete dome, wall, basemat, ring girders, buttresses, or reinforcing steel exposed to an environment of air-indoor or air-outdoor, so the applicable NUREG-1801 lines were not used.~~

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Revision to Table 3.5-1 to show item 90 is Not applicable because Callaway has no steel or stainless steel ASME Class 1 support members submerged in treated water.

Table 3.5-1 (page 3.5-51) is revised as follows (deleted text shown in strikethrough and new text is shown underlined):

Table 3.5-1 Summary of Aging Management Programs in Chapters II and III of NUREG-1801 for Containments, Structures, and Component Supports (Continued)

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.5.1.090	Support members; welds; bolted connections; support anchorage to building structure	Loss of material due to general (steel only), pitting, and crevice corrosion	Water Chemistry (B2.1.2), for BWR water and ASME Section XI, Subsection IWF (B2.1.28)	No	Not applicable - ~~BWR only~~ Callaway has no steel or stainless steel ASME Class 1 support members submerged in treated water, so the applicable NUREG-1801 lines were not used.

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Revision to Table 3.5.2-1 to add AMR lines for evaluation of inaccessible containment concrete.

Table 3.5.2-1 (page 3.5-56) is revised as follows (new text is shown underlined):

Table 3.5.2-1 Containments, Structures, and Component Supports – Summary of Aging Management Evaluation - Reactor Building

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Concrete Elements	FB, MB, SH, SLD, SS	Concrete	Atmosphere/ Weather (Structural) (Ext)	Cracking; loss of bond; and loss of material (spalling, scaling)	Structures Monitoring (B2.1.31)	II.A1.CP-97	3.5.1.025	A
Concrete Elements	FLB, SH, SLD, SPB, SS	Concrete	Buried (Structural) (Ext)	Cracking; loss of bond; and loss of material (spalling, scaling)	Structures Monitoring (B2.1.31)	III.A1.TP-212	3.5.1.065	A

A1 SUMMARY DESCRIPTIONS OF AGING MANAGEMENT PROGRAMS

The integrated plant assessment and evaluation of time-limited aging analyses (TLAA) identified existing and new aging management programs necessary to provide reasonable assurance that components within the scope of license renewal will continue to perform their intended functions consistent with the current licensing basis (CLB) for the period of extended operation. Sections A1 and A2 describe the programs and their implementation activities.

Quality Assurance for Aging Management Programs

Three elements common to all aging management programs discussed in Sections A1 and A2 are corrective actions, confirmation process, and administrative controls. These elements are included in the Callaway Plant QA Program, which implements the requirements of 10 CFR 50, Appendix B. The Callaway Plant QA Program is applicable to safety-related systems, structures and components that are subject to aging management review activities for license renewal. These three elements will also be applied to the nonsafety-related systems, structures and components subject to aging management activities after enhancement to existing Callaway procedures.

Consideration of Operating Experience in Aging Management Programs (AMPs)

Operating Experience from plant-specific and industry sources is captured and systematically reviewed on an on-going basis in accordance with the quality assurance program which meets the requirements of 10 CFR Part 50, Appendix B and the operating experience program, which meets the requirements of NUREG-0737, "Clarification of TMI Action Plan Requirements," Item I.C.5, "Procedures for Feedback of Operating Experience to Plant Staff." The operating experience program interfaces with and relies on active participation in the Institute of Nuclear Power Operations' operating experience program, as endorsed by the NRC. In accordance with these programs, all incoming operating experience items are screened to determine whether they may involve age-related degradation or aging management impacts. Items so identified are further evaluated and applicable AMPs may be enhanced or new AMPs may be developed, as appropriate, if it is determined that the effects of aging may not be adequately managed. Training on age-related degradation and aging management is provided to those personnel responsible for implementing the AMPs and who are likely to submit, screen, assign, evaluate, or otherwise process plant-specific and industry operating experience. Plant-specific operating experience associated with aging management and age-related degradation is reported to the industry in accordance with guidelines established in the operating experience program.

Table A4-1 License Renewal Commitments (Continued)

Item #	Commitment	LRA Section	Implementation Schedule
2	Upon receipt of the renewed operating license, the station operating experience review process and Corrective Action Program will perform reviews of plant-specific and industry operating experience to confirm the effectiveness of the license renewal aging management programs, to determine the need for aging management programs to be enhanced, or indicate the need to develop a new aging management program. Industry and plant-specific operating experience will be evaluated during the development and implementation of new aging management programs. In order to provide additional assurance that internal and external operating experience related to aging management continues to be used effectively in the aging management programs, Callaway will enhance its operating experience program to: • Explicitly require the review of operating experience for age-related degradation. • Establish criteria to define age-related degradation. In general, the criteria will be used to identify aging that is considered excessive relative to design, previous inspection experience, and inspection intervals. • Establish coding for use in identification, trending and communications of age-related degradation. This coding will assist plant personnel in ensuring that, in addition to addressing the specific issue, the adequacy of existing aging management programs is assessed. This could lead to AMP revisions or the establishment of new AMPs, as appropriate.	B1.4	Upon receipt of the renewed operating license

Table A4-1 License Renewal Commitments (Continued)

Item #	Commitment	LRA Section	Implementation Schedule
	• Require communication of significant internal age-related degradation, associated with SSCs in the scope of license renewal, to the industry. Criteria will be established for determining when aging-related degradation is significant. • Require review of external operating experience for information related to aging management, and evaluation of such information for potential improvements to Callaway aging management activities. License Renewal Interim Staff Guidance (LR-ISG) documents will be reviewed as part of this external operating experience information as they are issued on an ongoing basis, capturing new insights or addressing issues that emerge from license renewal reviews. Other guidance documents such as NUREG-1801 revisions may not be explicitly considered unless communicated in the form of one of the NRC generic communications. • Provide training to those responsible for screening, evaluating, and communicating operating experience items related to aging-related degradation. This training will be commensurate with their role in the process.		

B1.4 OPERATING EXPERIENCE

Operating experience is used at Callaway to enhance plant programs, prevent repeat events, and prevent events that have occurred at other plants from occurring at Callaway. The operating experience process screens, evaluates, and acts on operating experience documents and information ~~External nuclear industry operating experience is screened, evaluated, and acted on~~ to prevent or mitigate the consequences of similar events. The operating experience process reviews operating experience from external (also referred to as industry operating experience) and internal (also referred to as plant-specific operating experience) sources. External operating experience ~~may~~ includes INPO documents, NRC generic communications (e.g., NRC Generic Letters, Bulletins, Information Notices, Regulatory Issue Summaries), and other documents (e.g., 10 CFR 21 Reports, Licensee Event Reports). Internal operating experience ~~may~~ includes event investigations, trending reports, lessons learned from in-house events, self-assessments, and the 10 CFR 50, Appendix B, corrective action process.

Each aging management program summary in this appendix contains a discussion of operating experience relevant to the program. This information was obtained through the review of in-house operating experience in the Corrective Action Program and the review of industry operating experience. Plant-specific operating experience was obtained by a review of the Callaway corrective action program records for the period January 1999 through June 2011 and applicable industry operating experience was reviewed based on plant responses to specific NRC Generic Letters, Generic Safety Issues, Information Circulars, IE Bulletins, Information Notices, and Regulatory ~~Information~~Issue Summaries. This population of industry experience was supported by plant documentation available since the beginning of the project and includes the operating experience associated to the NUREG-1801, Revision 2 (January 2004 to approximately April 2009). These reviews ensured that there was no unique, plant-specific operating experience in addition to that provided in NUREG-1801. This review was augmented with information from the Callaway staff.

The applicable operating experience for each aging management program was reviewed and summarized in the Appendix B program summaries. Detailed records on the performance and effectiveness of each program are maintained in the Callaway records management system (including the Corrective Action Program). New programs utilized plant and/or industry operating experience as applicable, and discussed the operating experience and associated corrective actions as they relate to the implementation of the new program. The operating experience summary in each aging management program identifies past corrective actions and provides objective evidence that the effects of aging have been, and will continue to be, adequately managed so that the intended functions of

the structures and components within the scope of each program will be maintained during the period of extended operation.

Upon receipt of the renewed operating license, the station operating experience review process and Corrective Action Program will perform reviews of plant-specific and industry operating experience to confirm the effectiveness of the license renewal aging management programs, to determine the need for aging management programs to be enhanced, or indicate the need to develop a new aging management program. Industry and plant-specific operating experience will be evaluated during the development and implementation of new aging management programs. In order to provide additional assurance that internal and external operating experience related to aging management continues to be used effectively in the aging management programs, Callaway will enhance its operating experience program to:

1. Explicitly require the review of operating experience for age-related degradation.
2. Establish criteria to define age-related degradation. In general, the criteria will be used to identify aging that is considered excessive, relative to design, previous inspection experience and inspection intervals.
3. Establish coding for use in identification, trending and communications of age-related degradation. This coding will assist plant personnel in ensuring that, in addition to addressing the specific issue, the adequacy of existing aging management programs is assessed. This could lead to AMP revisions or the establishment of new AMPs, as appropriate.
4. Require communication of significant internal age-related degradation, associated with SSCs in the scope of license renewal, to the industry. Criteria will be established for determining when aging-related degradation is significant.
5. Require review of external operating experience for information related to aging management, and evaluation of such information for potential improvements to Callaway aging management activities. License Renewal Interim Staff Guidance (LR-ISG) documents will be reviewed as part of this external operating experience information as they are issued on an ongoing basis, capturing new insights or addressing issues that emerge from license renewal reviews. Other guidance documents such as NUREG-1801 revisions may not be explicitly considered unless communicated in the form of one of the above-listed NRC communications (e.g. Regulatory Issue Summaries, LR-ISG).
6. Provide training to those responsible for screening, evaluating and communicating operating experience items related to aging-related degradation. This training will be commensurate with their role in the process,