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

March 3, 2017

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

SUBJECT: CALLAWAY PLANT, UNIT NO. 1 – REQUEST FOR ALTERNATIVE I4R-03 APPLICABLE TO THE FOURTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL (CAC NO. MF7700)

Dear Mr. Diya:

By letter dated May 11, 2016, Union Electric Company (Ameren Missouri, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements for system leakage testing of the reactor pressure vessel (RPV) head flange leakoff lines at the Callaway Plant, Unit No. 1 (Callaway).

The proposed alternative in Relief Request I4R-03 is to perform the system leakage test of the RPV flange leakoff lines at Callaway, using the static pressure developed when the refueling cavity is filled to the normal refueling water level in lieu of the pressure required by ASME Code, Section XI, paragraph IWC-5221. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee proposed an alternative system leakage test on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Therefore, the NRC authorizes the licensee's proposed alternative for system leakage testing of the RPV for the duration of the fourth 10-year inservice inspection interval at Callaway ending on December 18, 2024.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Project Manager, John Klos, at 301-415-5136 or via e-mail at John.Klos@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR ALTERNATIVE I4R-03 REGARDING PRESSURE TESTING OF

REACTOR PRESSURE VESSEL FLANGE SEAL LEAKOFF LINES

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT NO. 1

DOCKET NO. 50-483

1.0 INTRODUCTION

By letter dated May 11, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16132A330), Union Electric Company (Ameren Missouri, the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code), Section XI requirements for system leakage testing of the reactor pressure vessel (RPV) head flange leakoff lines at the Callaway Plant, Unit No. 1 (Callaway).

The proposed alternative in Relief Request I4R-03 is to perform the system leakage test of the RPV flange leakoff lines at Callaway, using the static pressure developed when the refueling cavity is filled to the normal refueling water level in lieu of the pressure required by ASME Code, Section XI, paragraph IWC-5221. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), the licensee proposed an alternative system leakage test on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY REQUIREMENTS

Pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components (including supports) that are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI of editions and addenda of the ASME Code that become effective subsequent to editions specified in paragraphs (g)(2) and (3) of 10 CFR 50.55a and that are incorporated by reference in paragraph (a)(1)(ii) of 10 CFR 50.55a, to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(g)(4)(ii), "Applicable ISI Code: Successive 120-month Intervals," inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in paragraph (a) of 10 CFR 50.55a 12 months

before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 17, August 2014 (ADAMS Accession No. ML13339A689), when using Section XI, that is incorporated by reference in paragraph (a)(3)(ii) of 10 CFR 50.55a), subject to the conditions listed in paragraph (b) of 10 CFR 50.55a. However, a licensee whose inservice inspection interval commences during the 12 through 18-month period after July 21, 2011, may delay the update of its Appendix VIII program by up to 18 months after July 21, 2011.

Section 50.55a(z), "Alternatives to codes and standards requirements," of 10 CFR states, in part:

> Alternatives to the requirements of paragraphs (b) through (h) of [10 CFR 50.55a] or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation, or Director, Office of New Reactors, as appropriate. A proposed alternative must be submitted and authorized prior to implementation. The applicant or licensee must demonstrate that:
>
> (1) *Acceptable level of quality and safety, t*he proposed alternative would provide an acceptable level of quality and safety; or
>
> (2) *Hardship without a compensating increase in quality and safety,* compliance with the specified requirements of 50.55a would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the NRC to authorize the alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 Background

By letter dated August 13, 2013 (ADAMS Accession No. ML13221A091), the NRC authorized Relief Request I3R-14, which was the same alternative system leakage test of the RPV head flange seal leakoff lines for the third 10-year inservice inspection (ISI) interval of Callaway.

3.2 Component Affected

The component affected is ASME Code Class 2 RPV head flange seal leakoff line piping. In accordance with IWC-2500 (Table IWC-2500-1), this component is classified as Examination Category C-H, Item Number C7.10.

The licensee stated that scope of this relief request includes:

Line Numbers:	BB-075-BCB-¾", BB-075-BCB-1", BB-075-BCB-2", BB-076-BCB-¾", BB-076-BCB-1", BB-076-BCB-2", BB-077-BCB-⅜"
Valve Numbers:	BBV0079, BBV0080, BBV0081, BBHV8032

The licensee stated that the materials of construction for piping is austenitic stainless steel SA-312, TP-304, Schedule 160. The design and service pressure and temperature for the piping are as follows:

Design pressure:	2485 pounds per square inch gauge (psig)
Design temperature:	650 degrees Fahrenheit (°F)
Service pressure:	2235 psig
Service temperature:	618 °F

In a letter dated May 6, 2013 (ADAMS Accession No. ML13126A304), the licensee submitted additional information related to another request, Relief Request I3R-14, including that the total length of the pipe from the outer monitor tube, line BB-075-BCB, to valve BBHV8032, which is the outermost limit of the system subject to the pressure test, is 79 feet. This system does have 21 socket welds, 8 of which are inaccessible behind the primary shield wall, with the rest located outside of the bioshield wall.

3.3 Applicable Code Edition and Addenda

As stated by the licensee, the code of record for the fourth 10-year ISI interval is the 2007 Edition with 2008 Addenda of the ASME Code, Section XI.

3.4 Duration of Relief Request

The licensee submitted this relief request for the fourth 10-year ISI interval, which started on December 19, 2014, and is scheduled to end on December 18, 2024.

3.5 ASME Code Requirement

The ASME Code requirements applicable to this request originate in IWC-2500 of Section XI (Table IWC-2500-1, Examination Category C-H, Item No. C7.10). As required by Item No. C7.10, the pressure retaining components shall be subjected to system leakage test according to IWC-5220 and the associated VT-2 visual examination according to IWA-5240 during each inspection period. As required by IWC-5221 and stated in the licensee's application,

> The system leakage test shall be conducted at the system pressure obtained while the system, or portion of the system, is in service performing its normal operating function or at the system pressure developed during a test conducted to verify system operability (e.g., to demonstrate system safety function or satisfy technical specification surveillance requirements).

3.6 Proposed Alternative

The licensee proposed to perform system leakage test of the RPV head flange seal leakoff line piping with the static pressure head developed from the elevation of at least 23 feet of normal refueling water above the RPV closure flange when the reactor cavity is flooded for refueling, for at least 4 hours. The licensee stated that this yields a pressure of at least 10 psig at the flange and 17 psig at the lowest elevation of piping.

3.7 Basis for Alternative

The licensee stated that the RPV head flange O-ring leakoff lines direct leakage, if any, from the RPV head flange to the reactor coolant drain tank (RCDT) and provide alarms to alert the control room of leakage. These lines are separated from the reactor coolant system (RCS) operating pressure by an inner and outer RPV flange O-ring. The inner O-ring, in conjunction with the reactor vessel and reactor vessel head flange surfaces, functions to isolate the inner and outer RPV head flange leakoff lines from RCS pressure. The outer O-ring functions as a backup in the event of the inner O-ring failing to perform its intended function. Therefore, the affected leakoff lines are not expected to experience RCS pressure during normal operation. During normal operation, the lines are typically pressurized to the RCDT pressure of 4 psig.

The licensee stated that the Class 2 portions from the reactor vessel flange to the Class 2 boundaries are required to be subject to the associated VT-2 visual examination. Lines BB-075-BCB and BB-076-BCB run parallel to each other and are inaccessible for the first 32 feet due to being located in the annulus area between the RPV and primary shield wall. The annulus can only be accessed by way of the refueling cavity, which is filled with water during the test, or by way of the incore tunnel underneath the RPV, which is prohibited from being entered due to high radiation dose rates from the incore flux mapping thimbles being withdrawn from the reactor vessel. Accessible portions of the lines subject to the VT-2 visual examination include 22 feet of piping that is not insulated and 2 feet of piping that is insulated.

The licensee stated that Callaway's work history, as well as corrective action history, was reviewed for service-related failures of the piping and components in this relief request. The review identified no occurrences of leakage or other failures on these piping and welded connections.

3.8 Basis for Hardship

The licensee stated that with the new O-rings installed and performing their intended function, the leakoff lines are not expected to be pressurized above the RCDT pressure of 4 psig during the system leakage test following a refueling outage. Pressurizing by a hydrostatic test pump to perform the Code-required pressure test could unseat the installed inner O-ring and damage it. This would result for additional maintenance, which would require depressurizing and removing the RPV head, reinstalling new sets of O-rings, and reinstalling the head. The above activities would take additional time and expose personnel to additional radiation dose.

The licensee stated that performing a leakage test during shutdown prior to removal of the head for refueling activities would require the plant to be maintained in Mode 3 at normal operating temperature and pressure at higher decay heat loads, resulting in an incremental increase in core damage frequency. This would be contrary to site efforts to reduce the outage sequence/time to cold shutdown in order to minimize shutdown risk. Performing such a test would result in additional radiation exposure.

The licensee stated that with the RPV head removed, the configuration of the leakoff piping would require the lines to be plugged at the RPV flange to establish a boundary for leakage testing at system operating pressure. This would require a design modification to install mechanical threads into each leakoff line at the location of the RPV flange. Threaded plugs would then have to be installed prior to the pressure test and removed after the test was complete. Failure of either plug during the test would result in a personnel safety hazard, in addition to creating a foreign material exclusion (FME) issue. Performing the modification, as

well as installation and removal of the plugs for each pressure test, would result in additional dose, which would be contrary to keeping dose as low as reasonably achievable (ALARA), and would present FME issues.

3.9 NRC Staff Evaluation

The NRC staff has evaluated Relief Request 14R-03 pursuant to 10 CFR 50.55a(z)(2). The NRC staff focused on whether compliance with the specified requirements of 10 CFR 50.55a(g), or portions thereof, would result in hardship or unusual difficulty, and if there is a compensating increase in the level of quality and safety despite the hardship.

The NRC staff found that requiring the licensee to comply with IWC-5221 and conduct the ASME Code system leakage test of the RPV head flange seal leakoff lines at the RCS operating pressure would result in hardship. The basis for the hardship is as follows.

- When the RPV head is removed for refueling, the licensee would have to modify the existing RPV head flange taps to install plugs to facilitate for pressurizing the leakoff piping by use of a hydrostatic test pump. The activities associated with installing the plugs, pressurizing the piping to the RCS pressure and conducting the ASME Code required system leakage test, and removing the plugs after completion of test would cause personnel to incur additional radiation dose, and could introduce foreign materials into the reactor pool as well as the lines.

- When the RPV head is installed after refueling, pressurizing the lines would not be possible due to design and configuration of the RPV head flange taps and the inner O-ring. The inner O-ring is designed to withstand pressure in one direction only. Pressurizing in the opposite direction could damage the inner O-ring, and even result in an unsuccessful test. Activities associated with replacing the O-rings due to damage to the inner O-ring would expose personnel to additional radiation dose.

- At the beginning of the refueling outage when the RPV head is on, externally pressurizing the lines would result in pressurizing the inner O-ring in the opposite direction, which could damage the O-ring, result in an unsuccessful test, and subject personnel to additional radiation dose. The entire containment has access limitations due to high radiation levels.

Therefore, the NRC staff determined that concerns from the FME program and ALARA constitute a hardship.

Test Pressure

In evaluating the licensee's proposed alternative, the NRC staff assessed whether it appeared that the licensee used the highest achievable test pressure to conduct system leakage testing and the manner in which the licensee adequately preformed the testing and the associated VT-2 visual examinations of the piping for leakage. The NRC staff found that:

- The licensee will use the highest pressure that is obtainable without major modifications to existing configuration of the lines to test the leakoff piping for leakage. Specifically, the leakoff piping in this relief request will be subject to the static pressure of at least

10 psig. This static pressure head is developed from the elevation of 23 feet of refueling water above the vessel flange during the refueling cavity floodup.

- The licensee will conduct the associated VT-2 visual examination of the insulated area of the piping (according to IWA-5242) and the non-insulated area of the piping (according to IWA-4241) after attaining and maintaining the test pressure for 4 hours to allow for leakage accumulate at the potential leak location and be detected by the examination.

- The proposed system leakage test will be conducted at frequency of each inspection period as required by Table IWC-2500-1, Examination Category C-H, Item No. C7.10.

Therefore, the NRC staff determines that the proposed system leakage test is adequate because the leakoff piping in this relief request will be pressurized to a test pressure that is as high as reasonably achievable, and will be subject to the IWA-5240 required VT-2 visual examination after hold time of 4 hours that is equal or greater than hold time required by IWA-5213.

Structural Integrity and Leak Tightness

In addition to the analysis described above, the NRC staff considered whether performance of the system leakage test at an alternative reduced pressure provided reasonable assurance of structural integrity and leak tightness of the piping and associated welded connections.

The NRC staff notes that although the proposed test pressure is lower than the ASME Code required test pressure, it still allows for adequate pressurization of the components, and as accompanied with the ASME Code required VT-2 visual examination, it allows for detection of potential leakage.

- As part of pressure test, the licensee will perform the VT-2 visual examination of the components (accessible, inaccessible, insulated, and non-insulated) in accordance with the IWA-5240 requirements to identify any through wall leak.

- The VT-2 visual examination of accessible, inaccessible, insulated, and non-insulated segment of piping will be performed after attaining and holding test pressure for 4 hours to allow for leakage accumulate at the potential leak location, and be detected by the examination.

Therefore, the NRC staff determines that based on the alternative system leakage testing that subject these piping to the maximum obtainable pressure and the performance of the ASME Code required VT-2 visual examinations, it is reasonable to conclude that if significant service induced degradation had occurred, evidence of it would be detected by the examinations that the licensee performed.

4.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the Class 2 RPV head flange seal leakoff lines and complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set

forth in 10 CFR 50.55a(z)(2). Therefore, the NRC staff authorizes the use of the licensee's proposed alternative at Callaway, for the fourth 10-year ISI interval which started on December 19, 2014, and is scheduled to end on December 18, 2024.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Ali Rezai

Date: March 3, 2017

SUBJECT: CALLAWAY PLANT, UNIT NO. 1 – REQUEST FOR ALTERNATIVE I4R-03 APPLICABLE TO THE FOURTH 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL (CAC NO. MF7700) DATED MARCH 3, 2017

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