Ameren MISSOURI

Callaway Plant

July 20, 2012

ULNRC-05885

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

10 CFR 2.101
10 CFR 2.109(b)
10 CFR 50.4
10 CFR 50.30
10 CFR 51.53(c)
10 CFR 54

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
RESPONSES TO RAI SET #2 TO THE CALLAWAY LRA

References:
1) ULNRC-05830 dated December 15, 2011
2) NRC Letter, "Request For Additional Information for the Review of the Callaway Plant, Unit 1 License Renewal Application (TAC No. ME7708)," dated June 22, 2012
3) ULNRC-05874 dated June 5, 2012

By the Reference 1 letter, Union Electric Company (Ameren Missouri) submitted a license renewal application (LRA) for Callaway Plant Unit 1. Reference 2 dated June 22, 2012 transmitted the second set of Requests for Additional Information (RAIs) related to this application.

Enclosure 1 contains Union Electric Company's responses to the individual requests contained in the June 22, 2012 letter. Several of the RAI responses refer to changes that were made by Amendment #3 of the LRA per Reference 3. There are no additional LRA changes or changes to commitments associated with the application.

If you have any questions with regard to these RAI responses please contact me at (573) 823-9286 or Ms. Sarah Kovaleski at (314) 225-1134.

I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Executed on: July 20, 2012

Les H. Kanuckel

Les H. Kanuckel
Manager, Engineering Design

DS/SGK/nls

Enclosure: Request for Additional Information (RAI) Set #2 Responses

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CALLAWAY PLANT UNIT 1
LICENSE RENEWAL APPLICATION

REQUEST FOR ADDITIONAL INFORMATION (RAI) Set #2 RESPONSES

RAI B3.1-1 Fatigue Monitoring Program Transient Monitoring

Background:

License renewal application (LRA) Section B3.1 identifies an enhancement to the "preventive actions" program element of the Fatigue Monitoring Program. Specifically, it states that "[p]rocedures will be enhanced to require the review of the temperature and pressure transient data from the operator logs and plant instrumentation to ensure actual transient severity is bounded by the design and to include environmental effects where applicable."

The staff noted that the applicant's program is an existing program, which has been monitoring transients since initial plant startup.

Issue:

The staff noted that an essential part of a Fatigue Monitoring Program is to ensure that the design severity of a transient is not exceeded during plant operation; therefore, considering this enhancement to the program, it is not clear to the staff how the applicant ensures accumulated transients from initial plant start up will be bounded by the design transients prior to procedure enhancement.

Request:

(a) Explain how the existing program ensures that transients from initial plant startup are either bounded by the design transient or accurately captured by the Fatigue Monitoring Program.

(b) If a reconciliation or verification of transient severity was performed to obtain a baseline, justify that the Fatigue Monitoring Program includes an accurate account of transients that occurred such that fatigue will be managed during the period of extended operation.

(c) If the existing program already includes provisions for comparing transient severity between actual and design transients, discuss the purpose of the enhancement.

Callaway Response

(a) The reactor coolant pressure boundary components are designed to withstand the operating transients as defined in FSAR Section 3.9(N).1.1 and the system specifications. The plant operating procedures and technical specifications are designed to ensure that the severity of plant events is bounded by those described in the design analyses (i.e., maximum rates of change of temperatures, pressures, flows, etc.). The existing Callaway Fatigue Monitoring Program requires a review of the design transient tracking log at least once per cycle to ensure that components are maintained within their design limits. The review utilizes multiple data sources (e.g. Corrective Action Program, Plant Computer, Operator Logs/Rounds, Strip Charts, FatiguePro data) to assure that the actual transients have been appropriately characterized and are bounded by the design transients. If a thermal or pressure transient occurs that is not bounded by the design transient, the event is documented in the Corrective Action Program and an engineering evaluation is performed to determine the impact on applicable components and analyses.

(b) Reconciliation was not required for all historical transients for license renewal. Select transients were reconciled with the design basis using industry and plant specific operating experience. These included reanalysis of the Chemical and Volume Control System heat exchangers and charging nozzles for a normal letdown of 140 gpm, and re-analyses of the pressurizer lower head for a revised insurge-outsurge transient. The Fatigue Monitoring Program assumes that all historical events occur at the transient severity identified in the reanalysis which bounds the historical plant operation.

(c) The existing program already includes provisions for comparing severity between actual transients and design transients, which is the fundamental basis for a Fatigue Monitoring Program. The enhancement was added to document the process within the procedure.

Corresponding Amendment Changes

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

RAI B3.1-2 Discrepancy with Fatigue Monitoring Program Enhancement

Background:

LRA Section B3.1 identifies an enhancement to the "parameters monitored or inspected" program element of the Fatigue Monitoring Program. Specifically, it states that "[p]rocedures will be enhanced to include additional transients that contribute significantly to fatigue usage identified by evaluation of ASME Section III fatigue and fatigue crack growth analyses."

In contrast, LRA Section 4.3.1 states "[LRA] Table 4.3-2, *Transient Accumulations and Projections* lists the transients monitored by the Fatigue Monitoring Program. In addition, the transients included in the program were identified through a review of the design and licensing analyses."

Issue:

Based on LRA Section 4.3.1 it seems that a review of the design and licensing analyses has already been performed; therefore, it is not clear to the staff what will be enhanced in the procedures.

Request:

(a) Clarify the discrepancy between LRA Section B3.1 and LRA Section 4.3.1.

(b) Clarify what actions will be taken as part of this enhancement to the procedures to include additional transients that contribute significantly to fatigue usage identified by evaluation of ASME Section III fatigue and fatigue crack growth analyses.

Callaway Response

(a) Review and evaluation of ASME Section III fatigue and fatigue crack growth analyses to identify transients that contribute significantly to fatigue usage have been completed. LRA Section B3.1 element 3 enhancement requires incorporation of transients that contribute significantly to fatigue usage into the Fatigue Monitoring Program. LRA Section B3.1 enhancement section and LRA Appendix A4-1 item 31 were revised by LRA Amendment 3 to clarify the element 3 enhancement. LRA Amendment 3 was submitted to the NRC on June 5, 2012.

(b) Implementing procedures will be revised to require cycle counting of transients that contribute significantly to fatigue usage into the Fatigue Monitoring Program (see above).

Corresponding Amendment Changes

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

RAI B3.1-3 Callaway Evaluation of RIS 2011-14 and Use of Engineering Judgment

Background:

During its audit, the staff reviewed the applicant's evaluation of plant-specific and generic operating experience related to its Fatigue Monitoring Program. The "operating experience" program element of Generic Aging Lessons Learned (GALL) Report aging management program (AMP) X.M1 recommends that the program review industry experience relevant to fatigue cracking. The staff noted that regulatory issue summary (RIS) 2011-14, "Metal Fatigue Analysis Performed by Computer Software," was issued on December 29, 2011. This RIS is associated with the implementation of computer software packages used to demonstrate the ability of nuclear power plant components to withstand the cyclic loads associated with plant transient operations.

Issue:

Documentation of how the applicant addressed this recently issued RIS was not available to the staff during its audit; therefore, it is not clear if and how the applicant will address the issues discussed in RIS 2011-14.

During its audit, the staff noted that the applicant uses the computer software, FatiguePro, which can perform cycle counting, cycle-based and stress-based fatigue monitoring to manage cumulative fatigue damage. It is not clear, if the data collected by FatiguePro is reviewed and modified prior to the determination of cumulative fatigue usage for a component or of an accrued transient cycle.

Request:

(a) Describe and justify any actions that have been or will be taken to address the concerns described in RIS 2011-14, related to the use of computer software to demonstrate the ability of components to withstand cyclic loads associated with transients and the documentation of analyst's engineering judgment and intervention.

(b) Describe the activities that are performed to the information/data that is collected by FatiguePro prior to determining the cumulative fatigue usage for a component or an accrued transient cycle. Further justify if the concerns described in RIS-2011-14, related to documentation of the analyst's engineering judgment and intervention, have been addressed for the current use or will be addressed for the future use of a computer software for fatigue calculations.

Callaway Response

(a) RIS 2011-14 was evaluated by the Callaway Corrective Action Program. The CAP evaluation concluded that RIS 2011-14 was specific to the WESTEMS Fatigue Monitoring Program software. Callaway utilizes the FatiguePro Software to monitor fatigue usage, not WESTEMS. However, WESTEMS has been utilized by Westinghouse to support fatigue analysis for Callaway. Subsequent to NRC RIS 2011-14 issuance, Westinghouse issued IG-12-1, "NRC Regulatory Issue Summary 2011-14 – Metal Fatigue Analysis Performed By Computer Software" dated January 16, 2012 in response.

The following information was provided in IG-12-1:

> "In summary, the subject RIS does not identify an error in the WESTEMS™ program. Instead, it identifies the possible misuse of algebraic summation or the peak and valley options in the design analysis modules. **Westinghouse is able to demonstrate that the calculations generated for the operating plants which use the WESTEMS™ program have not misused algebraic summation or the peak and valley options and have met all ASME Code limits..."**

The peak and valley times selected by the WESTEMS algorithm in the Callaway fatigue analysis were reviewed and confirmed to be applicable and conservative. The review is documented in the Westinghouse calculations. No additional modifications were performed to reduce conservatism in the peak and valley times used in the fatigue analysis.

The following information was provided in Structural Integrity Letter DAG-12-003 dated January 31, 2012, to document the impact of RIS 2011-14 on FatiguePro version 3 (Utilized at Callaway):

> **"Effect on FatiguePro Installations**
> The software installed at ... Callaway... (**FatiguePro** version 3) does not use the algebraic summation of three orthogonal moment vectors nor does it permit modification of stress peaks and valleys (the two issues in the RIS). Thus, **FatiguePro** version 3 installed at (Callaway) is not affected by NRC RIS 2011-14. Specifically,
>
> - **FatiguePro** version 3 does not perform NB-3600 analysis, so the concerns about how to calculate moment range in accordance with NB-3600 do not apply.
> - **FatiguePro** version 3 does not have a manual stress peak/valley editor."

Based upon the response provided by Westinghouse in IG-12-1 and Structural Integrity in DAG-12-003 there is no adverse condition that exists for Callaway (associated with NRC RIS 2011-14).

(b) RIS 2011-14 addresses non-conservatisms specific to the WESTEMS Fatigue Monitoring Program software. Callaway is currently using FatiguePro to monitor fatigue usage, not WESTEMS. For FatiguePro it was determined that the software installed does not use the algebraic summation of three orthogonal moment vectors nor does it permit modification of stress peaks and valleys (the two issues in the RIS). Based upon these observations there is no adverse condition that exists for Callaway.

The only user manipulation that exists in the Fatigue Monitoring Program is to ensure if all transients were appropriately counted. In FP-CALL-304, "Baseline Analysis of Callaway Plant Cycles and Fatigue Usage – Startup through 1/31/2011", the collection and analysis of the Callaway fatigue data are documented. In FP-CALL-304, there are three locations where the data was altered in some fashion. Below are the explanations of the changes from the baseline analysis:

1. The Compressed Data Files (CDT) cover from 5/11/1995 through 1/31/2011. Most of the plant instruments necessary to detect the automatically counted cycles are included in the CDT files. The current **FatiguePro** software is a revision of an older version and as part of the revision, and in the course of the revision, the list of necessary instruments was expanded. The CDT files were created prior to issuing the revised instrument list and Callaway was unable to recreate them with the new instrument list. The CDT files were revised so that the initiation block for each file

contains the missing instruments with initial values set to zero. This was done so that the CDT files would run in the current **FatiguePro** version. Future CDT files will contain the full set of instruments.

This change is only for compatibility with the previously collected data and has no impact on the final analysis.

2. Plant data in the form of CDT files were run from 5/11/1995 through 1/31/2011. The data was corrected as needed to remove instrument test data, drop-out points, and other obviously bad instrument data. All data corrections are automatically logged by FatiguePro. The log is retained with the supporting files of calculation FP-CALL-304.

This change is only to ensure the accuracy of the data, and to remove erroneous results that may trigger false positives.

3. The charging and letdown transients are sometimes difficult to classify accurately using the automatic cycle counting logic due to the order in which letdown and/or charging flow is lost and the effect of the flow loss on the temperature at the charging nozzle. Additionally, due to instrument noise for the flow instruments, multiple events can be recorded when only one event has occurred. As such, the recorded charging and letdown transients were inspected to determine whether or not they had been counted accurately, and in some cases the transients were reclassified based on the thermal effect of the charging and letdown flows on the charging nozzle. The design transients in Westinghouse Systems Standard 1.3.X were used as a guide in the reclassification. In reclassifying transients, the thermal effect of the transient on the charging nozzle was studied and matched to the design transient in the Westinghouse System Standard that the transient most closely resembled. A few of the transients didn't match the design transients, in which case the severity of the thermal shock at the nozzle was considered and the transient matched to the design transient with a similar thermal shock.

These changes were done in accordance with Westinghouse System standards, and they are documented in FP-CALL-304, which ensures accountability for the reclassifications.

Corresponding Amendment Changes

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

RAI B3.1-4 Revise LRA Appendix A2.1 for Fatigue Monitoring Program

Background:

LRA Section A2.1 provides a summary description of the applicant's Fatigue Monitoring Program, which generally describes the key aspects of the program when implemented for the period of extended operation. During its audit and review of LRA Section B3.1, the staff noted that the applicant's Fatigue Monitoring Program uses three monitoring methods; specifically cycle counting, cycle-based fatigue monitoring and stress-based fatigue monitoring.

Issue:

The staff noted that the monitoring methods used by an applicant to manage cumulative fatigue damage are a key aspect to a Fatigue Monitoring Program. However, the applicant's Final Safety Analysis Report Supplement in LRA Section A2.1 for this program does not include a description or discussion of how the monitoring methods will manage cumulative fatigue damage during the period of extended operation.

Request:

Revise LRA Section A2.1 to provide a description of how each monitoring method of the Fatigue Monitoring Program will manage fatigue. Otherwise justify why a revision to LRA Section A2.1, to capture this key aspect of the Fatigue Monitoring Program, is not needed.

Callaway Response

LRA Appendix A2.1 was revised by LRA Amendment 3 to provide a description of the following fatigue monitoring methods of the Fatigue Monitoring Program.

- Cycle counting monitoring method
- Cycle-based fatigue monitoring method
- Stress-based fatigue monitoring method

LRA Amendment 3 was submitted to the NRC on June 5, 2012.

Corresponding Amendment Changes

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

RAI 4.2.2-1 USE – Beltline and Extended Beltline Material Info

The staff noted that the time-limited aging analysis (TLAA) of Charpy Upper-Shelf Energy (USE) discussed in LRA Section 4.2.2 includes direct projections of end-of-extended-license (EOLE, 54 effective full power years (EFPY)) USE values for all reactor vessel (RV) beltline and extended beltline materials.

For the RV extended beltline materials, please provide the following additional information:

(a) For the RV nozzle shell plates and inlet/outlet nozzle forgings, please identify their material types (i.e., SA-533B plate, SA-508, Class 2 forging, etc.).

(b) For the nozzle shell-to-intermediate shell weld and all inlet/outlet nozzle-to-shell welds, please identify the weld fabrication method and flux type.

(c) For all extended beltline materials, please identify the following:

i. The heat numbers for plates and forgings, and the weld wire heat number and flux lot number for welds; and

ii. The source of the initial USE and copper (Cu) content data. If the initial USE and Cu content data are not based on measured heat-specific values from certified material test reports (CMTRs), then please provide justification for using these values.

Callaway Response

(a) The material properties of the Callaway reactor pressure vessel are presented in FSAR SP Table 5.3-4. The Nozzle Shell Plates are A533B, Class 1 plate material. The Inlet and Outlet Nozzle Forgings are A508 Class 2 forging material.

(b) Table 2 (page 12 of this Enclosure) contains the weld fabrication method and flux type for the nozzle shell-to-intermediate shell weld and all inlet/outlet nozzle-to-shell welds.

(c)(i) Table 1 (page 11 of this Enclosure) contains the material types and heat numbers for plates and forgings in the extended beltline.

Table 2 contains the heat numbers; flux type and lot; weld fabrication method; initial RT_{NDT} values; and initial USE values for welds in the extended beltline.

(c)(ii) With the exception of those Linde 0091 welds identified in Table 2, all the initial USE values are based on heat specific CMTRs. The Linde 0091 welds use a generic value based on CEN-622-A Final Report, "Generic Upper Shelf Values for Linde 1092, 124 and 0091 Reactor Vessel Welds, CEOG Task 839."

With the exception of the inlet and outlet nozzles Cu content, all the initial Cu content are based on heat specific CMTRs. The CMTR for the Callaway inlet and outlet nozzle forgings did not contain measurements of copper content because it was not required. Instead the maximum copper content of 0.16 wt% for high-Copper materials are taken from the chemistry measurements available for A508 class 2 forgings from Oak Ridge National Laboratory Report ORNL/TM-2006/530 [ADAMS Accession Number ML081000630]. This document includes measurements, including copper content, made on pressurized water reactor surveillance capsule materials for various forging and plate specifications, as well as weld metals used to fabricate the vessel seams.

The welds in the extended beltline include multiple heat numbers with differing initial USE and Cu content. The USE at EOLE is calculated using the most limiting initial USE and Cu content.

Corresponding Amendment Changes

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

Table 1: Plates and Forgings

Table 1 contains the material types and heat numbers for plates and forgings in the extended beltline.

Component	ID	Base Metal	Heat Number
Nozzle Shell Plates	R2706-1	A533B, CL. 1	C4202-1
	R2706-2	A533B, CL. 1	C4242-1
	R2706-3	A533B, CL. 1	B8307-1
Inlet Nozzle Forgings	R2702-1	A508 CL. 2	12-5468-02-002
	R2702-2	A508 CL. 2	12-5468-02-001
	R2702-3	A508 CL. 2	11-5450-02-003
	R2702-4	A508 CL. 2	11-5450-02-004
Outlet Nozzle Forgings	R2703-1	A508 CL. 2	EX3132-5A756
	R2703-2	A508 CL. 2	EX3133-5A757
	R2703-3	A508 CL. 2	EX3134-5A758
	R2703-4	A508 CL. 2	EX3135-5A759

Table 2: Welds

Table 2 contains the heat numbers; flux type and lot; weld fabrication method; initial RT_{NDT} values; and initial USE values for welds in the extended beltline.

Component	Weld No.	Heat No.	Weld Method[1]	Flux Type	Flux Lot	Initial RT_{NDT} (°F)	USE (ft-lb)
Nozzle Shell to Intermediate Shell Weld Seam	103-121	90211	SAW	Linde 0091	0653	-60	145
		IAOJE	SMAW	-	-	-80	166
		JAACE	SMAW	-	-	-70	163
Inlet Nozzle to Shell Weld Seams	105-121A	3P7246	SAW	Linde 124	0951	-60	106
		HABIE	SMAW	-	-	-80	177
		EAAHF	SMAW	-	-	-40	128
	105-121B	4P7646	SAW	Linde 0091	1054	-70	101[2]
		BABEF	SMAW	-	-	-70	185
	105-121C	EAAHF	SMAW	-	-	-40	128
		FABAF	SMAW	-	-	-60	139
		3P7246	SAW	Linde 124	0951	-60	106
	105-121D	4P7656	SAW	Linde 0091	1054	-70	101[2]
		BABEF	SMAW	-	-	-70	185
Outlet Nozzle to Shell Weld Seams	107-121A	4P7656	SAW	Linde 0091	1054	-70	101[2]
		BABEF	SMAW	-	-	-70	185
	107-121B	3P7317	SAW	Linde 124	0951	-8	99
		FABAF	SMAW	-	-	-60	139
		EAAHF	SMAW	-	-	-40	128
	107-121C	4P7656	SAW	Linde 0091	1054	-70	101[2]
		BABEF	SMAW	-	-	-70	185
	107-121D	3P7246	SAW	Linde 124	0951	-60	106
		4P6524	SAW	Linde 124	0951	-80	104
		3P7317	SAW	Linde 124	0951	-80	99
		HABIE	SMAW	-	-	-80	177
		FAAHF	SMAW	-	-	-50	119
		EAAHF	SMAW	-	-	-40	128
Nozzle Shell Long Weld Seams	101-122A	87000	SAW	Linde 0091	0145	-40	132
		GABID	SMAW	-	-	-50	147
	101-122B	FAOED	SMAW	-	-	-60	155
		87000	SAW	Linde 0091	0145	-40	132
	101-122C	87000	SAW	Linde 0091	0145	-40	132
		EACAE	SMAW	-	-	-80	128

1. SAW - submerged arc welding
   SMAW - shielded metal arc welding. This fabrication method uses a coated electrode to create an inert environment to protect the weld from impurities.
2. Generic value based on CEN-622-A Final Report, "Generic Upper Shelf Values for Linde 1092,124 and 0091 Reactor Vessel Welds, CEOG Task 839"

RAI 4.2.3-1 Provide Initial RT_{NDT} and Ni Content Data

For all extended beltline materials, please identify the source of the initial reference temperature (RT_{NDT}) and nickel (Ni) content data. If the initial RT_{NDT} and Ni content data are not based on measured heat-specific values from CMTRs, then please provide justification for using these values.

Callaway Response

The initial RT_{NDT} and Ni content of the nozzle forgings, nozzle plates and associated welds are based on heat specific CMTRs. The welds in the extended beltline include multiple heat numbers with differing initial RT_{NDT}. The most limiting initial RT_{NDT} content are chosen for the evaluation of RT_{PTS}. To account for varying chemical content of the weld heats, a Chemistry Factor (CF) is calculated for each heat based on the measured Cu & Ni content using RG 1.99, Rev. 2, Position 1.1. The most limiting CF of all the weld heats is used for the evaluation of RT_{PTS}.

Corresponding Amendment Changes

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

RAI B2.1.17-1 Provide Neutron Fluence for Capsule X

LRA Section B2.1.17 states that the last surveillance capsule tested under the Reactor Vessel Surveillance Program was exposed to neutron fluence levels equivalent to about 54 EFPY of exposure, which exceed the 60-year peak RV wall neutron fluence.

Please identify the high energy (E > 1.0 MeV) neutron fluence for this capsule, as determined from the capsule dosimetry analysis.

Callaway Response

Capsule X was the last capsule tested and was exposed to a fluence of 3.33×10^{19} neutrons/cm^2 (E > 1.0 MeV) based on the calculated fluence in WCAP-15400-NP, Analysis of Capsule X From The Ameren-UE Callaway Unit 1 Reactor Vessel Surveillance Program. LRA Appendix B2.1.17 program description section and operating experience section were revised by LRA Amendment 3 to identify the high energy (E > 1.0 MeV) neutron fluence of Capsule X. LRA Amendment 3 was submitted to the NRC on June 5, 2012.

Corresponding Amendment Changes

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

RAI B2.1.17-2 – Identify Standby Surveillance Capsule Info

LRA Section B2.1.17 discusses the status of two standby surveillance capsules. The LRA states that one capsule was removed at 71 EFPY of equivalent RV exposure and is stored in the spent fuel pool for reinsertion or testing as deemed appropriate. The other capsule will be removed at approximately 108 EFPY of equivalent exposure.

Please identify these standby surveillance capsules (e.g., Capsule *"W"*, "Z", etc.).

Callaway Response

The standby surveillance capsules are Capsules W and Z. 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. LRA Appendix B2.1.17 program description section was revised by LRA Amendment 3 to identify the standby surveillance capsules. LRA Amendment 3 was submitted to the NRC on June 5, 2012.

Corresponding Amendment Changes

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