Ameren
MISSOURI

Callaway Plant

April 19, 2012

ULNRC-05855

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

10 CFR 50.55a(a)(3)(ii)

Ladies and Gentlemen:

**DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
RESPONSE TO NRC REQUEST FOR INFORMATION REGARDING
10 CFR 50.55a REQUEST: PROPOSED ALTERNATIVE TO
ASME OM CODE REPLACEMENT INTERVAL FOR
MAIN STEAM ISOLATION VALVE ACTUATOR RUPTURE DISKS**

Reference 1: Ameren Missouri Letter ULNRC-05844, "10 CFR 50.55a Request: Proposed Alternative Regarding ASME OM Code Replacement Interval for Main Steam Isolation Valve Actuator Rupture Disks," dated March 30, 2012

Pursuant to 10 CFR 50.55a(a)(3)(ii) and by letter dated March 30, 2012 (Reference 1), Union Electric Company (dba Ameren Missouri) submitted and requested NRC approval of a Relief Request regarding the requirements of ASME OM Code, Mandatory Appendix 1, I-1360 for periodic replacement of Class 2 and 3 non-reclosing pressure relief devices. Specifically per the request, which is under review by the NRC staff, Ameren Missouri requested approval of an alternative wherein the interval for replacing the rupture disks associated with the actuators for the main steam line isolation valves (MSIVs) at Callaway would be extended beyond the Code-specified 5-year replacement interval. The intent was that this would enable the rupture disks to be replaced during the next refueling outage with the plant in a shutdown condition, in lieu of having to replace the disks during the current operating cycle with the plant online.

Following NRC receipt of the Reference 1 letter, and from initial review of the request, the NRC staff identified the need for additional information to support their review. Consequently, two requests for additional information (RAIs) were transmitted via e-mail to the Callaway plant staff. The first RAI, containing nine specific questions/requests, was transmitted on April 5, 2012. Some information was e-mailed to the NRC on April 9 in response to that RAI. The second RAI, containing seven additional questions/requests was transmitted on April 10, 2012. Responses to the specific questions/requests from both RAIs are hereby provided in the attachment to this letter. (That is, both RAIs have been consolidated into one RAI such that Ameren Missouri's responses to all of the specific questions/responses from both RAIs are contained in Attachment 1.)

As noted in the Reference 1 letter, the current MSIV rupture disks were installed when the MSIV actuators were replaced in the spring of 2007, i.e., during Refuel 15. Based on the original installation dates for the rupture disks (which are not the same for all four disks), the soonest due date for rupture disk replacement is April 23, 2012. Therefore, to avoid non-compliance with Code requirements, verbal NRC approval of this 10 CFR 50.55a request is requested on or by that date.

Ameren Missouri appreciates your prompt attention to this matter. Please contact me at 573-823-4970 or Tom Elwood at 314-225-1905 for any questions you may have regarding this request.

No new regulatory commitments have been made or identified in this letter or its attachment.

Sincerely,

S. A. M

S. A. Maglio
Regulatory Affairs Manager

TBE/nls

Attachment 1: Responses to NRC Requests for Additional Information

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Responses to NRC Requests for Additional Information

1) *Can Callaway supply a sketch of the MSIV/actuator showing the rupture disk and describing its function?*

   Enclosures 1, 2, and 3 provide the requested information. Enclosure 1 shows a layout of one MSIV/actuator and its attendant valves, including rupture disk ABPSE0001. Enclosure 2, 1st drawing, shows the normal open position of the valve (which shows why the top and bottom of the valve are under a vacuum). Enclosure 2, 2nd drawing, shows the closing of the valve (fluid is ported to the top of the valve piston driving the valve closed). Enclosure 2, 3rd drawing, shows the lineup after the valve has been closed for 2 minutes (bottom port is filled with fluid to prevent continuous leakage pass the piston seals).

   The safety function of the rupture discs is to open to allow the lower piston chamber (LPC) of the MSIV actuators to vent and close the MSIV within the required time frame. To close an MSIV, the LPC must be open or vented. Two vent lines are provided for each MSIV actuator. The normal, non-safety vent line is routed from the actuator through a locked open manual valve and back to the condenser. The backup vent line is routed from the MSIV actuator through a locked open manual isolation valve and is safety-related up to the rupture disk set at 150 psig to an equipment floor drain.

2) *Please discuss the credible rupture disk failure modes (e.g., leakage, burst early, fail to burst) and their effect on MSIV functionality and the transients/events/analyzed accidents for which the MSIVs are either credited or which MSIV may cause.*

   See Enclosure 3 for a description of the failure modes, their causes and effects, how they may be detected, etc. With regard to the failure mode(s) in which a rupture disk bursts at a higher or lower than rated pressure, see the response to Question 5 below.

3) *Are there any spare rupture disks from the same lot number available for testing, or are there any old rupture disks that were previously removed available for testing? Can a visual exam be performed on the installed rupture disks?*

   Currently, there are four rupture disks installed on ABPSE0001/2/3/4. The rupture disks for ABPSE0001/4 have lot # 8042513A. The rupture disks for ABPSE0002/3 have lot # 8038119A.

   Although there are spare rupture disks for lot # 8038119A in the storeroom, the rupture disks are not available for testing since they are still new and have not been used in the plant. In addition, the rupture disks that are currently installed in the MISVs in the plant were first installed around April 2007 timeframe (RF15), and there are no old rupture disks that were previously removed that are available for testing. Based on the 5-year replacement interval, this replacement will be the first performance of the surveillance for replacing the rupture disks. The rupture discs as currently installed cannot be visually examined due to the companion flanges that hold the rupture disk/holder assembly together. A photograph of the rupture disk/holder assembly is provided as Enclosure A.

4) *Have the rupture disk material, service conditions and environment, stress history (pressure and temperature cycles), and visible condition (corrosion, leakage, etc.) been determined and considered?*

Yes. The rupture disks are made of 316SS stainless steel. The rupture discs are rated 150 psig @ 450 F. While the plant is online (primarily at Mode 1), the nominal temperature of the rupture disc is 142 F with a corresponding pressure of 3.04 psia. No pressure and temperature cycles are expected on the rupture disks while the plant is online. The only time pressure and temperature cycles are expected is when the MSIVs are actuated, i.e. when shutting down for an outage. When the rupture disks were first installed, a leakage check was performed as a post-maintenance test, and no leakage was identified. There are no corrosion concerns associated with the rupture disks since the disks are made of stainless steel and the medium (steam) is clean water.

5) *What rupture disk vendor information or data is available concerning expected service life and expected failure rate?*

Based on discussions with the vendor, the vendor will not predict the expected service life of the rupture disks because operating conditions vary from plant to plant. However, the pressure and temperature cycling that the rupture discs experience over time will only weaken them (not strengthen them), causing them to burst at a lower pressure. This may cause a rupture disc to prematurely burst when closing the MSIV, but the safety function of the MSIV would not be affected.

6) *Describe rupture disk storage and handling controls, as well as work controls during installation (e.g. torque, thread lubrication, and gasketing).*

See Enclosure 5 which is the Callaway procedure that provides the detailed instructions used during replacement/installation of the rupture disks.

7) *What are the design requirements for the rupture disc installation?*

- *Is the rupture disk, in fact, an overpressure protection device?*

No, the rupture disk is not an overpressure protection device. The rupture disks are considered “valves” with a specific safety function to open and vent the lower piston chamber of the MSIV actuator so that the MSIV can close within the specified timeframe. ASME OM Code ISTC-5250 states that "other valves" such as rupture disks shall meet the requirements for non-reclosing pressure relief devices of Mandatory Appendix I. Part of this requirement is the 5-year replacement frequency stipulated in Section I-1360 of Mandatory Appendix I.

- *Is it required to be there by BPV Section III?*

No, it is not required to be there by Section III.

- *Is the rupture disk code stamped per Section III?*

No, the rupture discs are not stamped parts, but the materials are Section III (SA-240 Grade 316)..

- *Is it protecting a code vessel? Which code? What are the code's test/inspection/replacement requirements?*

No, the rupture disk is not protecting a code vessel.

- *Is it properly scoped in the IST Program? Does it meet the applicability requirements of 50.55a, ISTA-1100, ISTC-1100, Mandatory Appendix I-1100?*

Yes, the rupture disks are properly scoped in the IST Program for the following reasons:

a. The rupture disks have a specified safety-related function to open to provide a vent path needed to close the MSIV within the required timeframe. This satisfies the requirements of ISTA-1100(a), *Scope.*
b. Based on item (1) above, ISTC-1100, *Applicability*, applies to the rupture disks in accordance with the Inservice Testing Program.
c. The rupture disks are considered "valves" in the Inservice Testing Program, and per ISTC-5250, rupture disks shall meet the requirements for non-reclosing pressure relief devices of Mandatory Appendix I.
d. For non-reclosing pressure relief devices, Mandatory Appendix I, Section I-1360 requires a 5-year replacement frequency unless historical data indicates a requirement for a more frequent replacement.
e. 10 CFR 50.55(a)(f)(4) states, "Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, pumps and valves which are classified as ASME OM Code Class 1, Class 2, and Class 3 must meet inservice test requirements..." The rupture disks are ASME Code Class 2.

8) *Why were the rupture disks not replaced at the last outage?*

The work was removed from the scope of the last refueling outage based on an initial determination that the work could be done with the plant on-line after the outage. However, when the work was evaluated by Operations management for on-line performance and scheduling after the outage, it was determined that the plant risk was too high, particularly in light of the estimated time for completing the work relative to the allowed outage time (Completion Time) specified in the Technical Specifications for an inoperable MSIV.

9) *Has the ANII been consulted on this issue? Does he have an opinion?*

The rupture disks are exempted from involvement in replacement/repair activities by IWA-4131.2(b).

10) *Please provide additional technical justification for the argument that the rupture disks will not burst at higher than design pressure.*

In addition to the information provided for Questions 4 and 5 (above), it may be noted that pressure cycling would not cause the rupture disks to burst at a higher than design pressure.

Pressure cycling of a rupture disk will induce fatigue and/or necking of the disk material. Neither of these effects will increase the rupture point of the disk. Fatigue results in crack initiation and propagation effectively causing a reduction in the material thickness and decrease in strength. Necking is a form of cold working. Cold working reduces the material thickness and will increase the true strength of the material if the material is "strain hardenable." If a metal is "strain hardenable," the increase in true strength may offset the reduced thickness, resulting in an overall increase in the load capacity of the material. However, this will not affect the rupture point because during any rupture, the material is ultimately necked (cold worked) until failure occurs. Thus, the same cumulative amount of cold work occurs during a rupture from a single pressure peak, or from a number of lesser peaks, leaving the rupture point unaffected.

References:

1. Shigley, J. E., Mischke. C. R., Budynas, R. G., Mechanical Engineering Design, Seventh Edition.

2. Introduction to Rupture Disks and Panels, at http://www.tempresco.com/intro.html

3. Selection and Sizing of Rupture Disks, at http://www.pdhonline.org/courses/m113/m113.htm

4. Continental Rupture Disc Corporation Rupture Disc Selection Guide 1-1100

5. A Structured Method for Proper Selection of Rupture Disks for Safety Relief in Ammonia Plants, 2003, at http://www.tempresco.com/AIChE-Paper-Ammoni.pdf

11) *Are the rupture disk cyclic failure test results provided by Continental Disc Corporation to the Hatch Nuclear Plant (Hatch) for their High Pressure Coolant Injection (HPCI) system rupture disks applicable (or scalable) to the Callaway Plant, Unit 1 (Callaway) rupture disks? Please indicate if a life cycle argument similar to the Hatch argument can be made for Callaway rupture disks.*

At Hatch, previously installed HPCI rupture disks were cyclic tested to destruction (failure). (See Enclosure 6 which is a copy of Hatch Nuclear Plant's Basis for Valve Relief Request RR-V-5.) As discussed in the response to Question 3 (above), the rupture disks currently installed in the MSIVs at Callaway were first installed in April 2007 (during Refuel 15). There are no old rupture disks that were previously removed from the plant and available for destruction (failure) testing. Based on the 5-year replacement interval, this will be the first performance of the surveillance for replacing the rupture disks. For Callaway, therefore, rupture disk cyclic destruction (failure) testing cannot be performed until after the currently installed rupture disks are removed from the system.

According to the vendor for the rupture disks at Callaway, samples of rupture disks are taken and subject to cyclic testing for product certification. Specifically, each sample disk(s) is subject to 1000 cycles from vacuum to 90% of rated pressure. Although this is a pass/fail test and not a cycle-to-destruction test, it provides an indication of the rupture disks' cyclic performance capability.

12) *Several failure detection monitoring activities were described in your Attachment 3 to the e-mail dated April 9, 2012. Please indicate if Callaway intends to implement these measures.*

Callaway is not committing to using the failure detection methods described in the e-mailed attachment since a leaking or ruptured disk supports the safety function of the MSIV. The only adverse consequence of a leaking or ruptured disk is increased air inleakage into the non-safety related main condenser. The leakage into the condenser would not be significant enough to affect operation of the plant. However, air inleakage into the condenser should be minimized in order to minimize oxygen levels in the condensate and feedwater systems for chemistry concerns. Therefore, leakage through the rupture disks is checked monthly by the system engineer by looking for the absence of a vacuum on the drains downstream of the rupture disks. (Condensate oxygen levels and condenser vacuum pump flowrates are other indications that may be used or monitored to ensure that excessive air is not entering into the condenser. Condensate oxygen levels are continuously monitored and vacuum pump flowrates are monitored twice per day.)

13) *Attachment 3 referenced in Question 12 above addresses the 'rupture disk leaking' and 'rupture disk bursts at lower pressure' failure modes. Please confirm that under either of these failure modes, the MSIV will perform its safety function to close.*

- If the rupture disk is leaking, the rupture disk has been fatigued and is cracking along the edges due to cycling. A vacuum will be present at the equipment drain. The disk may rupture at lower pressure. If the disk ruptures at a lower pressure, the safety function of the MSIV would not be affected.

- If the rupture disk bursts at lower pressure, the rupture disk has been degraded after being exposed to high temperatures and differential pressure (>90% of burst pressure). If the disk ruptures at a lower pressure, the safety function of the MSIV would not be affected.

A leaking or burst rupture disk supports the safety function of the MSIV. The only adverse consequence of a leaking or burst rupture disk is increased air leakage into the non-safety related condenser. Leakage into the condenser would not be significant enough to affect operation of the plant (other than feedwater chemistry, potentially).

14) *Your application dated March 30, 2012 indicates that the rupture disks will be replaced at the June 2013 Refueling Outage. Please indicate if Callaway will replace the rupture disks sooner, if plant conditions permit?*

Yes, Callaway plans to replace the rupture disks sooner if the plant is shut down for other reasons prior to Refuel 19 and plant conditions permit (including shutdown to a non-applicable Mode for the MISIVs, such as Mode 4 or 5). The jobs for replacing the MSIV rupture disks are being added to the appropriate contingency list.

15) *In your e-mail response dated April 9, 2012, the following response was provided to Question 8:*

> *The work was removed from the scope of the last refueling outage based on an initial determination that the work could be done with the plant on-line subsequent to the outage. However, when the work was evaluated by Operations management for on-line performance and scheduling after the outage, it was determined that the plant risk was too high, particularly in light of the estimated time for completing the work relative to the allowed outage time (Completion Time) specified in the Technical Specifications for an inoperable MSIV.*

- *This question was discussed during the phone call on April 5, 2012 with your staff. Your staff stated that the replacement time for the rupture disc was about 4 hours, which is ½ of the AOT. Additionally, the licensee referred to a Condition Report (CR) that discussed this issue. Please provide a copy of the CR and an explanation on the difference between the reasons provided in the phone call and what was included above.*

The completion time estimated for replacing the rupture disks includes consideration of "what if" scenarios such as the potential for a bolt to shear during removal of the existing/old rupture disk as part of the overall replacement work. In addition, the overall replacement time estimate must include the time needed for system/safety tagging (installation and removal) that would have to be completed for performing the work on-line. The estimated completion time for replacing the rupture disks is thus based on judgment, experience, and consideration of any contingencies. For this reason, estimated completion times for this task have ranged from two to six hours.

In any case, two to six hours represents a significant portion of the TS Completion Time of 8 hours allowed for an inoperable MSIV per TS 3.7.2, "Main Steam Isolation Valves (MSIVs)." Callaway's procedure for work scheduling and execution (i.e., APA-ZZ-00322, Appendix B, "Work Week Schedule and Execution"), identifies systems/tasks that represent a high risk for plant shutdown. Included in that guidance are system/component outages in which the out-of-service time could exceed one half of the TS allowed out-of-service time (i.e., Completion Time) for the inoperable system/component. Per this guidance, the MSIV rupture disk replacement constitutes a "high risk" work activity.

With regard to the requested Condition Report (referred to as a Callaway Action Request or "CAR" at Callaway), a copy of the document is provided as Enclosure 7.

- *Please confirm if you performed an operability assessment to address the impact, if the rupture disc is not replaced. Additionally, the NRC staff would like to know the results of your operability assessment, if it was performed.*

At present, an operability assessment has not been performed because the surveillances to replace the rupture disks are not yet "late."

16) *From a system configuration point of view, please confirm the correct operation of the components. Drawing M-628-00094 provided as Attachment 1 to your e-mail dated April 9, 2012 shows check valve ABHV0011V6 installed in an opposite direction from what is stated in the Final Safety Analysis Report (FSAR). The drawing shows the check valve allows flow from the bonnet area through the 3 way valve into the lower piston area. However, the FSAR states that after 120 seconds the 3 way valve energizes to allow residual steam and condensate to flow from the lower piston area to the bonnet. Please confirm if the drawing is incorrect, the check valves are installed incorrectly, or the FSAR is incorrect.*

FSAR Page 10.3.4 partly states, "...After a 120 second time delay both actuator lower piston chamber solenoid valves will energize, aligning the lower piston chamber to the valve bonnet chamber. Aligning the lower piston chamber to valve bonnet chamber will prevent any leakage of process fluid from either the piston rings or the steam seal from venting through the lower piston chamber to the condenser."

M-628-00094 is correct. In addition, the check valves were installed correctly, and the FSAR is correct. The lower piston chamber is lined up to the valve bonnet chamber. However, the word "to" is not intended to imply direction. Flow is from the valve bonnet chamber to the lower piston chamber.

When the MSIV is first closed, the upper piston chamber is at a high pressure and the lower piston chamber is at a vacuum (assuming the main condenser is aligned). This high pressure differential would eventually cause steam erosion on the piston seals. Therefore, two minutes after closing the MSIV, high pressure steam is ported from the valve bonnet chamber to the lower piston chamber. This results in high pressure steam in the lower piston chamber and upper piston chamber, thus preventing erosion since there is no pressure differential. The weight of the internal parts keeps the MSIV closed.