CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) Set #8 RESPONSES

RAI B3.2-1

Background:

The 2010 Environmental Qualification (EQ) Program Simple Self-Assessment Report recommended EQ Program health reports be issued in a timely manner. License renewal application (LRA) Section B3.2, "Environmental Qualification (EQ) of Electric Components," states that Callaway Plant (Callaway) routinely audits the EQ program to ensure that program elements are carried out properly. The staff has observed that self assessment reports and EQ health reports are tools commonly used by the nuclear industry to monitor the effectiveness of program performance including EQ programs.

Issue:

Although the staff identified two self assessment reports, the staff did not identify any EQ Program health reports in its review of EQ operating experience. EQ health and self assessments, performed periodically, can be useful in identifying adverse trends in EQ Program performance.

Request:

a) Provide the schedule for performing self assessment reports and EQ health reports consistent with LRA Section B3.2.

b) Provide additional operating experience [e.g., disposition of follow-up actions identified by the self assessments (2004 and 2010) including corrective actions] that further demonstrate the effectiveness of the EQ Program.

Callaway Response

a) The next self assessment of the EQ Program is scheduled in 2014. In accordance with Callaway procedures, self assessments and benchmarks for the EQ Program are performed on an as-needed frequency agreed upon by the supervisor and program owner. If declining performance is noted, the Callaway Self-Assessment and Benchmarking Program procedure provides additional guidance for the use of these activities to improve performance. Also in accordance with Callaway procedures, health reports are prepared for the EQ Program quarterly. The EQ health report for third quarter 2012 will be prepared in October, 2012.

b) The Self Assessments of the EQ Program conducted in 2004 and 2010 provide additional operating experience that further demonstrate the effectiveness of the EQ Program. These two self assessments ultimately identified two gaps:

   1) Bench strength was considered to be inadequate. Corrective actions have resulted in improved bench strength. The Callaway staff currently has six engineers qualified to the EQ Engineer Equipment Qualification Program, four of whom perform these responsibilities regularly.

   2) The EQ Program did not have a health report. Corrective actions have resulted in procedural requirements for development of an EQ Program health report on a quarterly frequency.

   The 2010 Self Assessment was conducted by a team of industry peers. It is notable that the 2010 Self Assessment identified issues that were already being resolved and were minor

documentation issues. As part of the assessment, the team reviewed corrective action documents and did not identify any adverse conditions that may result in aging that is more premature than analyzed. Some program enhancements also resulted from self assessment activities. For example, one enhancement was to provide training to personnel whose departments interface with the EQ Program. In 2012, First Line Supervisor Continuing Training included a session on the EQ Program and how site departments can impact the EQ Program. These corrective actions and self assessment results demonstrate that the EQ program is effective in preventing major qualification issues with EQ components.

Corresponding Amendment Changes

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

RAI 3.6.2.1-1

Background:

In LRA Table 3.6.2-1, items 3.6.1.016 and 017, the applicant stated that for fuse holders (not part of active equipment): metallic clamps exposed to air - indoor uncontrolled, increased resistance of connection due to chemical contamination, corrosion, and oxidation; fatigue due to ohmic heating, thermal cycling, electrical transients and metallic clamps exposed to air - indoor uncontrolled and controlled, increased resistance of connection due to fatigue caused by frequent manipulation or vibration are not applicable because in-scope fuse holders are part of larger assemblies and therefore no aging management program (AMP) is required. The applicant further stated that this includes fuses installed for electrical penetration protection. The aging management review (AMR) items (Table 3.6.2-1 of the LRA) do not include this component type or reference Note I (i.e., aging effect in NUREG-1801 for this component, material and environment combination are not applicable).

NUREG-1801, “Generic Aging Lessons Learned (GALL) Report,” Revision 2, items VI.A.LP-23 and -31, “Fuse Holders (not part of active equipment): Metallic Clamp,” identifies the aging/effect mechanisms for these items as increased resistance of connection due to chemical contamination, corrosion, oxidation; fatigue due to ohmic heating, thermal cycling, electrical transients, and increased resistance of connection due to fatigue caused by frequent manipulation or vibration, respectively. GALL Report AMP XI.E5, “Fuse Holders,” states that fuse holders located outside of active devices should be tested to provide an indication of the condition of the metallic clamps of fuse holders.

Issue:

The applicant stated that aging management is not required because all in-scope fuses are located in larger assemblies. This is inconsistent with the GALL Report AMP XI.E5 “scope of program” which only specifies in-scope fuses located outside of active assemblies as not requiring aging management. The applicant did not provide technical justification of why these fuse holders located in air indoor-uncontrolled and air indoor-uncontrolled or controlled and located in larger assemblies do not require aging management.

Request:

Provide an evaluation that addresses each aging effect/mechanism identified in GALL Report, items VI.A.LP-23 and -31 (fuse holders - metallic clamps).

Callaway Response

NUREG-1801, "Generic Aging Lessons Learned (GALL) Report," Revision 2, items VI.A.LP-23 and -31, apply only to fuse holders and metallic clamps which are not part of active equipment. In addition, the GALL report, in XI.E5, Scope of Program, states that fuse holders inside an active device are not within the scope of XI.E5. Callaway LRA Table 3.6-1, items 3.6.1.016 and 3.6.1.017 have been revised to state that all fuse holders utilizing metallic clamps within the scope of license renewal at Callaway are part of an active device.

LRA Table 3.6-1 has been revised, as shown on Amendment 10 in Enclosure 2, to indicate that all fuse holders utilizing metallic clamps within the scope of license renewal are part of an active device and do not require aging management.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, "Amendment 10, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI 3.6.2.1.4-1

Background:

LRA Section 3.6.1 lists the following electrical component types subject to AMR under "Insulated cable and connections" (including the following):

- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements
- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance
- Inaccessible power cables not subject to 10 CFR 50.49 EQ requirements

Issue:

LRA Section 3.6.2.1.4, "Insulated Cable and Connections," under AMPs only lists the following:

- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements
- Inaccessible power cables not subject to 10 CFR 50.49 EQ requirements

Request:

Explain why AMP, "Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance" is not listed in LRA Section 3.6.2.1.4.

Callaway Response

Section 3.6.2.1.4 inadvertently omitted AMP "Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance". LRA Subsection 3.6.2.1.4.3, "Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance," has been added as shown in Amendment 10 in Enclosure 2.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, "Amendment 10, LRA Changes from RAI Responses," for a description of LRA changes with this response.

RAI 3.6.2.2.3-1

Background:

NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (SRP-LR)," Revision 2, Section 3.6.2.2.3 states that loss of material due to wind induced-induced abrasion, loss of conductor strength due to corrosion, and increased resistance of connection due to oxidation or loss of preload could occur in transmission conductors and connections, and in switchyard bus and connections.

Issue:

The applicant did not include plant specific operating experience at Callaway to support the applicant's claim that loss of material due to wind induced abrasion and fatigue, loss of transmission conductor strength from corrosion, and increased resistance of connection due to oxidation or loss of preload are not significant aging effects for transmission conductors and connections. In addition, the applicant did not address whether a review of plant-specific operating experience indicated additional aging effects exist beyond those addressed in the GALL Report.

Request:

Confirm that there has been no plant-specific operating experience of loss of material due to wind induced abrasion or fatigue, loss of conductor strength due to corrosion, or increased resistance of connection due to oxidation or loss of preload at Callaway. If loss of material or loss of conductor strength has occurred, describe the corrective actions performed to prevent reoccurrence.

Provide a review of plant specific operating experience including whether additional aging effects exist beyond those identified by the GALL Report and SRP-LR Section 3.6.2.2.3 for transmission conductors and connections, and switchyard bus and connections.

Callaway Response

Based on a review of Callaway corrective action documents, there has been no plant-specific operating experience of loss of material due to wind induced abrasion or fatigue, loss of conductor strength due to corrosion, or increased resistance of connection due to oxidation or loss of preload in transmission conductors and connections, or in switchyard bus and connections. There were no additional aging effects beyond those identified by the GALL Report and SRP-LR Section 3.6.2.2.3.

Corresponding Amendment Changes

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

RAI 4.4-1

Background:

SRP-LR, Revision 2, Chapter 4.4, "Environmental Qualification (EQ) of Electric Equipment," Section 4.4.1, "Areas of Review," states that some nuclear power plants have mechanical equipment that was qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. If a plant has qualified mechanical equipment, it is typically documented in the plant's master EQ list.

If this qualified mechanical equipment requires the performance of a time-limited aging analysis (TLAA), it should be performed in accordance with the provisions of SRP-LR Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis." If a TLAA of qualified mechanical equipment is necessary, it usually involves the environmental effects on components such as seals, gaskets, lubricants, hydraulic fluid, or diaphragms.

Issue:

LRA Section 4.4, "Environmental Qualification (EQ) of Electric Equipment," TLAA includes a discussion of mechanical equipment qualification and states that the qualification for some mechanical equipment extends beyond 40 years. The applicant states that TLAA 4.4 also manages the aging of mechanical components.

Final Safety Analysis Report (FSAR) summary report A2.2, "Environmental Qualification (EQ) of Electrical Equipment," does not include mechanical equipment as part of the FSAR summary description.

FSAR Summary Report A3.3, "Environmental Qualification (EQ) of Electric Equipment," states that this program also manages the aging of mechanical EQ components.

AMP B3.2, "Environmental Qualification (EQ) of Electrical Components," states that the Callaway EQ Program assigns qualified lives to safety-related mechanical components located in harsh environments. The LRA states that these components are managed with the EQ maintenance and/or surveillance programs.

The inclusion of mechanical components in TLAA 4.4 is inconsistent with the guidance provided in SRP-LR Section 4.4.1, "Areas of Review," which states that a TLAA for mechanical components should be performed under the provision of SRP-LR Section 4.7, "Other Plant-Specific Time-Limited Aging Analysis." In addition Table 3.6.1, item number 3.6.1.1 does not identify mechanical equipment as a component type for EQ TLAA.

Request:

Explain why the inclusion of environmental qualification of mechanical components is included in TLAA 4.4, "Environmental Qualification (EQ) of Electric Components" contrary to the guidance provided in SRP-LR 4.4.1 with regard to TLAAs for mechanical components and associated AMR items. Explain the discrepancy between AMP B3.2, TLAA 4.4, Appendix A, Section A.2.2, and Section A3.3 with regard to the inconsistency in the application of aging management of EQ of mechanical components. Explain why the component type (electrical equipment) in Table 3.6.1, item number 3.6.1.1 is inconsistent with TLAA 4.4 (electrical and mechanical components).

Callaway Response

The following LRA sections have been revised as shown on LRA Amendment 10 in Enclosure 2 to address the following:

1) The environmental qualification of mechanical equipment discussion was removed from Section 4.4, “Environmental Qualification (EQ) of Electric Components,” and a new section 4.7.10, “Mechanical Environmental Qualification” was created.
2) The environmental qualification of mechanical equipment discussion was removed from Appendix A3.3, “Environmental Qualification (EQ) of Electric Components,” and a new section A3.6.10, “Mechanical Environmental Qualification” was created.
3) Appendix A2.2 and Appendix B3.2 for the Environmental Qualification of Electrical Components program were updated to be consistent with the mechanical environmental qualification disposition in Section 4.7.10.
4) Table 3.6.2-1 was revised to include a line for mechanical environmental qualification components. Further evaluation 3.6.2.2.1 was also revised to identify mechanical environmental qualification components.
5) Added Section 2.5.1.15 for mechanical environmental qualification (MEQ) components and incorporated conforming changes in Section 2.5 and Section 2.1.2.3.2.
6) Conforming changes were made to Table 4.1-1, List of TLAAs.

Corresponding Amendment Changes

Refer to the Enclosure 2 Summary Table, "Amendment 10, LRA Changes from RAI Responses,” for a description of LRA changes with this response.

Amendment 10, LRA Changes from RAI Responses

Enclosure 2 Summary Table

Affected LRA Section	LRA Page
Section 2.1.2.3.2	2.1-9
Section 2.5	2.5-1
Section 2.5.1.15	2.5-6
Section 3.6.2.2.1	3.6-9
Table 3.6.2-1	3.6-22, 3.6-24, and 3.6-28
Table 4.1-1	4.1-4 and 4.1-5
Section 4.4	4.4-1 and 4.4-2
Section 4.7.10	4.7-15
Section A2.2	A-21
Section A3.3	A-30
Section A3.6.10	A-35
Section B3.2	B131, B132, B133, and B134
Section 3.6.2.1.4.3	3.6-5
Table 3.6-1	3.6-19

Callaway
License Renewal Application
Amendment 10

Revised text separates the mechanical EQ program from the electrical EQ program.

Section 2.1.2.3.2 (page 2.1-9) is revised as follows (new text shown underlined):

2.1.2.3.2 Environmental Qualification

Criterion 10 CFR 54.4(a)(3) requires that all SSCs relied on in safety analyses or regulations for Environmental Qualification (EQ) (10 CFR 50.49) are included within the scope of license renewal.

The FSAR Section 3.11(B) SP states that a review of equipment environmental qualification programs against NUREG-0588 positions was performed. The scope of the review included plant areas exposed to harsh environments following a loss of coolant accident, a main steam line break, or a high energy line break.

Components within the scope of the Callaway EQ program which demonstrate compliance with 10 CFR 50.49 and the systems containing those components are classified as satisfying criterion 10 CFR 54.4(a)(3) and are identified within the scope of license renewal.

EQ is a time-limited aging analysis (TLAA) as defined by 10 CFR 54.3(a) and is addressed in Section 4.4, *Environmental Qualification (EQ) of Electric Equipment*, and Section 4.7.10, *Mechanical Environmental Qualification*.

Section 2.5 (page 2.5-1) is revised as follows (new text shown underlined):

2.5 SCOPING AND SCREENING RESULTS: ELECTRICAL AND INSTRUMENTATION AND CONTROL SYSTEMS

The scoping and screening results for electrical and instrumentation and control system components consist of a list (Table 2.5-1, *Electrical and I&C Component Groups Requiring Aging Management Review*) of component types that require aging management review.

Using the "plant spaces" approach all electrical and instrumentation and control components were reviewed as a group regardless of the system assigned to each component. Bounding environmental conditions were used to evaluate the identified aging effect(s) with respect to component function(s) to determine the component groups that require aging management review. This methodology is discussed in Section 2.1.3.3, *Electrical and Instrumentation and Control System Scoping Methodology* and is consistent with the guidance in NEI 95-10, *Industry Guideline for Implementing the Requirements of 10 CFR Part 54 - The License Renewal Rule*.

The interface of electrical and instrumentation and control components with other types of components and the assessments of these interfacing components are provided in the appropriate mechanical or structural sections. The evaluation of electrical racks, panels, frames, cabinets, cable trays, conduit, manhole, duct banks, transmission towers and their supports is provided in the structural assessment documented in Section 2.4, *Scoping and Screening Results: Structures*.

The following electrical component groups were evaluated to determine the groups that require aging management review:

Cable connections (metallic parts)

Connectors

High voltage insulator

Insulated cable and connections (includes the following):

- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements
- Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance
- Inaccessible power cables not subject to 10 CFR 50.49 EQ requirements

Switchyard bus and connections

Terminal blocks

Transmission conductors

Transmission connections

Electrical equipment subject to 10 CFR 50.49 environmental qualification (EQ) requirements

Metal Enclosed Bus (including the following):

Bus and connections

Enclosure

Insulation and insulators

Fuse holders (not part of a larger assembly)

Penetrations, electrical

Grounding conductors

Cable tie wraps

Mechanical environmental qualification (MEQ) components

License renewal drawing (LR-CW-ELEC-E-21001) was created based on the electrical single line diagram. The license renewal drawing schematically shows the portions of the plant AC electrical distribution system, including the SBO recovery path, that are included within the scope of license renewal.

New Section 2.5.1.15 (page 2.5-6) is added as follows (new text shown underlined):

2.5.1.15 Mechanical Environmental Qualification (MEQ) Components

Mechanical components subject to the provisions of Criterion 4 of Appendix A to 10 CFR Part 50 are evaluated as time-limited aging analyses and are managed under an exception to the environmental qualification program, as discussed in Section B3.2, *Environmental Qualification (EQ) of Electric Components*.

Section 3.6.2.2.1 (page 3.6-9) is revised as follows (new text shown underlined):

3.6.2.2.1 Electrical Equipment Subject to Environmental Qualification

The Callaway Environmental Qualification (EQ) of Electric Components program (B3.2) meets requirements of 10 CFR 50.49. The program also includes Mechanical Environmental Qualification Components qualified in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. Aging evaluations that qualify components to at least the end of the current licensed operating period are TLAAs. Section 4.4 describes the evaluation of the~~se~~ TLAAs associated with electrical equipment. Section 4.7.10 describes the evaluation of the TLAAs associated with mechanical equipment.

Table 3.6.2-1 (pages 3.6-22, 3.6-24 and 3.6-28) is revised as follows (new text shown underlined and deleted text shown in strikethrough):

Table 3.6.2-1 Electrical and Instrumentation and Controls – Summary of Aging Management Evaluation – Electrical Components

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Program	NUREG-1801 Item	Table 1 Item	Notes
10 CFR 50.49 Electrical Equipment	IN	Various Organic Polymers	Adverse Localized Environment (Ext)	Various aging effects	Time-Limited Aging Analysis evaluated for the period of extended operation	VI.B.L-05	3.6.1.001	~~A~~B
Mechanical Environmental Qualification Components	INS	Various Organic Polymers	Adverse Localized Environment (Ext)	Various aging effects	Time-Limited Aging Analysis evaluated for the period of extended operation	VI.B.L-05	3.6.1.001	D, 3

Notes for Table 3.6.2-1:

Standard Notes:

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

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

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

I Aging effect in NUREG-1801 for this component, material and environment combination is not applicable.

Plant Specific Notes:

1 See further evaluation in Section 3.6.2.2.2.

2 See further evaluation in Section 3.6.2.2.3.

3. See further evaluation in Section 3.6.2.2.1.

Chapter 4
TIME-LIMITED AGING ANALYSES

Table 4.1-1 List of TLAAs

TLAA Category	Description	Disposition Category(1)	Section
1.	**Reactor Vessel Neutron Embrittlement Analysis**	**N/A**	**4.2**
	Neutron Fluence Values	ii	4.2.1
	Charpy Upper-Shelf Energy	ii	4.2.2
	Pressurized Thermal Shock	ii	4.2.3
	Pressure-Temperature (P-T) Limits	iii	4.2.4
	Low Temperature Overpressure Protection	iii	4.2.5
2	**Metal Fatigue**	**N/A**	**4.3**
	Fatigue Monitoring Program	N/A	4.3.1
	ASME Section III Class I Fatigue Analysis of Vessels, Piping and Components	iii	4.3.2
	Reactor Coolant Pump Thermal Barrier Flange	iii	4.3.2.1
	Pressurizer Insurge-Outsurge Transients	iii	4.3.2.2
	Steam Generator ASME Section III Class 1, Class 2 Secondary Side, and Feedwater Nozzle Fatigue Analyses	i	4.3.2.3
	NRC Bulletin 88-11 Revised Fatigue Analysis of the Pressurizer Surge Line for Thermal Cycling and Stratification	iii	4.3.2.4
	ASME Section III Subsection NG Fatigue Analysis of Reactor Pressure Vessel Internals	iii	4.3.3
	Effects of the Reactor Coolant System Environment on Fatigue Life of Piping and Components (Generic Safety Issue 190)	iii	4.3.4
	Assumed Thermal Cycle Count for Allowable Secondary Stress Range Reduction Factor in ANSI B31.1 and ASME Section III Class 2 and 3 Piping	i	4.3.5
	Fatigue Design of Spent Fuel Pool Liner and Racks for Seismic Events	i	4.3.6
	Fatigue Design and Analysis of Class 1E Electrical Raceway Support Angle Fittings for Seismic Events	i	4.3.7
	Fatigue Analyses of Class 2 Heat Exchangers	ii, iii	4.3.8

Table 4.1-1 List of TLAAs

TLAA Category	Description	Disposition Category[1]	Section
3.	**Environmental Qualification (EQ) of Electric Equipment**	**iii**	**4.4**
4.	**Concrete Containment Tendon Prestress**	**i, ii**	**4.5**
5.	**Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analyses**	**N/A**	**4.6**
	Design Cycles for the Main Steam Line and Feedwater Penetrations	i, ii	4.6.1
	Fatigue Waiver Evaluations for the Access Hatches and Leak Chase Channels	i	4.6.2
6.	**Other Plant-Specific Time-Limited Aging Analyses**	**N/A**	**4.7**
	Containment Polar Crane, Fuel Building Cask Handling Crane, Spent Fuel Pool Bridge Crane, and Refueling Machine CMAA 70 Load Cycle Limits	i	4.7.1
	In-service Flaw Analyses that Demonstrate Structural Integrity for 40 years	i	4.7.2
	Corrosion Analysis of the Reactor Vessel Cladding Indications	i	4.7.3
	Reactor Vessel Underclad Cracking Analyses	i	4.7.4
	Reactor Coolant Pump Flywheel Fatigue Crack Growth Analysis	i	4.7.5
	High Energy Line Break Postulation Based on Fatigue Cumulative Usage Factors	iii	4.7.6
	Fatigue Crack Growth Assessment in Support of a Fracture Mechanics Analysis for the Leak-Before-Break (LBB) Elimination of Dynamic Effects of Piping Failures	i	4.7.7
	Replacement Class 3 Buried Piping	i	4.7.8
	Replacement Steam Generator Tube Wear	iii	4.7.9
	Mechanical Environmental Qualification	iii	4.7.10

[1] (i) 10 CFR 54.21(c)(1)(i), Validation: The analyses remain valid for the period of extended operation.
(ii) 10 CFR 54.21(c)(1)(ii), Projection: The analyses have been projected to the end of the period of extended operation.
(iii) 10 CFR 54.21(c)(1)(iii), Aging Management: The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.
N/A Not Applicable: Section heading or no TLAA. Disposition categories are not applicable.

4.4 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC EQUIPMENT

10 CFR 50.49, *Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants*, requires that certain electrical and instrumentation and control (I&C) equipment, important to safety and located in harsh environments, be qualified to perform their safety related functions in those harsh environments after the effects of in service aging. Aging evaluations that qualify components to at least the end of the current licensed operating period are TLAAs.

10 CFR 50.49, defines the scope of components to be included, and requires the preparation and maintenance of documentation that includes component performance specifications, electrical characteristics, and environmental conditions.

10 CFR 50.49(e)(5) contains provisions for aging that require, in part, consideration of all significant types of aging degradation that can affect component functional capability. 10 CFR 50.49(e)(5) also requires component replacement or maintenance prior to the end of designated life, unless additional life is established through ongoing qualification.

The Environmental Qualification (EQ) program is described in FSAR Sections 3.11(B) and 3.11(N) SP. The Callaway EQ program is consistent with the requirements of NUREG-0588, Category I. This demonstrates conformance to 10 CFR 50.49 for SNUPPS plants. The NRC acceptance of the Callaway EQ Program is documented in Safety Evaluation Report (SER), Supplement No. 3. Callaway is also committed to Regulatory Guide 1.89, Rev. 0.

The EQ program manages applicable component thermal, radiation, and cyclic aging effects through the aging evaluations for the current operating license using methods for qualification for aging and accident conditions established by 10 CFR 50.49(f). Qualification methods employed to meet the IEEE 323-1974 aging requirements for safety related equipment are documented in the individual equipment qualification data package (EQDP). Re-analysis of an aging evaluation to extend the qualification of components is performed on a routine basis as part of the EQ program. The important attributes of reanalysis include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria, and corrective actions (if acceptance criteria are not met).

Analytical Methods: The analytical models used in the reanalysis of an aging evaluation are the same as those previously applied during the prior evaluation. The Arrhenius methodology is an acceptable model for a thermal aging evaluation. For license renewal radiation aging evaluation, 60-year normal radiation dose is established by extrapolating the 40-year normal dose (40-year dose times 1.5) plus accident radiation dose. 60-year cyclical aging is established in a similar manner. Other models may be justified on a case-by-case basis.

Data Collection and Reduction Methods: Reducing excess conservatism in the component service conditions (for example, temperature, radiation, and cycles) used in the prior aging evaluation is the chief method used for a reanalysis. Actual monitored service conditions such as temperature are generally lower than the design service conditions used in the prior aging evaluation and therefore can support extended thermal life of the equipment.

Underlying Assumptions: EQ component aging evaluations contain sufficient conservatism to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

Excess conservatism in thermal life analysis may be reduced to support extended life at elevated temperature. Similar methods of reducing excess conservatism in the component service conditions and material properties used in prior aging evaluations may be used for radiation and cyclical aging.

Acceptance Criteria and Corrective Actions: If qualification cannot be extended by reanalysis, the component is refurbished or replaced prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner (that is, sufficient time is available to refurbish, replace or re-qualify the component if reanalysis is unsuccessful).

~~***Mechanical Equipment***~~

~~FSAR Section 3.11(B).6 SP describes the Mechanical EQ program at Callaway. The program includes identification of aging concerns and establishment of replacement intervals as required. As part of the qualification review, replacement intervals were identified either on the basis of aging performed during an IEEE 323-1974 qualification program or on the basis of published material aging data. The qualifications for some of the mechanical equipment extend beyond 40 years and are TLAAs.~~

The Environmental Qualification (EQ) of Electric Components program, summarized in Appendix B, Section B3.2, ensures that the aging effects will be managed and that the EQ components will continue to perform their intended functions for the period of extended operation. ~~This program also manages the aging of mechanical EQ components.~~ Aging effects addressed by the EQ program will therefore be managed for the period of extended operation, and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

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

4.7.10 Mechanical Environmental Qualification

FSAR Section 3.11(B).6 SP describes the Mechanical Environmental Qualification (MEQ) program at Callaway. The program establishes qualified lives for safety-related mechanical components located in harsh environments based on aging concerns in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. As part of the qualification, replacement intervals were identified as required either on the basis of aging performed during an IEEE 323-1974 qualification program or on the basis of published material aging data. The qualifications for some of the mechanical equipment extend beyond 40 years and are TLAAs.

The design basis conditions during the period of extended operation will remain the same as those in the current license period. Therefore, the design basis event parameters, including the temperature, radiation, and humidity, do not require further evaluation for license renewal. However, those components qualified for 40 years will need to extend the duration the components will be exposed to normal operating conditions through the period of extended operation prior to exceeding the current qualified life.

The Environmental Qualification (EQ) of Electric Components program, summarized in Appendix B, Section B3.2, includes an exception that expands the scope to include MEQ components. This ensures the effects of aging on the intended function(s) of equipment included under Mechanical Equipment Qualification will be adequately addressed for the period of extended operation. Therefore the aging effects on the MEQ components will be managed for the period of extended operation, and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

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

Appendix A
Final Safety Analysis Report Supplement

A2.2 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRICAL COMPONENTS

The Environmental Qualification (EQ) of Electrical Components program manages component thermal, radiation, and cyclical aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. This program also manages the aging of mechanical EQ components. As required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished or replaced, or have their qualification extended prior to reaching the aging limits established in the evaluation.

The Environmental Qualification (EQ) of Electrical Components program is consistent with the guidance of 10 CFR 50.49, NUREG-0588 Category I, and Regulatory Guide 1.89, *Qualification of Class IE Equipment for Nuclear Power Plants*, Revision 0 for maintaining qualifications of equipment.

Reanalysis of aging evaluations to extend the qualifications of components is performed on a routine basis as part of the EQ program. Important attributes for the reanalysis of aging evaluations include analytical methods, data collection and reduction methods, underlying assumptions, acceptance criteria and corrective actions (if acceptance criteria are not met).

A3.3 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC EQUIPMENT

10 CFR 50.49 requires that certain electrical and instrument and control equipment, important to safety, located in harsh environments, be qualified to perform their safety-related functions in those harsh environments after the effects of in-service aging.

The Callaway Environmental Qualification (EQ) of Electric Components program is consistent with the guidance of NUREG-0588, Category I, and the requirements of 10 CFR 50.49. The program outlines the methodology for performing activities required to establish, maintain, and document the environmental qualification of electrical equipment important to safety. The current list of equipment requiring environmental qualification is maintained in accordance with plant procedures and the Equipment Qualification Management System (EQMS). Safety-related electrical equipment and components located in a harsh environment are qualified by test or combination of test and analysis in accordance with the requirements of 10 CFR 50.49 and NUREG-0588 Revision 1. Detailed qualification results for electrical equipment located in a harsh environment are maintained in the Equipment Qualification Data Package (EQDP).

The Environmental Qualification (EQ) of Electric Components program, summarized in Section A2.2, ensures that the aging effects will be managed and that the EQ components will continue to perform their intended functions for the period of extended operation. ~~This program also manages the aging of mechanical EQ components.~~ Aging effects addressed by the EQ program will therefore be managed for the period of extended operation, and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

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A3.6.10 Mechanical Environmental Qualification

The Mechanical Environmental Qualification (MEQ) program establishes qualified lives for safety-related mechanical components located in harsh environments in accordance with the provisions of Criterion 4 of Appendix A to 10 CFR Part 50. Mechanical Environmental Qualifications (MEQ) extend beyond 40 years and are TLAAs. The Environmental Qualification (EQ) of Electric Components program includes MEQ components. Therefore the aging effects on the MEQ components will be managed for the period of extended operation, and the TLAAs are dispositioned in accordance with 10 CFR 54.21(c)(1)(iii).

B3.2 ENVIRONMENTAL QUALIFICATION (EQ) OF ELECTRIC COMPONENTS

Program Description

Callaway is a NUREG-0588 Category I plant. Electrical equipment within the scope of the Callaway EQ Program is environmentally qualified in accordance with NUREG-0588, Category I requirements as supplemented by 10 CFR 50.49. The NRC evaluated Callaway electrical equipment qualification based on Regulatory Guide 1.89 Revision 0, because Revision 1 was not yet issued. 10 CFR 50.49 and Regulatory Guide 1.89 Revision 0 and Revision 1 all invoke IEEE Standard 323-1974, which provides the criteria for safety-related equipment ("Class 1E" equipment). IEEE Standard 323-1974 also provides the basis for categorizing components important to safety, and defines environmental service conditions. The Callaway EQ Program therefore includes and identifies electrical components that are important to safety and that could be exposed to harsh environment accident conditions, consistent with 10 CFR 50.49. Compliance with 10 CFR 50.49 provides reasonable assurance that the component can perform its intended functions during accident conditions after experiencing the effects of inservice aging.

The Callaway EQ Program manages component thermal, radiation, and cyclical aging through the use of aging evaluations based on 10 CFR 50.49(f) qualification methods. As required by 10 CFR 50.49, EQ components not qualified for the current license term are to be refurbished or replaced, or have their qualification extended prior to reaching the aging limits established in the evaluation. Aging evaluations for EQ components that specify a qualification of at least 40 years are considered time-limited aging analyses (TLAAs) for License Renewal.

A list of qualified components is maintained in the Callaway Equipment List (CEL). For each component, the CEL references the Equipment Qualification Data Packages (EQDPs), which include the qualified life, specification, electrical characteristics, and environmental conditions. These equipment data packages are maintained in the Equipment Qualification Management System (EQMS). The equipment data packages in the EQMS are reanalyzed to extend the qualification of a component on a routine basis pursuant to 10 CFR 50.49(e) and utilizing the following methods.

Analytical Methods: The analytical models used in the reanalysis of an aging evaluation are the same as those previously applied. The Arrhenius methodology is an acceptable model for a thermal aging evaluation. For license renewal radiation aging evaluation, 60-year normal radiation dose is established by extrapolating the 40-year normal dose (40-year dose times 1.5) plus accident radiation dose. 60-year cyclical aging is established in a similar manner. Other models may be justified on a case-by-case basis.

Data Collection and Reduction Methods: Reducing excess conservatism in the component service conditions (for example, temperature, radiation, and cycles) used in the prior aging evaluation is the chief method used for a reanalysis. Actual monitored service conditions such as temperature are generally lower than the design service conditions used in the prior aging evaluation and therefore can support extended thermal life of the equipment.

Underlying Assumptions: EQ component aging evaluations contain sufficient conservatism to account for most environmental changes occurring due to plant modifications and events. When unexpected adverse conditions are identified during operational or maintenance activities that affect the normal operating environment of a qualified component, the affected EQ component is evaluated and appropriate corrective actions are taken, which may include changes to the qualification bases and conclusions.

Excess conservatism may be reduced by reevaluating the component service conditions and material properties used in prior aging evaluations for radiation and cyclical aging, to justify a value that would support extended life.

Acceptance Criteria and Corrective Actions: If qualification cannot be extended by reanalysis, the component is refurbished or replaced prior to exceeding the period for which the current qualification remains valid. A reanalysis is to be performed in a timely manner (that is, sufficient time is available to refurbish, replace or re-qualify the component if reanalysis is unsuccessful).

The Callaway EQ program also assigns qualified lives to safety-related mechanical components located in harsh environments. ~~The components are managed with the EQ maintenance and/or surveillance programs.~~

NUREG-1801 Consistency

The Environmental Qualification (EQ) of Electric Components program is an existing program that is consistent, with exception, to NUREG-1801, Section X.E1, *Environmental Qualification (EQ) of Electric Components.*

Exceptions to NUREG-1801

~~None~~

Scope of the Program - Element 1

Callaway EQ program takes exception to the scope of program, which is limited in NUREG-1801 to electrical equipment. Callaway intends to use the program to manage the qualified lives of safety-related mechanical components located in harsh environments as well.

Enhancements

None

Operating Experience

The following discussion of operating experience provides objective evidence that the Environmental Qualification (EQ) of Electric Components program will be effective in ensuring that intended functions are maintained consistent with the current licensing basis for the period of extended operation:

1. In 2010, Callaway performed a self assessment of the EQ program. The self assessment team identified several documentation, procedure, training, and data collection improvements to the current program. The self assessment identified the following items as possible gaps in the Callaway EQ Program that could affect the ability of the equipment to meet its intended function(s) consistent with the CLB for the period of extended operation:

   a. Post Accident Operating Time (PAOT) calculation does not consider motor winding temperature rise and no justification is provided. EQ engineer calculated PAOT with the heat rise added to the calculation and demonstrated that margin is available and plant qualification evaluation supports qualification.

   b. MSIV area temperature exceeded 120°F (design) at least six times in a two year period. Qualification reevaluation for components installed in main steam isolation valve/feedwater isolation valve was required to ensure that the degradation due to elevated temperature was accounted for and the component will be replaced prior to expiring life. The EQ engineer calculated qualified life and determined that a brief temperature spike does not impact qualified life.

2. In October 2008, overheating of the Grayboot connections caused the connectors to exceed their qualified life of 40 years. The cause of the condition was loose or inadequate crimps which resulted in more resistance across the connection causing the overheating. The overheating then caused the connectors to become weakened. The evaluation and extent of condition resulted in reterminating the hydrogen mixing fans using bolted ring tongue connections and Raychem rather than the Grayboot GB-3 connectors.

The operating experience of the Environmental Qualification (EQ) of Electrical Components program did not show any adverse trend in performance. The above examples provide objective evidence that the Environmental Qualification (EQ) of Electrical Components program methods are capable of detecting aging effects. Occurrences that would be identified under the Environmental Qualification (EQ) of Electrical Components program will

be evaluated to ensure there is no significant impact to safe operation of the plant, and corrective actions will be taken to prevent recurrence. Guidance for re-evaluation, repair, or replacement is provided for locations where aging is found. There is confidence that the continued implementation of the Environmental Qualification (EQ) of Electrical Components program will effectively identify aging effects prior to loss of intended function.

Conclusion

The continued implementation of the Environmental Qualification (EQ) of Electric Components program 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.

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Section 3.6.2.1.4.3 is added to add to account for electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance.

Section 3.6.2.1.4.3 (page 3.6-5) is added (new text is underlined) as follows:

3.6.2.1.4.3 Electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance

Materials

The materials of construction for the electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance are:

- Various Organic Polymers

Environment

The electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance are exposed to the following environment:

- Adverse Localized Environment

Aging Effects Requiring Management

The following electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance aging effects require management:

- Reduced insulation resistance

Aging Management Programs

The following aging management program manages the aging effects for the electrical cables and connections not subject to 10 CFR 50.49 EQ requirements used in instrumentation circuits that are sensitive to reduction in conductor insulation resistance:

- Insulation Material for Electrical Cables and Connections Not Subject to 10 CFR 50.49 Environmental Qualification Requirements Used in Instrumentation Circuits (B2.1.35)

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Changed the wording for fuse holders to conform to Table 3.6-1 of NUREG-1800.

Table 3.6-1, Summary of Aging Management Programs in Chapter VI of NUREG-1801 for Electrical Components (Page 3.6-19), is revised as follows (new text shown underlined and deleted text shown in strikethrough):

Table 3.6-1 Summary of Aging Management Programs in Chapter VI of NUREG-1801 for Electrical Components

Item Number	Component Type	Aging Effect / Mechanism	Aging Management Program	Further Evaluation Recommended	Discussion
3.6.1.016	Fuse holders (not part of active equipment): metallic clamps composed of Various metals used for electrical connections exposed to Air – indoor, uncontrolled	Increased resistance of connection due to chemical contamination, corrosion, and oxidation (in an air, indoor controlled environment, increased resistance of connection due to chemical contamination, corrosion and oxidation do not apply); fatigue due to ohmic heating, thermal cycling, electrical transients	Fuse Holders	No	Not applicable. ~~All fuse holders including the fuses installed for electrical penetration protection are part of larger assemblies~~. All fuse holders utilizing metallic clamps within the scope of license renewal are part of an active device and do not require aging management.

3.6.1.017	Fuse holders (not part of active equipment): metallic clamps composed of Various metals used for electrical connections exposed to Air – indoor, controlled or uncontrolled	Increased resistance of connection due to fatigue caused by frequent manipulation or vibration	Fuse Holders - No aging management program is required for those applicants who can demonstrate these fuse holders are located in an environment that does not subject them to environmental aging mechanisms or fatigue caused by frequent manipulation or vibration	No	Not applicable. ~~All fuse holders including the fuses installed for electrical penetration protection are part of larger assemblies~~. All fuse holders utilizing metallic clamps within the scope of license renewal are part of an active device and do not require aging management.