CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) Set #13 and Set #14 RESPONSES

Set #13 Responses

RAI B2.1.13-2a

Background:

The “detection of aging effects” program element of NUREG-1801, “Generic Aging Lessons Learned Report,” (GALL Report) aging management program (AMP) XI.M26, “Fire Protection,” states that visual inspections of fire barrier penetration seals, walls, ceilings, floors, doors, and other fire barrier materials are performed by fire protection qualified personnel. During the audit, the staff noted that Fire Protection Program inspections are performed by personnel qualified as Quality Control Inspectors and Operations personnel.

In RAI B2.1.13-2 issued by letter dated July 5, 2012, the staff requested that the applicant explain the minimum training and qualifications required for personnel who perform Fire Protection Program inspections and how only personnel with the required training and experience are assigned to perform Fire Protection Program inspections since a fire protection qualification is not used. In its response dated August 6, 2012, the applicant stated that the personnel performing the Fire Protection Program inspections are qualified consistent with American National Standards Institute (ANSI) N45.2.6-1978, “Qualifications of Inspection, Examination, and Testing Personnel for Nuclear Power Plants.” The applicant also stated that the quality control personnel are trained and qualified to perform their activities in accordance with procedure QCP-ZZ-01000, “QC Inspector Qualification.” The applicant further stated that the operations personnel who perform fire door inspections are qualified by a specific watch-station qualification program.

Issue:

The applicant’s response did not discuss any specific fire protection related training or qualifications required for personnel performing Fire Protection Program inspections. The staff noted that ANSI N45.2.6-1978 requires that personnel performing inspections be qualified within their respective areas of responsibility. However, since the personnel performing Fire Protection Program inspections are quality control or operations personnel, their qualifications could only be related to quality control or operations and that would be consistent with ANSI N45.2.6-1978. It remains unclear to the staff how only personnel with the required training and experience in fire protection are assigned to perform Fire Protection Program inspections since a fire protection qualification is not used.

Request:

Explain the specific fire protection related training and experience that the quality control and operations personnel who perform Fire Protection Program inspections receive and how only the personnel with fire protection related training and experience are used to perform Fire Protection Program inspections.

Callaway Response

In accordance with Callaway procedure APA-ZZ-00925, "Training and Qualification of Plant Personnel," all Callaway personnel assigned to perform work at Callaway may do so only after obtaining the necessary qualifications. Qualification is granted either for a specific task, or for a job (group of tasks). Qualification is obtained by successfully completing all formal and practical training activities that are identified as applicable to the task(s), and consists of any combination of classroom courses, computer-based training, structured on-the-job training, or performance based activities. All personnel are responsible for ensuring that they are qualified for the tasks which they perform by using a Callaway database called QualMaster. Aligned with APA-ZZ-00925, certification of Quality Control (QC) inspectors is in accordance with American National Standards Institute (ANSI) N45.2.6-1978, "Qualifications of Inspection, Examination, and Testing Personnel for Nuclear Power Plants," with site qualification guided by Callaway procedure QCP-ZZ-01000, "QC Inspector Qualification."

The Quality Control (QC) inspectors who perform Fire Protection Program inspections are certified Level 2 and Level 3 inspectors. The inspections of fire barriers, penetration seals, or fireproofing are performed using Callaway surveillance procedures that contain specific acceptance criteria, and have undergone review by the Fire Protection Engineer and/or Fire Protection System Engineer. Inspections associated with maintenance or modification activities are performed by Level 2 and Level 3 QC inspectors who have been certified in a specific discipline (e.g., Mechanical, Electrical or Civil) per ANSI N45.2.6-1978. Maintenance or modification of a fire barrier, penetration seal, or fireproofing would be inspected by a QC inspector certified in the civil discipline. As with other qualifications at Callaway, the Level 2 or 3 certifications as well as the discipline-specific certifications can be validated in QualMaster. Related qualifications, such as passing an annual visual acuity exam, are also validated in QualMaster.

The Operations personnel who perform Fire Protection Program inspections are Equipment Operators who are also qualified to perform the job of "Equipment Operator Inside (Watchstation Qualified)." An individual with this qualification has completed an Inside Equipment Operator qualification card which requires demonstrated proficiency in the areas of responsibility for an Inside Operator including familiarity with the fire protection system through a Fire Protection System Walkdown Checkout. The system walkdown checkout requires the trainee to demonstrate understanding of the system operation, its relation to other systems, and pertinent operating experience. As a qualified Equipment Operator, the individual also has completed all required initial training. This includes lesson plans on the Fire Protection System and Watch Station Practices and Rounds. Among the general watch stander practices that are reviewed is the expectation that the watch stander validates that fire doors are closed and visible fire barriers intact and in good operating condition. In some cases, Inside Equipment Operator undergoing qualification may perform Fire Protection surveillances or inspections for which they are qualified before they are fully qualified on all watch stations. Any personnel, including Equipment Operators, who are not qualified for the inspection or surveillance activity would not be allowed to perform that work independently. Equipment Operators are also qualified members of the Callaway Fire Brigade. While Fire Brigade responsibilities do not include performing fire protection inspections, this added responsibility contributes to a heightened awareness and sensitivity towards fire protection system functions and features.

Corresponding Amendment Changes

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

RAI B2.1.15-2a

Background:

The response to RAI B2.1.15-2 (part d) provided by letter dated August 6, 2012, stated that the condensate storage tank (CST) acrylic rubber sealant is credited as preventative measure for the CST urethane foam insulation and CST metallic surface.

The response to RAI B2.1.15-3 Part (a) provided by letter dated August 6, 2012, stated in part, "[e]xternal wall surface inspection will require insulation to be removed on 25 locations on the tank external walls to allow inspection for loss of material and cracking. At least 10 of the 25 locations will be near the base of the tank wall. Each location will measure approximately one square foot in area."

In addition, the response to B2.1.15-3 Part (a) stated, "[t]he tank bottom internal surface will be examined by measuring thickness along 12-inch wide bands of the bottom. The tank thickness measurements will be performed once within the five years of entering the period of extended operation and whenever the tank is drained.

Issue:

External visual inspections conducted by the Aboveground Metallic Tanks Program could detect cracking or blistering in the acrylic rubber sealant; however, minor cracks could occur between inspections and admit water that would leach through the urethane foam insulation. The staff agrees that a one-time inspection of 25 one square foot samples of the tank's external wall surfaces prior to entering the period of extended operation is an acceptable method to confirm that leakage through the insulation is not occurring. Inspecting only portions of the external surface of the tank is not consistent with GALL Report AMP XI.M29, and therefore the staff requires further information to ensure that the intended function(s) of the tank will be met during the period of extended operation.

- It is not clear to the staff when in the period prior to the period of extended operation the one-time inspection of the tank walls will be conducted. Inspection timing is important to ensure that adequate operating time has occurred such that degradation should be observable if it is occurring.
- The response stated that only wall inspections would be conducted; however, the dome region is important because water would be less likely to dissipate than from the vertical sides of the tank.
- Neither the program nor the Final Safety Analysis Report (FSAR) Supplement was revised to include details on the inspections, including the number and size. The basis for the staff's finding that the one-time inspection program is acceptable is in part based on the size of the inspections and locations where they will be occurring.

For tank bottom inspections, it is not clear to the staff how many bottom measurements will be obtained in each 12-inch band.

Request:

State the timing of the one-time inspection of external surfaces of the tank. State whether and how many inspections will be conducted in the external metallic surface of the dome region, or state the basis for why no inspections are necessary in the dome region. State how many inspection points will be conducted in each 12-inch band of the tank bottom. Amend the program and FSAR Supplement to include the timing of the one-time inspection, the size of the wall and dome inspections, and the number of inspections for the wall and dome.

Callaway Response

The timing of the one-time inspection of the external surfaces of the tanks will be within the five-year period prior to the period of extended operation.

A minimum of two locations of the 25 tank external wall one-square-foot surface samples will be inspected on the external metallic surface of the dome region.

The original response to RAI B2.1.15-3 discussed the inspection of the tank bottom using 12-inch bands with an ultrasonic scanning thickness measurement on the tank bottom. The inspection method is revised as follows:

First, a scanning technique (for example, low frequency electromagnetic technique or equivalent) will be utilized to screen the entire tank bottom internal surface. The scanning technique has the capability to detect loss of material below nominal plate thickness. For any region(s) on the tank bottom with a thickness below the nominal plate thickness, an ultrasonic thickness (UT) measurement will be performed to obtain the thickness of the tank bottom at the loss of material indication. If significant loss of material is indicated, future monitoring with UT thickness measurements and trending will be performed.

Amendment 14 in Enclosure 2, revises LRA Appendices A1.15 and Appendix B2.1.15 to include the timing of the one-time inspection, and the size and number of the wall and dome inspections.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI B2.1.15-4a

Background:

The response to B2.1.15-4 provided by letter dated August 6, 2012, stated that the fire water storage tanks (FWSTs) are cleaned and inspected on an alternating refueling outage (RFO) frequency and will be recoated prior to the period of extended operation to remove the coating delaminations and prevent them from becoming an impact on the intended function(s) of downstream components. The response also stated that the outlets of the FWSTs consist of 14-inch pipe that extends 3 feet inside the tank and ends in a 90 degree radius elbow turned downward ending 6 inches above the bottom of the tank and therefore, in the event of delamination, this geometry would preclude any large pieces of coating from entering the outlet of the tank and affecting downstream equipment.

The Callaway Addendum to the FSAR, Section 9.5.1.2.1 states, "[t]he FPS water supply is separated from all other site water supply systems and is based on providing 2300 gallons per minute of water for two hours to sprinkler systems with a simultaneous total flow of 1000 gallons per minute to hose stations."

Issue:

While the replacement of the coatings and subsequent inspections are beyond the recommendations in GALL Report AMP XI.M29, the plant-specific operating experience cited in RAI B2.1.15-4 results in the staff requiring further information to ensure that the intended function(s) of the tank and downstream in-scope components will be met during the period of extended operation. The staff understands that the coatings will be replaced prior to the period of extended operation; however, given past plant-specific operating experience, subsequent delamination of coatings could occur.

The fluid velocity corresponding to 3300 gpm in a 14-inch pipe is approximately 7.8 feet per second. Given the six inch clearance to the bottom of the tank, delaminated particles could be carried into the flow stream. The staff lacks sufficient information to determine that downstream components will not be impacted by delaminated coatings if the coatings are not managed for aging.

Request:

Revise the fire water system or Aboveground Metallic Tanks Program, and the corresponding FSAR supplement, to indicate the frequency of coating inspections to confirm that delamination of the coatings is not occurring. Alternatively, provide the basis for why the smallest size delaminated particle that could prevent an in-scope intended function from being performed will not be transported from the tank.

Callaway Response

LRA Section A1.14 and LRA Appendix B2.1.14 have been revised as shown in LRA Amendment 14, Enclosure 2 to indicate that the internal coatings on the fire water storage tanks will be inspected with a minimum frequency of alternating refueling outages.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI B2.1.25-5a

Background:

By letter dated August 6, 2012, in response to RAI B2.1.25-5 related to utilization of the 100 mV criterion the applicant stated:

> The Buried and Underground Piping and Tanks program will use the 100 mV polarization as an acceptance criterion based on protecting the most noble metal in a dissimilar metal environment consistent with NACE RP0169-2007 Section 6.2 criteria. Protection of the most noble buried in-scope material will consist of evaluating the buried metallic piping and tanks that are electrically tied together. Using published industry galvanic series charts, the most anodic material will be identified and then raised 100 mV greater than the published number in relation to the copper-copper sulfate half-cell. Instances where protection cannot be demonstrated with this method will be entered into the Corrective Action Program. The EPRI sponsored Cathodic Protection User's Group will be used to provide operating experience associated with the 100 mV criteria.

Issue:

Given that LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report," Revision 2, AMP XI.M41, "Buried and Underground Piping and Tanks," Table 6a, "Cathodic Protection Acceptance Criteria," provides specific cathodic protection criteria and does not cite NACE RP0169-2007, the intent of the reference to NACE RP0169-2007 is not clear.

In relation to the statement, "[p]rotection of the most noble buried in-scope material will consist of evaluating the buried metallic piping and tanks that are electrically tied together," it is not clear to the staff why the copper grounding grid is not considered in the evaluation.

The staff could not determine how the galvanic series chart will be utilized in relation to as-found cathodic protection survey data.

Finally, the staff believes that when the 100 mV polarization criterion is used, there must be some means (e.g., buried coupons, electrical resistance probes) to verify that the most anodic material is being protected.

Request:

a) Justify the use of RP0169-2007 Section 6.2 criteria if the 100 mV criterion will be used absent a means to verify its effectiveness in preventing corrosion of the least noble metal.

b) State why the copper grounding grid was not included in the scope of buried items to be evaluated.

c) State specifically how the 100 mV criterion will be applied in relation to the galvanic series chart and for which materials the criterion will be utilized.

d) State what methods will be utilized to confirm the results of the cathodic protection surveys. Revise the Buried and Underground Piping and Tanks Program and FSAR Supplement to reflect the use of this method. State what actions will be taken if the chosen method indicates that corrosion of in-scope buried components is occurring more rapidly than expected. This response should not be limited to a reference to entering the condition in the corrective action program.

Callaway Response

a) Callaway acknowledges that the applicable NACE Standard for buried piping is SP0169-2007, and not RP0169-2007 as stated in the response to RAI B2.1.25-5. Callaway's original response did not consider Final License Renewal Interim Staff Guidance (ISG) Document LR-ISG-2011-03 that was issued August 2, 2012. LR-ISG-2011-03, section titled Cathodic Protection Survey Acceptance Criteria has restricted the use of 100mV criterion unless the piping of question is:

a. Limited to electrically isolated piping sections or;
b. Areas of grounded piping where the effects of mixed potentials are shown to be minimal

Based on the network of grounding used at the Callaway site, there is limited if any, electrically isolated piping either from the grounding system or from other plant systems. All piping systems are electrically grounded to the plant grounding grid and cathodic protection "bonding jumpers" were used in the original cathodic protection design to limit stray current corrosion effects. Therefore, there are no electrically isolated piping sections.

The result of the mixed metal coupling as a result of the copper grounding grid and the bonding jumpers cannot be shown to be minimal at this time based as no data exists to quantify this effect. Therefore, there is no basis at this time to support use of the 100mV criterion for License Renewal in-scope piping systems.

b) The copper grounding grid is included with the response to a).

c) This response was revised under response a) above. In addition, during research of galvanic series charts, it was identified that there exists a wide range of polarization readings for similar metals. This varying range did not provide an adequate basis for which to draw acceptance criterion from and therefore will not be used.

d) Callaway will utilize corrosion coupons to ensure that the cathodic protection system is providing sufficient protection for buried steel components within the scope of license renewal. If the corrosion coupons indicate that corrosion of buried components within the scope of license renewal is occurring more rapidly than expected, troubleshooting of the cathodic protection system will be performed to determine if sufficient protection is being provided. Only buried steel components are within the scope of license renewal and use cathodic protection as a preventative measure. There are no copper or aluminum buried components within the scope of license renewal at Callaway.

LRA Appendix A1.25 and Appendix B2.1.25 have been revised as shown in Amendment 14 in Enclosure 2 to identify the use of corrosion coupons to ensure that the cathodic protection system is providing sufficient protection for buried steel components within the scope of license renewal.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI B2.1.25-6a

Background:

The staff noted that based upon a review of the response to RAI B2.1.1-1, dated August 21, 2012, associated with the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program, leaks in essential service water (ESW) piping have been categorized as being caused by microbiologically influenced corrosion (MIC), and since 2005, no leaks have occurred. The response to RAI B2.1.10-6, dated August 21, 2012, associated with the Open-Cycle Cooling Water System program, states that only one leak has occurred to date in buried ESW piping. This leak was caused by MIC.

LR-ISG-2011-03, "Generic Aging Lessons Learned (GALL) Report," Revision 2, AMP XI.M41, "Buried and Underground Piping and Tanks," revised the recommendation related to the number of buried piping inspections for instances where cathodic protection does not meet availability and effectiveness goals from four per 10-year period starting 10 years prior to the period of extended operation to 7, 10 and 12 inspections in each of the 10-year periods, respectively.

The response to RAI B2.1.25-6 dated August 6, 2012, states that while the cathodic protection system is not currently being operated in accordance with the recommendations in the AMP, the ESW piping coatings and backfill do meet AMP XI.M41 recommendations, and therefore, four inspections in the 10-year period prior to the period of extended operation would be appropriate. It also states that if operation of the cathodic protection system were to be brought into conformance with the recommendations in AMP XI.M41 during the period of extended operation, one inspection would be conducted in each 10-year period.

Issue:

It is not clear to the staff if any of the leaks in ESW piping occurred due to external corrosion. The staff noted that based on its review of plant-specific operating experience, three leaks and one instance of coating degradation occurred in fire protection piping. It is not clear to the staff whether the buried fire protection piping leaks and coating degradation occurred in locations with less rigorous specifications for backfill. If the ESW piping leaks originated from the outside surface of the buried piping or the fire protection buried piping leaks occurred in locations where the backfill specifications were the same as for the ESW piping, four inspections in the 10-year period prior to the period of extended operation would not be consistent with the recommendations in LR-ISG-2011-03.

Four inspections in each 10-year period starting 10 years prior to the period of extended operation where the cathodic protection system is not meeting availability or effectiveness goals is not consistent with LR-ISG-2011-03.

Request:

a) State whether any of the ESW leaks cited in the responses to the above RAIs originated from the outside surface of the buried piping.

b) State whether buried fire protection leaks originating from the outside surface of the buried piping occurred in locations where the backfill specifications were the same as those for the in-scope ESW piping.

c) State the basis for why four inspections would be sufficient to ensure that the buried in-scope ESW piping would meet its intended function(s) for instances where cathodic protection does not meet availability and effectiveness goals recommended in LR-ISG-2011-03.

Callaway Response

a) None of the leaks that were identified in the ESW system originated from the outside surface of buried piping.

b) The fire protection leaks which originated from the outside surface of buried piping were all on piping which was outside the power block, and not within the scope of license renewal. The backfill for non-power block buried piping is considered commercial-grade and is not the same as that for buried piping which is located within the power block. There are stricter requirements in place for backfill for piping located within the power block. The backfill for buried piping within the power block meets the requirements of Table 2a in LR-ISG-2011-03.

c) The cathodic protection will undergo refurbishment. The intent of this refurbishment is to demonstrate that prior to five years of entering the period of extended operation, the cathodic protection system will be operated consistent with GALL XI.M41 as revised by LR-ISG-2011-03. Following the refurbishment, annual surveys will be conducted to demonstrate that the cathodic protection system will have been operational (available) at least 85%. The cathodic protection system is also required to be effective 80% of the time following refurbishment. If the cathodic protection system meets these criteria, then consistent with category C in Table 4a of LR-ISG-2011-03, one inspection will be performed during each 10 year interval beginning with the 10 year interval prior to the period of extended operation.

   For sections of piping which do not meet the availability or effectiveness criteria recommended in LR-ISG-2011-03, then seven inspections (or 5% of the entire length of piping of that material) will be performed during years 30-40 (i.e. the 10 year interval prior to entering the period of extended operation). During years 40-50, 10 inspections (or 6% of the entire length of piping of that material) will be performed. During years 50-60, 12 inspections (or 7.5% of the entire length of piping of that material) will be performed. The number of inspections is consistent with LR-ISG-2011-03 based on the following:

   - Coatings and backfill are provided consistent with Table 2a of LR-ISG-2011-03,
   - Plant operating experience has not identified any leaks in buried piping within the scope of license renewal due to external corrosion or any significant coatings degradation.

Corresponding Amendment Changes

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

RAI B2.1.25-7

Background:

The response to RAI B2.1.14-5, dated August 6, 2012, related to the Fire Water System Program, stated, "[t]he coal tar enamel that is on the FPS can be expected to have a service life ranging from 15 to 50 years depending on soil environment. Plant operating experience reflects that some of the coating for buried fire protection system piping is nearing the end of its service life."

Issue:

It is not clear to the staff whether the portion of the fire water system where the coating is nearing the end of its service life is within the scope of license renewal. If coatings are nearing the end of their life, and the cathodic protection system is not meeting availability or effectiveness goals, the staff does not believe that four inspections in each 10-year period starting 10 years prior to the period of extended operation are sufficient to ensure that the intended function(s) of the piping will be met. If in-scope piping is affected, then LR-ISG-2011-03 recommends that 15, 20, and 25 inspections be conducted in each respective 10-year period (e.g., 15 inspections in the 30 – 40 year period) starting 10 years prior to the period of extended operation if the cathodic protection system is not meeting availability or effectiveness goals.

Request:

a) State whether the portion of the fire water system where the coating is nearing the end of its service life is within the scope of license renewal.

b) State whether the coating on any other buried in-scope piping is nearing the end of its service life.

c) If the coatings on any buried in-scope steel piping are approaching the end of life, state the basis for why four inspections would be sufficient to ensure that the buried in-scope ESW piping would meet its intended function(s) for instances where cathodic protection does not meet availability and effectiveness goals recommended in LR-ISG-2011-03.

Callaway Response

a) The information previously provided regarding the 15-50 year service life for coal tar enamel applied to buried piping was given to provide general information about the coating for a variety of applications and environmental considerations. This time frame was not intended to convey that, at a specific time, the coating will no longer provide protection for the buried piping. Inspections of buried fire protection piping within the scope of license renewal, including those performed in October of 2012, have shown no significant coating degradation and would provide the primary means of determining the effectiveness of the coating to protect the buried component. Based on inspections of buried component coatings, there is no indication that there are any sections of buried piping at Callaway which are nearing the end of the coating service life.

   The second line of defense is the cathodic protection system, which is applied to prevent corrosion at holidays, damaged or degraded areas in the coating. Annual pipe-to-soil cathodic protection surveys are conducted to measure the level of protection provided by the system and bimonthly rectifier checks are performed to ensure rectifiers are operational.

As part of the Buried and Underground Piping and Tanks program, as previously noted, trending and monitoring of cathodic protection will be included to ensure future effectiveness.

Table 1 provided in the original response to RAI B2.1.14-5, included one instance of external degradation of buried in scope fire protection piping that resulted in a leak. Further review determined that instance actually involved out of scope piping which has since been abandoned in place. An updated Table 1 has been provided in Enclosure 4 to this letter. It is concluded that there have been no leaks in buried in scope fire protection system piping as a result of external degradation.

b) The information previously provided regarding the 15-50 year service life for coal tar enamel applied to buried piping was given to provide general information about the coating for a variety of applications and environmental considerations. This time frame was not intended to convey that, at a specific time, the coating will no longer provide protection for the buried piping. Inspections of buried piping of other systems within the scope of license renewal have shown no significant coating degradation. Based on inspections of buried component coatings, there is no indication that there are any sections of buried piping at Callaway which are nearing the end of the coating service life.

The second line of defense is the cathodic protection system, which is applied to prevent corrosion at holidays, damaged or degraded areas in the coating. Annual pipe-to-soil cathodic protection surveys are conducted to measure the level of protection provided by the system and bimonthly rectifier checks are performed to ensure rectifiers are operational. As part of the Buried and Underground Piping and Tanks program, as previously noted, trending and monitoring of cathodic protection will be included to ensure future effectiveness.

c) The cathodic protection will undergo refurbishment in 2015. The intent of this refurbishment is for the cathodic protection system to demonstrate that the requirements stated in LR-ISG-2011-03 have been met prior to 2019 which is five years prior to entering the period of extended operation. Following the modification, annual surveys will be conducted to demonstrate that the cathodic protection system will have been available at least 85% and effective 80% of the time following refurbishment. If the cathodic protection system meets these criteria, then consistent with category C in Table 4a of LR-ISG-2011-03, one inspection will be performed during each 10 year interval beginning with the 10 year interval prior to the period of extended operation.

For sections of piping which do not meet these criteria, then 7 inspections (or 5% of the entire length of piping of that material) will be performed during years 30-40 (i.e. the 10 year interval prior to entering the period of extended operation). During years 40-50, 10 inspections (or 6% of the entire length of piping of that material) will be performed. During years 50-60, twelve inspections (or 7.5% of the entire length of piping of that material) will be performed. The number of inspections are consistent with LR-ISG-2011-03 since coatings and backfill are provided in accordance with Table 2a of LR-ISG-2011-03 and plant operating experience has not shown any leaks in buried piping within the scope of license renewal due to external corrosion nor any significant coatings degradation.

Corresponding Amendment Changes

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

CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) Set #13 and Set #14 RESPONSES

Set #14 Responses

RAI A1.17-1

Background:

The Callaway Plant, Unit 1 (Callaway), license renewal application (LRA), Section A 1.17 provides the final safety analysis report (FSAR) supplement for the Reactor Vessel Surveillance Program. The U.S. Nuclear Regulatory Commission (NRC or the staff) reviewed this FSAR supplement description of the program against the recommended description for this type of program as described in NUREG-1800, "Standard Review Plan for License Renewal," Revision 2 (SRP-LR), Table 3.0-1 and noted several inconsistencies between the two descriptions.

Issue:

SRP-LR Table 3.0-1 recommends that the FSAR supplement provide that (1) any future tests of surveillance capsules will meet the requirements of American Society for Testing and Materials (ASTM) Standard Practice E 185-82, "Conducting Surveillance Tests for Light-Water Cooled Nuclear Power Reactor Vessels;" (2) any changes to the capsule withdrawal schedule will be submitted to the NRC for approval; and (3) untested capsules placed in storage will be maintained for future reinsertion. The staff noted that these attributes of the program have been adequately described in LRA Section B2.1.17, which addresses the applicant's program elements; however they are not specifically addressed in the LRA Section A 1.17 FSAR supplement for the program. Therefore, the staff noted that the licensing basis for this program for the period of extended operation may not be adequate if the applicant does not incorporate this information in its FSAR supplement.

Request:

Taking into consideration the issue above, the staff requests that the applicant revise the FSAR supplement for this program so that it is consistent with the recommended description for this program in SRP-LR Table 3.0-1.

Callaway Response

Amendment 14 in Enclosure 2 has revised LRA Appendix A1.17 to be consistent with NUREG-1800, Table 3.0-1, by including the following:

- All capsules in the reactor vessel are removed and tested consistent with the test procedures and reporting requirements of ASTM E 185-82.
- Any changes to the capsule withdraw schedule, including spare capsules, must be approved by the NRC prior to implementation.
- Untested capsules placed in storage will be maintained for future insertion or testing.

Amendment 14 in Enclosure 2 has also revised LRA Appendix B2.1.17 to include the following:

- Any changes to the capsule withdraw schedule, including spare capsules, must be approved by the NRC prior to implementation.
- Evaluation of the impact of plant operating changes on the extent of reactor vessel embrittlement.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI B2.1.20-1a

Background:

By letter dated August 21, 2012, in response to RAI B2.1.20-1, the applicant amended LRA Sections B2.1.20 and A 1.20 to correct the number of in-scope socket welds for its "One-Time Inspection of ASME Code Class 1 Small-Bore Piping" AMP. The program includes a volumetric or opportunistic destructive examination of socket welds to identify potential cracking. The GALL Report AMP states that when opportunistic destructive examinations are used for socket welds, the applicant may take credit for each weld destructively examined as equivalent to having volumetrically examined two welds. The staff noted that the revised LRA is not clear on how each destructive test will be credited.

Issue:

The staff noted that the revised LRA is not clear on how each destructive examination will be credited. Specifically, if the applicant chooses to perform opportunistic destructive examinations on socket welds in lieu of volumetric examinations, it is not clear to the staff whether the applicant will adhere to the recommendation of the GALL Report AMP.

Request:

Revise LRA Sections B2.1.20 and A 1.20, to be specific about when and if opportunistic destructive examinations are used by the AMP, how each opportunistic destructive test on a socket weld will be credited in lieu of volumetric examinations. If the revised LRA Sections B2.1.20 and A.1.20 are not consistent with the GALL Report AMP program, provide justification for the exception.

Callaway Response

As allowed by the GALL Report, Callaway will credit each destructive examination of a socket weld as equivalent to having volumetrically examined two welds. LRA Sections A1.20 and B2.1.20 have been revised, as shown on Amendment 14 in Enclosure 2, to include the credit given for destructive examination of socket welds.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI B2.1.14-5a

Background:

In RAI B2.1.14-5 issued by letter dated July 5, 2012, the staff requested additional information regarding operating experience related to the water-based fire protection system piping. The response was received by letter dated August 6,2012.

The response to part (a) stated that there were two instances of leakage from the buried high-density polyethylene (HDPE) piping that was installed in 2007 which were attributed to poor fusion during installation. Although this is out-of-scope piping, similar replacements were performed in the in-scope essential service water (ESW) system. The staff lacks sufficient information to conclude that poor fusion failures will not occur on the in-scope ESW piping given that the fire water system failures did not reveal themselves for at least three months and upwards of 46 months after installation.

The response to part (b) stated that there have been no failures in the fire protection system piping related to internal aging effects since 2001. However, the staff noted that the fire main flow test failure in 2004 was attributed to internal corrosion, and that after chemical cleaning of the system in 2006, additional failures of the fire main flow test have occurred in 2009 and 2011 for which accumulation of corrosion products has not been eliminated as a cause. Although contributing factors to the flow test failures have been identified and the procedure has been revised in order to verify operability of the system, the test results indicate that the condition of the fire main is degrading and a cause has not been identified. It is not clear to the staff what caused the extensive buildup of corrosion products and tuberculation that contributed to the failed fire main flow tests and whether the existing flow testing frequency is adequate to identify degradation prior to loss of intended function given the repeat failures at the existing frequency.

The staff also noted that there were four instances in which buried piping experienced leakage but the cause could not be determined because the piping was abandoned in place or isolated. As a result of two of these cases, the entire length of piping between the plant and the training center was abandoned in place and new HDPE piping was installed. The RAI response stated that these leaks occurred just after chemical cleaning of the system, yet the summary table in the RAI response did not attribute any leakage to internal aging effects. In addition, for at least one of the cases where external corrosion was listed as the cause of the failure, the staff reviewed pictures of the failed piping during the audit which indicated that internal corrosion was also present in the piping and could have contributed to the failure. It is unclear to the staff whether the summary table included descriptions of all the degradation mechanisms observed for each instance, regardless of failure mechanism, and whether the applicant has adequately evaluated whether loss of material due to corrosion is contributing to leakage from the system.

The response to part (c) stated that microbial corrosion, coatings, and pipe wall thickness will be used to project the condition of the fire protection system piping through the period of extended operation. However, the microbiologically influenced corrosion (MIC) sampling plan, and nondestructive examination (NDE) testing plan are not credited for aging management of the fire protection system for license renewal.

The response to part (d) stated that the internal surfaces of fire protection system piping are monitored using the Raw Water Systems Control Program and the Raw Water Predictive Maintenance Program. The RAI response stated that the Raw Water Predictive Maintenance

Program includes opportunistic visual inspections to ensure the structural integrity of the piping. However, the activities in the Raw Water Systems Control and Raw Water Maintenance Programs, including water treatment activities, are not credited for aging management of the fire protection system for license renewal. It is unclear to the staff how opportunistic visual inspections of the fire water system piping are adequate to ensure the structural integrity of the piping given the unknown cause of past piping failures and failed flow tests.

The response to part (e) stated that the Fire Water System Program will be enhanced to include a sampling plan for performing NDE testing to determine general wall thickness with locations selected based on susceptible locations and information from inspections and chemistry sampling. The staff noted that the enhancement states that the program will be enhanced to include non-intrusive pipe wall thickness examinations or internal visual inspections prior to the period of extended operation and at 10-year intervals thereafter. The enhancement does not discuss the basis for where inspections will be conducted or the basis for the 10-year frequency. From the information requested, there does not appear to be a corrosion rate established for the fire protection system piping and failures have occurred much more frequently than 10 years apart.

Issue:

The staff lacks sufficient information to conclude that the activities in the Fire Water Program are adequate to manage aging for the fire protection system piping during the period of extended operation.

Request:

a) State the basis for why the inspections being conducted in accordance with the Buried and Underground Piping and Tanks Program will be sufficient to detect poor fusion of in-scope ESW piping, or state the basis for why this failure mechanism is not applicable to the piping.

b) State the cause of the extensive buildup of non-microbial corrosion products and tuberculation that contributed to the failed fire main flow tests and leakage that developed after chemical cleaning; the basis for acceptability of the existing fire main flow testing frequency for identifying degradation prior to loss of intended function; and the basis for why loss of material due to corrosion is not contributing to leakage from the system.

c) Include the MIC sampling plan, and NDE testing plan in the Fire Water System Program description and Final Safety Analysis Report (FSAR) Supplement for license renewal, or provide alternative provisions to project the condition of the fire water system components during the period of extended operation.

d) State the basis for why opportunistic visual inspections are adequate to ensure the structural integrity of the system given the unknown cause of past piping failures and failed flow tests. Include the activities which are being used to ensure the structural integrity of the fire water system in the Raw Water Systems Control and Raw Water Maintenance Programs, including water treatment activities, in the Fire Water System Program description and FSAR Supplement for license renewal, or provide alternative provisions to ensure the structural integrity of the fire water system components.

e) State the basis for the pipe wall thickness inspection frequency, inspection sample size, and inspection location selection criteria; and include this information in the Fire Water System Program and FSAR Supplement.

Callaway Response

a) The ESW piping was designed and installed consistent with ASME Class 3 quality controls. The firewater piping was installed as commercial grade piping, and the fusion joints which leaked were not within the scope of license renewal. Therefore, the fusion process used in the HDPE piping in the firewater system was not subject to the same quality controls as in the ESW system.

For the ESW piping, the polyethylene material is traceable to the resin supplier and pipe manufacturer. The resin manufacturer performed burst testing of its material in accordance with ASTM D 1599, *Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings*. Callaway performed performance testing of fused joints using test coupons prepared under its QA program, which demonstrated that the piping will fail before a properly fabricated fused joint fails. To ensure that the fused joints were properly fabricated, Callaway qualified the fusion procedure, fusion machine, and the fusion machine operators. NDE was performed on the fused joints by qualified inspectors. All joints received a visual examination, and all joints with suitable geometry received an ultrasonic Time-of-Flight Diffraction examination. Finally, a hydrostatic test was performed to verify the integrity of the ESW piping. Based on the difference in the quality control and rigor used in fabricating the fused joints, the failure mechanism observed in the fire water piping will not occur in the ESW system.

The ESW piping was installed in late 2008 and early 2009. Further evidence of the quality of the fusion joints in the ESW piping is provided by the fact that they have not leaked since they were created.

b) In 2004, the flow test of the fire water piping failed due to the buildup of deposits in the piping. The cause of the buildup of deposits was that the carbon steel piping was exposed to the raw water of the fire water system for over 20 years. The buried portions of the main fire loop piping were chemically cleaned in August 2006 to remove accumulated corrosion products from the interior pipe wall. Because the flow test failure in 2004 occurred after 20 years of operation, and the piping was chemically cleaned in 2006, performing flow tests every three years will provide adequate data for trending to identify degradation prior to loss of intended function.

Although internal corrosion was not identified as the cause of any of the leaks in the fire water system since 2001, there were leaks where the cause was not identified. However, the inspection program described in d) below will manage internal corrosion of the fire water system and ensure that it will be able to perform its intended functions.

c) Microbiological-influenced corrosion (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. Wall thickness measurements will be performed on fire water piping 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. Wall thickness measurements will use Low Frequency Electromagnetic Technique (LFET) or equivalent as a screening tool to identify "spots of interest" which are then followed up with ultrasonic (UT) testing on the spots of interest.

LRA Sections A1.14 and B2.1.14 have been revised, as shown on Amendment 14 in Enclosure 2, to include the description of the fire water piping wall thickness examinations, MIC quarterly testing, and biofouling chemical treatments. LRA Table A4-1 has also been revised, as shown on Amendment 14 in Enclosure 2, to add the requirements for NDE testing of the fire water piping.

d) As described in c) 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. Water treatment of the fire water system was initiated in 1996, which has contributed to the lack of failures in fire water piping within the scope of license renewal attributed to internal aging effects since 2001.

LRA Sections A1.14 and B2.1.14 have been revised, as shown on Amendment 14 in Enclosure 2, to include a description of the fire water piping wall thickness examination, MIC quarterly testing, and biofouling chemical treatments. LRA Table A4-1 has also been revised, as shown on Amendment 14 in Enclosure 2, to add the requirements for NDE testing of the fire water piping.

e) As discussed above, wall thickness examinations will be performed for portions of the fire water piping 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, commencing after 2014. The basis for this frequency is that it is the same frequency as the yard fire loop flush and the flow tests of the fire water loops, which is set by FSAR Table 9.5.1-2 SP, items 2.4 and 2.7. The sample size assures that over 1000 feet of piping in 30 locations will be inspected during the following 30 years. Sample locations for each inspection will be based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes.

LRA Sections A1.14 and B2.1.14 have been revised, as shown on Amendment 14 in Enclosure 2, to include the basis, as described above, for the inspection frequency, sample size, and sample location selection criteria.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table "Amendment 14, LRA Changes from RAI Responses," for a description of LRA changes with this response.

Amendment 14, LRA Changes from RAI Responses

Enclosure 2 Summary Table

Affected LRA Section	LRA Page
A1.14	A-8
A1.15	A-8 (continued)
A1.17	A-9
A1.20	A-11 and A-12
A1.25	A-13
Table A4-1, item 10	A-38
Table A4-1, item 11	A-39
Table A4-1, item 12	A-39 (continued) and A-40
Table A4-1, item 13	A-40 (continued)
Section B2.1.14	B-53, B-54, B-55, B-56, and B-56 (continued)
Section B2.1.15	B-57, B-58, and B-59
Section B2.1.17	B-64, B-65, and B-66
Section B2.1.20	B-72, B-73, and B-74
Section B2.1.25	B-87, B-88, B-89, and B-90

A1.14 FIRE WATER SYSTEM

The Fire Water System program manages loss of material for water-based fire protection systems. Consistent with National Fire Protection Association (NFPA) commitments, the program consists of periodic full-flow flush tests and system performance tests to prevent corrosion from biofouling in the fire protection system. The 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.

The Fire Water System program conducts flow tests through each open head spray/sprinkler nozzle to verify water flow is unobstructed. 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.

Non-intrusive wall thickness examinations are performed on fire water piping to identify loss of material. Wall thickness examinations will be performed on fire water piping every three years. Each three year sample will include at least three locations for a total of 100 feet of above-ground fire water piping and be selected based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes. The basis for the frequency is that three years is the frequency required by the FSAR for the yard fire loop flush and for the flow tests of the fire water loops. ~~As an alternative~~ In addition, visual internal inspections are used when the internal surface of the piping is exposed during plant maintenance. These inspections evaluate (a) wall thickness to ensure against catastrophic failure and (b) the inner diameter of the piping as it applies to the design flow of the fire protection system.

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 internal coating of the fire water storage tanks will be inspected with a minimum frequency of alternating refueling outages.

A1.15 ABOVEGROUND METALLIC TANKS

The Aboveground Metallic Tanks program manages loss of material and cracking on the external surfaces of aboveground metallic tanks within the scope of license renewal that are supported on concrete or soil. The program also manages cracking, blistering, and change in color of the acrylic/urethane insulation on the condensate storage tank (CST). The program applies to the CST, refueling water storage tank (RWST), and the two fire water storage tanks (FWSTs).

For the carbon steel fire water storage tanks, the program relies on application of paint, coating, or tank bottom edge grout as corrosion preventive measures. In addition, cathodic protection is used as a preventive measure to prevent corrosion on exposed bare metal as-left surfaces of the tanks.

This program performs visual inspections to monitor for aging of the tank wall and dome external surface paint or damage of the insulation covering. Twenty-five external locations of approximately one square foot in area will be inspected, with at least ten locations near the base of the tank wall and at least two locations on the dome. Removal of the tank insulation permits a sampling of the tank external surfaces to be inspected for aging.

Thickness measurements are taken from inside the emptied tanks to determine the thickness of the tank bottom. The entire tank bottom will be scanned to detect loss of material. Thickness measurements will be performed on regions of the tank bottom that indicate a loss of material below nominal plate thickness. The thickness measurements ensure significant loss of material is not occurring, so that the intended function of each tank is maintained during the period of extended operation.

The chemical treatments of cooling tower water do not contain chemical compounds that could cause cracking, pitting, or crevice corrosion on the external surfaces of the tanks. Within five years of entering the period of extended operation, a one-time soil surface sample near the CST and RWST will be performed. The soil surface sample will be evaluated to ensure that chlorides or other aggressive cooling tower water treatment chemicals are not creating an aggressive environment that would degrade the CST, RWST, or their insulation jacketing.

The Aboveground Metallic Tanks program is a new program that will be implemented within ~~five years of entering the~~ the five year period prior to the period of extended operation.

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

A1.17 REACTOR VESSEL SURVEILLANCE

The Reactor Vessel Surveillance program manages loss of fracture toughness and is consistent with ASTM E 185. The surveillance capsules contain reactor vessel steel specimens of the limiting beltline material; and associated weld metal and weld heat affected zone metal. The surveillance coupons are tested by a qualified offsite vendor, to its procedures. The testing program and reporting conform to requirements of The program extends the scope of 10 CFR 50, Appendix H, *Reactor Vessel Material Surveillance Program Requirements*, to provide sufficient material data and dosimetry for monitoring irradiation embrittlement at the end of the period of extended operation, and also determines the need for operating restrictions on the inlet temperature, neutron spectrum, and neutron flux.

All capsules in the reactor vessel are removed and tested consistent with the test procedures and reporting requirements of ASTM E 185-82. Any changes to the capsule withdraw schedule, including spare capsules, must be approved by the NRC prior to implementation. Untested capsules placed in storage will be maintained for future insertion or testing.

Vessel fluence will be determined by ex-vessel dosimetry after all capsules have been removed.

A1.20 ONE-TIME INSPECTION OF ASME CODE CLASS 1 SMALL-BORE PIPING

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program manages cracking of ASME Code Class 1 piping less than four inches nominal pipe size (NPS 4) and greater than or equal to NPS 1.

For ASME Code Class 1 small-bore piping, the Risk-informed (RI-ISI) ISI program requires volumetric examinations (by ultrasonic testing) on selected butt weld locations to detect cracking. Weld locations are selected based on the guidelines provided in EPRI TR-112657, *Revised Risk-Informed Inservice Inspection Evaluation Procedure*. Ultrasonic examinations are conducted in accordance with ASME Section XI with acceptance criteria from paragraph IWB-3000 for butt welds.

The program will include a volumetric or opportunistic destructive examination of socket welds to identify potential cracking. Callaway has experienced one case of cracking, in 1995, of an ASME Code Class 1 small-bore piping butt weld resulting from cyclical loading which was mitigated with a design change to prevent recurrence. Eight small-bore Class 1 socket welds will be selected for examination, which represents 10 percent of the population. There are 77 Class 1 small-bore socket welds in the population of ASME Code Class 1 piping less than NPS 4 and greater than or equal to NPS 1 at Callaway. Alternatively, an opportunistic destructive examination may be used in lieu of volumetric examinations. An opportunistic destructive examination may be performed when a weld is removed from service for reasons other than inspection. Because more information can be obtained from a destructive examination than from a nondestructive examination, each weld destructively examined will be considered equivalent to having volumetrically examined two welds.

Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. If a qualified volumetric examination procedure for socket welds endorsed by the industry or the NRC is available and incorporated into the ASME Section XI Code at the time of the small-bore inspections, then this will be used for the volumetric examinations. If no volumetric examination procedure for ASME Code Class 1 small-bore socket welds has been endorsed by the industry or the NRC and incorporated into ASME Section XI at the time Callaway performs inspections of small-bore piping, a plant procedure for volumetric examination of ASME Code Class 1 small-bore piping with socket welds will be used.

The program includes controls to implement an alternate plant-specific periodic inspection aging management program should evidence of ASME Class 1 small bore piping cracking caused by intergranular stress corrosion cracking or fatigue be confirmed by review of Callaway operating experience prior to the period of extended operation or by the examinations performed as part of this program.

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program and inspections will be completed and evaluated within six years prior to the period of extended operation.

In conformance with 10 CFR 50.55a(g)(4)(ii), the ISI program is updated during each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval. Callaway will use the ASME Code Edition consistent with the provisions of 10 CFR 50.55a during the 10-year period prior to the period of extended operation (fourth interval).

A1.25 BURIED AND UNDERGROUND PIPING AND TANKS

The Buried and Underground Piping and Tanks program manages loss of material, cracking, blistering, and change of color of the external surfaces of buried and underground piping and tanks. The program augments other programs that manage the aging of internal surfaces of buried and underground piping and tanks. The materials managed by this program include steel, stainless steel and high-density polyethylene. The program manages aging through preventive, mitigative, and inspection activities. .

Preventive and mitigative actions include selection of component materials, external coatings for corrosion control, backfill quality control and the application of cathodic protection. The cathodic protection system is operated consistent with the guidance of NACE SP0169-2007 for piping, and NACE RP 0285-2002 for tanks. Trending of the cathodic protection system is performed to identify changes in the effectiveness of the system and to ensure that the rectifiers are available to protect buried components. An annual cathodic protection survey is performed consistent with NACE SP0169-2007. Corrosion coupons are used to ensure that the cathodic protection system is providing sufficient protection for buried steel components within the scope of license renewal.

Inspection activities include non-destructive evaluation of pipe or tank wall thickness, and visual inspection of the exterior, as permitted by opportunistic or directed excavations.

The Buried and Underground Piping and Tanks program is a new program that will be implemented within the 10-year period prior to entering 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
10	Recoat the internal surface of fire water storage tanks. Enhance the Fire Water System program procedures to: • include non-intrusive pipe wall thickness examinations on fire water piping to be performed every three years. Each three year sample will include at least three locations for a total of 100 feet of above-ground fire water piping and be selected based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes. ~~As an alternative to wall thickness examinations~~ In addition, internal inspections will be performed on accessible exposed portions of fire water piping during plant maintenance activities. Pipe wall thickness examinations and~~/or~~ internal inspections will be performed ~~prior to~~ commencing after 2014 and throughout the period of extended operation ~~and at 10-year frequencies throughout the period of extended operation~~. • 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 • ~~recoat internal surface of fire water storage tanks~~	B2.1.14	Prior to the period of extended operation

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
11	Implement the Aboveground Metallic Tanks program as described in LRA Section B2.1.15	B2.1.15	Within the five-years period prior to ~~of entering~~ the period of extended operation

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
12	<u>Remove the blisters in the coating and inspect the base metal for aging in the Train A Emergency Diesel Generator Fuel Oil Storage Tank.</u> 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	Prior to the period of extended operation

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.		

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
13	Enhance the Reactor Vessel Surveillance program to: • determine the vessel fluence by ex-vessel dosimetry, following withdrawal of the final capsule. • require that pulled and tested surveillance capsules are placed in storage for future reconstitution or reinsertion unless given NRC approval to discard. • specifically require the design change process to evaluate the impact of plant operation changes on reactor vessel embrittlement. (Completed Amendment 14)	B2.1.17 4.2	Prior to the period of extended operation

B2.1.14 Fire Water System

Program Description

The Fire Water System program manages loss of material for water-based fire protection systems consisting of aboveground, buried and underground piping, fittings, valves, fire pump casings, sprinklers, nozzles, hydrants, hose stations, standpipes and water storage tanks. Periodic fire main and hydrant inspections and flushing, sprinkler inspections, functional test, and flow tests in accordance with National Fire Protection Association (NFPA) codes and standards ensure that the water-based fire protection systems are capable of performing their intended function. The fire protection system is maintained at the required normal operating pressure and monitored such that a loss of system pressure is immediately detected and corrective actions initiated.

The Fire Water System program performs a flow test of the system at least once every three years in accordance with plant procedures meeting the requirements of NFPA 25, including a yard fire loop flush and a flush of associated hydrants. A visual inspection and flow test of yard fire hydrants is performed annually in accordance with NFPA 25.

The Fire Water System program conducts flow tests through each open head spray/sprinkler nozzle in accordance with NFPA 25, to verify water flow is unobstructed. 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.

Pipe wall thickness examinations are performed on fire water piping using non-intrusive techniques. Wall thickness examinations will be performed on fire water piping every three years. Each three year sample will include at least three locations for a total of 100 feet of above-ground fire water piping and be selected based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes. The basis for the frequency is that three years is the frequency required by the FSAR for the yard fire loop flush and for the flow tests of the fire water loops. . ~~As an alternative to wall thickness examinations~~ In addition, internal inspections are performed on accessible exposed portions of fire water piping during plant maintenance activities. The inspections evaluate wall thickness measurements to ensure against catastrophic failure and the inner diameter of the piping as it applies to the design flow of the fire protection system. If a representative number of inspections have not been completed prior to the period of extended operation, Callaway will determine what additional inspections or examinations are required. The representative sample will be selected, based on system susceptibility to corrosion or fouling and evidence of performance degradation during system flow testing or periodic flushes. If material and environment conditions for above grade and below grade piping are similar, the results of the inspections of the internal surfaces of the above grade fire water piping can be extrapolated to evaluate the condition of the internal surfaces of the below grade fire water piping. If not, additional inspection activities will be performed to ensure that the intended function of below grade fire water piping will be maintained consistent with the current licensing basis. Pipe wall thickness examinations and~~/or~~ internal inspections will be performed ~~prior to~~ commencing after 2014 and throughout the period of extended operation ~~and at 10-year frequencies throughout the period of extended operation~~.

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.

Functional tests are periodically performed on fire detectors to ensure that they are operable.

The internal coating of the fire water storage tanks will be inspected with a minimum frequency of alternating refueling outages.

The fire water storage tank external surfaces are inspected and volumetric examinations of the tank bottom are performed as described in the Aboveground Metallic Tanks program (B2.1.15). External surfaces of buried fire main piping are evaluated as described in the Buried and Underground Piping and Tanks program (B2.1.25).

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.

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

The Fire Water System program will be enhanced to include non-intrusive pipe wall thickness examinations. Wall thickness measurements will be performed on fire water piping every three years. Each three year sample will include at least three locations for a total of 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. ~~As an alternative to wall thickness examinations~~ In addition, internal inspections will be performed on accessible exposed portions of fire water piping during plant maintenance activities. Pipe wall thickness examinations and~~/or~~ internal inspections will be performed ~~prior to~~ commencing after 2014 and throughout the period of extended operation ~~and at 10-year frequencies throughout the period of extended operation~~.

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.

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.

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 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.

5. 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.

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.

B2.1.15 Aboveground Metallic Tanks

Program Description

The Aboveground Metallic Tanks program manages cracking and loss of material on the external surfaces of outdoor, aboveground metallic tanks within the scope of license renewal that are supported on concrete or soil. The program also manages cracking, blistering, and change in color of the acrylic/urethane insulation on the condensate storage tank (CST). The program applies to the CST, refueling water storage tank (RWST), and the two fire water storage tanks (FWSTs). Tanks inside plant structures and protected from the outdoor environment are managed by the External Surfaces Monitoring of Mechanical Components program (B2.1.21).

The Aboveground Metallic Tanks program is a condition monitoring program that performs periodic inspections to monitor for aging effects on the external surfaces of the tank. For the carbon steel FWSTs, the program relies on the application of paint, coatings, or tank bottom edge grout as corrosion preventive measures. In addition, cathodic protection is used on the carbon steel FWSTs as a preventive measure to prevent corrosion on exposed bare metal as-left surfaces of the tanks. For the stainless steel CST and RWST, jacketed insulation with overlapping seams that prevent moisture intrusion or spray-on polyurethane foam insulation that adheres to tank surfaces are used as a corrosion preventive measure. There are no sealants or caulkings applied at the external interfaces between the FWST, CST, and RWST and their concrete or soil foundations.

This program performs visual inspections to monitor for aging of the tank wall and dome external surface paint or damage of the insulation covering. Twenty-five external locations of approximately one square foot in area will be inspected, with at least ten locations near the base of the tank wall and at least two locations on the dome. Removal of the tank insulation permits a sampling of the tank external surfaces to be inspected for aging. Insulation is removed for inspection of the tank surface if insulation damage is detected that would permit water ingress to the tank metallic surface. Painted exterior tank metallic surfaces are inspected for signs of degradation such as flaking, cracking, and peeling, to manage loss of material of the metallic surfaces.

The chemical treatments of cooling tower water do not contain chemical compounds that could cause cracking, pitting, or crevice corrosion on the external surfaces of the tanks. Within five years of entering the period of extended operation, a one-time soil surface sample near the CST and RWST will be performed. The soil surface sample will be evaluated to ensure that chlorides or other aggressive cooling tower water treatment chemicals are not creating an aggressive environment that would degrade the CST, RWST, or their insulation jacketing.

This program also performs UT thickness measurements of the bottom of the tank from the internal surface, to determine the thickness of the tank bottom. The entire tank bottom will be scanned to detect loss of material. Thickness measurements will be performed on regions of the tank bottom that indicate a loss of material below nominal plate thickness. With exception of the FWSTs, tank bottom UT thickness measurements will be performed when the tank is drained and within five years of entering the period of extended operation. Tank bottom UT thickness measurements of each FWST will be performed at least once every 10 years.

The Aboveground Metallic Tanks program is a new program that will be implemented within the five year period prior to the ~~five years of entering the~~ period of extended operation.

NUREG-1801 Consistency

The Aboveground Metallic Tanks program is new program that, when implemented, will be consistent with exception to NUREG-1801, Section XI.M29, *Aboveground Metallic Tanks*.

Exceptions to NUREG-1801

Program Element Affected

Detection of Aging Effects (Element 4)

NUREG-1801 requires UT thickness measurements of the tank bottoms whenever the tank is drained and at least once within five years of entering the period of extended operation. UT thickness measurements of the bottom of each FWST from the internal surface, to determine the thickness of the tank bottom will be performed at least once every ten years. Currently the internal surface of each FWST tank bottom will be visually inspected on an alternating refueling outage frequency. UT thickness measurements may be performed sooner if required by further evaluation of the tank bottom visual inspection results. Ten year periodic UT thickness measurements, supplemented when appropriate based on internal visual examinations, will be effective in managing loss of material of the tank bottoms.

Enhancements

None

Operating Experience

The following discussion of operating experience provides objective evidence that the Aboveground Metallic Tanks 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 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 was 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.

2. 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.

The above examples provide objective evidence that the new Aboveground Metallic Tanks program will be capable of detecting the aging effects associated with this program. Occurrences that would be identified under the Aboveground Metallic Tanks program will be evaluated to ensure there is no significant impact to the 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 Aboveground Metallic Tanks 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 Aboveground Metallic Tanks 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.

B2.1.17 Reactor Vessel Surveillance

Program Description

The Reactor Vessel Surveillance program manages loss of fracture toughness in accordance with ASTM E 185-73, and the requirements of 10 CFR 50 Appendix H. The surveillance capsules contain reactor vessel steel specimens of the limiting beltline material; and associated weld metal and weld heat affected zone metal. Current examination methods and report requirements are also controlled by commitment to ASTM E 185-82.

The program requires the evaluation of the impact of plant operating changes on the extent of reactor vessel embrittlement (i.e., Charpy upper-shelf energy and pressurized thermal shock screening criteria, and the P-T limit curves, including the effect of lower cold leg temperature or higher fluence.

The last-tested surveillance capsule removed from the reactor vessel, Capsule X, was exposed to fluences equivalent to about 54 effective full power years (EFPY), 3.33×10^{19} neutrons/cm^2 based on the calculated fluence. This fluence~~,~~ exceeds the 60-year peak reactor vessel wall neutron fluence. Capsule results are used to demonstrate compliance with Charpy upper-shelf energy requirements in 10 CFR 50 Appendix G and pressurized thermal shock screening criteria in 10 CFR 50.61, using the methodologies in Regulatory Guide 1.99, *Radiation Embrittlement of Reactor Vessel Materials,* Revision 2. Capsule results are also used to revise pressure-temperature curves and project the end-of-life fluence.

Two standby capsules will be removed at exposures greater than those expected at the beltline wall at 60 years. Capsule Z was removed at 71 EFPY of equivalent exposure and is stored in the spent fuel pool for reinsertion or testing as deemed appropriate. Capsule W will be removed at approximately 108 EFPY of equivalent exposure. This withdrawal schedule meets the ASTM E 185-82 criterion which states that capsules may be removed when the capsule neutron fluence is between one and two times the limiting fluence calculated for the vessel at the end of expected life. Any changes to the capsule withdrawal schedule, including spare capsules, ~~will~~ must be ~~communicated and~~ approved by the NRC ~~as appropriate~~ prior to implementation.

Following withdrawal of the final capsule, vessel fluence will be determined by ex-vessel dosimetry.

NUREG-1801 Consistency

The Reactor Vessel Surveillance program is an existing program that, following enhancement, will be consistent to NUREG-1801, Section XI.M31, *Reactor Vessel Surveillance*.

Exceptions to NUREG-1801

None

Enhancements

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

Detection of Aging Effects - Element 4

Following withdrawal of the final capsule, vessel fluence will be determined by ex-vessel dosimetry.

Testing specification will be enhanced to require that pulled and tested surveillance capsules are placed in storage for future reconstitution or reinsertion unless given NRC approval to discard.

~~*Monitoring and Trending - Element 5*~~

~~Procedures will be enhanced to specifically require the evaluation of the impact of plant operation changes on the extent of reactor vessel embrittlement (i.e., Charpy upper-shelf energy and pressurized thermal shock screening criteria, and the P-T limit curves, including the effect of lower cold leg temperature or higher fluence).~~

Operating Experience

The following discussion of operating experience provides objective evidence that the Reactor Vessel Surveillance 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 last-tested capsule specimens in Capsule X were exposed to fluences equivalent to approximately 54 EFPY, 3.33×10^{19} neutrons/cm^2 based on the calculated fluence, and satisfy the upper-shelf energy criterion and the pressurized thermal shock reference temperature screening criteria. The adjusted reference temperatures have been shown to be less than that used in the P-T limit curves, thereby demonstrating margin in the operating limits.

The operating experience of the Reactor Vessel Surveillance program did not identify an adverse trend in performance. Occurrences that would be identified under the Reactor Vessel Surveillance 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 Reactor Vessel Surveillance program will effectively identify aging prior to loss of intended function.

Conclusion

The continued implementation of the Reactor Vessel Surveillance 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.

B2.1.20 One-Time Inspection of ASME Code Class 1 Small-Bore Piping

Program Description

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program manages cracking of ASME Code Class 1 piping less than four inches nominal pipe size (NPS) and greater than or equal to NPS 1.

For ASME Code Class 1 small-bore piping, the Risk-informed (RI-ISI) ISI program requires volumetric examinations (by ultrasonic testing) on selected butt weld locations to detect cracking. Weld locations are selected based on the guidelines provided in EPRI TR-112657, *Revised Risk-Informed Inservice Inspection Evaluation Procedure.* There are 340 Class 1 small-bore butt welds less than NPS 4 and greater than or equal to NPS 1 at Callaway. At least 25 butt welds will be included in the examination population. Ultrasonic examinations are conducted in accordance with ASME Section XI with acceptance criteria from paragraph IWB-3000 for butt welds.

The program will include a volumetric or opportunistic destructive examination of socket welds to identify potential cracking. Callaway has experienced one case of cracking, in 1995, of an ASME Code Class 1 small-bore piping butt weld resulting from cyclical loading which was mitigated with a design change to prevent recurrence. Eight small-bore Class 1 socket welds will be selected for examination, which represents 10 percent of the population. There are 77 Class 1 small-bore socket welds in the population of ASME Code Class 1 piping less than NPS 4 and greater than or equal to NPS 1 at Callaway. Alternatively, opportunistic destructive examinations may be used in lieu of a volumetric examination. An opportunistic destructive examination may be performed when a weld is removed from service for reasons other than inspection. Because more information can be obtained from a destructive examination than from a nondestructive examination, each weld destructively examined will be considered equivalent to having volumetrically examined two welds. When selecting socket welds for examination, consideration will be given to selecting welds which are susceptible to cracking resulting from stress corrosion, cyclical (including thermal, mechanical, and vibration fatigue) loading, or thermal stratification and thermal turbulence. At least one socket weld selected for examination will have a risk ranking of "high", as determined by the RI-ISI program.

Socket welds that fall within the weld examination sample will be examined following ASME Section XI Code requirements. If a qualified volumetric examination procedure for socket welds endorsed by the industry or the NRC is available and incorporated into the ASME Section XI Code at the time of the small-bore inspections, then this will be used for the volumetric examinations. If no volumetric examination procedure for ASME Code Class 1 small-bore socket welds has been endorsed by the industry or the NRC and incorporated into ASME Section XI at the time Callaway performs inspections of small-bore piping, a plant procedure for volumetric examination of ASME Code Class 1 small-bore piping with socket welds will be used.

The program includes controls to implement an alternate plant-specific periodic inspection aging management program should evidence of ASME Class 1 small bore piping cracking caused by intergranular stress corrosion cracking or fatigue be confirmed by review of Callaway operating experience prior to the period of extended operation or by the examinations performed as part of this program.

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program inspections will be completed and evaluated within the six-year period prior to the period of extended operation.

In conformance with 10 CFR 50.55a(g)(4)(ii), the ISI program is updated during each successive 120-month inspection interval to comply with the requirements of the latest edition of the ASME Code specified twelve months before the start of the inspection interval. Callaway will use the ASME Code Edition consistent with the provisions of 10 CFR 50.55a during the 10 year period prior to the period of extended operation (fourth interval).

NUREG-1801 Consistency

The One-Time Inspection of ASME Code Class 1 Small-Bore Piping program is a new program that, when implemented, will be consistent with NUREG-1801, Section XI.M35, *One-Time Inspection of ASME Code Class 1 Small-Bore Piping.*

Exceptions to NUREG-1801

None

Enhancements

None

Operating Experience

The following discussion of operating experience provides objective evidence that the One-Time Inspection of ASME Code Class 1 Small-Bore Piping program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

1 A review of plant-specific operating experience indicates that one event of cracking has been observed for an ASME Code Class 1 small-bore pipe butt weld less than

NPS 4. In 1995, an ASME Class 1 butt weld on a two inch RCS Loop D crossover leg to chemical and volume control system excess letdown line developed a crack. The most probable cause was the combined effects of 1) high stresses resulting from interference with a flange/plate and 2) normal system vibration. The flange/plate was removed to prevent recurrence of this weld failure. A volumetric examination (UT) of the weld performed during Refuel 17 (Spring 2010) using the techniques described in MRP-146 identified no indications. There have been no additional failures since 1995.

Occurrences that would be identified under the One-Time Inspection of ASME Code Class 1 Small-Bore Piping 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 One-Time Inspection of ASME Code Class 1 Small-Bore Piping 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 One-Time Inspection of ASME Code Class 1 Small-Bore Piping 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.

B2.1.25 Buried and Underground Piping and Tanks

Program Description

The Buried and Underground Piping and Tanks program manages loss of material, cracking, blistering, and changes in color of external surfaces of buried and underground piping and tanks. The program augments other programs that manage the aging of internal surfaces of buried and underground piping and tanks. The materials managed by this program include steel, stainless steel and high-density polyethylene. The program manages aging through preventive, mitigative, and inspection activities.

Preventive and mitigative actions include the selection of component materials, external coatings for corrosion control, backfill quality control, and the application of cathodic protection. The cathodic protection system is operated consistent with the guidance of NACE SP0169-2007 for piping and NACE RP 0285-2002 for tanks. Trending of the cathodic protection system is performed to identify changes in the effectiveness of the system and to ensure that the rectifiers are available to protect buried components. An annual cathodic protection survey is performed consistent with NACE SP0169-2007. Corrosion coupons are used to ensure that the cathodic protection system is providing sufficient protection for buried steel components within the scope of license renewal.

Inspection activities may include nondestructive evaluation of pipe and tank wall thicknesses, and visual inspections of pipe and tank exterior surfaces, as permitted by opportunistic or directed excavations. The fire protection system jockey pump is monitored to identify changes in jockey pump activity.

Direct visual inspections will be performed on buried steel, stainless steel, and high density polyethylene piping and carbon steel tanks. Inspection locations will be selected based on susceptibility to degradation and consequences of failure. A minimum of 10 feet of pipe of each material type must be inspected. The inspection will consist of a 100 percent visual inspection of the exposed pipe. If adverse indications are detected, inspection sample sizes within the affected piping categories are doubled. If adverse indications are found in the expanded sample, further increases in inspection sample size would be based on an analysis of extent of cause and extent of condition. Visual inspections will be supplemented with surface or volumetric nondestructive testing (NDT) if significant indications are observed, to determine local area wall thickness.

Direct visual inspections will be performed on underground steel, stainless steel and high density polyethylene piping, tank access covers, and valves to detect external corrosion. Inspection locations will be selected based on susceptibility to degradation and consequences of failure.

Inspections will begin during the 10-year period prior to entering the period of extended operation. Upon entering the period of extended operation, inspections will occur every 10 years.

The internal surfaces of buried and underground piping and tanks are managed through other programs. Internal surfaces may be managed by the Open-Cycle Cooling Water System (B2.1.10), Closed Treated Water Systems (B2.1.11), Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components (B2.1.23), Fuel Oil Chemistry (B2.1.16), Fire Water System (B2.1.14) or Water Chemistry (B2.1.2) programs. The Selective Leaching program (B2.1.19) works in conjunction with this program to manage buried or underground components subject to selective leaching.

NUREG-1801 Consistency

The Buried and Underground Piping and Tanks program is a new program that, when implemented, will be consistent with exception to NUREG-1801, Section XI.M41, *Buried and Underground Piping and Tanks*.

Exceptions to NUREG-1801

<u>Program Elements Affected:</u>

Preventive Actions (Element 2)

NUREG-1801, Section XI.M41, Table 2a, Note 6 states that for polymeric piping, backfill is acceptable if the inspections conducted by this program do not reveal evidence of mechanical damage to buried pipe coatings due to backfill. However the high-density polyethylene (HDPE) piping at Callaway is not coated, nor does NUREG-1801 Section XI.M41 Table 2a require HDPE piping to be coated. The HDPE piping at Callaway is backfilled with controlled low strength materials (flowable fill) that uses fine aggregate consistent with ASTM C33. NUREG-1801, Section XI.M41, Table 2a, Note 6 states that the use of flowable fill meets the backfill objectives of SP0169-2007.

Detection of Aging Effects (Element 4)

NUREG-1801, Section XI.M41.4.c.iv states that underground pipe shall be inspected by a volumetric technique such as UT to detect internal corrosion. As mentioned in the NUREG-1801 program description, other aging management programs are used to manage the internal surface of buried components. Therefore, ultrasonic testing of underground piping to detect internal corrosion is not included in this program.

NUREG-1801, Section XI.M41.4.f.iv states that if adverse indications are found in the expanded sample, the inspection sample size is again doubled. This doubling of the inspection sample size continues as necessary. If adverse indications are found in the expanded sample at Callaway, further increases in inspection sample size would be based on an analysis of extent of cause and extent of condition.

Enhancements

None

Operating Experience

The following discussion of operating experience provides objective evidence that the Buried and Underground Piping and Tanks 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 the winter of 2005, an alarm was triggered for fire protection loop jockey pump excessive run time and an investigation was initiated. 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.

2. Prior to Refuel 15 (Spring 2007), Close Interval Surveys (CIS) were performed on various tanks and associated piping systems to identify cathodic protection effectiveness. The CIS testing measures cathodic protection levels along the pipeline at approximately 2.5 foot intervals. These surveys were performed on the following structures and components within the scope of license renewal: emergency fuel oil storage tanks, fire water storage tank bottoms, ESW system piping, and condensate storage tank piping. The results indicated that emergency fuel oil storage tanks, condensate storage tank piping, and one quadrant of the fire water storage tank, were not meeting the 850mV polarization potential criterion of the National Association of Corrosion Engineers (NACE). Corrective actions were taken to correct these deficiencies by adjusting the cathodic protection where possible. In some instances the cathodic protection system could not be adjusted to correct a condition. Cathodic protection system refurbishment and modifications are planned in areas where the system does not meet the NACE criteria.

3. From 2008 to 2009, the underground portions of the ESW supply from the ESW pump house and return to the ultimate heat sink cooling tower were replaced with 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.

4. In the summer of 2011, the annual cathodic protection survey was performed. Several locations in the fire water system had a negative potential below the NACE criteria of 850 mV. Modification and refurbishment of the cathodic protection system will address areas of low negative potential identified during the annual survey and the CIS described above.

5. Due to industry operating experience with buried condensate system piping, Callaway reviewed cathodic protection records related to the buried carbon steel piping for the condensate storage tank to determine if the external corrosion control provided for this piping was adequate. The review of the cathodic protection for this line found that the negative potential was below the NACE criteria. The cathodic protection system will be refurbished/modified in areas where it does not meet the NACE criteria. The buried portion of the condensate storage tank suction line will be inspected prior to the period of extended operation.

Inspection and preventive measures that will be implemented by the Buried and Underground Piping and Tanks program will be effective in managing aging of underground and buried components. Occurrences that would be identified under the Buried and Underground Piping and Tanks 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 Buried and Underground Piping and Tanks 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 Buried and Underground Piping and Tanks 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.

CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REGIONAL INSPECTION ITEM UPDATES

The following are updates from the Regional Inspections conducted at the Callaway Plant during the weeks of September 10 and 24, 2012:

1)	Revise XI.M26	Fire Protection	RI088
2)	Revise XI.M30	Fuel Oil Chemistry – Coating Repair Commitment	RI178
3)	Revise XI.M21A	Closed Treated Water Systems & Draft Procedure	RI202

1) **Regional Inspection Item RI088** (Fire Protection)

Element 4 has been revised to show that during fire barrier penetration seal visual inspections, if any degradation is noted, the sample size is expanded. This is done to be consistent with NUREG-1801.

2) **Regional Inspection Item RI178 (**Fuel Oil Chemistry – Coating Repair Commitment**)**

Element 2 has been revised to clarify the description of biocide addition to the Fuel Oil Storage Tanks.

Table A4-1 Item #12 (refer to Enclosure 2) has been revised to include a commitment to remove the blisters in the coating and inspect the base metal for aging in the Train A Emergency Diesel Generator Fuel Oil Storage Tank prior to the period of extended operation.

3) **Regional Inspection Item RI202 (**Closed Treated Water Systems & Draft Procedure)

AMP Evaluation Report has been revised to correct discrepancies between the AMP and the draft procedure for non-chemistry inspections of closed cycle cooling water systems. Changed the internal environment of Chemical and Volume Control System valve (BGV0061) from demineralized water to closed cycle cooling water.

CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

PREVIOUS RESPONSE UPDATE

The following table was provided by ULNRC-05886 (8/6/2012) in response to RAI Set #3. It has been updated to delete an item. The line item for CAR 200606030 was determined to be a duplication of the occurrence documented in CAR 200605969. The line item for CAR 200605969 correctly categorizes the leak as impacting an out of scope section of pipe.

Table 1 - Leak History

Date Discovered	Component	Internal/External	Above/ Buried	In/Out of Scope	Event	Apparent Cause	Configuration of Degradation	Extent of Degradation (EOC)	CARS
09/13/2004	Pipe	Unknown	Buried	Out of scope	Leak	Unknown - likely corrosion of abandoned in place piping or poor isolation	Unknown - Pipe was abandoned	Abandoned FPS piping outside of powerblock	200407150
10/29/2004	Pipe	Internal	Buried	In scope	Failure of flow test	Build up of deposits (not MIC)	Non-planar flaw	Main Fire Loop	200408232
12/13/2005	Pipe	Unknown	Buried	Out of scope	Leak	Likely failure of bell and spigot joint	N/A - joint failure	Original construction fire loop (not Main Fire Loop)	200510105
07/26/2006	Pipe	External	Buried	Out of scope	Leak	Coating Damage; ineffective cathodic protection	Non-planar flaw	FPS piping with coating (Note 1)	200605969
~~07/27/2006~~	~~Pipe~~	~~External~~	~~Buried~~	~~In scope~~	~~Leak~~	~~Coating Damage; ineffective cathodic protection~~	~~Non-planar flaw~~	~~FPS piping with coating~~	~~200606030~~
08/22/2006	Pipe	Internal	Above ground	Out of scope	No failure - blocked strainer observed	Corrosion products (hematite) from chemical cleaning clogged small diameter alarm test piping	N/A	FPS to Stores 1	200606874
8/23/2006	Pipe	Unknown	Buried	Out of scope	Leak	Unknown - likely coating damage. Pipe was abandoned in place and new HDPE pipe routed	Unknown - Pipe was abandoned	FPS to Training Center (non-powerblock)	200606913
09/18/2006	Pipe	Internal	N/A	In scope	No failure - valve leakby observed	Settling of corrosion products (hematite) from chemical cleaning in normally stagnant piping	N/A	FPS piping branches from Main Fire Loop	200607707
09/19/2006	Pipe	External	Buried	In scope	No failure - Pitting observed	Coating Damage; previously ineffective cathodic protection	Non-planar flaw	FPS piping with coating	200607749

Table 1 - Leak History

Date Discovered	Component	Internal/External	Above/ Buried	In/Out of Scope	Event	Apparent Cause	Configuration of Degradation	Extent of Degradation (EOC)	CARS
08/02/2007	Pipe	Unknown	Buried	Out of scope	Leak	Unknown - likely coating damage. Pipe was abandoned in place and new HDPE pipe routed	Unknown - Pipe was abandoned	FPS to Training Center (non-powerblock)	200707175
12/10/2007	Pipe	Unknown	Buried	In scope	Leak	Unknown - this branch from Main Fire Loop to Auxiliary Building subsequently isolated	Unknown - Pipe was isolated	Main Fire Loop	200711546
03/12/2008	Pipe	N/A	Buried	Out of scope	Leak	Improper installation	N/A - poor fusion	Buried HDPE FPS piping	200801913
11/18/2009	Pipe	N/A	Buried	In scope	Failure of flow test	Inaccurate calculation	N/A	Main Fire Loop	200909578
04/11/2011	Pipe	N/A	Buried	In Scope	Failure of flow test	Inaccurate calculation	N/A	Main Fire Loop	201102974
10/03/2011	Pipe	N/A	Buried	Out of scope	Leak	Improper installation	N/A - poor fusion	Buried HDPE FPS piping	201107928

Note 1: This piping has since been abandoned in place