



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

April 15, 2014

Vice President, Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 - PROPOSED ALTERNATIVE
ANO2-ISI-016, AMERICAN SOCIETY OF MECHANICAL ENGINEERS CODE
CASE N-770-1 SUCCESSIVE EXAMINATION (TAC NO. MF2320)

Dear Sir or Madam:

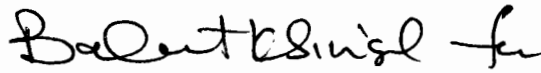
By letter dated June 25, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13176A403), supplemented by letter dated August 14, 2013 (ADAMS Accession No. ML13226A359), Entergy Operations, Inc. (the licensee), submitted proposed alternative request ANO2-ISI-016 for the use of an alternative to certain examination coverage requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Case N-770-1, at Arkansas Nuclear One, Unit 2 (ANO-2). These requirements are required and conditioned by Title 10 of the *Code of Federal Regulations*, Part 50 (10 CFR 50), paragraph 55a(g)(6)(ii)(F). Specifically, pursuant to 10 CFR 50.55a(a)(3)(ii), ANO2-ISI-016 proposes a reduction in the required "essentially 100 percent" examination coverage of several dissimilar metal welds associated with the ANO-2 reactor coolant pump piping, based on hardship or unusual difficulty without a compensating increase in the level of quality and safety. The reduction in coverage is due to field interference and geometry considerations of the associated welds.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the proposed alternative and, based on the enclosed safety evaluation, the staff concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, proposed alternative ANO2-ISI-016 is authorized, pursuant to 10 CFR 50.55a(a)(3)(ii). The alternative is authorized for a time period of 54 months, with the affected piping at greater than 525 degrees Fahrenheit, from the completion of the examinations conducted in the 2014 spring refueling outage. ANO2-ISI-016 is associated with the fourth 10-year inservice inspection interval, which will conclude on March 25, 2020, at ANO-2.

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If you have any questions, please contact the ANO Project Manager, Mr. Peter J. Bamford, at (301) 415-2833, or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Markley" with a stylized flourish at the end.

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Safety Evaluation

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
PROPOSED ALTERNATIVE ANO2-ISI-016, AMERICAN SOCIETY OF MECHANICAL
ENGINEERS CODE CASE N-770-1 SUCCESSIVE EXAMINATION
ENTERGY OPERATIONS, INC.
ARKANSAS NUCLEAR ONE, UNIT NO. 2
DOCKET NO. 50-368

1.0 INTRODUCTION

By letter dated June 25, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13176A403), supplemented by letter dated August 14, 2013 (ADAMS Accession No. ML13226A359), Entergy Operations, Inc. (the licensee), submitted proposed alternative request ANO2-ISI-016 for the use of an alternative to certain examination coverage requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities," at Arkansas Nuclear One, Unit 2 (ANO-2). These requirements are required and conditioned by Title 10 of the *Code of Federal Regulations*, Part 50 (10 CFR 50), paragraph 55a(g)(6)(ii)(F). Specifically, pursuant to 10 CFR 50.55a(a)(3)(ii), ANO2-ISI-016 proposes a reduction in the required "essentially 100 percent" examination coverage of several dissimilar metal welds associated with the ANO-2 reactor coolant pump (RCP) piping, based on hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee requested authorization to use the proposed alternative for 54 months following the spring 2014 refueling outage examinations.

The U.S. Nuclear Regulatory Commission (NRC) staff notes that examination coverage of the subject RCP dissimilar metal butt welds (DMBW) has been addressed in the previous authorization of alternative ANO2-ISI-007, dated May 30, 2013 (ADAMS Accession No. ML13129A298), regarding the baseline examination requirements of ASME Code Case N-770-1. At that time, the NRC staff found that the examination coverage that could be attained provided reasonable assurance of structural integrity and leak tightness, and authorized use of the proposed alternative for a 54-month time period. The previous authorization will expire at the completion of the weld examinations to be conducted in the spring 2014 refueling outage at ANO-2.

Enclosure

2.0 REGULATORY EVALUATION

Paragraph 55a(g)(6)(ii)(F) of 10 CFR 50 requires that licensees of existing operating pressurized-water reactors implement the requirements of ASME Code Case N-770-1, subject to the conditions specified in paragraphs 10 CFR 50.55a(g)(6)(ii)(F)(2) through (g)(6)(ii)(F)(10), by the first refueling outage after August 22, 2011.

Paragraph 55a(a)(3) of 10 CFR 50 states, in part, that alternatives to the requirements of 10 CFR 50.55a(g) may be used, when authorized by the NRC, if (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.

Based on analysis of the regulatory requirements, the NRC staff finds that the regulatory authority exists to authorize the licensee's proposed alternative on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(a)(3)(ii).

3.0 TECHNICAL EVALUATION

3.1 Licensee's Request for Alternative

The proposed alternative applies to the following ASME Code Class 1 dissimilar metal piping welds containing Alloy 82/182:

- RCP suction nozzle elbow-to-safe end welds 08-014, 10-014, 12-014, and 14-014
- RCP discharge nozzle safe-end-to-pipe welds 09-008, 11-008, 13-008, and 15-008

The ANO-2 inservice inspection (ISI) Code of record for the fourth 10-year ISI interval is Section XI of the ASME Code, 2001 Edition through the 2003 Addenda. The fourth ISI interval began on March 26, 2010, and is scheduled to end on March 25, 2020. The subject welds are classified as ASME Code Case N-770-1, Inspection Item B, "Unmitigated butt weld at Cold Leg operating temperature $\geq 525^{\circ}$ F [degrees Fahrenheit] and $< 580^{\circ}$ F," for which volumetric examinations are required every second inspection period, not to exceed 7 years. Paragraph (g)(6)(ii)(F)(4) of 10 CFR 50.55a states, "The axial examination coverage requirements of -2500(c) may not be considered to be satisfied unless essentially 100 percent coverage is achieved."

ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1," allows a reduction in coverage due to interference or geometry as long as the overall coverage is greater than 90 percent. ASME Code Case N-460 has been unconditionally accepted by the NRC in Regulatory Guide 1.147, Revision 16, "Inservice

Inspection Code Case Acceptability, ASME Section XI, Division 1," October 2010 (ADAMS Accession No. ML101800536).

The licensee states that previous ultrasonic (UT) examination of the subject welds performed in fall of 2009 (the baseline examination) was not able to obtain essentially 100 percent of the required examination volume coverage for axial flaws due to the weld taper and the presence of the cast austenitic stainless steel (CASS) safe-ends. Based on the previous baseline data and the known geometric limitations, it is anticipated that less than the required essentially 100 percent coverage will be obtained during the spring 2014 examination.

The licensee proposes to examine the subject welds using phased array UT examination and obtain, as a minimum, the same coverage as that for the baseline examination. In proposed alternative ANO2-ISI-016, the licensee cites the previous NRC authorization for ANO2-ISI-007, as well as previously submitted specific details of each weld examination, and requests that the examination be authorized for the same duration as was authorized previously, 54 months, contingent upon achieving the same examination coverage.

3.2 NRC Staff Evaluation

Primary water stress-corrosion cracking (PWSCC) of nickel-based pressure boundary materials is a safety concern. Operational experience has shown that PWSCC can occur as the result of the combination of susceptible material, corrosive environment, and tensile stresses, resulting in leakage and the potential for loss of structural integrity. The subject DMBWs meet these conditions and thus may be susceptible to PWSCC. The examination requirements of ASME Code Case N-770-1, as required and conditioned by 10 CFR 50.55a(g)(6)(ii)(F), are intended to provide reasonable assurance of the structural integrity and leak tightness of DMBWs through nondestructive examination.

The subject RCP DMBWs are PWSCC-susceptible Alloy 82/182 weld metal joining mill-clad carbon steel to CASS safe-ends. For this proposed alternative, the NRC staff reviewed the documents supporting previously approved alternative ANO2-ISI-007, as well as the NRC staff's safety evaluation authorizing that alternative dated May 30, 2013. As shown in Table 1 of the licensee's letter dated April 13, 2012 (ADAMS Accession No. ML12104A066), the licensee claims 100 percent axial direction scan coverage for detection of circumferential flaws. However, by letter dated May 21, 2012 (ADAMS Accession No. ML12142A319), circumferential direction scan coverage of the PWSCC susceptible nickel-alloy material for detection of axial flaws was reported to be between 14 percent and 100 percent.¹

The NRC staff has examined the drawings of the subject DMBWs previously submitted by letter dated May 21, 2012, which the licensee references in their current proposed alternative, and finds that the weld taper and the presence of the CASS safe-ends does not permit achieving essentially 100 percent examination requirement for axial flaws in the susceptible weld material with currently available technology and procedures. Therefore, the NRC staff concludes that

¹ In Table 1 of the licensee's letter dated April 13, 2012, the licensee averaged the scan coverage for the ferritic pipe and nickel-alloy weld metal. In Table 1 of the licensee's letter dated May 21, 2012, the licensee reported the circumferential direction scan coverage for the weld metal separately, resulting in lower scan coverage for the weld metal.

achieving the required examination coverage would require modification and/or replacement of the components, which would constitute a hardship.

The licensee is proposing that the examinations of the RCP welds that are to be performed in the spring 2014 refueling outage will achieve examination coverage for axial flaws of at least that of the fall of 2009 examination. The NRC staff has evaluated the ultrasonic scan coverage drawings and table submitted previously by the licensee, and has determined that the unexamined volume and the hypothetical axial flaw size for RCP suction nozzle weld 10-014 remain bounding for the subject welds. Further, the NRC staff has reviewed the information supporting the previous evaluation dated May 30, 2013, and continues to conclude that a conservative selection of 16.7 percent of wall thickness for the hypothetical flaw depth in the unexamined volume for the bounding RCP suction nozzle weld 10-014 is supported.

The NRC staff has examined the licensee's flaw growth calculation for the hypothetical 16.7 percent deep flaw from the previous authorization, submitted by letter dated December 4, 2012 (ADAMS Accession No. ML12340A449). The NRC staff has also performed an independent evaluation using the licensee's values for normal operational stress and weld residual stress (WRS) resulting from a 50 percent inside diameter weld repair without subsequent heat treatment. The NRC staff further performed confirmatory calculations using reference WRS values. The results of all of these calculations support the licensee's calculation of at least 54 months for the hypothetical 16.7 percent deep axial flaw to grow by PWSCC to the ASME Code limit of 75 percent at a service temperature of 551 °F.

The NRC staff further notes that the proposed alternative states: "Examination summary and coverage results will be provided to the NRC following completion of these examinations." Submission of this data from the 2014 refueling outage examinations to the NRC staff is therefore a requirement of the authorized alternative.

In summary, the NRC staff concludes that compliance with the requirements of 10 CFR 50.55a(g)(6)(ii)(F) for performing an ASME Code-compliant (essentially 100 percent) examination would result in hardship. The NRC staff further concludes that if 100 percent of the PWSCC susceptible weld material is examined by ASME Code-compliant examinations in the axial scan direction for detection of circumferential flaws, and if the volume of susceptible material previously examined during the fall 2009 refueling outage is successfully examined in the circumferential direction for detection of axial flaws, there is reasonable assurance of structural integrity and leak tightness for an additional 54 months of service at weld service temperatures above 525 °F. Based on the above, the NRC staff concludes that complying with the requirements of 10 CFR 50.55a(g)(6)(ii)(F) for the duration of this proposed alternative would result in hardship without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that the proposed alternative provides reasonable assurance of structural integrity and leak tightness of the subject RCP welds, and that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set

forth in 10 CFR 50.55a(a)(3)(ii). The NRC staff therefore authorizes use of the proposed alternative ANO2-ISI-016, "ASME Code Case N-770-1 Successive Examination," at ANO-2, for a period of 54 months at operating temperatures above 525 °F, contingent on successfully achieving examination coverage for the eight subject welds of at least that of the fall 2009 examination coverage.

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

Principal Contributor: J. Wallace

Date: April 15, 2014

If you have any questions, please contact the ANO Project Manager, Mr. Peter J. Bamford, at (301) 415-2833, or by e-mail at Peter.Bamford@nrc.gov.

Sincerely,

/RA by BSingal for/

Michael T. Markley, Chief
Plant Licensing Branch IV-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure:
Safety Evaluation

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