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

ARKANSAS NUCLEAR ONE, UNIT 2 – APPROVAL OF REQUEST FOR ALTERNATIVE FROM CERTAIN REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (EPID: L-2020-LLR-0150)

LICENSEE INFORMATION

Licensee: Entergy Operations, Inc.

Licensee Address:
ANO Site Vice President
Arkansas Nuclear One
Entergy Operations, Inc.
N-TSB-58
1448 S.R. 333
Russellville, AR 72802

Plant Name and Unit: Arkansas Nuclear One, Unit 2 (ANO-2)

Docket No.: 50-368

APPLICATION INFORMATION

Submittal Date: November 24, 2020

Submittal Agencywide Documents Access and Management System (ADAMS) Accession No.: ML20329A202

Supplement Date: Not applicable.

Supplement ADAMS Accession No.: Not applicable.

Licensee Proposed Alternative No. or Identifier: ANO2-ISI-022

Applicable Inservice Inspection (ISI) Program Interval Start Date: ANO-2 is in its fifth 10-year inservice inspection (ISI) interval, which commenced on March 26, 2020.

Alternative Provision: Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(z)(1), "Acceptable level of quality and safety."

Applicable Code Requirements: The regulation in 10 CFR 50.55a(g)(6)(ii)(D)(1), "Implementation," requires that examinations of the reactor vessel closure head (RVCH) be performed in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (ASME Code) Case N-729-6, "Alternative Examination Requirements for PWR [Pressurized Water Reactor] Reactor Vessel Upper Heads With Nozzles Having Pressure-Retaining Partial-Penetration Welds, Section XI, Division 1," subject to the conditions specified in 10 CFR 50.55a(g)(6)(ii)(D)(2) through 10 CFR 50.55a(g)(6)(ii)(D)(8).

ASME Code Components Affected: There are 90 ASME Class 1 RVCH penetration nozzles comprised of 81 control element drive mechanism (CEDM) nozzles, 8 incore instrument nozzles, and 1 vent line nozzle. The proposed alternative pertains to the CEDM nozzles only.

Applicable Code Edition and Addenda: ASME Code, Section XI, 2007 Edition with the 2008 Addenda

Brief Description of the Proposed Alternative: The proposed alternative consists of three parts.

Ultrasonic Testing (UT) Examination: The inner diameter of each CEDM nozzle (i.e., nozzle base material) will be ultrasonically examined from the point above the root of the J-groove to 1.544 inches above the bottom of the nozzle.

Analysis: For the portions of the CEDM nozzle not examined by UT, analysis has been performed to:

a. Determine if sufficient space exists between the blind zone and the weld to facilitate one (1) operating cycle of crack growth without the crack reaching the weld.

b. For nozzles or portions of nozzles not meeting the item above, determine the propagation length required to facilitate one cycle of crack growth without the crack reaching the weld. This length is composed of the distance between the weld and the blind zone plus some additional distance into the blind zone. This area to be inspected may include a portion of the weld.

Augmented Inspections: CEDM nozzles that have been demonstrated by analysis to have inadequate free-span to ensure a crack will not grow to the J-groove weld within one operating cycle will be inspected on that portion of the nozzle and weld fillet cap that has been determined by analysis as necessary to prevent a crack from reaching the J-groove weld in less than one operating cycle.

For additional details on the licensee's submittal, please refer to the documents located at the ADAMS Accession No. identified above.

REGULATORY EVALUATION

Regulatory Basis: 10 CFR 50.55a(z)(1)

The licensee is proposing an alternative to the requirements of 10 CFR 50.55a(g)(6)(ii)(D)(1), concerning augmented ISI requirements for implementation of reactor vessel head inspections.

The regulations in 10 CFR 50.55a(z), "Alternatives to codes and standards requirements," state that alternatives to the requirements of 10 CFR 50.55a(b) through 10 CFR 50.55a(h) may be used when authorized by the Director, Office of Nuclear Reactor Regulation, if (1) the proposed alternative would provide an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The licensee submitted this request on the basis that a proposed alternative would provide an acceptable level of quality and safety.

TECHNICAL EVALUATION

The licensee is proposing an alternative to the requirements of 10 CFR 50.55a(g)(6)(ii)(D)(1) on the basis that the proposed alternative provides an acceptable level of quality and safety. The regulation in 10 CFR 50.55a(g)(6)(ii)(D)(1) requires that examinations of the RVCH be performed in accordance with ASME Code Case N-729-6. The regulations require, in part, the licensee to perform a volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the CEDM nozzle tubes, as identified by Figure 2 of Code Case N-729-6. If a surface examination is being substituted for a volumetric examination on a portion of a penetrating nozzle that is below the toe of the J-groove weld, the surface examination shall be of the inside and outside wetted surfaces of the penetration nozzle, not examined volumetrically. A demonstrated volumetric or surface leak path assessment through all J-groove welds shall be performed.

In its alternative request, the licensee specified the limitations preventing full volumetric inspections of the nozzle below the J-groove weld. These limitations include nozzle bottom-end geometry (such as guide cone-threaded connection and 45-degree chamfer) and the design of the UT probe. To overcome these limitations, the reactor vessel upper head and nozzles would have to be removed, redesigned, and reinstalled.

The history of the proposed alternative originates from the U.S. Nuclear Regulatory Commission (NRC) Order EA-03-009, “Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors,” dated February 11, 2003, (ADAMS Accession No. ML030380470), which established interim inspection requirements for reactor pressure vessel heads at PWRs. The Order was revised on February 20, 2004 (ADAMS Accession No. ML040220181).

By letters dated August 27, 2003, March 11, 2004, and September 9, 2005 (ADAMS Accession Nos. ML032790019, ML040780340, and ML052560109, respectively), the licensee submitted three requests for relaxation of the provisions of Order EA-03-009. These relaxation requests were based on an alternative inspection and analysis procedure, with an analysis described in Entergy Engineering Report M-EP-2003-002, Revision 1 (ADAMS Accession No. ML032690649). In these relaxation requests, the licensee proposed to assure the structural integrity of the subject nozzles using a combination of methods including UT examinations, analysis, and augmented inspections.

The NRC staff approved these relaxation requests by letters dated October 9, 2003, February 7, 2005, and May 17, 2006 (ADAMS Accession Nos. ML032820552, ML043560492, and ML060750482, respectively). NRC Order EA-03-009 was revoked by an NRC rulemaking dated September 10, 2008 (73 FR 52742). By this change, all previous NRC authorized relaxation requests from the requirements of the Order were withdrawn due to the change in the regulatory requirements.

The licensee submitted request for alternative ANO2-ISI-002, dated February 9, 2009 (ADAMS Accession No. ML090400962), requesting to use the same proposed alternative inspection and analysis process as in the relaxation requests. This alternative was authorized by letter dated August 27, 2009 (ADAMS Accession No. ML092300551).

The NRC staff has evaluated the licensee's proposed alternative to ensure that the combination of UT examinations, analysis, and augmented inspections provides reasonable assurance of structural integrity for the nozzles.

UT Examination

The licensee states that UT of a reduced volumetric examination zone below the lowest point of the toe of the J-groove weld will be performed. This is a distance "a" above the highest point of the root of the J-groove weld down to approximately 1.544 inches above the bottom end of the nozzle tube. This distance of 1.544 inches (i.e., 1.25-inch threaded connection + 0.094-inch chamfer + 0.2-inch acoustic uncoupling) is designated as the unexamined region by volumetric examinations.

For the unexamined region not inspected by UT, the licensee states that the analysis technique would demonstrate the adequacy of the examination volume or surface. In addition, the licensee states that the required leak path assessment through J-groove welds will be performed to determine if leakage has occurred into the annulus between the CEDM nozzle and the reactor vessel head low-alloy steel.

Analysis

By letter dated August 27, 2003, the licensee submitted an engineering evaluation of the unexamined region of the nozzle and the associated J-groove weld. The licensee's engineering evaluation included a finite element stress analysis and a fracture mechanics-based crack-growth evaluation that is detailed in Entergy Engineering Report M-EP-2003-002, Revision 1. The engineering evaluation assessed various postulated cracks that could have potential to grow to the J-groove weld and might lead to pressure boundary leakage. The NRC staff reviewed the licensee's engineering evaluation and the results documented in the previous relaxation requests. The licensee's predicted time for a potential postulated crack to grow from the unexamined region to the pressure boundary was reviewed by the NRC staff. It is noted that the downhill location of the nozzles is the critical location at which a crack could potentially grow to the bottom of the weld in less than one cycle of operation. The NRC staff has noticed that the licensee's analysis could not be performed for two cases, outer diameter part through-wall and through-wall cracks, at the downhill location due to the extension of the weld into the unexamined region.

In the review of the relaxation request dated September 9, 2005, the NRC staff reviewed the licensee's fracture mechanics analysis results regarding the postulated cracks. It was shown that the postulated cracks would not grow through-wall and reach into the weld establishing a leak path within one cycle of operation for any of the nozzle locations. By letter dated May 17, 2006, the NRC staff concluded that this analysis is acceptable.

Augmented Inspections

In its letter dated September 9, 2005, the licensee stated that 57 of the 81 CEDM nozzles are subject to the augmented inspections. The 57 nozzles are those nozzles that do not have adequate margin based on the analysis. The NRC staff notes that the licensee attained axial coverage of approximately 0.80 inch below the top of the unexamined region during the augmented inspections in the fall 2003 and the spring 2005 outages.

The augmented inspections will be performed using eddy current testing, penetrant testing, or a combination of both inspection methods. Eddy current testing and/or penetrant testing inspection methods are an effective means to detect surface opening flaws. The NRC staff notes that through-wall and outer diameter partly through-wall cracks are the limiting flaws, as established by the licensee's analysis, and that it is highly likely that eddy current testing and/or penetrant testing will detect these types of flaws in the inspection area, if present.

In summary, the NRC staff concludes that the licensee's proposed alternative with three layers of defense, including UT examination, a flaw analysis, and augmented inspections, provides reasonable assurance of structural integrity of the CEDMs. With these considerations, Proposed Alternative ANO2-ISI-022 would provide an acceptable level of quality and safety for the fifth 10-year ISI interval.

While the requested duration of proposed alternative is for the fifth 10-year ISI interval, which commenced on March 26, 2020, and the sixth ISI interval, or until the end of the current operating license for ANO-2, the regulations in 10 CFR 50.55a(z) allow the NRC staff to authorize alternatives to the requirements in paragraphs (b) through (h) of 10 CFR 50.55a, but do not allow the staff to approve alternatives to requirements not currently established by these paragraphs. The requirements for subsequent 10-year inservice inspection (ISI) intervals are established by 10 CFR 50.55a(g)(4)(ii) 18 months prior to the start of the ISI interval. Therefore, the fifth 10-year ISI interval is the longest period for which the proposed alternative can be authorized.

CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Since the ISI requirements beyond the fifth 10-year intervals have not yet been established in accordance with 10 CFR 50.55a(g)(4)(ii), no authorization can be made for subsequent intervals. Therefore, the staff authorizes the use of proposed alternative ANO2-ISI-022 at Arkansas Nuclear One, Unit 2, for the fifth 10-year inservice inspection interval, which commenced on March 26, 2020.

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

Principal Contributor: S. Cumblidge, NRR

Date: July 9, 2021

Samson S. Lee

Digitally signed by Samson S. Lee
Date: 2021.07.09 10:13:12 -04'00'

Jennifer Dixon-Herrity, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

cc: Listserv

ARKANSAS NUCLEAR ONE, UNIT 2 – APPROVAL OF REQUEST FOR ALTERNATIVE FROM CERTAIN REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (EPID: L-2020-LLR-0150) DATED JULY 9, 2021

DISTRIBUTION:
PUBLIC
PM File Copy
RidsACRS_MailCTR Resource
RidsNrrDorlLpl4 Resource
RidsNrrDnrlNphp Resource
RidsNrrLAPBlechman Resource
RidsNrrPMANO Resource
RidsRgn4MailCenter Resource
SCumblidge, NRR
BJain, NRR
RRichardson, OEDO
AMcCraw, OEDO

ADAMS Accession No. ML21168A056 * by e-mail

OFFICE	NRR/DORL/LPL4/PM/it	NRR/DORL/LPL4/PM	NRR/DORL/LPL4/LA
NAME	BJain	TWengert	PBlechman
DATE	6/16/2021	6/25/2021	6/22/2021
OFFICE	NRR//DNRL/NPHP/BC*	NRR/DORL/LPL4/BC	
NAME	MMitchell	JDixon-Herrity (SLee for)	
DATE	6/9/2021	7/9/2021	

OFFICIAL RECORD COPY