Amendment 36, LRA Changes

Enclosure 1 Summary Table

Affected LRA Section	LRA As-Submitted Page Number(s)
Table 4.3-5	4.3-30 and 4.3-31
Section 4.7.3	4.7-7 and 4.7-8
Section A1.8	A-5 and A-6
Table A4-1, item 5	A-37
Table A4-1, item 6	A-37
Section B2.1.8	B-34 through B-37
Section B2.1.10	B-41 through B-44
Section B2.1.23	B-81 through B-83

Callaway Plant
License Renewal Application
Amendment 36

Changes made to delete reactor vessel internals baffle-edge bolting which has been confirmed not to exist in the Callaway reactor vessel internals per Westinghouse.

Table 4.3-5 (Pages 4.3-30 and 4.3-31) is revised as follows (deleted text shown in strikethrough):

Table 4.3-5 Reactor Internals Design Basis Fatigue Analysis Results

Component	CUF
Lower Support Columns	0.270
Core Barrel Nozzle	0.762
Lower Core Plate Assembly Perforated Region	0.0744
Upper Core Plate	0.183
Lower Support Plate	0.183
Radial Key Weld	0.001
Baffle-Former Bolts	Qualified by test CUF < 1
Barrel-Former Bolts	Qualified by test CUF < 1
Guide Tubes	0.102
Upper Support Plate Assembly	0.094
~~Baffle Edge Bolts~~	~~Qualified by Test~~ ~~CUF < 1~~
Lower Core Barrel	0.351
Upper Core Barrel	0.155
Guide Cards	0.083
Guide Tube Lower Flange	0.946 (bottom flange weld) 0.009 (bottom flange)
Neutron Panel Bolts	0.978
Hold Down Spring	0.004

Callaway Plant
License Renewal Application
Amendment 36

The last paragraph of Section 4.7.3 is clarified to state that the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will perform depth measurements of the flaws, or vessel thickness readings in the area of the flaws.

Section 4.7.3 (Pages 4.7-7 and 4.7-8) is revised as follows (new text shown underlined and deleted text shown in strikethrough):

4.7.3 Corrosion Analysis of the Reactor Vessel Cladding Indications

FSAR Section 5.2.3.2.2 SP identifies two areas where the reactor pressure vessel low-alloy steel has been left exposed to the reactor coolant. The first area is 1.5 in. x 0.75 in. and is located between penetrations #54 and 58 and approximately 6 inches above the penetrations. The second area is 0.53 in. x 0.3 in. and is located approximately 4 in. above penetration #51. The existence of these areas has been evaluated as acceptable.

The first area was identified during Refuel 13 (Spring 2004) while performing bottom mounted instrumentation inspections inside the reactor pressure vessel, when a small rust colored mark was identified on the lower reactor vessel wall. The rust stain is indicative of exposed low-alloy steel. These findings support the characterization of this indication as an area where the cladding is missing. This indication was determined to be acceptable with IWB-3510.1(d) that indicates cladding damage is not detrimental, and calculation BB-183 that showed any metal loss due to corrosion would be minimal.

The second area was identified during Refuel 15 (Spring 2007). The flaw was characterized as the same type of flaw identified during Refuel 13 and the analysis, calculation BB-183 (Reference 11), was updated to include both flaws within the scope of its structural integrity evaluation.

The evaluation demonstrated that the ASME Code criteria will continue to be met relative to the corrosion exposure vessel minimum wall thickness. The corrosion evaluation projected future corrosion losses on the as-found condition of the reactor vessel and concluded that adequate margin above design minimum wall thickness will continue to exist over the life of the plant. Design minimum wall thickness will not be approached even when considering the metal would experience 0.119 in. of corrosion. The evaluation considered a plant life of 40 years, which includes 20 years under the current license plus 20 years for plant life extension. The amount of corrosion was calculated assuming a corrosion rate of 0.001 in/yr for normal operating conditions; an outage corrosion rate of 0.015 in./yr with the average outage duration of less than 8 weeks every 18 months; and a 2-week startup period after each outage with a corrosion rate of 0.010 in./yr. The corrosion rates are from EPRI Technical Report, *Boric Acid Corrosion Guidebook*, Revision 1.”

The minimum required thickness of the reactor vessel, without cladding, in the area of the indications is 5.38 inches. The minimum measured thickness of the reactor vessel, including cladding, in the area of the cladding indications is 6.08 inches. The maximum average cladding thickness in the area of the cladding indications is 0.23 inches. The maximum depth of the cladding indications is 0.15 inches. The projected corrosion loss over 40 years is 0.119 inches. Subtracting from the minimum measured thickness of the reactor vessel wall the thickness of the cladding, the depth of the indication, and the projected corrosion loss over 40 years, leaves a wall thickness of 5.58 inches (6.08 inches – 0.23 inches – 0.15 inches – 0.119 inches = 5.58 inches) which is greater than the minimum required thickness of 5.38 inches.

The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program will perform depth measurements ~~Profiles~~ of the flaws, or vessel thickness readings in the area of the flaws, ~~will continue to be performed~~ concurrent with the ASME Section XI Category B-N-3 examinations. Previous inspection results are compared to the current results and reconciled to be consistent with the corrosion analysis that includes the period of extended operation. ASME Section XI Category B-N-3 examinations are performed on a 10 year frequency by the ASME Section XI Inservice Inspection, Subsection IWB, IWC, and IWD program summarized in Appendix B2.1.1 (ISI program). Periodic inspection of the reactor vessel indications and reconciliation of the results with the corrosion analysis ensures the analytical bases of the analysis are maintained; therefore, the TLAA is dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

- **Disposition: Aging Management, 10 CFR 54.21(c)(1)(iii)**

A1.8 BOLTING INTEGRITY

The Bolting Integrity program manages cracking, loss of material and loss of preload for pressure retaining bolting. The program includes periodic inspection of closure bolting for pressure-retaining components consistent with recommendations as delineated in NUREG-1339, *Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants* and EPRI NP-5769, *Degradation and Failure of Bolting in Nuclear Power Plants*, Volume 1 and 2 with the exceptions noted in NUREG-1339. The Bolting Integrity program also includes activities for preload control, material selection and control, and use of lubricants/sealants as delineated in EPRI TR-104213, *Bolted Joint Maintenance and Application Guide.*

The ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD program supplements the Bolting Integrity program by providing the requirements for inservice inspection of ASME Class 1, 2, and 3 safety-related pressure retaining bolting. The integrity of non-ASME Class 1, 2, 3 system and component bolted joints is evaluated by detection of visible leakage during maintenance or routine observation such as system walkdowns.

A sample of submerged bolting heads in raw water and waste water environments is visually inspected every four refueling outages (six years) when the pumps are dewatered. ~~or opportunistically inspect the bolting threads when the pumps~~ In addition, when submerged raw water and waste water pump casings are disassembled during maintenance activities, the bolting threads will be opportunistically inspected. A sample of submerged bolting on the fuel oil storage tank transfer pumps is visually inspected every 10 years when the pumps are disassembled during maintenance activities. The sample for submerged bolting will be 20% of the population with a maximum of 25 for each environment. The inspection of submerged bolting focuses on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions.

Safety-related and nonsafety-related structural bolting is managed by the following programs:

(a) ASME Section XI, Subsection IWE program (A1.26) provides the requirements for inspection of structural bolting.

(b) ASME Section XI, Subsection IWF program (A1.28) provides the requirements for inservice inspection of safety-related component support bolting.

(c) Structures Monitoring program (A1.31) monitors the condition of structures and structural supports that are within the scope of license renewal.

(d) RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program (A1.32) provides the requirements for inspection of water control structures associated with emergency cooling water systems.

(e) Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program (A1.12) provides the requirements for inspection of handling systems within the scope of license renewal.

Reactor pressure vessel head closure studs are managed by the Reactor Head Closure Stud Bolting program (A1.3).

Inspection activities for bolting in buried and underground applications is performed in conjunction with inspection activities for the Buried and Underground Piping and Tanks (A1.25) program due to the restricted accessibility to these locations.

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
5	Enhance the Bolting Integrity program procedures to: • reference NUREG-1339 and EPRI NP-5769 to meet the NUREG-1801 recommendations. (Completed LRA Amendment 1) • include bolting in the list of items to be inspected during walkdowns. (Completed LRA Amendment 15) • include a visual inspection of a sample of submerged bolting heads in raw water and waste water environments every four refueling outages (six years) when the pumps are dewatered. ~~or opportunistically inspect the bolting threads when the pumps~~ In addition, when submerged raw water and waste water pump casings are disassembled during maintenance activities, the bolting threads will be opportunistically inspected. A sample of submerged bolting on the fuel oil storage tank transfer pumps will be visually inspected every 10 years when the pumps are disassembled during maintenance activities. The sample for submerged bolting will be 20% of the population with a maximum of 25 for each environment. The inspection of submerged bolting will focus on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions.	B2.1.8	Completed no later than six months prior to the PEO. Inspections and testing to be completed no later than six months prior to PEO or the end of the last refueling outage prior to the PEO, whichever occurs later.

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
6	Enhance the Open-Cycle Cooling Water System program procedures to: • include polymeric material inspection requirements, parameters monitored, and acceptance criteria. Examination of polymeric materials by OCCW System program will be consistent with examinations described in the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program. • include inspection and cleaning, if necessary, of the air-side of safety-related air-to-water heat exchangers cooled by essential service water. • Prior to the period of extended operation, an inspection technique will be selected from available technologies to identify internal pipe wall degradation due to MIC for performance of a one-time inspection of a buried carbon steel piping segment that is representative of other accessible carbon steel ESW piping segments. • Procedures will be enhanced to perform periodic visual inspections on all accessible internal surface coatings of the component cooling water heat exchangers, Class IE electrical equipment air conditioners, control room air conditioners, and essential service water self-cleaning strainers. Baseline inspections will be conducted in the ten year period prior to the period of extended operation on the accessible internal surfaces coatings of the in-scope components. Coatings are inspected every six years on an alternating train basis based on no observed degradation or cracking and flaking that has been evaluated as acceptable; and the component is not subject to turbulent flow. Baseline inspections may be used to demonstrate that long-term coatings are or are not subject to turbulent flow conditions that could result in mechanical damage to the coating. Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a four year frequency. For peeling, delaminations and blisters determined to not meet the acceptance criteria and that will not be repaired or replaced, physical testing is performed where physically possible (i.e., sufficient room to conduct testing). Testing consists of destructive or nondestructive adhesion testing using ASTM International Standards endorsed in RG 1.54, “Service Level I, II, and III Protective Coatings Applied to Nuclear Plants.”	B2.1.10	Completed no later than six months prior to the PEO. Inspections and testing to be completed no later than six months prior to PEO or the end of the last refueling outage prior to the PEO, whichever occurs later.

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	Monitoring and trending of coatings is based on a review of the previous two inspections results (including repairs) with the current inspection results. The training and qualification of individuals involved in coating inspections are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard. Coating acceptance criteria are as follows: • Indications of peeling and delamination are not acceptable and the coatings are repaired or replaced. • Blisters are evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard. • Indications such as cracking, flaking, and rusting are to be evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard. • Adhesion testing results meet or exceed the degree of adhesion recommended in engineering documents specific to the coating and substrate. Inspection results not meeting the acceptance criteria will be evaluated by a qualified coatings evaluator. Corrective actions will be determined using the corrective action program.		

B2.1.8 Bolting Integrity

Program Description

The Bolting Integrity program manages cracking, loss of material and loss of preload for pressure retaining bolting. The program includes preload control, selection of bolting material, use of lubricants/sealants, and performance of periodic inspections for indication of aging effects.

The general practices that are established in this program are consistent with the recommendations, as delineated in NUREG-1339, *Resolution of Generic Safety Issue 29: Bolting Degradation or Failure in Nuclear Power Plants*, and EPRI NP-5769, *Degradation and Failure of Bolting in Nuclear Power Plants*, Volume 1 and 2 with the exception noted in NUREG-1339 for safety-related bolting. In addition to the inspection activities noted above, the Bolting Integrity program includes activities for preload control, material selection and control, and use of lubricants/sealants as delineated in EPRI TR-104213, *Bolted Joint Maintenance and Applications Guide*.

ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD program (B2.1.1) supplements the Bolting Integrity program to manage cracking, loss of preload, and loss of material by providing the requirements for inservice inspection of ASME Class 1, 2, and 3 safety-related pressure retaining bolting. Examinations are currently performed in accordance with the ASME Section XI, 1998 Edition with the 2000 Addenda, per the ISI program plan. As required by 10 CFR 50.55a(g)(4)(ii), the Callaway ISI Program is updated during each successive 120-month inspection interval to comply with the requirements of the latest edition of the Code specified twelve months before the start of the inspection interval. Callaway will use the ASME Code Edition consistent with the provisions of 10 CFR 50.55a during the period of extended operation. The extent and schedule of the inspections is in accordance with IWB-2500-1, IWC-2500-1 and IWD-2500-1 and assures that detection of leakage or fastener degradation occurs prior to loss of system or component intended functions. Bolting associated with Class 1 vessel, valve and pump flanged joints receive visual (VT-1) inspection. For other pressure retaining bolting, routine observations identify any leakage before the leakage becomes excessive.

A sample of submerged bolting heads in raw water and waste water environments is visually inspected every four refueling outages (six years) when the pumps are dewatered.~~ or opportunistically inspect the bolting threads when the pumps ~~In addition, when submerged raw water and waste water pump casings are disassembled during maintenance activities, the bolting threads will be opportunistically inspected. A sample of submerged bolting on the fuel oil storage tank transfer pumps is visually inspected every 10 years when the pumps are disassembled during maintenance activities. The sample for submerged bolting will be 20% of the population with a maximum of 25 for each environment. The inspection of submerged bolting focuses on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions.

The integrity of non-ASME Class 1, 2, 3 system and component bolted joints is evaluated by detection of visible leakage during maintenance or routine observation such as system walkdowns. Inspection activities for non-ASME Class 1, 2, or 3 bolting in a submerged environment are performed in conjunction with associated component maintenance activities.

The Corrective Action Program is used to document and manage those locations where leakage was identified during routine observations including engineering walkdowns and equipment maintenance activities. Based on the severity of the leak and the potential to impact plant operations, nuclear or industrial safety, a leak may be repaired immediately, scheduled for repair, or monitored for change. If the leak rate changes (increases, decreases or stops), the monitoring frequency is re-evaluated and may be revised.

High strength bolts (actual yield strength ≥150 ksi) are not used on pressure retaining bolted joints within the scope of the Bolting Integrity program.

Procurement controls and installation practices, defined in plant procedures, include preventive measures to ensure that only approved lubricants, sealants, and proper torque are applied.

Safety-related and nonsafety-related structural bolting is managed by the following programs:

(a) ASME Section XI, Subsection IWE program (B2.1.26) provides the requirements for inspection of structural bolting.

(b) ASME Section XI, Subsection IWF program (B2.1.28) provides the requirements for inservice inspection of safety-related component support bolting.

(c) Structures Monitoring program (B2.1.31) monitors the condition of structures and structural supports that are within the scope of license renewal.

(d) RG 1.127, Inspection of Water-Control Structures Associated with Nuclear Power Plants program (B2.1.32) provides the requirements for inspection of water control structures associated with emergency cooling water systems.

(e) Inspection of Overhead Heavy Load and Light Load (Related to Refueling) Handling Systems program (B2.1.12) provides the requirements for inspection of handling systems within the scope of license renewal.

Reactor pressure vessel head closure studs are not included in the Bolting Integrity program. The Reactor Head Closure Stud Bolting program (B2.1.3) provides the requirements for inspection of the reactor vessel head closure studs.

Inspection activities for bolting in buried and underground applications is performed in conjunction with inspection activities for the Buried and Underground Piping and Tanks (B2.1.25) program due to the restricted accessibility to these locations.

NUREG-1801 Consistency

The Bolting Integrity program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M18, *Bolting Integrity*.

Exceptions to NUREG-1801

None

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

Scope (Element 1) and Parameters Monitored or Inspected (Element 3)

Procedures will be revised to include a visual inspection of a sample of submerged bolting heads in raw water and waste water environments every four refueling outages (six years) when the pumps are dewatered. ~~or opportunistically inspect the bolting threads when the pumps~~ In addition, when submerged raw water and waste water pump casings are disassembled during maintenance activities, the bolting threads will be opportunistically inspected. A sample of submerged bolting on the fuel oil storage tank transfer pumps will be visually inspected every 10 years when the pumps are disassembled during maintenance activities. The sample for submerged bolting will be 20% of the population with a maximum of 25 for each environment. The inspection of submerged bolting will focus on the bounding or lead components most susceptible to aging due to time in service and severity of operating conditions.

Operating Experience

The following discussion of operating experience provides objective evidence that the Bolting Integrity program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation.

1. The Bolting Integrity program incorporates the applicable industry experience on bolting issues into the program. Actions taken include confirmatory testing/analysis or inspections. Also included are the addition of procedures of inspection, material procurement and verification processes.

2. A review of plant operating experience identified issues with corrosion, missing or loose bolts, inadequate thread engagement, and improper bolt applications. Identified concerns were corrected or evaluated to be accepted as-is. No generic bolting failure issues or trends have been identified. There is no documented case of cracking of pressure retaining bolting due to stress corrosion cracking.

The operating experience of the Bolting Integrity program shows that the program effectively monitors and trends the aging effects of cracking, loss of material, and loss of preload on pressure retaining bolting and takes appropriate corrective action prior to loss of intended function. Occurrences that would be identified under the Bolting Integrity program will be evaluated to ensure there is no significant impact to safe operation of the plant and corrective actions will be taken to prevent recurrence. Guidance for re-evaluation, repair, or replacement is provided for locations where aging is found. There is confidence that the continued implementation of the Bolting Integrity program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Bolting Integrity program, following enhancement, provides reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B2.1.10 Open-Cycle Cooling Water System

Program Description

The Open-Cycle Cooling Water (OCCW) System program manages loss of material, wall thinning, reduction of heat transfer, cracking, blistering, change in color, and hardening and loss of strength for those components that are exposed to the raw water environment of the essential service water (ESW) system and heat exchangers and other components in other systems serviced by the essential service water system. The program also manages loss of coating integrity on components with an internal coating.

The activities for this program are consistent with the Callaway commitments to the requirements of NRC Generic Letter 89-13, *Service Water System Problems Affecting Safety-Related Components* and provide for management of aging effects in raw water cooling systems through tests, inspections and component cleaning. System and component testing, visual inspections, nondestructive examination (i.e., ultrasonic testing and eddy current testing), and biocide and chemical treatment are conducted to ensure that aging effects are managed such that system and component intended functions and integrity are maintained.

Periodic heat transfer testing or inspection and cleaning of heat exchangers with a heat transfer intended function is performed in accordance with Callaway commitments to NRC Generic Letter 89-13 to verify heat transfer capabilities.

Routine inspections and maintenance of the OCCW System program ensure that corrosion, erosion, sediment deposition and biofouling cannot degrade the performance of safety-related systems serviced by the essential service water system.

The guidelines of NRC Generic Letter 89-13 are utilized for the surveillance and control of biofouling. Procedures provide instructions and controls for biocide injection. Periodic inspections are performed for the presence of mollusks and biocide treatments are applied as necessary.

System walkdowns are performed periodically to assess the material condition of OCCW system piping and components. Compliance with the licensing basis is ensured by review of system design basis documents as well as periodic performance of self assessments.

Visual inspections are performed on all accessible internal surface coatings of the component cooling water heat exchangers, Class IE electrical equipment air conditioners, control room air conditioners, and essential service water self-cleaning strainers. Baseline inspections will be conducted in the ten year period prior to the period of extended operation on the accessible internal surfaces coatings of the in-scope components. Coatings are inspected every six years on an alternating train basis based on no observed degradation or cracking and flaking that has been evaluated as acceptable; and the component is not subject to turbulent flow. Baseline inspections may be used to demonstrate that long-term coatings are or are not subject to turbulent flow conditions that could result in mechanical damage to the coating. Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a four year frequency. For peeling, delaminations and blisters determined to not meet the acceptance criteria and that will not be repaired or replaced, physical testing is performed where physically possible (i.e., sufficient room to conduct testing). Testing consists of destructive or nondestructive adhesion testing using ASTM International Standards endorsed in RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Plants." Monitoring and trending of coatings is based on a review of the previous two inspections results (including repairs) with the current inspection results. The training and qualification of individuals involved in coating inspections are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard.

Coating acceptance criteria are as follows:

- Indications of peeling and delamination are not acceptable and the coatings are repaired or replaced.
- Blisters are evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Indications such as cracking, flaking, and rusting are to be evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Adhesion testing results meet or exceed the degree of adhesion recommended in engineering documents specific to the coating and substrate.

Inspection results not meeting the acceptance criteria will be evaluated by a qualified coatings evaluator. Corrective actions will be determined using the corrective action program.

Examination of polymeric materials by OCCW System program will be consistent with examinations described in the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program (B2.1.23).

The external surfaces of the buried OCCW components are managed by the Buried and Underground Piping and Tanks program (B2.1.25). The aging management of closed-cycle cooling water systems is described in B2.1.11, Closed Treated Water Systems program, and is not included as part of this program.

NUREG-1801 Consistency

The Open-Cycle Cooling Water System program is an existing program that, following enhancement, will be consistent with NUREG-1801, Section XI.M20, *Open-Cycle Cooling Water System*.

Exceptions to NUREG-1801

None

Enhancements

Prior to the period of extended operation, the following enhancements will be implemented in the following program elements:

Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Acceptance Criteria (Element 6)

Procedures will be enhanced to include polymeric material inspection requirements, parameters monitored, and acceptance criteria. Examination of polymeric materials by OCCW System program will be consistent with examinations described in the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program (B2.1.23).

Procedures will be enhanced to include inspection and cleaning, if necessary, of the air-side of safety-related air-to-water heat exchangers cooled by essential service water.

Preventive Actions (Element 2), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), Monitoring and Trending (Element 5), and Acceptance Criteria (Element 6)

Procedures will be enhanced to perform periodic visual inspections on all accessible internal surface coatings of the component cooling water heat exchangers, Class 1E electrical equipment air conditioners, control room air conditioners, and essential service water self-cleaning strainers. Baseline inspections will be conducted in the ten year period prior to the period of extended operation on the accessible internal surfaces coatings of the in-scope components. Coatings are inspected every six years on an alternating train basis based on no observed degradation or cracking and flaking that has been evaluated as acceptable; and the component is not subject to turbulent flow. Baseline inspections may be used to demonstrate that long-term coatings are or are not subject to turbulent flow conditions that could result in mechanical damage to the coating. Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a four year frequency. For peeling, delaminations and blisters determined to not meet the acceptance criteria and that will not be repaired or replaced, physical testing is performed where physically possible (i.e., sufficient room to conduct testing). Testing consists of destructive or nondestructive adhesion testing using ASTM International Standards endorsed in RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Plants." Monitoring and trending of coatings is based on a review of the previous two inspections results (including repairs) with the current inspection results. The training and qualification of individuals involved in coating inspections are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard.

Coating acceptance criteria are as follows:

- Indications of peeling and delamination are not acceptable and the coatings are repaired or replaced.

- Blisters are evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Indications such as cracking, flaking, and rusting are to be evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Adhesion testing results meet or exceed the degree of adhesion recommended in engineering documents specific to the coating and substrate.

Inspection results not meeting the acceptance criteria will be evaluated by a qualified coatings evaluator. Corrective actions will be determined using the corrective action

Detection of Aging Effects (Element 4),

Prior to the period of extended operation, an inspection technique will be selected from available technologies to identify internal pipe wall degradation due to MIC for performance of a one-time inspection of a buried carbon steel piping segment that is representative of other accessible carbon steel ESW piping segments.

Operating Experience

The following discussion of operating experience provides objective evidence that the Open-Cycle Cooling Water System program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

1. In 2000, during routine maintenance, Asiatic clams were found in an RHR room cooler, blocking approximately 15 percent of the tubes. In subsequent inspections, clams were found in several service water and essential service water heat exchangers and room coolers. It was determined that the clams originated in the waste treatment clearwell, from which they were flushed into the suction of the service water pumps. The service water pumps distributed the clams to the heat exchangers and room coolers. As corrective action, procedures were strengthened to require more frequent inspections and provide for a more robust chemistry program to control the clams. Corrective action also included plant modifications, such as installing strainers on the discharge line of the service water pumps.

2. In 2001, through-wall corrosion had been observed in the RHR pump room cooler. The exact cause could not be determined but was believed to be from microbiologically influenced corrosion attack. The cooler was repaired.

3. Performance of the containment coolers degraded over time due to debris from the service water system, so that by 2001 there was very little margin available. The design of the original containment cooler coils did not allow them to be mechanically cleaned, and flushing was ineffective. The coils for containment coolers A and B were replaced in Refuel 11 (Spring 2001), and the coils for C and D were replaced in Refuel 12 (Fall 2002). The replacement coils have a removable cover plate which permits access to mechanically clean individual tubes.

4. In 2007, Callaway revised the program so that the component cooling water heat exchangers are the only heat exchangers that are performance tested. In order to maintain heat removal capability of the other NRC Generic Letter 89-13 heat exchangers, Callaway cleans and inspects heat exchangers at regular intervals, as well as performs flow and pressure measurements according to the essential service water flow balance procedure. The inspections check for micro-fouling, and include thermographics or ultrasonic examinations of internal surfaces. These maintenance activities supplement the commitment to thermal performance testing made in response to NRC Generic Letter 89-13. The primary and additional monitoring methods have been determined for each of the NRC Generic Letter 89-13 heat exchangers, in accordance with the guidance of EPRI Technical Report 1007248, *Alternative to Thermal Performance Testing and/or Tube-side Inspections of Air-to-Water Heat Exchangers*.

5. In 2007 while performing UT inspections, it was discovered that the top portion of the “B” ESW pump discharge piping was partially eroded. Extent of condition inspections identified a similar condition on the discharge of the “A” ESW pump. The piping segments were replaced and added to the Raw Water monitoring program to inspect the segments for erosion.

6. From 2008 to 2009, the buried portions of the ESW supply from the ESW pump house and return to the ultimate heat sink cooling tower were replaced with high-density polyethylene (HDPE) piping. In addition, sections of above ground or underground carbon steel piping that interfaces with the buried piping was replaced with stainless steel piping. These modifications were performed as a result of the material condition of the ESW system. These modifications were performed as a result of corrective action documents that have been written concerning pinhole leaks, pitting, and other localized degradation of the ESW piping system.

7. In 2009, the replacement of the emergency diesel generator jacket water heat exchangers was evaluated due to loss of material in the tubes. The evaluation determined that a better material of construction and a better design would minimize aging effects due to raw water environment in the emergency diesel generators. The replacement jacket water heat exchangers and the emergency diesel generator lube oil coolers had tubes made of AL6XN stainless steel and were replaced in Refuel 17 (Spring 2010). The emergency diesel generator intercoolers were replaced in Refuel 18 (Fall 2011), and also have tubes fabricated from AL6XN stainless steel.

8. In 2009, room cooler flow rates had been observed to be low in the RHR pump room cooler and the containment spray pump room cooler. The low flow rates were determined to be from material that was dislodged during weld repairs from the outage prior to flow testing. The coolers were flushed to remove the debris, and flow rates were restored to their normal operating condition.

9. Prior to 2010, the coils for the following safety-related room coolers were replaced due to performance or aging issues: auxiliary building north penetration room cooler, auxiliary building south penetration room cooler, component cooling water pump room cooler train A, component cooling water pump room cooler train B, and spent fuel pool room cooler A. The material for the replacement coils is AL6XN stainless steel.

Actions have been taken to address examples of recurring corrosion due to MIC identified above. Low Frequency Electromagnetic Technique (LFET) is used for screening large areas of piping to detect changes in the wall thickness of the pipe. Thinned areas found during the LFET scan are followed up with pipe wall thickness examinations. In addition to the pipe wall thickness examination, opportunistic visual inspections of the ESW system are also performed whenever the ESW system is opened for maintenance. Prior to the period of extended operation, an inspection technique will be selected from available technologies to identify internal pipe wall degradation due to MIC for performance of a one-time inspection of a buried carbon steel piping segment that is representative of other accessible carbon steel ESW piping segments.

The above examples provide objective evidence that the existing Open-Cycle Cooling Water System program preventive, condition, and performance monitoring activities prevent or detect aging effects. Occurrences that would be identified under the Open-Cycle Cooling Water System program will be evaluated to ensure there is no significant impact to safe operation of the plant and corrective actions will be taken to prevent recurrence. Guidance for re-evaluation, repair, or replacement is provided for locations where aging is found. There is confidence that the continued implementation of the Open-Cycle Cooling Water System program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Open-Cycle Cooling Water System program, following enhancement, will provide reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.

B2.1.23 Inspection of Internal Surfaces of Miscellaneous Piping and Ducting Components

Program Description

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program manages cracking, loss of material, hardening and loss of strength. The program also manages loss of coating integrity on components with an internal coating. The program inspects internal surfaces of metallic piping, piping components, piping elements, ducting, heat exchanger components, polymeric and elastomeric components, and other components that are exposed to plant indoor air, ventilation atmosphere, atmosphere/weather, condensation, borated water leakage, diesel exhaust, lubricating oil, and any water system environment not managed by Open-Cycle Cooling Water System (B2.1.10), Closed Treated Water System (B2.1.11), Fire Water System (B2.1.14), and Water Chemistry (B2.1.2) programs.

Internal inspections are performed opportunistically whenever the internal surfaces are made accessible, such as periodic system and component surveillance activities or maintenance activities. Visual inspections of internal surfaces of plant components are performed by qualified personnel. For certain materials, such as polymers, visual inspections will be augmented by physical manipulation of at least 10 percent of the accessible surface area or pressurization to detect hardening, loss of strength, and cracking. Volumetric evaluations are performed when appropriate for the component environment and material. Volumetric evaluations such as ultrasonic examinations are used to detect stress corrosion cracking of internal surfaces such as stainless steel components exposed to diesel exhaust.

At a minimum, in each 10-year period during the period of extended operation a representative sample of 20 percent of the population (defined as components having the same combination of material, environment, and aging effect) or a maximum of 25 components per population is inspected. Where practical, the inspections focus on the bounding or lead components most susceptible to aging because of time in service, and severity of operating conditions. Opportunistic inspections continue in each period despite meeting the sampling limit.

Identified aging deficiencies are documented and evaluated by the Corrective Action Program. Acceptance criteria are established in the maintenance and surveillance procedures or are established during engineering evaluation of the degraded condition. If the inspection results are not acceptable, the condition is evaluated to determine whether the component intended function is affected, and a corrective action is implemented.

Following a failure due to recurring internal corrosion, this program may be used if the failed material is replaced by one that is more corrosion-resistant in the environment of interest, or corrective actions have been taken to prevent recurrence of the recurring internal corrosion.

Visual inspections are performed on all accessible internal surface coatings of the service water self-cleaning strainers and a representative 73 1-foot axial length circumferential segments of service water piping from the circulating and service water pumphouse to the ESW system connection. Baseline inspections will be conducted in the ten year period prior to the period of extended operation on the accessible internal surfaces coatings of the in-scope components. Coatings are inspected every six years on an alternating train basis based on no observed degradation or cracking and flaking that has been evaluated as acceptable; and the component is not subject to turbulent flow. Baseline inspections may be used to demonstrate that long-term coatings are or are not subject to turbulent flow conditions that could result in mechanical damage to the coating. Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a four year frequency. For peeling, delaminations and blisters determined to not meet the acceptance criteria and that will not be repaired or replaced, physical testing is performed where physically possible (i.e., sufficient room to conduct testing). Testing consists of destructive or nondestructive adhesion testing using ASTM International Standards endorsed in RG 1.54, "Service Level I, II, and III Protective Coatings Applied to Nuclear Plants." Monitoring and trending of coatings is based on a review of the previous two inspections results (including repairs) with the current inspection results. The training and qualification of individuals involved in coating inspections are conducted in accordance with ASTM International Standards endorsed in RG 1.54 including guidance from the staff associated with a particular standard.

Coating acceptance criteria are as follows:

- Indications of peeling and delamination are not acceptable and the coatings are repaired or replaced.
- Blisters are evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Indications such as cracking, flaking, and rusting are to be evaluated by a coatings specialist qualified in accordance with an ASTM International standard endorsed in RG 1.54 including staff guidance associated with use of a particular standard.
- Adhesion testing results meet or exceed the degree of adhesion recommended in engineering documents specific to the coating and substrate.

Inspection results not meeting the acceptance criteria will be evaluated by a qualified coatings evaluator. Corrective actions will be determined using the corrective action program.

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program is a new program that will be implemented prior to entering the period of extended operation.

NUREG-1801 Consistency

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program is a new program that, when implemented, will be consistent with exception to NUREG-1801, Section XI.M38, *Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components*.

Exceptions to NUREG-1801

Program Elements Affected:

Scope of Program (Element 1), Parameters Monitored or Inspected (Element 3), Detection of Aging Effects (Element 4), and Monitoring and Trending (Element 5)

NUREG-1801 requires a visual examination of the internal surface of components within the scope of this program. The diesel exhaust is not available for internal surface inspection, so a volumetric examination will be performed for this component. The volumetric examination is adequate for detecting loss of material (wall thinning) and cracking of piping and tubing.

Enhancements

None

Operating Experience

The following discussion of operating experience provides objective evidence that the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation.

1. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will be a new program at Callaway. Internal surface monitoring through visual inspections conducted during maintenance activities and surveillance testing are already in effect in Callaway. The results of the inspections provide data for performance trending, are an input to work planning and prioritization process, and are communicated in the System Health Reports and System Performance Monitoring Indicators. Plant-specific operating experience since 2000 was reviewed to ensure that the operating experience discussed in the corresponding NUREG-1801 aging management program is bounding, i.e., that there is no unique plant-specific operating experience in addition to that described in NUREG-1801. The review also showed that the Plant Health and Performance Monitoring Program had been effective in maintaining the condition of component internal surfaces.

2. In 2007, during maintenance activities, the threaded tube end plugs on the 'B' centrifugal charging pump room cooler were found to have a loss of material due to corrosion as introduced by wear and deformation to the plugs from the repeated assembly/disassembly and cleanings. None of the plugs were leaking. An evaluation determined that 125 plugs would be replaced, future inspections of the room cooler coils would include inspection of tube plugs for loss of material due to corrosion, and replacements would be determined on a case-by-case basis. Later in 2007, the 'A' containment spray pump room cooler was inspected. There was no noticeable damage to the plugs in this cooler. Additional corrective action was to ensure a continuous on-site availability of enough plugs to replace all the plugs in one room cooler.

Internal inspections conducted during maintenance activities and surveillance testing and the Plant Health and Performance Monitoring Program have been effective in maintaining the condition of component internal surfaces. Occurrences that would be identified under the Internal Surfaces in Miscellaneous Piping and Ducting Components program will be evaluated to ensure there is no significant impact to safe operation of the plant and corrective actions will be taken to prevent recurrence. Guidance for re-evaluation, repair, or replacement is provided for locations where aging is found. There is confidence that the implementation of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will effectively identify aging prior to loss of intended function.

Industry and plant-specific operating experience will be evaluated in the development and implementation of this program.

Conclusion

The implementation of the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program will provide reasonable assurance that aging effects will be managed such that the systems and components within the scope of this program will continue to perform their intended functions consistent with the current licensing basis for the period of extended operation.