UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 6, 2012

Mr. Adam C. Heflin
Senior Vice President and Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE CALLAWAY PLANT UNIT 1 LICENSE RENEWAL APPLICATION, SET 6 (TAC NO. ME7708)

Dear Mr. Heflin:

By letter dated December 15, 2011, Union Electric Company d/b/a Ameren Missouri (the applicant) submitted an application pursuant to Title 10 of the *Code of Federal Regulations* Part 54 (10 CFR Part 54) for renewal of Operating License NPF-30 for the Callaway Plant Unit 1 (Callaway). The staff of the U.S. Nuclear Regulatory Commission (NRC or the staff) is reviewing this application in accordance with the guidance in NUREG-1800, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants." During its review, the staff has identified areas where additional information is needed to complete the review. The staff's requests for additional information are included in the enclosure. Further requests for additional information may be issued in the future.

Items in the enclosure were discussed with Sarah G. Kovaleski, of your staff, and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me by telephone at 301-415-2946 or by e-mail at Samuel.CuadradoDeJesus@nrc.gov.

Sincerely,

Samuel Cuadrado de Jesús, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:
As stated

cc w/encl: Listserv

CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION, SET 6

RAI B1.4-1 – Operating Experience

Background:

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

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

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

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

Based on its review of the Callaway, Unit 1, license renewal application (LRA), the staff determined that LRA Section B1.4, "Operating Experience," provides a general description of how the applicant gathered and considered operating experience in preparing its LRA, and LRA

Sections B2.1.1 through B2.1.39 and B3.1 through B3.3 summarize the specific operating experience considered for each AMP.

Issue:

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

Request:

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

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

RAI 3.2.2.2.4-1

Background:

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

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

Issue:

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

Request:

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

RAI 3.3.2.28-1

Background:

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

For the below elastomeric components, the LRA states:

LRA Table	Component	Environment	AERM	AMP
3.3.2-23	Expansion Joint	Fuel Oil (Int.)	Hardening and Loss of Strength	Inspection of Internal Surfaces in Miscellaneous Piping and Ducting Components

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

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

Issue:

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

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

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

Request:

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

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

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

RAI 3.5.1.25-1

Background:

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

Issue:

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

Request:

a) Verify that no containment concrete exposed to an air environment is inaccessible or revise the LRA accordingly. Reference the response to American Society of Mechanical Engineers (ASME) Section XI, Subsection IWL AMP RAI B.1.27-3 as necessary.

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

RAI 3.5.2.2.2.2-1

Background:

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

Issue:

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

Request:

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

RAI 3.5.1.90-1

Background:

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

Issue:

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

Request:

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

RAI 4.7.2-1

Background:

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

Issue:

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

Request:

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

RAI 4.7.2-2

Background:

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

Issue:

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

Request:

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

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

RAI 4.7.2-3

Background:

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

Issue:

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

Request:

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

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

RAI 4.7.7-1

Background:

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

Issue:

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

Request:

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

RAI 4.7.7-2

Background:

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

Issue:

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

applicant's basis may be predicated on Charpy or thermal aging data that are not up-to-date or conservative when compared to the most recent data for the state of the industry.

Request:

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

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

August 6, 2012

Mr. Adam C. Heflin
Senior Vice President and Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

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Dear Mr. Heflin:

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Items in the enclosure were discussed with Sarah G. Kovaleski, of your staff, and a mutually agreeable date for the response is within 30 days from the date of this letter. If you have any questions, please contact me by telephone at 301-415-2946 or by e-mail at Samuel.CuadradoDeJesus@nrc.gov.

Sincerely,
/RA/

Samuel Cuadrado de Jesús, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket No. 50-483
Enclosure:
As stated
cc w/encl:
See next page
ADAMS Accession No.: ML12206A264

OFFICE	LA:DLR/RPB1	PM:DLR/RPB1	BC:DLR/RPB1	PM:DLR/RPB1
NAME	YEdmonds	SCuadrado	DMorey	SCuadrado
DATE	8/2/2012	8/2/2012	8/6/2012	8/6/2012

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Letter to A. Heflin from S. Cuadrado DeJesus dated, August 6, 2012

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE CALLAWAY PLANT UNIT 1 LICENSE RENEWAL APPLICATION, SET 6 (TAC NO. ME7708)

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