CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) SET # 31 RESPONSES

RAI 3.0.3-2a, Loss of Coating Integrity (Followup)

Background:

1. RAI 3.0.3-2 Request (c) requested that the frequency of coating inspections be stated. The response to the RAI, dated December 20, 2013, stated in part, "[i]f no indications are found during inspection of one train, the redundant train would not be inspected". The response further stated that the scope of internally coated components includes heat exchangers, air conditioners, and strainers.
2. The response to the RAI stated that the interior surfaces of the fuel oil storage tanks are managed by the Fuel Oil Chemistry program. The "detection of aging effects" program element of GALL Report AMP XI.M30, "Fuel Oil Chemistry," states that, at least once every 10 years, each diesel fuel tank is drained and cleaned, and the internal surfaces are visually inspected. LRA Section B2.1.16 states that the Fuel Oil Chemistry program is consistent with GALL Report AMP XI.M30. LRA Section B2.1.16, "operating experience" example number five describes a 10-year cleaning and inspection frequency for emergency fuel oil system storage tanks.
3. The response to the RAI stated that peeling and delamination are not permitted and testing will be performed to confirm that the blisters are completely surrounded by sound coating bonded to the surface.
4. The response to the RAI did not address inspection of a component's base material if its coatings are credited for corrosion prevention (e.g., the corrosion allowance in design calculations is zero, the "preventive actions" program element credits the coating) and the base metal has been exposed.
5. The revised LRA Sections A1.10 and A1.23 state that the internal coatings are periodically inspected.
6. LRA Sections B2.1.10 and A1.23 were revised to address activities associated with coating inspections; however:
    a. LRA Sections B2.1.10 and B2.1.23 do not state: (a) that a baseline inspection will be conducted in the 10-year period prior to the period of extended operation, (b) the inspection interval for subsequent inspections, (c) the extent of inspections, (d) a summary description of how monitoring and trending of the coatings will be conducted, and (e) a summary description of corrective actions when coating degradation is detected.
    b. LRA Section B2.1.23 does not state the qualifications for individuals performing activities associated with coating inspections, and acceptance criteria.
7. The response to the RAI states, "[m]onitoring and trending will include pre-inspection reviews of previous inspection results. Inspection results will be compared to previous inspection results."
8. LRA Tables 3.3.2-4, 3.3.2-5, 3.3.2-7, 3.3.2-11, and 3.3.2-20 state that carbon steel (with coating or lining) components exposed to raw water (internal) are being managed for loss of material by the Open-Cycle Cooling Water System, Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components, and Fire Water System programs.

Issue:

1. The staff has concluded that if no indications are found during inspection of one train, the redundant train would not need to be inspected as long as components within the redundant trains are not subject to turbulent conditions. Turbulent conditions are those where fluid flow is such that the velocity at a given point varies erratically in magnitude and direction and mechanical damage to coatings can occur (e.g., heat exchanger end bells). The staff has also concluded that baseline inspections of the internal coatings on the in-scope heat exchangers, air conditioners, and strainers in all trains conducted in the 10-year period prior to the period of extended operation would demonstrate whether coatings are being degraded due to turbulent conditions.
2. The staff has concluded that coating inspections for diesel fuel oil storage tanks may be conducted at the frequency stated in the Fuel Oil Chemistry program as long as: (a) no peeling, delamination, blisters, or rusting are observed during inspections, and (b) any cracking and flaking has been found acceptable by a coating specialist. If this is not the case, inspections should be conducted more frequently. The staff noted that the Fuel Oil Chemistry program was not revised to include activities associated with coatings inspections (e.g., acceptance criteria, inspector qualifications).
3. The staff has concluded that where the visual inspection of the coated surfaces determines that the coating is deficient or degraded, physical tests, where physically possible are performed in conjunction with the visual inspection. The staff also concluded that physical testing should consist of destructive or nondestructive adhesion testing using ASTM International standards endorsed in RG 1.54 with a minimum of three sample points being conducted adjacent to the defective area. Physical testing is necessary to ensure that the extent of underlying degradation is detected.
4. The staff has concluded that if coatings are credited for corrosion prevention and the component's base material has been exposed or is beneath a blister, the base metal should be examined to determine if minimum wall thickness is met and will be met until the next inspection.
5. The staff has concluded that the UFSAR Supplement should include key aspects of the program associated with coating degradation such as the inspection method; follow-up testing that will be conducted when degradation is determined not to meet acceptance criteria, and the basis for the training and qualification of individuals involved in coating inspections.
6. The staff has concluded that the programs credited for detecting loss of coating integrity should include a summary description of (a) when baseline inspections will be conducted, (b) the inspection interval for subsequent inspections, (c) the extent of inspections, (d) qualifications for individuals performing activities associated with coating inspections, (e) a summary description of how monitoring and trending of the coatings will be conducted, (f) acceptance criteria, and (g) a summary description of corrective actions when coating degradation is detected.

7. The staff has concluded that a coatings specialist should prepare a post inspection report to include: a list and location of all areas evidencing deterioration, a prioritization of the repair areas into areas that must be repaired before returning the system to service and areas where repair can be postponed to the next refueling outage, and where possible, photographic documentation indexed to inspection locations. The RAI response and associated LRA changes lacks this specificity. The post inspection report should be compiled or approved by a coatings specialist and it should include sufficient information to ensure that degraded areas are appropriately dispositioned through the corrective action program and future inspection locations are selected based on known areas where degradation has occurred.
8. Draft LR-ISG-2013-01, "Aging Management of Loss of Coating Integrity for Internal Service Level III (augmented) Coatings," states that the applicable aging effect for internal coatings is loss of coating integrity. In addition, GALL Report Items CP-152 and TP-301 state that the aging effect for Service Level I coatings is loss of coating integrity. While the GALL Report definition of loss of material incorporates aging mechanisms that are applicable to coatings (e.g., fretting, erosion, wastage, wear), the definition of loss of coating integrity in LR-ISG-2013-01 includes the concepts of consequential damage due to unanticipated or accelerated corrosion and debris generation that are not described in the definition of loss of material.

Request:

1. State the basis for why turbulent conditions sufficient to degrade internal coatings on the in-scope heat exchangers, air conditioners, and strainers described in the RAI response cannot occur. Alternatively, revise the Open Cycle Cooling Water System and Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components programs to include baseline inspections of all trains conducted in the 10-year period prior to the period of extended operation of the internal coatings on the in-scope heat exchangers, air conditioners, and strainers described in the RAI response and revise the proposed frequency of inspections (i.e., redundant trains would be inspected for components susceptible to turbulent flow) based on the results of the inspections.

2. Confirm that the internal surfaces of the internally coated fuel oil storage tanks are inspected every 10 years. State the periodicity of inspections, and basis for the periodicity of inspections if the prior inspection detected peeling, delamination, blisters, rusting, or unacceptable cracking and flaking. State how activities associated with coatings inspections (e.g., acceptance criteria, inspector qualifications) will be managed given that they are not included in the Fuel Oil Chemistry program. Revise LRA Sections A1.16 and B2.1.16 accordingly as described in Issue items 5 and 6 above.
3. State what testing will be performed when peeling, delamination or blisters are detected during inspections and the coating is not repaired or replaced. If the testing does not include destructive or nondestructive adhesion testing, state why the testing will effectively detect the extent of the degraded condition. State how it will be determined that a repair or replacement of a coating is extended to sound coating material.
4. State whether a component's base material will be inspected if its coatings have been credited for corrosion prevention and the base metal has been exposed or is beneath a blister. In addition, state the inspection method and acceptance criteria. If inspections will not be conducted, state the basis for why there is reasonable assurance that the current licensing basis intended function of the component will be met.

5. Revise LRA Sections A1.10 and A1.23 to include a summary description of the follow-up testing that will be conducted when degradation is determined not to meet acceptance criteria and the basis for the training and qualification of individuals involved in coating inspections.
6. Revise LRA Sections B2.1.10 and B2.1.23 to include (a) when baseline inspections will be conducted, (b) the inspection interval for subsequent inspections, (c) the extent of inspections, (d) qualifications for individuals performing activities associated with coating inspections, (e) a summary description of how monitoring and trending of the coatings will be conducted, (f) acceptance criteria, and (g) a summary description of corrective actions when coating degradation is detected.
7. State who will prepare and approve post-inspection reports and the key information that will be included in the report.
8. State why the term "loss of material" as an aging effect for coatings as cited in LRA Tables 3.3.2-4, 3.3.2-5, 3.3.2-7, 3.3.2-11, and 3.3.2-20 is sufficient to convey the consequential concepts of unanticipated or accelerated corrosion, and debris generation. Alternatively, revise the aging effect to loss of coating integrity in the cited AMR tables.

Callaway Response

1. With exception of piping, 100% 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 noted below. Piping baseline inspection will include a representative 73 1-foot axial length circumferential segments of piping. The inspection surface includes the entire inside surface of the 1-foot sample. An equivalent 73 1-foot axial length circumferential segments will be used if geometric limitations impede movement of the inspection tools. The Open Cycle Cooling Water Systems Program and the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components, as well as the Fuel Oil Chemistry, programs have been revised as shown in Enclosure 2 to include baseline inspections.

   <u>Essential Service Water (ESW)</u>
   (B2.1.10 Open Cycle Cooling Water Systems Program)
   - component cooling water heat exchangers,
   - class 1E electrical equipment air conditioners,
   - control room air conditioners (in the Control Building HVAC System), and
   - essential service water self-cleaning strainers

   <u>Service Water and Circulation Water</u>
   (B2.1.23 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components)
   - service water self-cleaning strainers
   - service water piping (circulating and service water pumphouse to ESW system connection)

Emergency Diesel Engine Fuel Oil Storage and Transfer System
(B2.1.16 Fuel Oil Chemistry)

- Emergency Diesel Fuel Oil Storage Tanks and Day Tanks

Re-inspection of the coatings will be conducted as follows:

- 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.
- Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a four year frequency.
- Coatings requiring remediation will be repaired or replaced and inspected every six years on an alternating train basis.

2. The internal surfaces of the internally coated emergency fuel oil storage tanks are inspected every six years based on an alternating train basis with no observable degradation or cracking or flaking that has been evaluated as acceptable. Coatings with blisters, peeling, delaminations or rusting that has been determined not to require remediation are inspected on a six year frequency. A six year frequency is based on operating experience, coating installation in a monitored, non-turbulent environment, and the same coating being installed on each train. There have been no failures at Callaway of the internal coatings in the emergency fuel oil storage tanks that resulted in loss of the intended function. The internal coatings in the emergency fuel oil storage tanks are located in a non-turbulent environment that is monitored and controlled by the Fuel Oil Chemistry program that would detect tank corrosion products or paint debris in the sediment monitoring or particulate analysis. Because both emergency fuel oil storage tanks use the same coating, alternating train inspections would also provide an indication of coating performance.

   The Fuel Oil Chemistry Program in LRA Sections A1.16 and B2.1.16 has been revised as noted in Enclosure 2 to identify the following:

   a. When baseline inspections are conducted (B2.1.16 only)
   b. Inspection intervals for subsequent inspections (B2.1.16 only)
   c. Extent of inspections and inspection method
   d. Training and qualifications for individuals performing activities associated with coating inspections
   e. Summary description of how monitoring and trending of the coatings will be conducted (B2.1.16 only)
   f. Acceptance criteria (B2.1.16 only)
   g. Summary description of corrective actions when a coating degradation is detected.

3. For peeling, delaminations and blisters determined to not meet 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.” For repaired or replaced coating, a minimum of three sample points adjacent to the defective area are tested to verify sound coating material.

4. None of the internally coated components within the scope of license renewal have credited the coatings for corrosion prevention either in a documented corrosion allowance in a design analysis or as a preventative action in an aging management program. If the base metal is exposed due to coating degradation the applicable inspection requirements for management of loss of material in the metallic component will apply. Blisters will be evaluated by a qualified coating specialist to determine extent of coating degradation and exposure of the metallic surface. Based on the potential exposure of the metallic surfaces and their susceptibility to corrosion, corrective actions will be determined by the corrective action program.
5. The Open Cycle Cooling Water Systems program in LRA Section A1.10, and the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components in LRA Section A1.23 have been revised as noted in Enclosure 2 to identify the following:
   - A summary description of the follow-up testing that will be conducted when degradation is determined not to meet acceptance criteria
   - Training and qualifications for individuals performing activities associated with coating inspections
6. The Open Cycle Cooling Water Systems program in LRA Section B2.1.10, and the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components in LRA Section B2.1.23 have been revised as noted in Enclosure 2 to identify the following:
   a. When baseline inspections are conducted
   b. Inspection intervals for subsequent inspections
   c. Extent of inspections and inspection method
   d. Training and qualifications for individuals performing activities associated with coating inspections
   e. Summary description of how monitoring and trending of the coatings will be conducted
   f. Acceptance criteria
   g. Summary description of corrective actions when a coating degradation is detected.
7. A coatings specialist prepares and approves the post-inspection report to include: a list and location of all areas evidencing deterioration, a prioritization of the repair areas into areas that must be repaired before returning the system to service and areas where repair can be postponed to the next refueling outage, and where possible, photographic documentation indexed to inspection locations.
8. The following LRA Tables have been revised as noted in Enclosure 2 to identify “loss of coating integrity” for the internal coatings of applicable components.
   - Table 3.3.2-4 Essential Service Water System
   - Table 3.3.2-5 Service Water System
   - Table 3.3.2-7 Component Cooling Water
   - Table 3.3.2-11 Control Building HVAC
   - Table 3.3.2-20 Fire Protection System
   - Table 3.3.2-21 Emergency Diesel Engine Fuel Oil Storage and Transfer System

Loss of coating integrity is only applicable to the service water supply piping that connects to the ESW system supply piping. Loss of coating integrity is not applicable to the service water and circulating water system return piping downstream of in-scope ESW components because the degradation of coatings cannot result in downstream effects such as reduction in flow, drop in pressure, or reduction in heat transfer for in-scope components. The internal coating for the service water and circulating water return line is not credited for corrosion prevention.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 34, LRA Changes" for a description of LRA changes with this response.

RAI 3.0.3-3a, Firewater system (Followup)

Background:

1. As amended by letter dated December 20, 2013, LRA Section B2.1.14 states an exception to conducting main drain tests. Alternative testing and inspections are listed, including annual fire protection loop flow tests; fire protection water system flushes; hydrant flushes; and wet pipe, deluge, and preaction system visual inspections. Alternatively, the basis for the exception states the fire suppression system is fed from two or more directions such that failure of one isolation valve will not impair the system and long runs of pipe are flow tested.
2. As amended by letter dated December 20, 2013, LRA Section B2.1.14 is inconsistent with the response to RAI 3.0.3-3 Request (d) in regard to augmented testing or inspections of portions of the fire water system that are periodically subject to flow, but designed to be normally dry.
    a. LRA Section B2.1.14 and Commitment No. 10 state, "[i]n each five-year interval, beginning five years prior to the period of extended operation, either conduct a flow test or flush sufficient to detect potential flow blockage, or conduct a visual inspection of 100 percent of the internal surface of piping segments that cannot be drained or allow water to collect."
    b. The RAI response states, [i]nspections will be performed in each five-year interval beginning five years prior to the period of extended operation. A 100 percent baseline inspection will be performed prior to the period of extended operation with 20 percent of the inspections performed in each five year interval of the period of extended operation”
3. The response to RAI 3.0.3-3 Request (a) and LRA Section B2.1.14, in relation to NFPA 25, "Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems," Section 14.2, "Internal Inspection of Piping," in part state, "[t]he internal surface of piping and branch lines is inspected for foreign material every five years by flushing wet pipe system piping." The response to Request (b) states, "[i}nternal visual inspections are performed during plant maintenance activities and the five year flush of wet pipe system piping."

Issue:

1. The basis for the exception lacks sufficient detail for the staff to conclude that the listed alternative tests and inspections are capable of detecting potential flow blockage in system risers.
2. The staff has concluded that in order to provide reasonable assurance that flow blockage has not occurred in portions of the fire water system that are periodically subject to flow, but designed to be normally dry, inspections or tests should be conducted on 100 percent of the portions that do not drain every 5 years commencing 5 years prior to the period of extended operation. The RAI response appears to state that only 20 percent of the piping will be inspected at 5-year intervals during the period of extended operation.
3. The response to RAI 3.0.3-3 Request (a) related to NFPA 25 Section 14.2 internal inspections appears to rely solely on flushes and not internal visual inspections. The staff has concluded that inspections conducted in accordance with NFPA 25, Section 14.2, should include internal visual inspections. While flushing procedures can detect loose corrosion products, internal conditions such as tubercules (NFPA Section 14.2.1.2) may not

be detected with a flush. The response to Request (b) states that internal visual inspections will be conducted during maintenance activities and the 5-year flush of wet pipe systems; however, the minimum amount or percentage of piping that will be visually inspected was not stated.

Request:

1. Describe the alternative tests and inspections with sufficient detail to demonstrate that they are capable of detecting potential flow blockage in system risers. Alternatively, revise the program to include main drain tests per NFPA Section 13.2.5 or provide technical justification for performing a representative sample of main drain tests.
2. Revise LRA Section B2.1.14 or the RAI response to be consistent. If inspections or tests will not be conducted on 100 percent of the portions of the fire water system that: (a) are periodically subject to flow, (b) are designed to be normally dry, and (c) do not drain, every 5 years commencing 5 years prior to the period of extended operation, state the basis for why there is reasonable assurance that flow blockage will not occur in this piping.
3. State the minimum amount of wet pipe system piping, excluding private fire service main piping that will be internally visually inspected on a 5-year basis. In addition, state the basis for why this amount of piping provides a sufficient sample to establish sufficient insight into the internal condition of wet pipe system piping.

Callaway Response

1. NFPA 25 Section 13.2.5 recommends a main drain test at each fire water system riser. The primary purpose of the test is to identify significant obstructions to flow such as a failed valve disc or mispositioned valve. As noted in the response to RAI 3.1.3-3, Callaway has not previously conducted main drain tests.

   To ensure that valves will not impede flow in fire suppression systems, several actions are performed. Valve positions are verified every 31 days for each valve in the flow path (except those located in the Reactor Building). Each testable valve in the flow path is cycled through at least one complete cycle of full travel every 12 months. A functional test is performed every 18 months, which includes cycling every valve in the flow path which is not testable.

   To address flow blockage due to causes other than valves, flow testing is performed at the hydraulically most limiting location in each major structure every five years. This includes two locations in the Reactor Building, three locations in the Auxiliary Building, one location in the Radwaste Building, two locations in the Control Building, and five locations in the Turbine Building. For each test, it is verified the water supply provides the design pressure at the required flow. Every three years, each hose station valve is partially opened to verify no flow blockage. The use of these tests is a more effective method to determine if any flow obstructions exist in the fire water system. In addition, the use of the drain valves does not include the risers or the distribution piping to hose stations and spray systems in the flow path and would not reveal any obstructions to flow in that piping. The hydraulically most limiting hose stations are normally located at the most remote point from the main header piping. Using these locations would include the risers and some distribution piping in the test flow path.

These tests identify flow obstructions in the fire system piping and demonstrate that there are no significant changes in the condition of the piping system that could result in loss of intended function.

In addition, Callaway will perform main drain tests per NFPA Section 13.2.5 of a representative sample of 20% of the main drains within the scope of License Renewal annually in order to check for potential flow blockage in system risers. There are 21 main drain valves within the scope of License Renewal, so that five main drain tests will be performed annually. During annual testing one of the tests is performed in a radiologically controlled area. This sample size is consistent with sampling methodology recommendations in other GALL Report AMPs (i.e., GALL Report AMP XI.M32 and GALL Report AMP XI.M33). The Callaway corrective action program will be used to address failures of main drain tests, and include determination of the cause of failure and an extent of condition evaluation.

LRA Appendix A1.14, LRA Table A4-1 item 10, and Appendix B2.1.14 have been revised as shown in Enclosure 2 to require main drain tests of 20% of the main drains within the scope of License Renewal annually.

2. The response to RAI 3.0.3-3 Request (d) is revised as follows.

The portions of the fire water system that are periodically subject to flow, but designed to be normally dry, such as dry-pipe or preaction sprinkler system piping and valves, will be identified and inspected prior to the PEO. For those piping segments where drainage may not occur as expected, the following actions will be performed.

i. Either a flow test or flush sufficient to detect potential flow blockage, or a visual inspection of 100% of the internal surface of the piping segments that cannot be drained or allow water to collect will be conducted.

ii. The piping segment where drainage is not occurring as expected will be monitored for flow blockage or loss of material.

iii. ~~Inspections will be performed in each five-year interval beginning five years prior to the PEO. A 100% baseline inspection will be performed prior to the period of extended operation with 20% of the inspections performed in each five year interval of the period of extended operation.~~ <u>The tests or inspections described in part "i" will be conducted in each five-year interval, beginning five years prior to the period of extended operation.</u>

iv. See the response in part “i” for the extent of the inspections.

v. Inspections will be acceptable if there is no debris that could obstruct pipe or sprinklers and minimum design wall thickness is maintained.

vi. In each five year interval of the PEO, 20% of the length of piping segments that cannot be drained or that allow water to collect will be subject to volumetric wall thickness examinations. The 20% of piping that is periodically inspected in each five-year interval will be in different locations than previously inspected piping. If the results of a 100% internal visual inspection are acceptable, and the segment is not subsequently wetted, no further augmented tests or inspections will be performed.

LRA Table A4-1 item 10 and LRA Appendix B2.1.14 have been revised as shown in Amendment 28 in Enclosure 2 to include the tests and inspections noted in this response for

those normally dry piping segments subjected to periodic flow where drainage is not occurring as expected in the Fire Water System program.

3. Callaway has two types of suppression systems within the scope of License Renewal. There are eight wet pipe systems and twelve dry pipe preaction systems.

   NFPA 25 section 14.2 recommends performing a (visual) inspection “every five years by opening a flushing connection at the of one main and by removing a sprinkler toward the end of one branch line for the purpose of inspecting for the presence of foreign organic and inorganic material.” In buildings having multiple wet pipe systems, NFPA 25 allows half the systems to be inspected in one inspection period, and the remaining systems inspected in the next. If sufficient foreign material is found in any system in a building during the five year inspection, then all systems in the building will be inspected.

   For the eight wet pipe systems in the scope of License Renewal, Callaway will perform the inspections as recommended by NFPA 25 section 14.2. At Callaway, there are four wet pipe systems in the control building, so two of these will be inspected in the first five-year interval, and the other two will be inspected in the second five-year interval. The auxiliary building has two wet pipe systems, so one will be inspected in the first five-year interval, and the other will be inspected in the second five-year interval. The turbine building and fire water pump house each have only one wet pipe system, so these will be inspected every five years.

   The dry pipe preaction systems are normally dry and filled with pressurized air from the instrument air system until actuated. The dry pipe systems are not periodically tested with water, so they are not subject to the intermittent wet and dry conditions that promote corrosion. Therefore, Callaway will perform an internal visual inspection consistent with NFPA 25 section 14.2 of any dry pipe preaction system following actuation prior to return to service.

   If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted per NFPA 25, Annex D. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.

   LRA Appendix A1.14, LRA Table A4-1 item 10, and Appendix B2.1.14 have been revised as shown in Enclosure 2 to require internal visual inspections per NFPA 25 of wet pipe suppression systems every five years. In buildings with multiple systems, half of the wet pipe systems will be inspected in the first five-year interval, and the remaining systems will be inspected in the second five-year interval. Dry pipe preaction systems will be inspected after actuation prior to return to service.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 34, LRA Changes” for a description of LRA changes with this response.

RAI 3.3.2-2a, Submerged Bolting (Followup)

Background:

By letter dated December 2, 2013, the staff issued RAI 3.3.2-2, requesting details on the parameters that would be inspected to detect bolting degradation in submerged environments. The response dated January 16, 2014, described the bolting inspections as follows:

1. Essential Service Water (ESW) Pump Closure Bolting: a representative sample of submerged closure bolting of the ESW pumps will be visually inspected for degradation when they are made accessible during dewatering of the ESW intake bays for structures monitoring inspections. Dewatering of the ESW pump house intake bays is performed on a four refueling outage frequency (six years). The ESW pumps are tested at least quarterly and are repaired or refurbished when necessary, based on trending of pump parameters such as pressure, flow, and vibration.
2. Service Water Pump Closure Bolting: each service water pump is replaced nominally every six years with a refurbished pump. Because the pumps are periodically replaced every six years with a refurbished pump, the pumps and associated bolting are not subject to aging management requirements.
3. Waste Water Pump Closure Bolting: a representative sample of submerged pump closure bolting in the oily waste system and the floor and equipment drainage system will be visually inspected for degradation when they are made accessible during pump maintenance activities. The bolting will be inspected on a four refueling outage frequency (six years) if an opportunistic inspection has not been performed. The waste water sumps are monitored during operator rounds to confirm that the sumps are being drained.

The RAI response deleted pumps from LRA Table 2.3.3-5, "Service Water System." And closure bolting and pumps from LRA Table 3.3.2-5.

Issue:

1. Visual inspections of the ESW and waste water pump closure bolting are capable of detecting loss of material of only the exposed bolt heads. Given that crevices (e.g., threaded regions or the shank below the bolt heads) likely represent locations with the most aggressive environments, the staff considers it important that these areas are evaluated for loss of material on at least an opportunistic basis (e.g. , during repair and replacement activities).
2. The staff does not agree with the proposal that managing the aging effects of the service water pump and its closure bolting is not required. Pump refurbishments frequently result in many passive long-lived parts being reused (e.g., casings, closure bolting).
3. The staff requires greater specificity regarding the frequency of the operator rounds that confirm that the waste water sumps are being drained.

Request:

1. For the ESW and waste water pumps' closure bolting, describe how loss of material will be identified in crevice locations that are not readily visible, or describe an alternative method for evaluating degradation of those regions. If opportunistic inspections are proposed, provide historical information regarding how often the pumps have been disassembled in the past such that an inspection of crevice regions could have been conducted.
2. For the service water pumps and associated closure bolting, state whether the in-scope components are replaced every 6 years during refurbishment without using condition monitoring to conclude that replacement was not necessary. If these components are not necessarily replaced, propose appropriate means to manage the applicable aging effects.
3. State the frequency of the operator rounds that confirm that the waste water sumps are being drained.
4. State what procedures or logs have been revised to appropriately capture the basis of these aging management activities (e.g., operator rounds to inspect waste water sumps, work orders that contain steps to conduct a visual inspection of bolt regions that are not readily observable, quarterly pump testing procedure).

Callaway Response

1. Submerged closure bolting of the ESW pumps will be visually inspected for degradation on a four refueling outage frequency (six years) if an opportunistic inspection has not been performed. Opportunistic inspections of the submerged ESW pump closure bolts will be performed when the pumps are disassembled for maintenance activities. There have been no documented maintenance activities that would allow opportunistic inspections on the submerged ESW pump closure bolts since the pumps were replaced with stainless steel pumps in 1999 and 2009. Degradation of waste water pumps is identified through operator rounds, as described in the response to question #3.
2. Each service water pump is replaced nominally every six years with a refurbished pump. As part of the refurbishment activities, the submerged pump casing closure bolting and the interior pump coating are replaced. Condition monitoring is not used for the replacement of the service water pump coatings or submerged pump casing closure bolting of the refurbished pump. The submerged pump casing is inspected and reworked as necessary to like new condition during the refurbishment activities. The refurbished pump casing will be considered as a long lived, passive component that requires aging management. Since the internal and external environments for this component are the same, the External Surfaces Monitoring of Mechanical Components program (B2.1.21) is credited to manage the aging of the internal surfaces and the external surfaces of the pump casing. LRA Table 2.3.3-5, LRA Table 3.3-1 item 134, and Table 3.3.2-5 have been revised as shown in Enclosure 2 to require aging management of the service water pump casing by the External Surfaces Monitoring of Mechanical Components program (B2.1.21).
3. As required by the Operations Technician General Inspection Guide, inspections are conducted once every twelve hours to confirm waste water sump pumps are operating as required and sump liquid levels, if visible, are within normal range.

4. See the response to question #3 for the procedure and logs that identify the basis for waste water sump inspections.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 34, LRA Changes" for a description of LRA changes with this response.

Amendment 34, LRA Changes

Enclosure 2 Summary Table

Affected LRA Section	LRA As-Submitted Page Number(s)
Table 2.1-2	2.1-22
Section 2.1.5.9	2.1-23
Table 2.3.1-1	2.3-4
Table 2.3.3-5	2.3-36
Table 3.1.2-1	3.1-68 and 3.1-69
Table 3.2-1	3.2-33
Table 3.3-1	3.3-81
Section 3.3.2.1.4	3.3-8
Section 3.3.2.1.5	3.3-9
Section 3.3.2.1.7	3.3-10 and 3.3-11
Section 3.3.2.1.11	3.3-15 and 3.3-16
Section 3.3.2.1.20	3.3-25
Section 3.3.2.1.21	3.3-26
Table 3.3.2-4	3.3-97 and 3.3-99
Table 3.3.2-5	3.3-100, 3.3-101, and 3.3-104
Table 3.3.2-7	3.3-108 and 3.3-112
Table 3.3.2-11	3.3-153 and 3.3-160
Table 3.3.2-20	3.3-213 and 3.3-216
Table 3.3.2-21	3.3-217, 3.3-219 and 3.3-221
Table 3.4-1	3.4-31
Section A1.10	A-6 and A-7
Section A1.14	A-8
Section A1.16	A-9
Section A1.23	A-13
Table A4-1, item 6	A-37
Table A4-1, item 10	A-38 and A-39
Table A4-1, item 12	A-39 and A-40
Table A4-1, item 19	A-41
Table A4-1, item 44	A-49
Section B2.1.10	B-41 through B-44
Section B2.1.14	B-53 through B-56
Section B2.1.16	B-60 through B-63
Section B2.1.23	B-81 through B-83
Section B2.1.24	B-84 through B-86

Callaway Plant
License Renewal Application
Amendment 34

Changes made to update Table 2.1-2 to add LR-ISG-2013-01 that was issued as a draft for public comment.

Table 2.1-2 (Page 2.1-22) is revised as follows (new text shown underlined)

Table 2.1-2 NRC Interim Staff Guidance Associated with License Renewal

Issue Number	Purpose	Discussion Status
LR-ISG-2006-03	Staff Guidance for Preparing Severe Accident Mitigation Alternatives (SAMA) Analyses	The staff has issued LR-ISG-2006-03.
LR-ISG-2011-01	Aging Management of Stainless Steel Structures and Components in Treated Borated Water	The staff has issued LR-ISG-2011-01.
LR-ISG-2011-02	Aging Management Program for Steam Generators	The staff has issued LR-ISG-2011-02.
LR-ISG-2011-03	Aging Management Program for Buried and Underground Piping and Tanks	The staff has issued LR-ISG-2011-03.
LR-ISG-2011-04	Updated Aging Management Criteria for Reactor Vessel Internal Components of Pressurized Water Reactors	The staff has issued LR-ISG-2011-04.
LR-ISG-2011-05	Ongoing Review of Operating Experience	The staff has issued LR-ISG-2011-05.
LR-ISG-2012-01	Wall Thinning Due to Erosion Mechanisms	The staff has issued LR-ISG-2012-01.
LR-ISG-2012-02	Aging Management of Internal Surfaces, Fire Water Systems, Atmospheric Storage Tanks, and Corrosion Under Insulation	The staff has issued LR-ISG-2012-02.
LR-ISG-2013-01	Aging Management of Loss of Coating Integrity for Internal Service Level III (Augmented) Coatings	This ISG has been issued in draft for public comment.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add 2.1.5.9 on LR-ISG-2013-01.

Section 2.1.5.9 (Page 2.1-23) is revised as follows (new text shown underlined).

2.1.5.9. (LR-ISG-2013-01) Aging Management of Loss of Coating Integrity for Internal Service Level III (Augmented) Coatings

This LR-ISG was issued in draft and is applicable to Callaway. The aging management program for loss of coating integrity in service level III (augmented) coatings is discussed in Section B2.1.10 Open-Cycle Cooling Water System, Section B2.1.16 Fuel Oil Chemistry, and B2.1.23 Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program.

Callaway Plant
License Renewal Application
Amendment 34

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

Table 2.3.1-1 (Page 2.3-4) is revised as follows (deleted text shown in strikethrough):

Table 2.3.1-1 Reactor Vessel and Internals

Component Type	Intended Function
~~RVI Baffle-Edge Bolting~~	~~Structural Support~~

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add pump casings that are periodically replaced with refurbished pump casings.

Table 2.3.3-5 (Pages 2.3-36) is revised as follows (new text underlined):

Table 2.3.3-5 Service Water System

Component Type	Intended Function
Closure Bolting	Leakage Boundary (spatial) Pressure Boundary Structural Integrity (attached)
Flow Orifice	Pressure Boundary
Piping	Leakage Boundary (spatial) Pressure Boundary Structural Integrity (attached)
Pump	Pressure Boundary
Strainer	Pressure Boundary
Thermowell	Pressure Boundary
Tubing	Pressure Boundary
Valve	Leakage Boundary (spatial) Pressure Boundary Structural Integrity (attached)

Callaway Plant
License Renewal Application
Amendment 34

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

Table 3.1.2-1 (Pages 3.1-68 and 3.1-69) is revised as follows (deleted text shown in strikethrough):

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

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
~~RVI Baffle-Edge Bolting~~	~~SS~~	~~Stainless Steel~~	~~Reactor Coolant (Ext)~~	~~Loss of material~~	~~Water Chemistry (B2.1.2)~~	~~IV.B2.RP-24~~	~~3.1.1.087~~	~~A~~
~~RVI Baffle-Edge Bolting~~	~~SS~~	~~Stainless Steel~~	~~Reactor Coolant (Ext)~~	~~Cracking~~	~~Water Chemistry (B2.1.2) and PWR Vessel Internals (B2.1.6) (Primary Components - No Expansion Components)~~	~~IV.B2.RP-275~~	~~3.1.1.053~~	~~A~~
~~RVI Baffle-Edge Bolting~~	~~SS~~	~~Stainless Steel~~	~~Reactor Coolant (Ext)~~	~~Loss of fracture toughness, Change in dimension, and Loss of preload~~	~~PWR Vessel Internals (B2.1.6) (Primary Components - No Expansion Components)~~	~~IV.B2.RP-354~~	~~3.1.1.059~~	~~A~~

Callaway Plant
License Renewal Application
Amendment 34

Changes made to incorporate new aging effect for loss of coating integrity.

Table 3.2-1, Summary of Aging Management Programs in Chapter V of NUREG-1801 for Engineered Safety Features, (Page 3.2-33) is revised as follows (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
3.2.1.67a	Metallic piping, piping components, heat exchangers, tanks with Service Level III (augmented) internal coatings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, or lubricating oil	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.M42, "Service Level III (augmented) Coatings Monitoring and Maintenance Program"	No	Not applicable. Callaway has no in-scope internally coated metallic components exposed to closed-cycle cooling water, raw water, treated water, treated borated water, or lubricating oil within the engineered safety features, so the applicable NUREG-1801 line was not used.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to discussion column as a result of aging management changes to service water system submerged pumps and to incorporate new aging effect for loss of coating integrity.

Table 3.3-1, Summary of Aging Management Programs in Chapter VII of NUREG-1801 for Auxiliary Systems, (Page 3.3-81) is revised as follows (new text underlined):

Table 3.3-1 Summary of Aging Management Programs in Chapter VII of NUREG-1801 for Auxiliary Systems

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.3.1.128a	Metallic piping, piping components, heat exchangers, tanks with Service Level III (augmented) internal coatings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, waste water, lubricating oil, or fuel oil	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.M42, "Service Level III (augmented) Coatings Monitoring and Maintenance Program"	No	Consistent with NUREG-1801 for material, environment, and aging effect, but a different aging management program Open-Cycle Cooling Water System (B2.1.10), Fuel Oil Chemistry (B2.1.16) or Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23) is credited.

Table 3.3-1 Summary of Aging Management Programs in Chapter VII of NUREG-1801 for Auxiliary Systems

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.3.1.134	Steel, stainless steel, or copper alloy piping, piping components, and piping elements, and heat exchanger components exposed to a raw water environment (for nonsafety-related components not covered by NRC GL 89-13)	Loss of material due to general (steel and copper alloy only), pitting, crevice, and microbiologically influenced corrosion, fouling that leads to corrosion	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)	No	Consistent with NUREG-1801 for material, environment, and aging effect, but a different aging management program External Surfaces Monitoring of Mechanical Components (B2.1.23) is credited for the submerged service water pumps because the material and environment combinations are the same for the internal and external surfaces. ~~with aging management program exceptions. The aging management program(s) with exceptions to NUREG-1801 include: Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)~~

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the essential service water system.

Section 3.3.2.1.4 (Page 3.3-8) is revised as follows (new text shown underlined):

3.3.2.1.4 Essential Service Water System

Aging Effects Requiring Management

The following essential service water system aging effects require management:

- Cracking and changes in material properties
- Cracking, blistering, change in color
- Loss of coating integrity
- Loss of material
- Loss of material and cracking
- Loss of preload
- Wall thinning

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the service water system.

Section 3.3.2.1.5 (Page 3.3-9) is revised as follows (new text shown underlined):

3.3.2.1.5 Service Water System

Aging Effects Requiring Management

The following service water system aging effects require management:

- Loss of coating integrity
- Loss of material
- Loss of preload

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the component cooling water system.

Section 3.3.2.1.7 (Pages 3.3-10 and 3.3-11) is revised as follows (new text shown underlined):

3.3.2.1.7 Component Cooling Water System

Aging Effects Requiring Management

The following component cooling water system aging effects require management:

- Loss of coating integrity
- Loss of material
- Loss of preload
- Reduction of heat transfer

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the control building HVAC system.

Section 3.3.2.1.11 (Pages 3.3-15 and 3.3-16) is revised as follows (new text shown underlined):

3.3.2.1.11 Control Building HVAC System

Aging Effects Requiring Management

The following control building HVAC system aging effects require management:

- Hardening and Loss of Strength
- Loss of coating integrity
- Loss of material
- Loss of material and cracking
- Loss of preload
- Reduction of heat transfer

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the fire protection system.

Section 3.3.2.1.20 (Page 3.3-25) is revised as follows (new text shown underlined):

3.3.2.1.20 Fire Protection System

Aging Effects Requiring Management

The following fire protection system aging effects require management:

- Loss of coating integrity
- Loss of material
- Loss of material and cracking
- Loss of material and flow blockage
- Loss of preload

Callaway Plant
License Renewal Application
Amendment 34

Added loss of coating integrity as a new aging effect for internally coated components in the emergency diesel engine fuel oil and transfer system.

Section 3.3.2.1.21 (Page 3.3-26) is revised as follows (new text shown underlined):

3.3.2.1.21 Emergency Diesel Engine Fuel Oil Storage and Transfer System

Aging Effects Requiring Management

The following emergency diesel engine fuel oil storage and transfer system aging effects require management:

- Loss of coating integrity
- Loss of material
- Loss of preload

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add an aging evaluation for loss of coating integrity for internally strainers.

Table 3.3.2-4 (Pages 3.3-97 and 3.3-99) is revised as follows (new text underlined):

Table 3.3.2-4 Auxiliary Systems – Summary of Aging Management Evaluation – Essential Service Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Strainer	FIL, PB	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Open-Cycle Cooling Water System (B2.1.10)	VII.C1.A-401a	3.3.1.128a	E, 7

Notes for Table 3.3.2-4:

Plant Specific Notes:

1 External Surfaces Monitoring of Mechanical Components program (B2.1.21) is used instead of Open Cycle Cooling Water program (B2.1.10) to manage the aging of the external surfaces of nonsafety-related components exposed to raw water.

2 HDPE components in a plant indoor air environment are not exposed to an aggressive chemical environment that would concentrate contaminants and degrade HDPE chemical and mechanical properties. HDPE is not exposed to ozone, ionizing radiation or a UV source (sunlight or fluorescent light) that would result in aging. Operating temperatures do not exceed 140°F. HDPE components in a plant indoor air environment have no aging effects requiring aging management.

3 This TLAA is applicable to the high-density polyethylene (HDPE) piping. Section 4.7.7 describes the evaluation of this TLAA for the replacement ESW piping.

4 Open-Cycle Cooling Water System program (B2.1.10) is used instead of Flow-Accelerated Corrosion program (B2.1.7) to manage wall thinning due to erosion of carbon steel piping exposed to raw water.

5 The Open-Cycle Cooling Water System program (B2.1.10) is used to monitor for recurring internal corrosion in the ESW system. See Further Evaluation 3.3.2.2.8.

6 The Bolting Integrity program (B2.1.8) is used instead of the Open-Cycle Cooling Water program (B2.1.10) to manage loss of material in submerged closure bolting.

7. The Open-Cycle Cooling Water System program (B2.1.10) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add pump casings that are periodically replaced with refurbished pump casings. Also added an aging evaluation for loss of coating integrity for internally coated carbon steel piping and strainers.

Table 3.3.2-5 (Pages 3.3-100, 3.3-101, and 3.3-104) is revised as follows (new text underlined):

Table 3.3.2-5 Auxiliary Systems – Summary of Aging Management Evaluation – Service Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Piping	PB, SIA	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)	VII.C1.A-401a	3.3.1.128a	E, 3
Pump	PB	Cast Iron (Gray Cast Iron)	Plant Indoor Air (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.I.A-77	3.3.1.078	A
Pump	PB	Cast Iron (Gray Cast Iron)	Raw Water (Ext)	Loss of material	Selective Leaching (B2.1.19)	VII.C1.A-51	3.3.1.072	B
Pump	PB	Cast Iron (Gray Cast Iron)	Raw Water (Ext)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.C1.A-408a	3.3.1.134	E, 2
Pump	PB	Cast Iron (Gray Cast Iron)	Raw Water (Int)	Loss of material	Selective Leaching (B2.1.19)	VII.C1.A-51	3.3.1.072	B
Pump	PB	Cast Iron (Gray Cast Iron)	Raw Water (Int)	Loss of material	External Surfaces Monitoring of Mechanical Components (B2.1.21)	VII.C1.A-408a	3.3.1.134	E, 2

Table 3.3.2-5 Auxiliary Systems – Summary of Aging Management Evaluation – Service Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Strainer	PB	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23)	VII.C1.A-401a	3.3.1.128a	E, 3

Notes for Table 3.3.2-5:

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.
E Consistent with NUREG-1801 for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.

Plant Specific Notes:
1 NUREG-1801, Section XI.M20, *Open-Cycle Cooling Water System* is for water which cools safety-related components and rejects heat to the ultimate heat sink. Since the service water system rejects heat to the circulating water system and is nonsafety-related, the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program (B2.1.23) is credited.
2 Since the internal and external environments for this component are the same, the External Surfaces Monitoring of Mechanical Components (B2.1.21) is credited to manage the aging of the internal surfaces of this component.
3. The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program (B2.1.23) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add an aging evaluation for loss of coating integrity for internally coated heat exchangers.

Table 3.3.2-7 (Pages 3.3-108 and 3.3-112) is revised as follows (new text underlined):

Table 3.3.2-7 Auxiliary Systems – Summary of Aging Management Evaluation – Component Cooling Water System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger (CCW Heat Exchanger)	PB	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Open-Cycle Cooling Water System (B2.1.10)	VII.C1.A-401a	3.3.1.128a	E, 1

Notes for Table 3.3.2-7:

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

E Consistent with NUREG-1801 for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.

Plant Specific Notes:

1 The Open-Cycle Cooling Water System program (B2.1.10) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add an aging evaluation for loss of coating integrity for internally coated heat exchangers.

Table 3.3.2-11 (Pages 3.3-153 and 3.3-160) is revised as follows (new text underlined):

Table 3.3.2-11 Auxiliary Systems – Summary of Aging Management Evaluation – Control Building HVAC System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Heat Exchanger (Control Building HVAC)	PB	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Open-Cycle Cooling Water System (B2.1.10)	VII.C1.A-401a	3.3.1.128a	E, 6

Notes for Table 3.3.2-11:

Plant Specific Notes:

1 The subject component is enclosed within another component. Loss of material on the external surface of the subject component is managed by the Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program (B2.1.23).

2 Component is refrigeration piping which is expected to experience condensation during times of elevated humidity on the external surface.

3 Fire Protection (B2.1.13) manages the aging effects associated with this fire damper material and environment combination.

4 Reduction of heat transfer of the air-side of safety-related air-to-water heat exchangers is managed by the Open-Cycle Cooling Water System program (B2.1.10) consistent with Callaway commitments to GL 89-13.

5 Loss of material of the air-side of safety-related air-to-water heat exchangers is managed by Open-Cycle Cooling Water System program (B2.1.10) consistent with Callaway commitments to GL 89-13.

6 The Open-Cycle Cooling Water System program (B2.1.10) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add an aging evaluation for loss of coating integrity for internally coated tanks.

Table 3.3.2-20 (Pages 3.3-213 and 3.3-216) is revised as follows (new text underlined):

Table 3.3.2-20 Auxiliary Systems – Summary of Aging Management Evaluation – Fire Protection System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Tank	PB	Carbon Steel (with coating or lining)	Raw Water (Int)	Loss of coating integrity	Fire Water System (B2.1.14)	VII.H2.A-401a	3.3.1.128a	E, 4

Notes for Table 3.3.2-20:

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.

E Consistent with NUREG-1801 for material, environment, and aging effect, but a different aging management program is credited or NUREG-1801 identifies a plant-specific aging management program.

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

Plant Specific Notes:

1 The fire water storage tanks rest on a sand cushion surrounded by a reinforced concrete ring beam.

2 PVC in a wastewater environment is unaffected by water, concentrated alkalies, nonoxidizing acids, oils, ozone, or humidity changes. PVC in a waste water environment is not exposed to direct sunlight or ionizing radiation. Therefore PVC in a wastewater environment has no aging effect.

3 The Fire Water System (B2.1.14) program is used to manage components in the fire water system.

4 The Fire Water System program (B2.1.14) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to add an aging evaluation for loss of coating integrity for internally coated tanks.

Table 3.3.2-21 (Pages 3.3-217, 3.3-219 and 3.3-221) is revised as follows (new text underlined):

Table 3.3.2-21 Auxiliary Systems – Summary of Aging Management Evaluation – Emergency Diesel Engine Fuel oil Storage and Transfer System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
Closure Bolting	PB	Stainless Steel	Fuel Oil (Ext)	Loss of material	Bolting Integrity (B2.1.8)	VII.H1.AP-136	3.3.1.071	~~E, 3~~ E, 2
Tank	PB	Carbon Steel	Fuel Oil (Int)	Loss of material	Fuel Oil Chemistry (B2.1.16) and One-Time Inspection (B2.1.18)	VII.H1.AP-105	3.3.1.070	~~A, 2~~ A
Tank	PB	Carbon Steel (with coating or lining)	Fuel Oil (Int)	Loss of coating integrity	Fuel Oil Chemistry (B2.1.16)	VII.H1.A-401a	3.3.1.128a	E, 3

Notes for Table 3.3.2-20:

Plant Specific Notes:

1 Loss of preload for underground bolting is managed by the Bolting Integrity program (B2.1.8).

~~2 The internal surface of this tank is coated, and the aging effect includes flow blockage due to degradation of the coating. Inspections of the internal surface of the tank performed under the Fuel Oil Chemistry program (B2.1.16) include inspections of the coating.~~

2~~3~~ The Bolting Integrity program (B2.1.8) is used instead of the Fuel Oil Chemistry program (B2.1.16) and the One-Time Inspection program (B2.1.18) to manage loss of material in closure bolting submerged in fuel oil.

3. The internal surface of the Fuel Oil Storage Tanks is coated. The Fuel Oil Chemistry program (B2.1.16) is used to manage the coatings on the internal surfaces of this component.

Callaway Plant
License Renewal Application
Amendment 34

Changes made to incorporate new aging effect for loss of coating integrity.

Table 3.4-1, Summary of Aging Management Programs in Chapter VIII of NUREG-1801 for Steam and Power Conversion System, (Page 3.4-31) is revised as follows (new text shown underlined):

Table 3.4-1 Summary of Aging Management Programs in Chapter VIII of NUREG-1801 for Steam and Power Conversion System

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.4.1.62a	Metallic piping, piping components, heat exchangers, tanks with Service Level III (augmented) internal coatings exposed to closed-cycle cooling water, raw water, treated water, treated borated water, or lubricating oil	Loss of coating integrity due to blistering, cracking, flaking, peeling, or physical damage	Chapter XI.M42, “Service Level III (augmented) Coatings Monitoring and Maintenance Program”	No	Not applicable. Callaway has no in-scope internally coated metallic components exposed to closed-cycle cooling water, raw water, treated water, treated borated water, or lubricating oil within the steam and power conversion system, so the applicable NUREG-1801 line was not used.

A1.10 OPEN-CYCLE COOLING WATER SYSTEM

The Open-Cycle Cooling Water System program manages loss of material, wall thinning, reduction of heat transfer, cracking, blistering, change in color, and hardening and loss of strength for components within the scope of license renewal and exposed to the raw water of the essential service water 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 program is consistent with commitments as established in responses to NRC Generic Letter 89-13, *Service Water System Problems Affecting Safety-Related Components* and includes:

(a) surveillance and control of biofouling,
(b) tests to verify heat transfer,
(c) routine inspection and maintenance program,
(d) system walkdown inspection, and
(e) review of maintenance, operating, and training practices and procedures.

The Open-Cycle Cooling Water System program includes the essential service water system that transfers heat from the safety-related structures, systems and components to the ultimate heat sink as defined in NRC Generic Letter 89-13. Periodic heat transfer testing or inspection and cleaning of heat exchangers with a heat transfer intended function is performed in accordance with commitments to NRC Generic Letter 89-13 to verify heat transfer capabilities.

~~In addition, the internal coatings of components within the scope of this program are periodically visually inspected to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage.~~

Visual inspections are performed 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. For coated surfaces 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). The test 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.” 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.

.

A1.14 FIRE WATER SYSTEM

The Fire Water System program manages loss of material and flow blockage for water-based fire protection systems. This program manages aging effects through the use of flow testing and visual inspections performed consistent with provisions of the 2011 Edition of National Fire Protection Association (NFPA) 25 noted in Table A1.14-1. Unless noted in Table A1.14-1, flow testing and visual inspections are performed at intervals specified in the 2011 Edition of NFPA 25. Testing or replacement of sprinklers that have been in place for 50 years is performed in accordance with the 2011 Edition of NFPA 25.

In addition to NFPA codes and standards, portions of the water-based fire protection system that are: (a) normally dry but periodically subjected to flow (e.g., dry-pipe or preaction sprinkler system components) and (b) cannot be drained or allow water to collect are to be subjected to augmented testing beyond that specified in NFPA 25, including (a) periodic full flow tests at the design pressure and flow rate or internal visual inspections and (b) volumetric wall-thickness examinations.

The water-based fire protection system is normally maintained at required operating pressure and is monitored such that loss of system pressure is immediately detected and corrective actions initiated.

Internal visual internal inspections are used when the internal surface of the piping is exposed during plant maintenance

Samples are collected for microbiologically-influenced corrosion quarterly and when fire water piping and components are opened for maintenance or are accessible. Biofouling is prevented by periodically adding treatment chemicals such as an anti-scalant, a biopenetrant, and a biostat to the fire water system annually and when monitoring indicates they should be added. The MIC Index is trended to evaluate treatment effectiveness in specific locations.

Inspections of wetted normally dry piping segments that cannot be drained or that allow water to collect begin five years before the period of extended operation. The program's remaining inspections begin during the period of extended operation.

Table A1.14-1 Fire Water System Aging Management

Component	NFPA 25 Section	Aging Management Performed
Sprinkler Systems: Sprinkler inspections	5.2.1.1	Sprinklers are inspected for signs of leakage, corrosion, and foreign material.

Component	NFPA 25 Section	Aging Management Performed
Sprinkler Systems: Sprinkler testing	5.3.1	Prior to 50 years in service, the Fire Water System program requires sprinkler heads to be replaced or have representative samples submitted for field-service testing by a recognized testing laboratory in accordance with NFPA 25. The program field-service tests additional representative samples every 10 years thereafter during the period of extended operation to ensure signs of aging are detected in a timely manner.
Standpipe and Hose Systems: Flow Tests	6.3.1	Flow testing is conducted at least every five years at the hydraulically most remote hose connections of each zone of an automatic standpipe system to verify the water supply provides the design pressure at the required flow.
Private Fire Service Mains: Underground and Exposed Piping	7.3.1	Underground and exposed piping is flow tested at flows representative of those during a fire to determine the internal condition of the piping at minimum 3-year intervals.
Private Fire Service Mains: Hydrants	7.3.2	Hydrants are flow tested annually to ensure proper functioning.
Fire Pumps: Suction Screens	8.3.3.7	Not applicable. Callaway's fire protection pumps do not have suction screens.
Water Storage Tanks: Exterior Inspections	9.2.5.5	The exterior painted surface of the fire water storage tanks (FWSTs) is inspected annually for signs of degradation.
Water Storage Tanks: Interior inspections	9.2.6, 9.2.7	The interior of each FWST is inspected every other refueling cycle for signs of aging. Testing of interior surfaces is performed for coating integrity and tank bottom integrity when FWSTs exhibit signs of interior pitting, corrosion, or coating failure.

Component	NFPA 25 Section	Aging Management Performed
Valves and System-Wide Testing: Main Drain Test	13.2.5	~~Main drain tests are not conducted at Callaway. As an alternative, one of the following methods is used to assure the reliable operation of the fire protection water supply system.~~ ~~1. The fire suppression system is fed from two or more directions such that the failure of one isolation valve will not impair the system and the long runs of pipe are flow tested under other surveillances.~~ ~~OR~~ ~~2. The flow path from the fire pump to the system control valve is verified on an 18-month frequency, and the following surveillances are performed with acceptable results:~~ ~~• Fire water valve position verification~~ ~~• Fire protection valve cycling~~ ~~• Annual fire protection loop flow test~~ ~~• Fire protection water system flush~~ ~~• Hydrant flush~~ ~~• Post indicator valve testing~~ ~~• Wet pipe, deluge, and preaction system visual inspection~~ Main drain tests are performed on a representative sample of 20% of the main drains within the scope of License Renewal annually in order to check for potential flow blockage in system risers. During annual testing, one of the tests is performed in a radiologically controlled area.
Valves and System-Wide Testing: Deluge Valves	13.4.3.2.2 to 13.4.3.2.5	A full flow test using air or water is performed every refueling outage by trip testing each deluge valve to verify that spray/sprinkler nozzles are unobstructed.
Water Spray Fixed Systems: Strainers	10.2.1.6, 10.2.1.7, 10.2.7	Spray system strainers are inspected and cleaned every refueling outage and after each system actuation. Callaway does not have main line strainers.
Water Spray Fixed Systems: Operation Test	10.3.4.3	A full flow test is performed every refueling cycle using air or water to verify that spray/sprinkler nozzles are unobstructed.

Component	NFPA 25 Section	Aging Management Performed
Foam Water Sprinkler Systems: Strainers	11.2.7.1	Not applicable. Callaway does not have a foam water sprinkler system.
Foam Water Sprinkler Systems: Operational Test Discharge Patterns	11.3.2.6	Not applicable. Callaway does not have a foam water sprinkler system.
Foam Water Sprinkler Systems: Storage tanks	Visual inspection for internal corrosion	Not applicable. Callaway does not have a foam water sprinkler system.
Obstruction Investigation: Obstruction, Internal Inspection of Piping	14.2 and 14.3	~~The internal surface of piping and branch lines is inspected for foreign material every five years by flushing wet pipe system piping. In buildings having multiple wet pipe systems, every other system is inspected every five years, and the remaining systems are inspected at the next five year interval. If foreign material is found in any system in a building during the five year inspection, then all systems in the building will be inspected.~~ Wet pipe suppression systems are inspected every five years. For buildings containing multiple systems, half are inspected in the first 5 year interval, and the remaining half inspected in the next 5 year interval. If sufficient foreign material is found in any system in a building, then all systems in the building will be inspected. Dry pipe preaction systems will be inspected following actuation, prior to return to service. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.

A1.16 FUEL OIL CHEMISTRY

The Fuel Oil Chemistry program manages loss of material on the internal surface of components in the emergency diesel engine fuel oil storage and transfer system, fire protection system, standby diesel generator engine system, and EOF and TSC diesels security building system. The program also manages loss of coating integrity for the emergency diesel fuel oil storage tanks and day tanks. The program includes (a) surveillance and monitoring procedures for maintaining fuel oil quality by controlling contaminants in accordance with plant technical specifications and ASTM Standards D1796-83 and D2276-78, (b) periodic draining of the emergency fuel oil system storage tanks and day tanks, (c) cleaning and visual inspection of internal surfaces of the emergency fuel oil system storage tanks and day tanks during periodic draining, (d) ultrasonic measurements of the emergency fuel oil system storage tank and fuel oil day tank bottom thickness if there are indications of reduced cross sectional thickness found during the visual inspection, (e) periodic volumetric examination of tank bottom from the external surface the diesel fire pump fuel oil day tank and security diesel generator fuel oil day tank where tank design prevents cleaning and inspection from the inside, and (f) inspection of new fuel oil before introduction to storage tanks.

Visual inspections are performed on all accessible internal surface coatings of the emergency fuel oil storage tanks and day tanks. For coated surfaces 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). The test 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.” 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.

The One-Time Inspection program (A1.18) will be used to verify the effectiveness of the Fuel Oil Chemistry program.

A1.23 INSPECTION OF INTERNAL SURFACES IN MISCELLANEOUS PIPING AND DUCTING COMPONENTS

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program manages changes in material properties, 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, concrete 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 water system environment not managed by Open-Cycle Cooling Water System (A1.10), Closed Treated Water System (A1.11), Fire Water System (A1.14), and Water Chemistry (A1.2) programs.

Internal inspections are normally performed at opportunities where 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 or pressurization to detect hardening, loss of strength, and cracking. The program includes inspections to detect material degradation that could result in a loss of component intended function.

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.

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.

~~In addition, the internal coatings of the service water pump strainers are periodically visually inspected to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage.~~

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. For coated surfaces 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). The test 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." 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.

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

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

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. • ~~perform periodic visual inspections of the internal coatings of components within the scope of this program to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage. Inspection frequency is based on coating condition. Inspection results will be evaluated by personnel qualified consistent with ASTM D7108-05, "Standard Guide for Establishing Qualifications for a Nuclear Coating Specialist," as described in the Protective Coating Monitoring and Maintenance program (B2.1.33). Acceptance criteria will include the following:~~ ~~1. Peeling and delaminations are not permitted~~ ~~2. Cracking is not permitted if accompanied by delamination or loss of adhesion.~~ ~~3. Blisters are limited to intact blisters. Testing will be performed confirm that the blisters are completely surrounded by sound coating bonded to the surface.~~ ~~4. Localized areas of coating degradation without subsequent loss of material of the base metal are considered acceptable if the area is completely surrounded by sound coating bonded to the surface.~~ • 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.	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 the 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
	• 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. 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.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	• 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.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
10	Recoat the internal surface of fire water storage tanks. Enhance the Fire Water System program procedures to: • Internal inspections will be performed on accessible exposed portions of fire water piping during plant maintenance activities. When visual inspections are used to detect loss of material, the inspection technique is capable of detecting surface irregularities that could indicate wall loss to below nominal pipe wall thickness due to corrosion and corrosion product deposition. Where such irregularities are detected, follow-up volumetric wall thickness examinations are performed. • replace sprinkler heads prior to 50 years in service or have a recognized testing laboratory field-service test a representative sample in accordance with NFPA 25 and test additional samples every 10 years thereafter to ensure signs of aging are detected in a timely manner. • review and evaluate trends in flow parameters recorded during the NFPA 25 fire water flow tests. • perform annual hydrant flow testing in accordance with NFPA 25. • perform annual hydrostatic testing of fire brigade hose. • ~~Inspect the internal surface of piping and branch lines for foreign material every five years by flushing wet pipe system piping. In buildings having multiple wet pipe systems, every other system is inspected every five years, and the remaining systems are inspected at the next five year interval. If foreign material is found in any system in a building during the five year inspection, then all systems in the building will be inspected. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted per NFPA 25, Annex D. Visual inspections will include an inspection technique that is capable of detecting surface irregularities due to corrosion and corrosion product deposition. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.~~	B2.1.14	Implementation is started five years before the period of extended operation. Recoat the internal surface of the fire water storage tanks~~,~~ and, inspections of wetted segments that cannot be drained or that allow water to collect 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. The program's remaining inspections begin during the period of extended operation.

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	▪ Perform augmented tests and inspections of water-based fire protection system components that have been wetted but are normally dry. The augmented tests and inspections are conducted as follows on piping segments that cannot be drained or that allow water to collect: • In each five-year interval, beginning five years prior to the period of extended operation, either conduct a flow test or flush sufficient to detect potential flow blockage, or conduct a visual inspection of 100 percent of the internal surface of piping segments that cannot be drained or allow water to collect. • A 100% baseline inspection will be performed prior to the period of extended operation. In each five-year interval of the period of extended operation, 20 percent of the length of piping segments that cannot be drained or that allow water to collect is subject to volumetric wall thickness inspections. Measurement points will be obtained to the extent that each potential degraded condition can be identified (e.g., general corrosion, MIC). The 20 percent of piping that is inspected in each five-year interval will be in different locations than previously inspected piping. If the results of a 100 percent internal visual inspection are acceptable, and the segment is not subsequently wetted, no further augmented tests or inspections will be performed. ▪ require the inspection of the interior of the fire water storage tanks to include checking for evidence of voids beneath the floor. ▪ change the frequency of trip testing each deluge valve from every three years to every refueling outage. ▪ change the frequency of tests of spray/sprinkler nozzle discharge patterns from every three years to every refueling outage.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	▪ perform the following additional inspections if pitting, corrosion, or coating failure is found during the inspection of the fire water storage tanks: (1) tank coatings are evaluated using an adhesion test consistent with ASTM D 3359, Standard Test Methods for Measuring Adhesion by Tape Test; (2) dry film thickness measurements are taken at random locations to determine the overall coating thickness; (3) nondestructive ultrasonic readings are taken to evaluate the wall thickness where there is evidence of pitting or corrosion; (4) interior surfaces are spot wet-sponge tested to detect pinholes, cracks, or other compromises in the coating; (5) tank bottoms are tested for metal loss on the underside by use of ultrasonic testing where there is evidence of pitting or corrosion; (6) bottom seams are vacuum-box tested in accordance with NFPA 22, Standard for Water Tanks for Private Fire Protection. ▪ Require the removal of foreign material if its presence is found during pipe inspections to obstruct pipe or sprinklers. In addition, the source of the material is determined and corrected. ▪ Perform main drain tests consistent with NFPA 25, Section 13.2.5 of a representative sample of 20% of the main drains within the scope of License Renewal annually in order to check for potential flow blockage in system risers. During annual testing, one of the tests is performed in a radiologically controlled area. ▪ Inspect wet pipe suppression systems every five years consistent with NFPA 25, Section 14.2. For buildings containing multiple systems, half are inspected in the first 5 year interval, and the remaining half inspected in the next 5 year interval. If sufficient foreign material is found in any system in a building, then all systems in the building will be inspected. The NFPA 25, Section 14.2 inspection of dry pipe preaction systems will be performed following actuation, prior to return to service. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted per NFPA 25 Annex D. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	• Revise the implementation procedure and calculation for changing test and inspection frequencies associated with the NFPA 805 license amendment (Amendment 206) to note the following restrictions when changing license renewal Fire Water System program and Fire Protection program test and inspection frequencies. • EPRI Report 1006756, Fire Protection Equipment Surveillance Optimization and Maintenance Guide will be used to adjust test and inspection frequencies. • Data to be used in analyzing the potential for modifying test and inspection frequencies would not be obtained any earlier than 5 years prior to the period of extended operation. • A Minimum sample size consistent with EPRI Report 1006756 Section 11.2 will be used to modify test and inspection frequencies. • EPRI Report 1006756 would not be used to modify: fire water storage tank inspections/tests, underground flow tests, and inspections of normally dry but periodically wetted piping that will not drain due to its configuration.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
12	Remove the blisters in the coating, inspect the base metal for aging, and repair the coating in the Train A Emergency Diesel Generator Fuel Oil Storage Tank. Enhance the Fuel Oil Chemistry program procedures to: • include periodic draining of the water from the bottom of the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank. • include the addition of biocide to the diesel fire pump fuel oil day tank and security diesel generator fuel oil day tank if periodic testing indicates biological activity or evidence of corrosion. • include draining, cleaning, and inspection of the emergency fuel oil system day tanks within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation. • include a determination of water and sediment in the periodic sampling of the emergency fuel oil system day tanks and security diesel generator fuel oil day tank. • include a determination of particulate concentrations in the periodic sampling of the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank. • include a determination of microbial activity concentrations in the periodic sampling of the emergency fuel oil system storage tanks, emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank. • include new fuel oil receipt sampling for water and sediment prior to introduction into the security diesel generator fuel oil day tank and diesel fire pump fuel oil day tank. • perform a volumetric examination of the emergency fuel oil system storage tanks and day tanks after evidence of tank degradation is observed during the visual inspection within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation.	B2.1.16	Completed no later than six months prior to the PEO. Inspections and referenced coating repairs 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
	• perform a volumetric examination on the external surface of the diesel fire pump fuel oil day tanks and security diesel generator fuel oil day tank within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation. • include at least quarterly trending for water, biological activity, and particulate concentrations on the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank. ▪ include immediate removal of accumulated water when discovered in the emergency fuel oil system day tank, diesel fire pump fuel oil day tank, and security diesel generator fuel oil day tank. ▪ perform periodic visual inspections on all accessible internal surface coatings of the emergency fuel oil storage tanks and day tanks. 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. 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.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
	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.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
19	Enhance the Lubricating Oil program procedures to: • indicate that lubricating oil contaminants are maintained within acceptable limits, thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer, (Completed LRA Amendment 34) • state the testing standards for water content and particle count, and (Completed LRA Amendment 34) • state that phase separated water in any amount is not acceptable. (Completed LRA Amendment 34)	B2.1.24	~~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.~~ Completed

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
44	For all MRP-191 Table 4-4 components, as applicable to Callaway, Ameren Missouri commits to perform one or more of the following resolution options for the non-CASS RVI components: Option1: Replacement RVI components determined to be subject to 20% or greater cold work and 30 ksi operating stress will be replaced. Option 2: Inspection For RVI components determined to be subject to 20% or greater cold work and 30 ksi operating stress, an augmented inspection program capable of detecting cracking will be developed. Minimum examination coverage criteria consistent with MRP-227-A Primary Inspection Category Components will apply. The augmented inspection program will be submitted to the NRC prior to performance of the inspection(s). Option 3: Impact Evaluation For RVI components determined to be subject to 20% or greater cold work and 30 ksi operating stress, an impact evaluation will be prepared to establish that the effects of aging are minimal and will not have an adverse impact on future plant operability or component intended function. The impact evaluation(s) will be submitted to the NRC. Option 4: Mitigation RVI components determined to be subject to 20% or greater cold work and 30 ksi operating stress will be mitigated of stress corrosion cracking (SCC) susceptibility. Note: Indeterminate components will be conservatively assumed to be subject to 20% or greater and subject to 30 ksi operating stress. (Closed, evaluation (ULNRC-06106, 3/28/2014) concluded that the plant-specific material fabrication and design are consistent with the MRP-191 basis and the MRP-227-A aging management requirements as related to cold work are directly applicable to Callaway Unit 1.	B2.1.6	~~To be completed no later than 24 months prior to the period of extended operation.~~ Closed

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.

Callaway uses internal coatings only on the component cooling water heat exchanger end bells, channels, and tubesheets; the control room air conditioner tubesheets; the class 1E electrical equipment air conditioner tubesheets; and the essential service water system strainers. The internal coatings of components within the scope of this program are periodically visually inspected to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage.

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. 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), and Acceptance Criteria (Element 6)

Procedures will be enhanced to perform periodic visual inspections ~~of the internal coatings of components within the scope of this program to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage. Inspection frequency is based on coating condition. Inspection results will be evaluated by personnel qualified consistent with ASTM D7108-05, "Standard Guide for Establishing Qualifications for a Nuclear Coating Specialist," as described in the Protective Coating Monitoring and Maintenance program (B2.1.33). Acceptance criteria will include the following:~~

- ~~Peeling and delaminations are not permitted.~~
- ~~Cracking is not permitted if accompanied by delamination or loss of adhesion.~~
- ~~Blisters are limited to intact blisters. Testing will be performed to confirm that the blisters are completely surrounded by sound coating bonded to the surface.~~
- ~~Localized areas of coating degradation without subsequent loss of material of the base metal are considered acceptable if the area is completely surrounded by sound coating bonded to the surface.~~

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. 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 ~~thermographies~~ 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.

B2.1.14 Fire Water System

Program Description

The Fire Water System program conducts full-flow testing and visual inspections to ensure that loss of material and flow blockage is adequately managed. This AMP applies to water-based fire protection system components, including sprinklers, nozzles, fittings, valve bodies, fire pump casings, hydrants, hose stations, standpipes, water storage tanks, and above ground, buried, and underground piping and components that are tested consistent with the 2011 Edition of National Fire Protection Association (NFPA) 25, "Inspection, Testing and Maintenance of Water-Based Fire Protection Systems", noted in Table B2.1.14-1. Unless noted in Table B2.1.14-1, flow testing and visual inspections are performed at intervals specified in the 2011 Edition of NFPA 25.

Either sprinklers are replaced before reaching 50 years inservice or a representative sample of sprinklers from one or more sample areas is tested by using the guidance of the 2011 Edition of NFPA 25 to ensure that signs of degradation, such as corrosion, are detected in a timely manner.

In addition to NFPA codes and standards, portions of the water-based fire protection system that are: (a) normally dry but periodically are subject to flow (e.g., dry-pipe or preaction sprinkler system piping and valves) and (b) that cannot be drained or allow water to collect, are subjected to augmented testing or inspections. Also, portions of the system (e.g., fire service main, standpipe) are normally maintained at required operating pressure and monitored such that loss of system pressure is immediately detected and corrective actions are initiated.

Internal inspections are performed on accessible exposed portions of fire water piping during plant maintenance activities.

Samples are collected for microbiologically-influenced corrosion quarterly and when fire water piping and components are opened for maintenance or are accessible. Biofouling is prevented by periodically adding treatment chemicals such as an anti-scalant, a biopenetrant, and a biostat to the fire water system annually and when monitoring indicates they should be added. The MIC Index is trended to evaluate treatment effectiveness in specific locations.

External surfaces of buried fire main piping are evaluated as described in the Buried and Underground Piping and Tanks program (B2.1.25).

Inspections of wetted normally dry piping segments that canot be drained or that allow water to collect begin five years before the period of extended operation. The program's remaining inspections begin during the period of extended operation.

Table B2.1.14-1 Fire Water System Aging Management

Component	NFPA 25 Section	Aging Management Performed
Sprinkler Systems: Sprinkler inspections	5.2.1.1	Sprinklers are inspected for signs of leakage, corrosion, and foreign material.
Sprinkler Systems: Sprinkler testing	5.3.1	Prior to 50 years in service, the Fire Water System program requires sprinkler heads to be replaced or have representative samples submitted for field-service testing by a recognized testing laboratory in accordance with NFPA 25. The program field-service tests additional representative samples every 10 years thereafter during the period of extended operation to ensure signs of aging are detected in a timely manner.
Standpipe and Hose Systems: Flow Tests	6.3.1	Flow testing is conducted at least every five years at the hydraulically most remote hose connections of each zone of an automatic standpipe system to verify the water supply provides the design pressure at the required flow.
Private Fire Service Mains: Underground and Exposed Piping	7.3.1	Underground and exposed piping is flow tested at flows representative of those during a fire to determine the internal condition of the piping at minimum 3-year intervals.
Private Fire Service Mains: Hydrants	7.3.2	Hydrants are flow tested annually to ensure proper functioning.
Fire Pumps: Suction Screens	8.3.3.7	Not applicable. Callaway's fire protection pumps do not have suction screens.
Water Storage Tanks: Exterior Inspections	9.2.5.5	The exterior painted surface of the fire water storage tanks (FWSTs) is inspected annually for signs of degradation.
Water Storage Tanks: Interior inspections	9.2.6, 9.2.7	The interior of each FWST is inspected every other refueling cycle for signs of aging. Testing of interior surfaces is performed for coating integrity and tank bottom integrity when FWSTs exhibit signs of interior pitting, corrosion, or coating failure.

Component	NFPA 25 Section	Aging Management Performed
Valves and System-Wide Testing: Main Drain Test	13.2.5	~~Main drain tests are not conducted at Callaway. As an alternative, one of the following methods is used to assure the reliable operation of the fire protection water supply system.~~ ~~1. The fire suppression system is fed from two or more directions such that the failure of one isolation valve will not impair the system and the long runs of pipe are flow tested under other surveillances.~~ ~~OR~~ ~~2. The flow path from the fire pump to the system control valve is verified on an 18-month frequency, and the following surveillances are performed with acceptable results:~~ ~~• Fire water valve position verification~~ ~~• Fire protection valve cycling~~ ~~• Annual fire protection loop flow test~~ ~~• Fire protection water system flush~~ ~~• Hydrant flush~~ ~~• Post indicator valve testing~~ ~~• Wet pipe, deluge, and preaction system visual inspection~~ Main drain tests are performed on a representative sample of 20% of the main drains within the scope of License Renewal annually in order to check for potential flow blockage in system risers. During annual testing, one of the tests is performed in a radiologically controlled area.
Valves and System-Wide Testing: Deluge Valves	13.4.3.2.2 to 13.4.3.2.5	A full flow test using air or water is performed every refueling outage by trip testing each deluge valve to verify that spray/sprinkler nozzles are unobstructed.
Water Spray Fixed Systems: Strainers	10.2.1.6, 10.2.1.7, 10.2.7	Spray system strainers are inspected and cleaned every refueling outage and after each system actuation. Callaway does not have main line strainers.
Water Spray Fixed Systems: Operation Test	10.3.4.3	A full flow test is performed every refueling cycle using air or water to verify that spray/sprinkler nozzles are unobstructed.

Component	NFPA 25 Section	Aging Management Performed
Foam Water Sprinkler Systems: Strainers	11.2.7.1	Not applicable. Callaway does not have a foam water sprinkler system.
Foam Water Sprinkler Systems: Operational Test Discharge Patterns	11.3.2.6	Not applicable. Callaway does not have a foam water sprinkler system.
Foam Water Sprinkler Systems: Storage tanks	Visual inspection for internal corrosion	Not applicable. Callaway does not have a foam water sprinkler system.
Obstruction Investigation: Obstruction, Internal Inspection of Piping	14.2 and 14.3	~~The internal surface of piping and branch lines is inspected for foreign material every five years by flushing wet pipe system piping. In buildings having multiple wet pipe systems, every other system is inspected every five years, and the remaining systems are inspected at the next five year interval. If foreign material is found in any system in a building during the five year inspection, then all systems in the building will be inspected.~~ Wet pipe suppression systems are inspected every five years. For buildings containing multiple systems, half are inspected in the first 5 year interval, and the remaining half inspected in the next 5 year interval. If sufficient foreign material is found in any system in a building, then all systems in the building will be inspected. Dry pipe preaction systems will be inspected following actuation, prior to return to service. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.

NUREG-1801 Consistency

The Fire Water System program is an existing program that, following enhancement, will be consistent, with exception to NUREG-1801, Section XI.M27, *Fire Water System*.

Exceptions to NUREG-1801

Program Element Affected:

Detection of Aging Effects (Element 4)

NUREG-1801 requires inspection of fire protection systems in accordance with the guidance of NFPA-25. Callaway performs power block hose station gasket inspections at least once every 18 months. The inspection interval is in accordance with the approved fire protection program, as described in FSAR Table 9.5.1-2 - SP, Section 5.4, rather than annually as specified by NFPA-25.

NUREG-1801 requires annual testing of fire hydrant hose. Callaway hydrostatically tests fire hoses at interior fire hose stations five years from installation and at least every three years thereafter. The testing interval is in accordance with the approved fire protection program, as described in FSAR Table 9.5.1-2 - SP, Section 5.6.

~~NFPA 25, Section 13.2.5, requires annual main drain tests. Main drain tests are not conducted at Callaway. Main drain testing is a potentially risk significant activity that requires the discharge of several thousand gallons of water, the disposal of which may be problematic for a nuclear plant. As an alternative, one of the following methods is used to assure the reliable operation of the fire protection water supply system.~~

1. ~~The fire suppression system is fed from two or more directions such that the failure of one isolation valve will not impair the system and the long runs of pipe are flow tested under other surveillances.~~

   ~~OR~~

2. ~~The flow path from the fire pump to the system control valve is verified on an 18-month frequency, and the following surveillances are performed with acceptable results:~~
   - ~~Fire water valve position verification~~
   - ~~Fire protection valve cycling~~
   - ~~Annual fire protection loop flow test~~
   - ~~Fire protection water system flush~~
   - ~~Hydrant flush~~
   - ~~Post indicator valve testing~~
   - ~~Wet pipe, deluge, and preaction system visual inspection~~

Enhancements

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

Preventive Actions (Element 2)

The Fire Water Storage Tanks internal surfaces will be recoated prior to the period of extended operation.

Parameters Monitored or Inspected (Element 3) and Detection of Aging Effects (Element 4)

~~The Fire Water System program will be enhanced to inspect the internal surface of piping and branch lines for foreign material every five years by flushing wet pipe system piping. In buildings having multiple wet pipe systems, every other system is inspected every five years, and the remaining systems are inspected at the next five year interval. If foreign material is found in any system in a building during the five year inspection, then all systems in the building will be inspected. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted per NFPA 25, Annex D. Visual inspections will include an inspection technique that is capable of detecting surface irregularities due to corrosion and corrosion product deposition. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.~~

The Fire Water System program will be enhanced to require augmented tests and inspections of water-based fire protection system components that have been wetted but are normally dry. The augmented tests and inspections are conducted as follows on piping segments that cannot be drained or that allow water to collect:

- In each five-year interval, beginning five years prior to the period of extended operation, either conduct a flow test or flush sufficient to detect potential flow blockage, or conduct a visual inspection of 100 percent of the internal surface of piping segments that cannot be drained or allow water to collect.
- A 100% baseline inspection will be performed prior to the period of extended operation. In each five-year interval of the period of extended operation, 20 percent of the length of piping segments that cannot be drained or that allow water to collect is subject to volumetric wall thickness inspections. Measurement points will be obtained to the extent that each potential degraded condition can be identified (e.g., general corrosion, MIC). The 20 percent of piping that is inspected in each five-year interval will be in different locations than previously inspected piping.

If the results of a 100 percent internal visual inspection are acceptable, and the segment is not subsequently wetted, no further augmented tests or inspections will be performed.

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

Internal inspections will be performed on accessible exposed portions of fire water piping during plant maintenance activities. When visual inspections are used to detect loss of material, the inspection technique is capable of detecting surface irregularities that could indicate wall loss to below nominal pipe wall thickness due to corrosion and corrosion product deposition. Where such irregularities are detected, follow-up volumetric wall thickness examinations are performed.

Detection of Aging Effects (Element 4)

The Fire Water System program will be enhanced to include annual hydrostatic testing of fire brigade hose.

The Fire Water System program will be enhanced such that prior to 50 years in service, sprinkler heads will be replaced or representative samples will be submitted for field-service testing by a recognized testing laboratory in accordance with NFPA 25. The program will field-service test additional representative samples every 10 years thereafter to ensure signs of aging are detected in a timely manner.

The Fire Water System program will be enhanced to require the inspection of the interior of the fire water storage tanks to include checking for evidence of voids beneath the floor.

The Fire Water System program will be enhanced to change the frequency of trip testing each deluge valve from every three years to every refueling outage.

The Fire Water System program will be enhanced to change the frequency of tests of spray/sprinkler nozzle discharge patterns from every three years to every refueling outage.

The Fire Water System program will be enhanced to require the following additional inspections if pitting, corrosion, or coating failure is found during the inspection of the fire water storage tanks: (1) tank coatings are evaluated using an adhesion test consistent with ASTM D 3359, Standard Test Methods for Measuring Adhesion by Tape Test; (2) dry film thickness measurements are taken at random locations to determine the overall coating thickness; (3) nondestructive ultrasonic readings are taken to evaluate the wall thickness where there is evidence of pitting or corrosion; (4) interior surfaces are spot wet-sponge tested to detect pinholes, cracks, or other compromises in the coating; (5) tank bottoms are tested for metal loss on the underside by use of ultrasonic testing where there is evidence of pitting or corrosion; (6) bottom seams are vacuum-box tested in accordance with NFPA 22, Standard for Water Tanks for Private Fire Protection.

The Fire Water System program will be enhanced to perform main drain tests consistent with NFPA 25, Section 13.2.5 of a representative sample of 20% of the main drains within the scope of License Renewal annually in order to check for potential flow blockage in system risers. During annual testing, one of the tests is performed in a radiologically controlled area.

The Fire Water System program will be enhanced to inspect wet pipe suppression systems every five years consistent with NFPA 25, Section 14.2. For buildings containing multiple systems, half are inspected in the first 5 year interval, and the remaining half inspected in the next 5 year interval. If sufficient foreign material is found in any system in a building, then all systems in the building will be inspected. The NFPA 25, Section 14.2 inspection of dry pipe preaction systems will be performed following actuation, prior to return to service. If sufficient foreign material is found to obstruct pipe or sprinklers, then an obstruction investigation is conducted per NFPA 25 Annex D. If the visual inspection detects surface irregularities that could indicate wall loss below nominal pipe wall thickness, then follow-up volumetric examinations will be performed.

Detection of Aging Effects (Element 4) and Acceptance Criteria (Element 6)

The Fire Water System program will be enhanced to include annual hydrant flow testing in accordance with NFPA 25.

Monitoring and Trending (Element 5)

The Fire Water System program will be enhanced to review and evaluate trends in flow parameters recorded during the NFPA 25 fire water flow tests.

Acceptance Criteria (Element 6)

The Fire Water System program will be enhanced to require the removal of foreign material if its presence is found during pipe inspections to obstruct pipe or sprinklers. In addition, the source of the material is determined and corrected.

Operating Experience

The following discussion of operating experience provides objective evidence that the Fire 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 2005, during a surveillance test, 10 sprinkler heads had signs of corrosion or mechanical damage. Two of the sprinkler heads were replaced, and the other eight were cleaned. There have been no additional issues with the sprinkler heads since then.

2. In 2005, an alarm was triggered for fire protection loop jockey pump excessive run time and an investigation was initiated to identify the leak. The location of the leak was determined and promptly isolated from the main fire water loop. The isolation of the leak did not affect any required suppression systems. The leak was promptly repaired and the fire water piping was returned to service.

3. In 2006, a low C-factor lead to the fire water system being chemically cleaned, resulting in removal of approximately 8900 pounds of corrosion products. The cleaning was successful in keeping the system C-factor above 91.5 as required by plant procedure. During the chemical cleaning, five leaks developed, all of which were repaired. Since that time, two additional leaks have occurred. One was due to a cracked valve, and the cause of the other is still under investigation.

4. In 2007, an inspection of the train B fire water storage tank, performed in accordance with the Callaway fire water storage tank inspection procedure, identified small amounts of corrosion and mineral deposits, generally at the weld seams. An evaluation determined another application of the tank coating would be planned. In 2009, an inspection of the train B fire water storage tank identified several areas of blistering in the coating, mainly near the welds, and calcium deposits. No major delaminations were identified, and the anodes were in good shape. Minor corrosion was identified on bare metal surfaces, with no pitting. An evaluation determined that the tank internal surfaces were satisfactory. In 2011, an inspection of the train B fire water storage tank was performed. Little to no damage or degradation was found to the internal metallic surface of the tank. There was some surface roughness/pitting when compared to clean bare metal. General blistering and some local delamination of the coating were found. The blistering on the wall and most of the floor is intact, while there was heavy blistering near the welds with smaller blistering on general plate areas. Since the fire water storage tanks are cathodically protected and most of the blisters were intact, the substrate is not expected to degrade significantly by the next inspection or re-coating, and no repair to the exposed metal is necessary.

5. In 2008, an inspection of the train A fire water storage tank identified minor blistering and limestone deposits. No corrosion was found on the tank internal surface, and the tank cathodic protection was found in satisfactory condition. The internal surface of the tank was determined to be in satisfactory condition. In 2010, an inspection of the train A fire water tank identified discontinuities and delaminations of the coating. The weld at the floor to wall interface had the most pitting, and weld locations contained heavy blistering. The adjustments on the rectifier of the cathodic protection system were found to be adequate. An evaluation determined that, since the cathodic protection system was determined to be effective, through voltage and current measurements, the substrate would not degrade excessively before the next planned inspection.

6. In 2008, during microbiological sampling of the fire water system, elevated levels of microbiologically influenced corrosion (MIC) were detected in stagnant portions of fire water pipe supplying fire water to hose stations. As a result, a new preventive maintenance task has been created to flush hose stations with a biocide.

7. In 2011, C-factor testing was performed on the main fire loop piping to check for restrictions due to corrosion and or biofouling. The testing results did not meet the acceptance criteria, indicating excessive pressure drop leading to reduced fire water flow. The testing results were called into question so with more accurate digital crystal gauges, the system was reevaluated and the results improved by 6% to 89.5, still less than the required acceptance criteria of 91.5. A functionality determination concluded that provided compensatory measures were taken, the reduced cleanliness could be fully offset so the required fire water flow rate could be achieved and maintained. As a corrective action, the acceptance criteria in Calculation KC-005 Addendum 2 have been modified, and the test procedure updated accordingly. These revisions provide significant margin and consider the cleanliness trends, ensuring the fire water system is capable of performing its intended function.

Actions have been taken to address examples of recurring corrosion identified above. Pipe wall thickness examinations will be performed in addition to the opportunistic visual inspections of the fire water system. Sections of the above-ground fire water piping will be tested every three years. Each three year sample will include at least three locations for a total of at least 100 feet of above-ground fire water piping, and will be selected based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes. This sampling program will commence after 2014, ensuring that over 1000 feet of piping in 30 locations will be inspected during the following 30 years.

MIC samples are collected quarterly and when fire water piping and components are opened for maintenance or are accessible. The MIC Index is trended to evaluate treatment effectiveness in specific locations. Biofouling is prevented by adding treatment chemicals such as an anti-scalant, a biopenetrant, and a biostat to the fire water system annually and when monitoring indicates they should be added.

The above examples provide objective evidence that the existing Fire Water System program includes activities that are capable of detecting aging effects, evaluating system leakage, and initiating corrective actions. Occurrences that would be identified under the Fire 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 Fire Water System program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Fire Water System 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.

B2.1.16 Fuel Oil Chemistry

Program Description

The Fuel Oil Chemistry program manages loss of material on the internal surface of components in the emergency diesel engine fuel oil storage and transfer system, fire protection system, standby diesel generator engine system, and EOF and TSC diesels security building system. The program also manages loss of coating integrity for the emergency fuel oil storage tanks and day tanks. The program includes (a) surveillance and monitoring procedures for maintaining fuel oil quality by controlling contaminants in accordance with plant technical specifications and ASTM Standards D1796-83 and D2276-78, (b) periodic draining of the emergency fuel oil system storage tanks and day tanks, (c) cleaning and visual inspection of internal surfaces of the emergency fuel oil system storage tanks and day tanks during periodic draining, (d) ultrasonic measurements of the emergency fuel oil system storage tank and fuel oil day tank bottom thickness if there are indications of reduced cross sectional thickness found during the visual inspection, (e) periodic volumetric examination of tank bottom from the external surface of the diesel fire pump fuel oil day tank and security diesel generator fuel oil day tank where tank design prevents cleaning and inspection from the inside, and (f) inspection of new fuel oil before introduction to storage tanks.

Visual inspections are performed on all accessible internal surface coatings of the emergency diesel fuel oil storage tanks and day tanks. 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. 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 One-Time Inspection program (B2.1.18) will be used to verify the effectiveness of the Fuel Oil Chemistry program.

NUREG-1801 Consistency

The Fuel Oil Chemistry program is an existing program that, following enhancement, will be consistent, with NUREG-1801, Section XI.M30, *Fuel Oil Chemistry*.

Exceptions to NUREG-1801

None

Enhancements

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

Preventive Actions (Element 2)

Procedures will be enhanced to include periodic draining of the water from the bottom of the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank.

Procedures will be enhanced to add biocide to the diesel fire pump fuel oil day tank and security diesel generator fuel oil day tank if periodic testing indicates biological activity or evidence of corrosion.

Preventive Actions (Element 2) and Detection of Aging Effects (Element 4)

Procedures will be enhanced to include draining, cleaning, and inspection of the emergency fuel oil system day tanks within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation.

Parameters Monitored or Inspected (Element 3)

Procedures will be enhanced to include a determination of water and sediment in the periodic sampling of the emergency fuel oil system day tanks and security diesel generator fuel oil day tank.

Procedures will be enhanced to include a determination of particulate concentrations in the periodic sampling of the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank.

Procedures will be enhanced to include a determination of microbial activity concentrations in the periodic sampling of the emergency fuel oil system storage tanks, emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank.

Procedures will be enhanced to include new fuel oil receipt sampling for water and sediment prior to introduction into the security diesel generator fuel oil day tank and diesel fire pump fuel oil day tank.

Detection of Aging Effects (Element 4)

Procedures will be enhanced to perform a volumetric examination of the emergency fuel oil system storage tanks and day tanks after evidence of tank degradation is observed during the visual inspection within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation.

Procedures will be enhanced to perform a volumetric examination on the external surface of the diesel fire pump fuel oil day tanks and security diesel generator fuel oil day tank within the 10-year period prior to the period of extended operation and at least once every ten years after entering the period of extended operation.

Monitoring and Trending (Element 5)

Procedures will be enhanced to include at least quarterly trending for water, biological activity, and particulate concentrations on the emergency fuel oil system day tanks, diesel fire pump fuel oil day tanks, and security diesel generator fuel oil day tank.

Corrective Actions (Element 7)

Procedures will be enhanced to include immediate removal of accumulated water when discovered in the emergency fuel oil system day tank, diesel fire pump fuel oil day tank, and security diesel generator fuel oil day tank.

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 emergency diesel fuel oil storage tanks and day tanks. 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. 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.

Operating Experience

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

1. Historically, Callaway has met technical specification acceptance criteria for particulate concentration in the diesel fuel oil. Over the last ten years since 2001, particulate results averaged 0.181 ppm for the "A" tank and 0.190 ppm for the "B" tank. For the last five years since 2006 these values have been 0.104 ppm and 0.173 ppm, respectively. These results are below the Technical Specification requirement of 10 ppm. Callaway also filters both in-ground diesel fuel oil tanks every two years with a portable filter skid and adds biocide for microbiological control. This filtering provides additional assurance that particulate remains low in the diesel fuel oil storage tanks. A review of the maintenance history for the emergency fuel oil system diesel fuel oil filters for the past ten years indicates no examples of fuel oil system fouling.

2. During Refuel 16 (Fall 2008), as part of the 10-year cleaning and inspection of the emergency fuel oil system storage tank TJE01B, the condition of the internal protective coating was inspected. The coating was compared to plant specifications and vendor documents, which require two coats of bitumastic coal-tar epoxy. There were no concerns with the coating, and the tank was very clean without any sediment or organic matter.

3. In 2009, a diesel fuel oil program self-assessment was performed. The following changes were made as a result of the assessment findings. (a) The Certificate of Compliance for incoming diesel fuel oil truck loads was updated to include assurances that no biodiesel is present. (b) The diesel fuel oil testing program procedure was changed to include PMs for sampling of both underground storage tanks after each outage, including specific gravity, density, lubricity and microbial activity.

4. In 2010, in response to industry operating experience concerning contamination of diesel fuel oil with biodiesel, the following actions were taken to ensure that biodiesel is not used at Callaway: (a) a procedure which tests for biodiesel was created; (b) both diesel fuel oil storage tanks were sampled for biodiesel and verified to have less than minimum detectable; (c) testing for biodiesel was added to the required analyses for truck receipt sampling; (d) PMs were created to sample the fuel oil storage tanks after the 24 hour diesel runs at the end of each outage.

5. During Refuel 17 (Spring 2010), as part of the 10-year cleaning and inspection of the emergency fuel oil system storage tank TJE01A, the condition of the internal coating was inspected and determined to be in acceptable condition. No debris, sludge, or bare metal areas were identified during the inspection. The coal tar epoxy coating was in good condition, however, coating blisters were identified in various places. An engineering evaluation determined the identified blistering was acceptable since all instances were less than nickel size. No issue with the coatings has been documented in any of the previous inspections. The procedure requiring the condition of each tank coating to be documented was enhanced to require inclusion of pictures of the internal coating condition and additional details regarding tank internal coating cleanliness, coating color, coating uniformity, and general tank condition.

The above examples provide objective evidence that the existing Fuel Oil Chemistry program is capable of both monitoring and detecting the aging effects associated with fuel oil environments. Occurrences that would be identified under the Fuel Oil Chemistry 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 Fuel Oil Chemistry program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Fuel Oil Chemistry program, following enhancement, supplemented by the One-Time Inspection program (B2.1.18), 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.

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

Program Description

The Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components program manages changes in material properties, 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, concrete 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.

~~In addition, the internal coatings of the service water pump strainers are periodically visually inspected to ensure that loss of coating integrity is detected prior to (1) loss of component intended function, including loss of function due to accelerated degradation caused by localized coating failures, and (2) degradation of downstream component performance due to flow blockage.~~

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. 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.

B2.1.24 Lubricating Oil Analysis

Program Description

The Lubricating Oil Analysis program manages oil environments in order to prevent loss of material and reduction of heat transfer. The program does not manage component surfaces directly, but maintains lubricating oil contaminants (primarily water and particulates) within acceptable limits, thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer.

The Lubricating Oil Analysis program provides sampling, analysis, and condition monitoring activities in order to identify detrimental contaminants, such as water, particulates, and specific wear elements. Water and particulate contaminant levels are trended, and recommendations are made when adverse trends are observed, including in-leakage and corrosion product build-up. Sampling frequencies and acceptance criteria for water and particulate concentrations are consistent with vendor and industry guidelines. Corrective actions are initiated when the component's oil sample has phase separated water in any amount or water content exceeds an establish target value.

The One-Time Inspection program (B2.1.18) will be used to verify the effectiveness of the Lubricating Oil Analysis program.

NUREG-1801 Consistency

The Lubricating Oil Analysis program is an existing program that is ~~, following enhancement, will be~~ consistent with NUREG-1801, Section XI.M39, *Lubricating Oil Analysis*.

Exceptions to NUREG-1801

None

Enhancements

None

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

~~*Scope of Program (Element 1)*~~

~~Procedures will be enhanced to indicate that lubricating oil contaminants are maintained within acceptable limits, thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer.~~

~~*Detection of Aging Effects (Element 4) and Acceptance Criteria (Element 6)*~~

~~Procedures will be enhanced to state the testing standards for water content and particle count.~~

~~*Acceptance Criteria (Element 6)*~~

~~Procedures will be enhanced to state that phase separated water in any amount is not acceptable.~~

Operating Experience

The following discussion of operating experience provides objective evidence that the Lubricating Oil Analysis 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 2004, during an analysis of the auxiliary feedwater pump turbine lubricating oil, the oil sample from the reservoir was found to contain elevated water content (over 5000 ppm). The cause was a turbine steam leak from the outboard gland casing that migrated into the lube oil system. The steam leak was repaired, and the oil quality was restored through an oil change.

2. In 2005, during a routine oil analysis on the turbine driven auxiliary feedwater pump, the particle count and silicon levels were found to be above the acceptable ranges. An evaluation could not determine the origin of the dust or dirt contaminant ingression. One potential cause was the vented filler cap allowing dust stirred up by nearby work. The oil was determined to be able to continue to provide acceptable lubrication, as demonstrated by the viscosity, lack of water, and lack of other contaminants. Vibration test results were reviewed, and no bearing degradation was evident. The pump was determined to be qualified for continued use after bearing reservoir draining and flushing. There has not been a reoccurrence of dust or dirt contamination in the turbine driven auxiliary feedwater pump lubricating oil.

3. In 2009, during a routine analysis of the turbine driven auxiliary feedwater pump lubricating oil, the oil sample on the outboard bearing reservoir was observed to be dark due to an elevated iron content. The cause was determined to be an improperly installed bearing retainer ring. The ring was subsequently installed correctly.

4. In 2009, routine oil samples indicated viscosity of the safety injection pump was increasing. The condition was documented and the oil was replaced.

The Lubricating Oil Analysis program operating experience provides objective evidence that the program is capable of monitoring lubricating oils to preserve an environment that is not conducive to aging effects. Occurrences that would be identified under the Lubricating Oil Analysis 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 Lubricating Oil Analysis program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Lubricating Oil Analysis program, ~~following enhancement,~~ supplemented by the One-Time Inspection program (B2.1.18), 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.