July 1, 2003

Mr. Garry L. Randolph
Vice President and Chief Nuclear Officer
Union Electric Company
P.O. Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 – SECOND TEN-YEAR INTERVAL INSERVICE INSPECTION PROGRAM RELIEF REQUEST TO USE AN ALTERNATIVE EXAMINATION METHOD (TAC NO. MB6534)

Dear Mr. Randolph:

By letter dated October 17, 2002 (ULNRC-04760), as supplemented by letters dated October 30, 2002 (ULNRC-04768), and February 13, 2003 (ULNRC-04807), Union Electric Company submitted a request for relief for the second 10-year inservice inspection interval at Callaway Plant, Unit 1 (Callaway). This request seeks relief from the 1974 Edition with Summer 1975 Addenda, Section III, Subarticle NC-5200 of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (the ASME Code) for certain Class 2 piping. Specifically, relief from the requirements that longitudinal pipe butt-welded joints and circumferential pipe welds be radiographed. As a proposed alternative, the welds would be examined using a qualified ultrasonic testing (UT) examination method in lieu of the Code-required radiography testing (RT) method examinations for the welds.

Based on the enclosed safety evaluation, the staff concludes that the proposed alternative to perform UT examinations with personnel and procedures qualified to Section XI, Appendix VIII methodology, with coverage from four directions, and through-wall volume in lieu of the ASME Code-required Section III RT will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for Callaway for the second 10-year inservice inspection interval.

Sincerely,

/RA/

Stephen Dembek, Chief, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SECOND TEN-YEAR INTERVAL INSERVICE INSPECTION PROGRAM PLAN

REQUEST FOR RELIEF TO USE AN ALTERNATIVE EXAMINATION METHOD

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

1.0 INTRODUCTION

The inservice inspection (ISI) of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (the ASME Code) Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states in part that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to Commission approval. The ISI Code of record for the second 10-year ISI interval for the Callaway Plant, Unit 1 (Callaway) is the 1989 Edition of Section XI of the ASME Code.

By letter dated February 13, 2003, the Union Electric Company (the licensee) submitted a request for relief from certain ISI requirements specified in the ASME Code; specifically, the radiographic examination of repair welds in Class 2 piping required by ASME Code, Section III, Subarticle NC-5200. In lieu of the Code requirements, the licensee proposed an alternative to

to examine the welds using a qualified ultrasonic testing (UT) examination method. The February 13, 2003, submittal supersedes the licensee's submittals dated October 17 and 30, 2002. The subject relief request is for the second 10-year interval at Callaway.

2.0 DISCUSSION

2.1 System/Components for which Relief is Requested

The components affected by this request for relief are 30 feedwater pipe welds and 16 main steam pipe welds which are listed in Tables 1 and 2 attached to the February 13, 2003 submittal.

2.2 Code Requirements from which Relief is Requested

The licensee is requesting relief from the 1974 Edition with Summer 1975 Addenda, ASME Code, Section III, Subarticle NC-5200; specifically, the NC-5212 requirement that longitudinal pipe butt-welded joints be radiographed, and the NC-5222 requirement that circumferential pipe welds be radiographed.

2.3 Proposed Alternative

The licensee proposed an alternative to use the UT method described in the proposed alternative section of the attachment to the licensee's submittal dated February 13, 2003, in lieu of the Code-required radiography testing (RT) method examinations for the welds listed above. The proposed alternative uses procedures and personnel qualified to Section XI, Appendix VIII carbon steel pipe methodology. The coverage consists of scanning with angle beam transducers in two opposite directions perpendicular to the weld axis and two opposite directions parallel to the weld axis and with a straight beam transducer scanning through-wall. The scan volume is 100 percent of the weld volume and the identified adjacent base metal.

2.4 Basis for Relief

The licensee stated the following as justification for the proposed UT method in the attachment to its February 13, 2003, submittal:

> The proposed alternative ultrasonic examination will ensure an adequate level of safety and quality, and will provide adequate verification that the Class 2 welds are free of significant flaws that could affect structural integrity. The examination will cover 100% of the weld volume and include base material for a distance of ½ the nominal through-wall weld thickness on each side of the weld. A demonstration of the ultrasonic examination system's capability to detect both subsurface and surface workmanship type flaws (i.e., slag, porosity, lack of fusion, and incomplete penetration) will be performed on a qualification block. All flaws and indications will be evaluated in accordance with the standard acceptance criteria of NC-5330. In addition, an automated scan and data acquisition system will be used to improve examination repeatability and provide permanent storage of the raw data. Finally, the proposed alternative ultrasonic examination will be limited to base material and weld material that is conducive

to ultrasonic examinations.
Ultrasonic and radiographic examination methods are complimentary and are not directly comparable or equivalent. Depending on flaw type (i.e., volumetric or planar) and orientation, ultrasonic examination may be superior to radiography or vice versa. Radiography is most effective in detection of volumetric type flaws (i.e., slag and porosity) and detection of planar type flaws (i.e., lack of fusion and cracks) that are oriented in a plane parallel to the x-ray beam. However, radiography is limited in detection of planar flaws not oriented parallel to the beam. In contrast, ultrasonic examination is very effective in detection of planar type flaws that are not oriented in a plane parallel to the sound beam .... Finally, ultrasonic examination is capable of detecting volumetric type flaws such as slag or porosity but is limited, compared to radiography, in ability to characterize volumetric flaws.

The proposed alternative ultrasonic examination requirements and provisions address the known limitations of the ultrasonic method to ensure both planar and volumetric flaws in all orientations are detected and properly evaluated. First, examination using two angle beams (i.e., 45 and 60 degree nominally) or a procedure qualified on 100% of the weld volume in accordance with the performance demonstration methodology of Section XI, Appendix VIII is required. Second, examination scans in two directions perpendicular to the weld axis and two directions parallel to the weld axis or examination scans as qualified on 100% of the weld volume in accordance with the performance demonstration methodology of Section XI, Appendix VIII is required. Third, to ensure laminar type flaws are detected, a supplemental examination using straight beam is also required. Finally, if an indication, such as slag or porosity, is not characterized as volumetric, the indication will be characterized as a planar type flaw and evaluated in accordance with the acceptance criteria of NC-5330. The acceptance criteria of NC-5330 specify acceptable lengths of indications only and do not differentiate between planar and volumetric type flaws. Most importantly, planar type flaws such as cracks, incomplete penetration, and lack of fusion, which are rejectable by NC-5330 for any size, are more readily and properly characterized by ultrasonic examination.

In addition to the effectiveness of the proposed alternative, use of ultrasonic examination in lieu of radiography will provide a significant reduction in personnel radiation exposure during refueling outage maintenance work. Also outage duration and costs will be reduced by allowing parallel path work to progress uninterrupted during examination of welds. Finally, the personnel safety risk of inadvertent or accidental exposure and also the normal anticipated exposure associated with transporting, positioning and exposing a source for radiography is eliminated.

The proposed alternative UT requirements and provisions were provided in the attachment to the licensee's February 13, 2003, submittal.

3.0 EVALUATION

The licensee anticipates wall deterioration of the steam generator, main feedwater Class 2 piping during the next refueling outage (RF-12). The deterioration is caused by corrosion of the surface near the supports holding the piping which are manufactured from cast and wrought carbon steel components. The component dimensions are 14- and 16-inch nominal diameter with 0.750-inch and 0.844-inch wall thickness, respectively.

In the event that the main feedwater and steam piping is repaired, the welds would be examined in accordance with the requirements of the 1974 Edition with Summer 1975 Addenda, ASME Code, Section III and Code Case N-416-1, "Alternative Pressure Test Requirement for Weld Repairs or Installation of Replacement Items by Welding Class 1, 2, and 3 Section XI, Division 1." ASME Code, Section III, Paragraph NC-5212 requires longitudinal pipe butt-welded joints be radiographed, and NC-5222 requires circumferential pipe welds be radiographed. The licensee proposed an alternative UT examination described in an enclosure to their February 13, 2003, submittal in lieu of the required RT examinations. The UT personnel and procedure will be qualified using the carbon steel pipe methodology of ASME Code, Section XI, Appendix VIII. The methodology adds a minimum of three construction flaws to the performance demonstration of the appropriate supplement of a prior qualified procedure or to a supplement test set of an initial procedure and personnel qualification.

RT and UT examination methods are complimentary. They are not directly comparable or equivalent. Depending on the flaw type and orientation, RT may be superior to UT or vice versa. RT is most effective in detecting changes in material density, such as volumetric type flaws (i.e., slag and porosity), and planar type flaws with detectable density differences, such as lack-of-fusion and open cracks that are oriented in a plane parallel to the X-ray beam. RT is limited in detecting small changes in density such as tight, irregular planar flaws and non-optimal oriented planar flaws with respect to the x-ray beam. RT is also limited in determining depth characteristics. The flaws that are easiest for RT to detect are associated with construction (3-dimensional) with the exception of tight planar flaws from the welding process.

In contrast, UT examinations are capable of detecting the features in a component that reflects sound waves. The degree of reflection depends largely on the physical state of matter on the opposite side of the reflective surface and to a lesser extent on specific physical properties of that matter. For instance, sound waves are almost completely reflected at metal-gas interfaces, and partially reflected at metal-to-solid interfaces. Discontinuities that act as metal-gas interfaces, like cracks, laminations, shrinkage cavities, bursts, flakes, pores, and bonding faults are easily detected. These are the types of flaws that generally originate during plant operations and from the welding process. UT is less effective in detecting flaws in a plane parallel to the sound beam because of target size, and volumetric type flaws such as slag, porosity, and other inhomogeneities because of sound dispersion from irregular surfaces. UT may also have difficulty in detecting discontinuities (flaws) that are present in the shallow layer immediately beneath the surface and in separating discontinuities from background noises that are caused by certain metal characteristics like large grains in stainless steels. However, modern UT techniques involving partial reflection of sound waves have successfully detected flaws parallel to the sound beam and volumetric type flaws, and UT is capable of characterizing flaws.

In the proposed alternative, the examination coverage consists of scanning with angle beam transducers in two opposite directions perpendicular to the weld axis and two opposite directions parallel to the weld axis and with a straight beam transducer scanning through-wall. The scan volume is 100 percent of the weld volume and the adjacent base material for a distance of one-half the nominal through-wall weld thickness on each side. Where the scan perpendicular to the weld is limited on one side, a full V-path will be used for the second direction provided the procedure is qualified for a full V-path. The scans provide assurance that planar flaws, regardless of orientation, will be detected and non-planar, construction flaws will be easier to discern from inhomogeneities. Also, the licensee will perform an examination of the weld area for laminar flaws with a straight beam scan. The qualification process assures that the UT procedure contains sufficient detail and that the personnel have the necessary skills for detecting various types of flaws. In order to detect construction and material flaws occurring axially, circumferentially, and volumetrically, the coverage will exceed that used during the Appendix VIII demonstration. Flaws that are detected using UT will be evaluated in accordance with the acceptance criteria of NC-5330, ASME Code, Section III, which is the same for crack-type flaws detected by RT. Because UT is capable of characterizing depth, the length acceptance criteria also applies to depth measurements. Based on the review, the staff finds that the proposed alternative using the Section XI, Appendix VIII methodology, as supplemented, will provide an acceptable level of quality and safety.

Since the licensee is using Section XI, Appendix VIII methodology for qualifying procedures and personnel, the staff did not evaluate ASME Code, Section V applications.

4.0 CONCLUSION

Based on the above evaluation, the staff has concluded that the proposed alternative to perform UT examinations with personnel and procedures qualified to Section XI, Appendix VIII methodology, with coverage from four directions, and through-wall volume in lieu of the Code-required ASME Code, Section III RT will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for Callaway for the second 10-year inservice inspection interval which began on August 1, 1995.

Principal Contributor: D. Naujock

Date: July 1, 2003

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