



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

August 30, 2016

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

SUBJECT: CALLAWAY PLANT UNIT 1 - RELIEF REQUEST NO. I3R-08 FROM THE
REQUIREMENTS OF THE ASME CODE, SECTION XI, CODE CASE N-460
FOR 100 PERCENT WELD EXAMINATION OF CLASS 1 AND 2 PIPING
WELDS (CAC NO. MF6729)

Dear Mr. Diya:

By letter dated September 14, 2015, as supplemented by letter dated July 7, 2016, Union Electric Company (dba Ameren Missouri, the licensee), submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI requirements at Callaway Plant, Unit 1.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), in Relief Request No. I3R-08, the licensee requested relief from the requirements of ASME Code, Section XI, Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds." This inservice inspection (ISI) requires the performance of greater than 90 percent coverage of the examination volume, or surface area, as applicable. This relief request is proposed for use during the third 10-year ISI interval, which began on December 19, 2004, and ended on December 18, 2014.

The request was submitted because compliance with the above examination is impractical where existing technology will not give meaningful results relative to the requirements, where inaccessibility exists due to design features and meeting the Code would require plant design modification. The licensee included a proposed alternative to the greater than 90 percent coverage volume examination above.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that it is impractical for the licensee to comply with the ASME Code, Section XI requirement; that the proposed inspection provides reasonable assurance of structural integrity or leak tightness of the subject welds; and that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Therefore, the NRC staff grants this relief request at Callaway Plant, Unit 1, for the third 10-year ISI interval, which began on December 19, 2004, and ended on December 18, 2014.

F. Diya

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All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in the subject request for relief 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-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure:
Safety Evaluation

cc w/encl: Distribution via ListServ



UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. I3R-08 REGARDING WELD EXAMINATION COVERAGE

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

1.0 INTRODUCTION

By letter dated September 14, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15258A432), as supplemented by letter dated July 7, 2016 (ADAMS Accession No. ML16189A407), Union Electric Company (dba Ameren Missouri, the licensee) requested relief from the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, specifically related to ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." Relief Request No. I3R-08 pertains to the examination coverage of the piping welds at the Callaway Plant, Unit 1 (Callaway).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(5)(iii), the licensee requested relief from the required examination coverage and to use alternative requirements (if necessary), for inservice inspection (ISI) of the piping welds on the basis that the ASME Code requirement is impractical.

Relief Request Nos. I3R-09, I3R-11, and I3R-18 were submitted in the application dated September 14, 2015; however, this safety evaluation only addresses Relief Request No. I3R-08. By letter dated March 17, 2016 (ADAMS Accession No. ML16055A464), the U.S. Nuclear Regulatory Commission (NRC) staff approved Relief Request Nos. I3R-09, I3R-11, and I3R-18 for Callaway.

2.0 REGULATORY REQUIREMENTS

Pursuant to 10 CFR 50.55a(g)(4), the ASME Code Class 1, 2, and 3 components (including supports) must 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)(ii), inservice examination of components 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 50.55a 12 months before

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the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," 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.

Pursuant to 10 CFR 50.55a(g)(5)(iii), if the licensee has determined that conformance with the ASME Code requirement is impractical for its facility, the licensee must notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted to the NRC no later than 12 months after the expiration of the initial or subsequent 120-month inspection interval for which relief is sought.

Pursuant to 10 CFR 50.55a(g)(6)(i), the Commission will evaluate determinations under paragraph (g)(5) of 10 CFR 50.55a that ASME Code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, and will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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 January 3, 2007 (ADAMS Accession No. ML063520007), the NRC approved implementation of the risk-informed inservice inspection (RI-ISI) program for the Class 1 piping welds (Examination Categories B-F and B-J) and Class 2 piping welds (Examination Categories C-F-1 and C-F-2) in Callaway's third 10-year ISI interval. The licensee developed the RI-ISI program in accordance with the NRC-approved methodology of the Electric Power Research Institute (EPRI) Topical Report (TR)-112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure," dated February 10, 2000 (ADAMS Accession No. ML013470102).

3.2 Components Affected

In this relief request, the affected components are ASME Code Class 1 and 2 piping welds. The licensee identified these welds in Table 1 of Attachment 1 of its letter dated September 14, 2015. These welds are classified as Examination Category R-A, Item Numbers R1.11 (elements subject to thermal fatigue) and R1.20 (elements not subject to a damage mechanism) in accordance with EPRI TR-112657, Revision B-A (Table 1 of ASME Code Case N-578-1, "Risk-Informed Requirements for Class 1, 2, and 3 Piping, Method B, Section XI, Division 1," approved September 2, 1997.).

The welds listed in Table 1 of Attachment 1 to this relief request are the pipe-to-valve, elbow-to-valve, pipe-to-tee, pipe-to-flange, and pipe-to-elbow welds in the chemical and volume control system, reactor coolant system, residual heat removal system, and containment spray system. Table 1 contains nominal pipe size and wall thickness for each pipe. By letter dated July 7, 2016, in response to NRC staff's request for additional information dated June 29, 2016 (ADAMS Accession No. ML16181A334), the licensee stated that the pipes and the welds are made of austenitic stainless steel and the components welded to the pipes are made of forged austenitic stainless steel. The licensee also provided information on the operating temperature and pressure for each weld.

3.3 Applicable Code Edition and Addenda

The Code of record for the third 10-year ISI interval is the 1998 Edition through 2000 Addenda of the ASME Code.

3.4 Duration of Relief Request

The licensee submitted this relief request for the third 10-year ISI interval, which began on December 19, 2004, and ended on December 18, 2014.

3.5 ASME Code Requirement

The ASME Code requirements applicable to this request originate in ASME Code, Section XI, Table IWB-2500-1. An alternative to these requirements is the RI-ISI program for Callaway that was developed by the licensee in accordance with the NRC-approved methodology in EPRI TR-112657, Revision B-A, which was authorized by the NRC staff in a safety evaluation dated January 3, 2007 (ADAMS Accession No. ML063520007). In both the ASME Code requirements and the NRC's safety evaluation, the welds under this request are required to be volumetrically examined during each 10-year ISI interval, and 100 percent coverage of the required examination volume must be achieved. The extent of required examination coverage is reduced to essentially 100 percent by ASME Code Case N-460. This code case has been incorporated by reference into 10 CFR 50.55a by inclusion in Regulatory Guide 1.147, Revision 17.

3.6 Impracticality of Compliance

The licensee stated that it was not possible to obtain greater than 90 percent of the ASME Code required examination volume due to:

- inaccessibility limitations which include configuration and geometry of the welds and/or the associated components (in Table 2 of Attachment 1 to the licensee's letter dated September 14, 2015, the licensee described these limitations for each weld (e.g., the valve body limits access to valve side; tee or crotch of tee limits access to tee side; flange limits access to flange side; and crotch of elbow limits access to elbow side.))
- existing technology which would not give meaningful results relative to the requirements, and

- that meeting the Code would require major plant design modification including redesign and replacement of components.

3.7 Basis for Relief

The licensee stated that it performed the ultrasonic testing (UT) to the maximum extent possible utilizing personnel qualified and procedures demonstrated in accordance with Appendix VIII of Section XI.

The licensee stated that for the welds with single-sided access, it extended the beam path (using applicable refracted longitudinal (L)-waves or shear waves) into the far side of the weld centerline to examine to the extent practical the other side of weld as a "best effort" examination. The licensee provided the percentage of coverage for the "best effort" examinations in the Supplemental Report section of Attachment 1 of the licensee's letter dated September 14, 2015. However, the licensee did not claim credit for any coverage obtained past the weld centerline ("best effort" examination) in a single-sided examination because a UT procedure must be qualified with flaws on the inaccessible side of the weld. There are currently no qualified single-side examination procedures that demonstrate equivalency to two-sided examination procedures on austenitic piping welds. Current UT technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld. The licensee did not find any unacceptable indications in the subject welds in the examination volumes covered by the UT during the third 10-year ISI intervals.

The licensee stated that there were not any other welds composed of the same materials and subject to similar environmental conditions which were selected for inspection and achieved the required ASME Code coverage.

The licensee stated that welds included in this request are not part of any augmented inspection programs. Additionally, the licensee stated that no degradation has been observed in any welds included in this request. The licensee also stated, in the supplemental letter response to RAI 3.5, that no degradation has been observed in welds included in the MRP-146¹ program.

The licensee stated that the subject welds have been subjected to system leakage testing and no sign of leakage has been identified.

3.8 Proposed Alternative

In Table 2 of Attachment 1 to the licensee's letter dated September 14, 2015, the licensee reported the percent coverage achieved for each weld examined. The percentage of volumetric examination coverage obtained is summarized below.

- For five welds that are classified as Examination Category R-A, Item No. R1.11, the volumetric coverage achieved for each weld was 50 percent.

¹ Electric Power Research Institute, "Materials Reliability Program: Management of Thermal Fatigue in Normally Stagnant Non-Isolable Reactor Coolant System Branch Lines (MRP-146, Revision 1)," June 22, 2011, Palo Alto, California.

- For 12 welds that are classified as Examination Category R-A, Item No. R1.20, the volumetric coverage achieved for each weld was between minimum of 50 percent up to maximum of 90 percent.

The licensee proposed this alternative coverage for the volumetric examination of the subject welds in lieu of the ASME Code required essentially 100 percent coverage.

3.9 NRC Staff Evaluation

The NRC staff has evaluated Relief Request No. I3R-08 pursuant to 10 CFR 50.55a(g)(6)(i). The NRC staff's evaluation focused on: (1) whether a technical justification exists to support the determination that the ASME Code requirement is impractical; (2) that imposition of the Code-required inspections would result in a burden to the licensee; and (3) that the licensee's proposed alternative (accepting the reduced inspection coverage in this case) provides reasonable assurance of structural integrity and leak tightness of the subject weld. The NRC staff finds that if these three criteria are met that the requirements of 10 CFR 50.55a(g)(6)(i), (i.e., granting the requested relief will not "endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility") will also be met.

Impracticality of Compliance

As described and demonstrated in the submittal, Tables 1 and 2, and the sketches in Attachment 1 to Relief Request No. I3R-08, the predominant limitations that prevented the licensee's UT to achieve essentially 100 percent coverage of the ASME Code-required volume were the pipe-to-valve, elbow-to-valve, pipe-to-tee, pipe-to-flange, and pipe-to-elbow weld configurations. The licensee performed the UT from one side of the welds because scanning from the other side of the welds was not possible (single-sided scan). The NRC staff confirms that each weld's particular design configuration prevented the licensee to scan the welds from both sides. Therefore, the NRC staff concludes that a technical justification exists to support the determination that achieving essentially 100 percent coverage is impractical.

Burden of Compliance

The licensee proposed that making the welds accessible for inspection from both sides would require replacement or significant design modification to the welds and their associated components. The NRC staff concludes that replacing or reconfiguring the components of the subject welds is the only reasonable means to achieve dual sided coverage of these welds and that replacement or reconfiguration of the pipe, valve, flange, tee, and elbow constitutes a burden on the licensee.

Structural Integrity and Leak Tightness

The NRC staff considered whether the licensee's proposed alternative provided reasonable assurance of structural integrity and leak tightness of the subject weld based on the examination coverage achieved and safety significance of unexamined volumes - unachievable coverage (e.g., the presence or absence of known active degradation mechanisms and essentially 100 percent coverage achieved for similar welds in similar environments subject to similar degradation mechanisms).

Examination Coverage Achieved

In evaluating the licensee's proposed alternative, the NRC staff assessed whether it appeared that the licensee obtained as much coverage as reasonably possible and the manner in which the licensee reported the coverage achieved. Based on its review of the submittal and the sketches in Attachment 1 to Relief Request No. I3R-08, the NRC staff confirms that:

- The welds were examined using the appropriate equipment, ultrasonic modes of propagation, probe angles, frequencies, and scanning directions to obtain maximum coverage;
- The coverage was calculated in a reasonable manner;
- The UT procedures used were qualified as required by the regulation;
- The coverage was limited by physical access (i.e., the configuration of one side of the weld did not permit access for scanning); and
- No unacceptable indications were identified.

Therefore, the NRC staff concludes that the licensee made every effort to obtain as much coverage as reasonably possible with the ASME Code-required UT.

Safety Significance of Unexamined Volumes - Unachievable Coverage

In addition to the coverage analysis described above, the NRC staff evaluated the safety significance of the unexamined volumes of welds - unachievable coverage. Based on its review of the submittal and the sketches in Attachment 1 to Relief Request No. I3R-08, the NRC staff verified that:

- The licensee's UT has covered, to the extent possible, the regions (i.e., the weld root and the heat-affected zone of the base material near the inside diameter surface of the joint) that are typically susceptible to higher stresses and, therefore, potential degradation.
- For the stainless steel welds, the NRC staff notes that the coverage obtained for axial scans was limited to the volume up to the weld centerline (near-side), because claiming coverage for the volume on the opposite side of the weld centerline (far-side) requires meeting the 10 CFR 50.55a(b)(2)(xv)(A)(2) far-side UT qualifications, which has not been demonstrated in any qualification attempts to date. The far-side volume was inspected by the "best effort" examination, no indications were identified, and no credit was taken for the coverage achieved from the "best effort" examination.

Therefore, the NRC staff determined that based on the coverage achieved by the qualified UT, the supplemental "best effort" examinations, and the examination of the weld root and its heat-affected zone to the extent possible, it is reasonable to conclude that if significant

service-induced degradation had occurred, evidence of it would have been detected by the examinations that the licensee performed.

In this analysis, the NRC staff also determined that, in addition to the required volumetric examinations, these welds have received the required system leakage test according to the ASME Code, Section XI, IWB-2500 (Table IWB-2500-1, Examination Category B-P) during each refueling outage and IWC-2500 (IWC-2500-1, Examination Category C-H) each inspection period. Despite reduced coverage of the required examination volume, the NRC staff concludes that this inspection will provide additional assurance that any pattern of degradation, if it were to occur, would be detected and the licensee will take appropriate correction actions.

Therefore, the NRC staff concludes that the volumetric examinations performed to the extent possible provide a reasonable assurance of structural integrity and leak tightness of the subject welds. Compliance with the ASME Code requirements for these welds would be a burden on the licensee.

4.0 CONCLUSION

As set forth above, the NRC staff determines that it is impractical for the licensee to comply with the ASME Code, Section XI requirement; that the proposed inspection provides reasonable assurance of structural integrity or leak tightness of the subject welds; and that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Therefore, the NRC staff grants this relief request at Callaway Plant, Unit 1, for the third 10-year ISI interval which began on December 19, 2004, and ended on December 18, 2014.

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

Principal Contributor: A. Rezai

Date: August 30, 2016

F. Diya

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All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in the subject request for relief 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,

/RA/

Robert J. Pascarelli, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-483

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Safety Evaluation

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