



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

March 17, 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 NOS. I3R-09, I3R-11, AND I3R-18 FROM THE REQUIREMENTS OF THE ASME CODE, SECTION XI, CODE CASE N-460 FOR 100 PERCENT WELD EXAMINATION AND ASME CODE, SECTION XI, TABLE IWB-2500-1, EXAMINATION CATEGORY B-B, ITEM NO. B2.40 (CAC NOS. MF6735, MF6736, AND MF6737)

Dear Mr. Diya:

By letter dated September 14, 2015, as supplemented by letter dated November 24, 2015, 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 (RRs) I3R-09 and I3R-11, 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. These relief requests are being proposed for use during the third 10-year ISI interval that began on December 19, 2004, and ended on December 18, 2014.

The requests have been submitted because compliance with the above examination is impractical where inaccessibility exists and a design modification would be required to meet the Code. The licensee included a proposed alternative to the greater than 90 percent coverage volume examination above.

Additionally, in RR I3R-18, the licensee requested relief pursuant to 10 CFR 50.55a(g)(5)(iii) from ASME Code, Section XI, Table IWB-2500-1, Examination Category B-B, Item No. B2.40, which requires a volumetric examination of all welds during the first inspection interval – which for the replaced steam generators occurred during the third 10-year ISI interval (December 19, 2004 - December 18, 2014).

The licensee identified RR I3R-18 as an impracticality pursuant to 10 CFR 50.55a(g)(5)(iii) and proposed an alternative which involved the use of an Appendix VIII examination in lieu of an ASME Code, Section V, Article 4 examination for RR I3R-18.

The NRC staff has reviewed the subject requests 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(g)(6)(i) and, therefore, the NRC grants relief for RR I3R-11, Steam Generator (SG) B, C, and D, welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001 contained in RR I3R-09. The NRC's granting of relief is authorized by law, 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject components.
- the licensee has not adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC denies relief for RR I3R-09, SG A Head-to-Tubesheet Weld EBB01A-RSG-SC001. Specifically, the licensee used an unauthorized alternative ultrasonic examination methodology to examine the subject weld contrary to the requirements of 10 CFR 50.55a(z). The staff also concludes that the subject examinations present no safety significant issues and had the licensee submitted its proposed alternative, by regulatory authority, the relief would have been granted.
- the licensee has not adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC denies relief for RR I3R-18. Specifically, the licensee used an unauthorized alternative ultrasonic examination methodology to examine the subject weld contrary to the requirements of 10 CFR 50.55a(z). The staff also concludes that the subject examinations present no safety significant issues and had the licensee submitted its proposed alternative, by regulatory authority, the relief would have been granted.

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.

F. Diya

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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
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELIEF REQUEST NOS. I3R-09, I3R-11, and I3R-18 REGARDING THIRD 10-YEAR
INSERVICE INSPECTION INTERVAL OF CLASS 1 AND CLASS 2 WELDS
AND VESSELS GREATER THAN 2 INCHES
UNION ELECTRIC COMPANY (DBA AMEREN MISSOURI)
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 November 24, 2015 (ADAMS Accession No. ML15328A243), which provided more information concerning relief request I3R-11, Union Electric Company (dba Ameren Missouri, the licensee) requested U.S. Nuclear Regulatory Commission (NRC) approval of relief from American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI for 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 and proposed alternatives for inservice inspection (ISI) items on the basis that the Code requirement is impractical. The licensee's Code of record for the third 10-year interval ISI program, which began on December 19, 2004, and ended on December 18, 2014, is the 1998 Edition, including the 2000 Addenda, of Section XI of the ASME Code.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, 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, which was incorporated by reference in 10 CFR 50.55a(a)(1)(ii) 12 months prior to the start of the 120-month interval, subject to the conditions listed in 10 CFR 50.55a(b)(2).

Enclosure

Paragraph 10 CFR 50.55a(g)(5)(iii) states, in part, that licensees may determine that conformance with certain ASME Code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination. Determination 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 ISI 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 120-month inspection interval or subsequent 120-month inspection interval for which relief is sought.

Paragraph 10 CFR 50.55a(g)(6)(i) states that the Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines 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.

Pursuant to 10 CFR 50.55a(z), alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate (1) the proposed alternative would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

3.0 TECHNICAL EVALUATION

3.1 Request for Relief I3R-18, ASME Code, Section XI, Examination Category B-B Item B2.40 Figure IWB-2500-6 Pressure Retaining Welds in Vessels Other Than Reactor Vessel

ASME Code Component Affected

Steam Generator (SG) Bottom Head-to-Tubesheet Weld EBB01A-RSG-SC001.

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-B, Item No. B2.40, requires a volumetric examination of all welds during the first inspection interval. The four SGs were replaced at the end of the second interval, so the third interval is the first inspection interval for the replacement SGs. The volumetric examination method used is ultrasonic testing (UT) examination, and IWA-2232 requires UT examination be conducted in accordance with Appendix I. For vessels other than the reactor vessel, I-2120 directs that UT examination of all vessels greater than 2 inches in thickness shall be conducted in accordance with ASME Code, Section V, Article 4.

ASME Code Relief Request

The licensee proposed an alternative to use ASME Code Section XI, Appendix VIII examination requirements in lieu of ASME Code, Section V, Article 4 examination requirements. This alternative will be evaluated pursuant to 10 CFR 50.55a(z).

Basis for Relief Request and Proposed Alternative

In its letter dated September 14, 2015, the licensee stated, in part, that:

The subject weld is the steam generator bottom-head-to-tubesheet weld on steam generator "A" and is greater than 2 inches in thickness but was examined using Section XI, Appendix VIII techniques instead of Section V, Article 4.

At the time of the examination, NDE [non-destructive examination] equipment problems arose which prevented the performance of a Section V, Article 4 examination. Since this is a high dose area and the scaffold had been built and the insulation removed, an Appendix VIII examination was performed using Appendix VIII qualified personnel, procedures, and equipment. The need for NRC relief to allow use of the Appendix VIII technique was overlooked until the examinations for interval closeout of the third Inservice Inspection interval were reviewed.

All four steam generators were examined during the third interval and all had limited coverage on the bottom head to tube-sheet weld. Relief request I3R-09 has been submitted concerning the limited coverage.

Due to the difficulty that resulted from the previously cited NDE equipment problems, compliance with Article 4 of Section V would have resulted in additional expenditure of time, resources and dose without a corresponding increase in quality or safety when compared to the Appendix VIII examination that was performed.

It is proposed that the Appendix VIII examination performed on steam generator "A" be accepted for meeting Table IWB-2500-1, Examination Category B-B, Item No. B2.40, first inspection interval examination requirements.

From the 2005 Addenda of Section XI onward, substitution of an Appendix VIII examination in lieu of a Section V, Article 4 examination has been acceptable per Section XI, Appendix I so long as the item to be examined is within scope of the Appendix VIII examination procedure. The NRC has reviewed and endorsed the 2007 Edition with 2008 Addenda of ASME Section XI that contains this allowance.

I-2600 APPENDIX VIII EXAMINATION

- (a) For components to which Appendix VIII is not applicable, examination procedures, personnel, and equipment qualified in accordance with Appendix VIII may be applied,

provided such components, materials, sizes, and shapes are within the scope of the qualified examination procedure.

- (b) Examination coverage shall be in accordance with I-3000.
- (c) No other I-1000 or I-2000 requirements apply.

The personnel, equipment and procedures used were qualified in accordance with Appendix VIII for use on reactor pressure vessel circumferential and longitudinal welds. The personnel, equipment and procedures have been proven to be effective at finding actual flaws. An additional zero degree scan was performed in accordance with Section V because this was the only part of the Section V examination not addressed by Appendix VIII.

No recordable indications were found during the limited coverage examinations of the other three steam generators that were performed during this third Inservice Inspection interval using Section V Article 4 techniques. As provided in Note 1 of Table IWB-2500-1, only one steam generator needs examination in subsequent intervals. Steam generator "A" has been chosen for future examinations in the subsequent intervals.

NRC Staff Evaluation

The licensee proposed an alternative pursuant to 10 CFR 50.55a(z)(i) to use ASME Code, Section XI, Appendix VIII examination procedures in lieu of ASME Code, Section V, Article 4 examination procedures to examine SG Head-to-Tubesheet Weld EBB01A-RSG-SC001. The regulations in 10 CFR 50.55a(z) require that an alternative must be submitted and authorized prior to implementation. The licensee overlooked the need to submit its proposed alternative until the examinations for interval closeout of the third ISI interval were reviewed.

Since the licensee did not follow the requirements in 10 CFR 50.55a(z), the NRC staff does not have the regulatory authority to authorize the licensee's proposed alternative. The staff will evaluate the alternative for any safety significant issues, but will not authorize the licensee's proposed alternative contained RR I3R-18.

The NRC staff recognizes that using the ASME Code, Section XI, Appendix VIII UT examination methodology results in a more effective way of identifying flaws than by using the ASME Code, Section V, Article 4 UT methodology. Ultrasonic testing examinations are qualified under a different standard when performing examinations using the ASME Code, Section XI, Appendix VIII methodology than using the Section V, Article 4 methodology. When using Appendix VIII, examiners must qualify and demonstrate their ability to find flaws with the UT equipment they will use for the examination on a mock-up of the subject component being examined; alternatively, when using Section V, Article 4 methodology, the examiners calibrate the UT equipment on a calibration block with holes drilled in it at various depths and locations within/on the calibration block.

In addition, starting with the 2005 Addenda, Section XI allows substitution of an Appendix VIII examination in lieu of a Section V, Article 4 examination provided the item to be examined is

within scope of the Appendix VIII examination procedure. The NRC has reviewed and endorsed the 2005 Addenda, and the 2007 Edition with 2008 Addenda of ASME Section XI that contains the allowance to use Appendix VIII in 10 CFR 50.55a(a)(1)(ii)(C)(46),(48), and (49), respectively.

The NRC staff determined that since the licensee used a more accurate UT technique in finding flaws by using Appendix VIII requirements in examining SG Head-to-Tubesheet Weld EBB01A-RSG-SC001, and no indications were found during the examination, there are no safety significant issues in using the alternative UT examination requirements in lieu of Section V, Article 4 requirements. Furthermore, had the licensee submitted its proposed alternative as required by 10 CFR 50.55a(z), the staff would have authorized the licensee's proposed alternative to use Appendix VIII requirements pursuant to 10 CFR 50.55a(z)(1).

For the alternative contained in RR I3R-18, the NRC staff does not have the regulatory authority to authorize the subject alternative because the licensee did not submit it as required by 10 CFR 50.55a(z) and denies the relief request.

3.2 Request for Relief I3R-09, ASME Code, Section XI, Examination Category B-B Item No. B2.40, Figure IWB-2500-6 Pressure Retaining Welds in Vessels Other Than Reactor Vessel

ASME Code Component(s) Affected

Table 1

| Weld Number | Description | ASME Code Exam Category | ASME Code Item No. |
|--------------------|-----------------------------|--------------------------------|---------------------------|
| EBB01A-RSG-SC001 | SG Bottom Head-to-Tubesheet | B-B | B2.40 |
| EBB01B-RSG-SC001 | SG Bottom Head-to-Tubesheet | B-B | B2.40 |
| EBB01C-RSG-SC001 | SG Bottom Head-to-Tubesheet | B-B | B2.40 |
| EBB01D-RSG-SC001 | SG bottom Head-to-Tubesheet | B-B | B2.40 |

ASME Code Requirement

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-B, Item No. B2.40, Figure IWB-2500-6, requires essentially 100 percent volume coverage of the accessible weld length. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," August 2014 (ADAMS Accession No. ML13339A689).

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination for Callaway's SG bottom head-to-tubesheet welds listed in Table 1 above.

Licensee's Basis for Relief Request and Proposed Alternative

In its letter dated September 14, 2015, the licensee stated, in part, that:

The steam generator vertical supports block access to approximately 22.5 percent of the required examination area. Removal of the supports to allow access for examination is considered impractical. Each steam generator has four supports and the supports would have to be removed one at a time. Analyses would have to be performed to see if temporary supports would be required for those removed in order to limit stresses on the steam generator, piping, and remaining supports. Each support has an approximately 15-foot vertical column and an approximately 6-foot column adapter that would have to be moved. These are large, heavy pieces that would require temporary rigging as no cranes or hoists are present in the area. These supports are located in a congested area of containment, and consequently, manipulating these supports would pose safety hazards to personnel and equipment. Work on the vertical supports would also require checking and possibly re-shimming the lateral supports on the steam generators. The dose received during steam generator replacement to re-attach the support columns, shim the lower lateral supports, and remove all temporary clamps and restraints accumulated over 29 [roentgen equivalent man (Rem)].

The pre-service examinations were performed during steam generator replacement prior to installation, so the supports were not obstructions.

A design modification would be necessary to allow complete examination coverage without removal of supports. The supports, and likely the steam generators, would require modification, and the cost of such a modification would be a considerable burden.

It is proposed that the examinations performed with the coverage obtained be accepted for meeting Code requirements. No recordable indications were found in any of the subject examinations.

NRC Staff Evaluation

For SG bottom head-to-tubesheet welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001, the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-B, Item No. B2.40, Figure IWB-2500-6, requires essentially 100 percent volume coverage of the accessible weld length. The Callaway subject SG welds were scanned to the extent possible. However, the design configuration of the subject weld limited examination of the weld volume due to the configuration of the SG vertical supports blocked access to approximately 22.5 percent of the required examination area of the subject welds.

In order to effectively increase the examination coverage, the licensee considered removal of the supports to allow access for examination; however, it was found to be impractical. Each SG has four supports and the supports would have to be removed one at a time. The analyses performed by the licensee determined that temporary supports would be required for the supports removed in order to limit stresses on the SG, piping, and remaining supports. The licensee noted that each support has an approximately 15-foot vertical column and an approximately 6-foot column adapter that would have to be moved. These are large, heavy pieces that would require temporary rigging as no cranes or hoists are present in the area. These supports are located in a congested area of containment and, consequently, manipulating these supports would pose safety hazards to personnel and equipment. Work on the vertical supports would also require checking and possibly re-shimming the lateral supports on the SGs. The SG supports would require design modifications or replacement. This would place a burden on the licensee; thus, examining 100 percent of the ASME Code-required volume is considered impractical.

As shown in the sketches in supplemental reports and technical descriptions included in the licensee's submittals, examination of the SG bottom head-to-tubesheet welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001 have been performed to the extent practical, with the licensee obtaining coverage of 77.5 percent of the ASME Code-required inspection volume. The SG welds were examined with manual UT techniques using 0-degree longitudinal and 45- and 60-degree shear waves in accordance with applicable requirements of the ASME Code, Section V, Article 4. No unacceptable indications were observed in these welds.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject welds due to the design configurations of the SG bottom head-to-tubesheet welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001, and their adjacent components. Based on the volumetric coverage obtained, along with the examinations completed on other pressure retaining welds in ASME Code, Section XI, Examination Category B-B, it is reasonable to conclude that if significant service-induced degradation had occurred, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff determined that the examinations performed provide reasonable assurance of structural integrity of the subject components.

For RR I3R-09 SG A Bottom Head-to-Tubesheet Weld EBB01A-RSG-SC001, the licensee used an unauthorized alternative UT examination methodology to examine the subject weld. The licensee used ASME Code, Section XI, Appendix VIII (Appendix VIII) in lieu of ASME Code, Section V, Article 4 as required by the ASME Code. The licensee submitted RR I3R-18, discussed above in Section 3.1 of this safety evaluation, proposing an alternative to use Appendix VIII; however, the licensee used the alternative examination UT methodology to examine SG A head-to-tubesheet weld EBB01A-RSG-SC001 prior to submitting for NRC approval as required by 10 CFR 50.55a(z). The NRC staff does not have the regulatory authority to grant relief for the less than essentially 100 percent volume coverage of the accessible weld length that was obtained using the unapproved alternative UT examination methodology.

The NRC staff recognizes that obtaining essentially 100 percent volume coverage is impractical for the subject SG head-to-tubesheet weld EBB01A-RSG-SC001 based on its evaluation of the relief for the other SG head-to-tubesheet welds above. Furthermore, as noted in the evaluation of RR I3R-18 in Section 3.1 above, the staff also recognizes that the Appendix VIII UT examination methodology results in a more effective technique in finding flaws than by using the Section V, Article 4 methodology. Therefore, the staff determined that examinations performed on SG head-to-tubesheet weld EBB01A-RSG-SC001 using the Appendix VIII requirements, the coverage of 77.5 percent obtained, and that no recordable indications were found during the subject examination present no safety significant issues. Furthermore, had the licensee submitted its proposed alternative to use Appendix VIII examination requirements as required by 10 CFR 50.55a(z), the staff would have had the regulatory authority to grant relief pursuant to 10 CFR 50.55a(g)(6)(i) for SG A head-to-tubesheet weld EBB01A-RSG-SC001.

For RR I3R-09 SG A head-to-tubesheet weld EBB01A-RSG-SC001, the licensee used an unauthorized alternative UT examination methodology to examine the subject weld. Based on the above, the NRC staff denies the licensee's request for relief for SG A Weld EBB01A-RSG-SC001 since it involved an alternative that was not authorized prior to its use.

3.3 Request for Relief I3R-11, ASME Code, Section XI, Examination Category B-D Item B3.110, Figure IWB-2500-7(b) Pressure Retaining Welds in Vessels Other Than Reactor Vessel

ASME Code Component(s) Affected

Table 2

| Weld No. | ASME Code Exam Category | ASME Code Item No. | Percent Coverage Obtained | Limitation |
|-----------------|-------------------------|--------------------|---------------------------|--|
| 2-TBB03-10B-A-W | B-D | B3.110 | 75.65 | Pressurizer Safety nozzle A limited due to nozzle configuration. |
| 2-TBB03-10B-B-W | B-D | B3.110 | 75.65 | Pressurizer Safety nozzle B limited due to nozzle configuration. |
| 2-TBB03-10B-C-W | B-D | B3.110 | 75.65 | Pressurizer Safety nozzle C limited due to nozzle configuration. |
| 2-TBB03-10B-D-W | B-D | B3.110 | 75.65 | Pressurizer Safety nozzle D limited due to nozzle configuration. |
| 2-TBB03-10C-W | B-D | B3.110 | 82.7 | Pressurizer Spray nozzle limited due to nozzle configuration. |
| 2-TBB03-10A-W | B-D | B3.110 | 54.8 | Pressurizer Surge nozzle limited due to nozzle configuration and adjacent heater penetrations. |

ASME Code Requirement

ASME Code, Section XI, Paragraph IWB-2412, Inspection Program B, requires volumetric examination of essentially 100 percent of each pressure-retaining weld identified in Table IWB-2500-1 once each 10-year interval. ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, requires volumetric examination of Item B3.110 (Pressurizer Nozzle-to-Vessel welds) as shown in Figures IWB-2500-7(a) through (d). Callaway's nozzle configuration corresponds to Figure IWB-2500-7(b), which shows the examination volume to include the actual circumferential weld and the adjacent base metal on either side of the weld extending to a distance of one-half the thickness of the wall from the extremities of the weld crown. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in RG 1.147, Revision 17.

Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code-required volumetric examination for the pressurizer (PZR) nozzle welds listed in Table 2 above.

Licensee's Basis for Relief Request and Proposed Alternative

In its letter dated September 14, 2015, the licensee stated, in part, that:

In accordance with 10 CFR 50.55a(g)(5)(iii), relief is requested for the Pressurizer Nozzle-to-Vessel Welds, ASME Section XI, Category B-D, Item Number B3.110 from the "essentially 100 percent" volumetric examination coverage requirements. Callaway was limited in the amount of Code coverage obtainable. The essentially 100 percent code coverage (greater than 90 percent) requirement is considered impractical due to the pressurizer shell-to-nozzle welds configuration. Ultrasonic examinations of the pressurizer nozzle-to-head welds are limited in coverage due to the configuration of the nozzle. Ultrasonic examination of the pressurizer surge nozzle-to-shell weld is limited due to interference with the pressurizer heater penetrations. Examination was performed to the extent practical using qualified equipment and personnel.

The design configuration of the nozzles and surrounding components restricts complete access to the subject welds, making the Code required examination coverage impractical. Plant modifications or replacements with components designed to allow for complete coverage would be needed in order to meet the Code requirements. The cost and dose of such modifications or replacements would be a considerable burden.

The following alternatives are proposed in lieu of the required examination coverage of essentially 100 percent:

1. Ultrasonic testing (UT) of the subject component welds was performed to the maximum extent practical during the third ten-year interval.

2. Pressure test VT-2 visual examinations were performed, as required by Code Category BP, during the third 10-year interval. No evidence of leakage was identified for this component.

NRC Staff Evaluation

The ASME Code requires 100 percent volumetric examination of Class 1 nozzle-to-vessel welds. However, the design configuration of the subject welds and curvature of the nozzle blend radii limit access for UT scanning. In order to effectively increase the examination coverage, the nozzle-to-vessel welds would require design modifications. This would place a burden on the licensee; therefore, obtaining 100 percent of ASME Code-required volumetric examinations is considered impractical.

The licensee provided additional information in its November 24, 2015, response to an NRC staff's request for additional information (RAI) dated November 12, 2015 (ADAMS Accession No. ML15316A153), that the subject PZR nozzle-to-vessel welds in Callaway are constructed of carbon steel material with stainless steel inside diameter surface cladding to minimize corrosion. These full penetration butt welds extend the full thickness of the vessel head, and the nozzle configurations are of the "set-in" design, which essentially makes the welds concentric rings aligned parallel with the nozzle axes in the through-wall direction of the vessel. This nozzle design geometry restricts UT scanning to only the shell side of the welds. In addition, UT scans cannot be performed from the curved outside diameter surface on the nozzle blend radius regions, further limiting the volumetric examinations.

As shown on the sketches and technical descriptions included in the licensee's submittals, examinations of the subject PZR welds have been completed to the extent practical with volumetric coverage ranging from approximately 54.8 to 75.65 percent (see Table 2 above) of the ASME Code-required volumes. The examination volumes included the weld and base materials near the inside surface of the weld joint, which are high regions of stress, and where one would expect degradation sources to be manifested should they occur. The licensee provided additional information in its RAI response that the PZR examinations were performed with UT techniques in accordance with the applicable requirements of the ASME Code, Section V, Article 4 as supplemented by Section XI, Table 1-2000-1. The welds were examined using a 0-degree longitudinal wave examination performed on the accessible examination volume. In addition, 45- and 60-degree shear wave examinations were performed in two directions axial to the weld and in two directions parallel to the weld on the available examination volume. No unacceptable indications were observed in these welds.

Although UT scans were primarily limited to the vessel side, studies have found that inspections conducted through carbon steel are equally effective whether the UT waves have only to propagate through the base metal, or have to also propagate through the carbon steel weldment.¹ Therefore, it is expected that the UT techniques employed by the licensee on the PZR nozzle-to-vessel welds would detect structurally significant flaws that might occur on either side of the subject welds due to the fine-grained carbon steel microstructures present in these

1 P.G. Heasler, and S. R. Doctor, 1996. *Piping Inspection Round Robin*, NUREG/CR-5068, PNNL-10475, U.S. Nuclear Regulatory Commission, Washington, DC.

materials. The licensee has also performed pressure test VT-2 visual examinations as required by ASME Code, Section XI, Category B-P, during the third 10-year interval. No evidence of leakage was identified for this component.

The licensee has shown that it is impractical to meet the ASME Code-required 100 percent volumetric examination coverage for the subject inservice PZR welds due to nozzle design and curvature of the nozzle blend radii. Based on the volumetric coverage obtained, and VT-2 visual examinations, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected by the examinations that were performed. Furthermore, the NRC staff determined that the examinations performed provide reasonable assurance of structural integrity and leak tightness of the subject components.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC grants relief for RR I3R-11, SG B, C, and D, welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001 contained in RR I3R-09. The NRC's granting of relief is authorized by law, 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject components.

4.0 CONCLUSION

Concerning RR I3-18, the licensee has not adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC denies relief. Specifically, the licensee used an unauthorized alternative ultrasonic examination methodology to examine the subject weld contrary to the requirements of 10 CFR 50.55a(z). The staff also concludes that the subject examinations present no safety significant issues and had the licensee submitted its proposed alternative, by regulatory authority, the relief would have been granted.

The licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC grants relief for RR I3R-11, SG B, C, and D, welds EBB01B-RSG-SC001, EBB01C-RSG-SC001, and EBB01D-RSG-SC001 contained in RR I3R-09 for Callaway's third 10-year interval. The NRC's granting of relief is authorized by law, 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. Furthermore, the staff concludes that the examinations performed provide reasonable assurance of structural integrity of the subject components.

The licensee has not adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i) and, therefore, the NRC denies relief for RR I3R-09, SG A Head-to-Tubesheet Weld EBB01A-RSG-SC001. Specifically, the licensee used an unauthorized alternative ultrasonic examination methodology to examine the subject weld contrary to the requirements of 10 CFR 50.55a(z). The staff also concludes that the subject

examinations present no safety significant issues and had the licensee submitted its proposed alternative, by regulatory authority, the relief would have been granted.

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

Principal Contributor: J. Klos, T. McClellan

Date: ~~March~~ 17, 2016

F. Diya

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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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