November 17, 2006

Mr. Charles D. Naslund
Senior Vice President and Chief Nuclear Officer
Union Electric Company
Post Office Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 - RELIEF REQUESTS I3R-05 AND I3R-06 FOR THE THIRD 10-YEAR INSERVICE INSPECTION INTERVAL (TAC NOS. MD2031 AND MD2032)

Dear Mr. Naslund:

By letter dated May 18, 2006 (ULNRC-05291), the Union Electric Company (the licensee) submitted relief requests proposing alternatives to certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (the ASME Code) at the Callaway Plant, Unit 1 (Callaway). Specifically, the licensee proposed (1) coordinated qualifications of ASME Code, Section XI, Appendix VIII, Supplements 2 and 10 (Relief Request (RR) No. I3R-05), and (2) using Appendix VIII, Supplements 4 and 6, to examine the reactor pressure vessel shell-to-flange and head-to-flange welds (RR No. I3R-06). These relief requests are for the remainder of the third 10-year inservice inspection (ISI) interval.

Based on the enclosed safety evaluation, the Commission concludes that RRs I3R-05 and I3R-06 provide an acceptable level of quality and safety and, therefore, are authorized pursuant to paragraph 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulation*. These two RRs are authorized for the third 10-year ISI program interval at Callaway. All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Sincerely,

/RA/

David Terao, 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: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

THIRD 10-YEAR INSERVICE INSPECTION PROGRAM INTERVAL

RELIEF REQUEST NOS. I3R-05 AND I3R-06

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

1.0 INTRODUCTION

By letter dated May 18, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML061460043), the Union Electric Company (the licensee) submitted relief requests (RRs) proposing alternatives to certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (the ASME Code) at the Callaway Plant, Unit 1 (Callaway). Specifically, the licensee proposed (1) coordinated qualifications of ASME Code, Section XI, Appendix VIII, Supplements 2 and 10 (RR No. I3R-05), and (2) using Appendix VIII, Supplements 4 and 6, to examine the reactor pressure vessel shell-to-flange and head-to-flange welds (RR No. I3R-06). The requests are for the remainder of the third 10-year inservice inspection (ISI) interval, which began December 19, 2005, and ends December 18, 2014.

RRs I3R-05 and I3R-06 were addressed by the licensee in Attachments 1 and 2, respectively, to the letter dated May 18, 2006.

2.0 REGULATORY EVALUATION

The ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable editions and addenda as required by Section 50.55a(g) of Part 50, "Domestic Licensing of Production and Utilization Facilities," of Title 10 of the *Code of Federal Regulations* (10 CFR 50.55a(g)), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i) for impracticality. Paragraph 50.55a(a)(3) of 10 CFR states in part that proposed alternatives to the requirements of paragraph (g) may be used when authorized by the Nuclear Regulatory Commission (NRC), if the applicant 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.

Pursuant to 10 CFR 50.55a(g)(4)(i) and (ii), the inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals are required to comply with the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. Paragraph 50.55a(g)(4)(iv) of 10 CFR states that inservice examination of components and system-pressure tests may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modification listed in 10 CFR 50.55a(b), and subject to Commission approval. Portions of editions or addenda may be used provided that all related requirements of the respective editions or addenda are met.

In its May 18, 2006, letter, the licensee stated that the code of record for the third 10-year ISI interval at Callaway is the 1998 Edition through 2000 Addenda of the ASME Code.

3.0 TECHNICAL EVALUATION OF RR NO. I3R-05

3.1 Affected Components

The affected components are ASME Code Class 1, pressure-retaining piping welds examined from the inside surface of pressurized-water reactors using procedures, equipment, and personnel qualified to ASME Code, Section XI, Appendix VIII, Supplement 2 or Supplement 10 criteria. The specific weld identifications are listed in two tables on safe-end welds in Attachment 1 to the licensee's letter dated May 18, 2006.

3.2 Applicable ASME Code Requirements

The applicable code requirements are the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1998 Edition through 2000 Addenda, Appendix VIII, Supplement 2 and Supplement 10, as specified in Table VIII-3110-1.

3.3 Proposed Alternative

The licensee's proposed alternative to the applicable code requirements is described in the table within RR I3R-05 that is entitled "Supplement 14 - Qualification Requirements for Coordinated Implementation of Supplement 10, 2 and 3 for Piping Examinations Performed from the Inside Surface." The alternative is also discussed in ASME Code Case N-696, "Qualification Requirements for Appendix VIII Piping Examinations Conducted from the Inside Surface, Section XI, Division 1," date May 21, 2003.

3.4 Licensee's Basis for the Alternative

The licensee provided the basis for its request for relief in Attachment 1 to its letter dated May 18, 2006. The licensee stated that separate qualifications for Supplements 2, 3, and 10 are redundant when done in accordance with the Electric Power Research Institute Performance Demonstration Initiative (PDI) program and provided the following example.

During a personnel qualification to the PDI program, the candidate would be exposed to a minimum of 10 flawed grading units for each individual supplement and personnel qualifications to Supplements 2, 3, and 10, and would, therefore, require a total of 30 flawed grading units. A full-procedure qualification requires 3 personnel qualifications which is a minimum of 90 flawed grading units. The licensee stated that this duplication is particularly burdensome for personnel and procedures that use the same essential variables for all three supplements.

The licensee also stated that, to resolve these issues, the PDI program recognized that the Supplement 10 qualifications are the most stringent and technically-challenging ultrasonic application and the same essential variables are used for the examinations subject to the requirements of Supplements 2, 3, and 10. A coordinated add-on approach to implementation would be sufficiently stringent for qualification to the requirements of Supplements 2 and 3, if the requirements used for qualification to Supplement 10 are satisfied as a prerequisite. The licensee stated that the basis for this conclusion is the fact that the majority of the flaws addressed in Supplement 10 are located wholly in austenitic weld material. This configuration is known to be challenging for ultrasonic techniques due to the variable dendritic structure of the weld material. Conversely, the flaws addressed in Supplements 2 and 3 initiate in fine-grained base materials.

The licensee stated further that the use of the PDI program for implementation of Supplement 2 requirements in coordination with Supplement 10 implementation would be more stringent than current ASME Code requirements for detection and length-sizing qualifications. The licensee gave an example that the current ASME Code would allow a detection procedure, personnel, and equipment to be qualified to Supplement 10 requirements with 5 flaws, Supplement 2 requirements with 5 flaws, and Supplement 3 requirements with 5 flaws, for a total of only 15 flaws. The proposed alternative of qualifying to Supplement 10 requirements using 10 flaws and adding 5 Supplement 2 flaws and 3 Supplement 3 flaws results in a total of 18 flaws. For procedure qualification, the PDI program consists of three times the number of flaws as a personnel qualification.

Based on the above analysis, the licensee concluded that the use of a limited number of Supplement 2 or Supplement 3 flaws is sufficient to assess the capabilities of procedures and personnel that have already satisfied Supplement 10 requirements and, therefore, the statistical basis used for screening personnel and procedures is maintained at the same level. The licensee also stated that the proposed alternative is addressed in ASME Code Case N-696, which has been approved by the ASME Code committee.

3.5 Technical Evaluation

The NRC staff has reviewed the licensee's RR No. I3R-05. The licensee requested relief from the qualification requirements of ASME Code, Section XI, Appendix VIII, Supplement 2 criteria. The ASME Code requires separate qualifications for Supplements 2 (austenitic piping welds), 3 (ferritic piping welds), and 10 (dissimilar metal piping welds). Personnel qualifications for each of the three supplements would entail a minimum of 10 flaws for a total of 30 flaws minimum. The minimum number of flaws per supplement established a statistically-based pass/fail objective. The process of qualification, using a single qualification for each supplement, would greatly expand the minimum number of ferritic and austenitic flaws required to be identified, which would also raise the pass/fail acceptance criteria.

In Supplement 12, the ASME Code recognized that flaws in austenitic materials are more difficult to detect and size than flaws in ferritic material. This supplement provides for a Supplement 3 add-on to a Supplement 2 qualification. A Supplement 12 performance demonstration consists of a minimum of 10 flaws with a minimum of six Supplement 2 flaws and a maximum of four Supplement 3 flaws. A statistical evaluation of test results using Supplement 12 acceptance criteria satisfied the pass/fail objective established for Appendix VIII performance demonstration acceptance criteria.

The licensee's proposed alternative builds upon the experiences of Supplement 12 by starting with the most challenging Supplement 10 qualifications, as implemented by the PDI program (PDI Supplement 10), and adding a sufficient number of Supplement 2 flaws to demonstrate personnel skills and procedure effectiveness. The proposed alternative is identified in a table in Attachment 1 to the licensee's May 18, 2006, submittal as Supplement 14.

PDI Supplement 10 personnel performance demonstration requires a minimum of 10 flaws with at least one flaw and a maximum of 10 percent of the total number of flaws being in the ferritic material. The rest of the flaws (nine or more) are in the more challenging austenitic material (Supplement 2). When expanding PDI Supplement 10 qualification to include Supplement 2, the proposed alternative would add a minimum of five flaws in the austenitic material to the performance demonstration which would bring the total number of flaws in austenitic material to 14 or greater. The performance demonstration results added to the appropriate PDI Supplement 10 results must satisfy the PDI Supplement 10 acceptance criteria. For a procedure qualification which includes equipment, the performance demonstration requirement is the equivalent of three personnel qualifications. The combined number of flaws in austenitic material of a Supplement 10 with an add-on Supplement 2 performance demonstration exceeds a stand-alone Supplement 2 performance demonstration.

3.6 Conclusion

The NRC staff has determined that qualification to Supplement 2 through the use of a limited number of Supplement 2 flaws added to the austenitic flaws of Supplement 10 provides equivalent flaw detection performance to that of a stand-alone Supplement 2 qualification for procedure, equipment, and personnel. As such, the licensee's proposed alternative provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's proposed alternative contained in Relief Request I3R-05 is authorized for the third 10-year ISI interval at Callaway.

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

4.0 TECHNICAL EVALUATION OF RR NO. I3R-06

4.1 Affected Components

The affected components are ASME Code, Section XI, Examination Category B-A pressure-retaining welds in the reactor pressure vessel (RPV), Item B1.30, shell-to-flange weld (2-CH-101-101), and B1.40, head-to-flange weld (2-RV-101-121).

4.2 Applicable Code Requirements

The applicable code requirements are the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1998 Edition through 2000 Addenda, Subsection IWA-2232 which requires ultrasonic testing (UT) of the RPV-to-flange weld be examined according to ASME Code, Section V, Article 4. Regulatory Guide (RG) 1.150, Revision 1, "Ultrasonic Testing of Reactor Vessel Welds During Preservice and Inservice Examinations," provides guidance for UT examinations of RPV welds.

4.3 Proposed Alternative

The licensee's proposed alternative is to examine the shell-to-flange weld and head-to-flange weld using qualified procedures in accordance with ASME Code, Section XI, 1998 Edition with 2000 Addenda, Appendix VIII, Supplements 4 and 6 as modified by 10 CFR Part 50 in accordance with the Final Rule published in the *Federal Register* (64 FR 51370 through 51400, dated September 22, 1999). The examination of the shell-to-flange weld and head-to-flange weld, when performed from the flange face, will continue to be performed in accordance with ASME Code, Section V, Article 4, and RG 1.150, Revision 1.

4.4 Licensee's Basis for the Alternative

The licensee provided the basis for its request for relief in Attachment 2 to its letter dated May 18, 2006. The licensee proposed to employ personnel, procedures, and equipment that are qualified to the 1998 Edition with 2000 Addenda of ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, as modified by an amendment to 10 CFR 50.55a per the Final Rule published in the *Federal Register* (64 FR 51370 through 51400) for the examination of the RPV shell-to-flange weld and RPV head-to-flange welds. The qualifications were administered by the PDI program.

The licensee stated that Appendix VIII was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous, item-specific performance demonstration. The performance demonstration was conducted on an RPV mockup containing flaws of various sizes at various locations and established the capability of equipment, procedures, and personnel to find flaws that would be detrimental to the integrity of the RPV.

The licensee explained that although conformance with Appendix VIII is not a requirement when examining these welds, the Appendix VIII personnel and procedure qualifications have been demonstrated to be equal or superior to the requirements of paragraph IWA-2232, and the guidance in RG 1.150 demonstrations and requirements.

The licensee stated further that the PDI-qualified sizing method is considered more accurate than the method used in ASME Code, Section V, Article 4. The PDI program is in compliance with the detection and sizing tolerance requirements of Appendix VIII and the PDI sizing method is based on a group of representative flaws in samples that are used to demonstrate the sizing accuracy required by Section XI. The sensitivity to detect these flaws is considered to be equal to or greater than the sensitivity used by Section V, Article 4, UT techniques.

Based on the above considerations, the licensee concluded that the proposed alternate UT examination technique provides an acceptable level of quality and examination repeatability as compared to the Section V, Article 4, requirements.

4.5 Technical Evaluation

The NRC staff has reviewed the licensee's RR No. I3R-06. The 1998 Edition through 2000 Addenda of the ASME Code, Section XI, IWA-2232 states, "Ultrasonic examination shall be conducted in accordance with Appendix I." Subparagraph I-2100(b) states, "Ultrasonic examination of reactor vessel-to-flange welds, closure head-to-flange welds, and integral attachment welds shall be conducted in accordance with Article 4 of Section V, except that alternative examination beam angles may be used. These examinations shall be further supplemented by Table I-2000-1." Section V, Article 4, as supplemented by Appendix I provides a prescriptive process for qualifying UT procedures. In lieu of Subparagraph I-2100(b) requirements, the licensee proposed using procedures, equipment, and personnel qualified in accordance with performance-based criteria as administered by the PDI program for the examination of RPV welds. The PDI program implements the requirements of Section XI, Appendix VIII, Supplements 4 and 6, as modified by 10 CFR 50.55a(b)(2)(xv).

When prescriptive Section V, Article 4, UT procedures were applied in a controlled setting containing real flaws in mockups and the sizing results were statistically analyzed according to the performance-based screening criteria in Section XI, Appendix VIII, the prescriptive-based sizing results were determined to be equal to or less effective than the sizing results from performance-based Section XI, Appendix VIII, procedures[1]. The improvement in sizing is attributable to the echo-dynamic motion and tip-diffraction criteria used by performance-based UT, as opposed to the less accurate amplitude-drop criteria of prescriptive Section V, Article 4, requirements.

For detection of flaws, Section V, Article 4 and RG 1.150 require indications of 20 percent distance amplitude correction (DAC) and greater to be evaluated, whereas, performance-based UT requires that the essential variable settings used during the performance demonstration be used for the examinations which usually is DAC above the background noise. The performance-based UT is performed with higher sensitivity, which increases the chances of detecting a flaw when compared to prescriptive Section V, Article 4, requirements. Procedures, equipment, and personnel qualified through the PDI program have shown high probability of detection levels.

Based on the above evaluation, the NRC staff concludes that this method has resulted in the increased reliability of inspections for weld configurations within the scope of the PDI program and, therefore, the proposed alternative provides an acceptable level of quality and safety.

[1]EPRI Report NP-6273, "Accuracy of Ultrasonic Flaw Sizing Techniques for Reactor Pressure Vessels," dated March 1989.

4.6 Conclusion

Based on the increased reliability of inspections within the scope of the PDI program, as discussed in the previous section, the NRC staff concludes that the licensee's proposed alternative in RR No. I3R-06 to use UT procedures, equipment, and personnel qualified to the 1998 Edition with 2000 Addenda of the ASME Code, Section XI, Appendix VIII, Supplements 4 and 6, as modified by 10 CFR 50.55a(b)(2)(xv) for the RPV shell-to-flange weld and RPV head-to-flange weld, provides an acceptable level of quality and safety and is, therefore, acceptable. Based on this conclusion, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative in I3R-06 is authorized for the subject welds at Callaway for the third 10-year ISI interval.

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

Principal Contributor: Don Naujock

Date: November 17, 2006

cc:
Professional Nuclear Consulting, Inc.
19041 Raines Drive
Derwood, MD 20855

John O'Neill, Esq.
Pillsbury Winthrop Shaw Pittman LLP
2300 N. Street, N.W.
Washington, D.C. 20037

Mr. Keith A. Mills, Supervising Engineer
Regional Regulatory Affairs/Safety Analysis
AmerenUE
P.O. Box 620
Fulton, MO 65251

U.S. Nuclear Regulatory Commission
Resident Inspector Office
8201 NRC Road
Steedman, MO 65077-1302

Mr. Les H. Kanuckel
Manager, Quality Assurance
AmerenUE
P.O. Box 620
Fulton, MO 65251

Missouri Public Service Commission
Governor Office Building
200 Madison Street
Jefferson City, MO 65102-0360

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-4005

Mr. H. Floyd Gilzow
Deputy Director for Policy
Missouri Department of Natural Resources
P. O. Box 176
Jefferson City, MO 65102-0176

Mr. Rick A. Muench
President and Chief Executive Officer
Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, KA 66839

Mr. Dan I. Bolef, President
Kay Drey, Representative
Board of Directors Coalition for the
Environment
6267 Delmar Boulevard
University City, MO 63130

Mr. Lee Fritz, Presiding Commissioner
Callaway County Court House
10 East Fifth Street
Fulton, MO 65151

Mr. David E. Shafer
Superintendent, Licensing
Regulatory Affairs
AmerenUE
P.O. Box 66149, MC 470
St. Louis, MO 63166-6149

Mr. Keith D. Young
Manager, Regulatory Affairs
AmerenUE
P.O. Box 620
Fulton, MO 65251

Mr. Keith G. Henke, Planner
Division of Community and Public Health
Office of Emergency Coordination
930 Wildwood P.O. Box 570
Jefferson City, MO 65102

Certrec Corporation
4200 South Hulen, Suite 630
Fort Worth, TX 76109

Director, Missouri State Emergency
Management Agency
P.O. Box 116
Jefferson City, MO 65102-0116