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

January 23, 2018

Vice President, Operations
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, NY 10511-0249

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 2 – SAFETY EVALUATION REGARDING RELIEF REQUESTS IP2-ISI-RR-20, IP2-ISI-RR-21, AND IP2-ISI-RR-22 REGARDING THE FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM (EPID L-2017-LLR-0052, L-2017-LLR-0050, AND L-2017-LLR-0051)

Dear Sir or Madam:

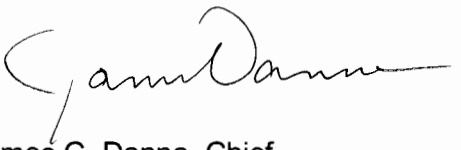
By three letters dated May 30, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML17159A524, ML17191A921, and ML17159A523), as supplemented by letter dated November 1, 2017 (ADAMS Accession No. ML17311A144), Entergy Nuclear Operations, Inc. (the licensee) submitted Relief Requests IP2-ISI-RR-20, IP2-ISI-RR-21, and IP2-ISI-RR-22 to the U.S. Nuclear Regulatory Commission (NRC). Entergy Nuclear Operations, Inc. proposed alternatives to certain inservice inspection requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for volumetric and visual examination requirements for certain welds at Indian Point Nuclear Generating Unit No. 2 (Indian Point 2). Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternatives on the basis that the proposed alternatives provide an acceptable level of quality and safety.

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(z)(1). Therefore, the NRC staff authorizes the proposed alternatives for the fourth 10-year inservice inspection interval at Indian Point 2, which began on March 1, 2007, and concluded on May 31, 2016.

All other ASME Code requirements for which relief was not specifically requested and approved remain applicable.

If you have any questions concerning this matter, please contact the Indian Point 2 Project Manager, Mr. Richard Guzman, at (301) 415-1030 or Richard.Guzman@nrc.gov.

Sincerely,



James G. Danna, Chief
Plant Licensing Branch 1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-247

Enclosure:
Safety Evaluation

cc w/Enclosure: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUESTS IP2-ISI-RR-20, IP2-ISI-RR-21, AND IP2-ISI-RR-22

REGARDING THE FOURTH 10-YEAR INTERVAL

OF THE INSERVICE INSPECTION PROGRAM

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

DOCKET NO. 50-247

1.0 INTRODUCTION

By three letters dated May 30, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML17159A524, ML17191A921, and ML17159A523), as supplemented by letter dated November 1, 2017 (ADAMS Accession No. ML17311A144), Entergy Nuclear Operations, Inc. (the licensee) submitted Relief Requests IP2-ISI-RR-20, IP2-ISI-RR-21, and IP2-ISI-RR-22 (hereafter RR-20, RR-21, and RR-22, respectively) to the U.S. Nuclear Regulatory Commission (NRC). Entergy Nuclear Operations, Inc. proposed alternatives to certain inservice inspection (ISI) requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for volumetric and visual examination requirements for certain welds at Indian Point Nuclear Generating Unit No. 2 (IP2). Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(z)(1), the licensee requested to use the proposed alternatives on the basis that the proposed alternatives provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Section 50.55a(g) of 10 CFR requires, in part, that ISI of certain ASME Code Class 1, 2, and 3 components must meet the requirements of the ASME Code and applicable addenda, except where alternatives have been authorized by the NRC pursuant to paragraphs (z)(1) or (z)(2) of 10 CFR 50.55a.

In proposing alternatives, a licensee must demonstrate that the alternatives provide an acceptable level of quality and safety in accordance with 10 CFR 50.55a(z)(1), or that compliance would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety in accordance with 10 CFR 50.55a(z)(2).

Paragraph (g)(1) of 10 CFR 50.55a states that for a boiling or pressurized water-cooled nuclear power facility whose construction permit was issued before January 1, 1971, components (including supports) must meet the requirements of paragraphs (g)(4) and (g)(5) of this section, to the extent practical.

Pursuant to 10 CFR 50.55a(g)(4), ISI of 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 ISI interval and subsequent intervals comply with the latest edition and addenda of Section XI of the ASME Code, which were 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 limitations and modifications listed therein.

Paragraph 10 CFR 50.55a(g)(5)(iii) states that if the licensee has determined that conformance with an ASME Code requirement is impractical for its facility, the licensee must notify the NRC and submit, as specified in 10 CFR 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 ASME 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 or subsequent 120-month inspection interval for which relief is sought.

Paragraph 10 CFR 50.55a(g)(5)(iv) requires that where an examination requirement by the ASME Code or addenda is determined to be impractical by a licensee, the basis for this determination must be demonstrated to the satisfaction of the Commission not later than 12 months after the expiration of the initial 120-month period of operation from the start of facility commercial operation and each subsequent 120-month period of operation during which the examination is determined to be impractical.

Paragraph 10 CFR 50.55a(g)(6)(i) states, in part, that the Commission will evaluate determinations under paragraph 10 CFR 50.55a(g)(5) 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, 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,[1] the NRC staff finds that regulatory authority exists for the licensee to request, and the Commission to authorize, the alternatives requested by the licensee.

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[1] As discussed in Section 3.0 of this safety evaluation, for ASME Code items that require examination of "accessible" regions and where a licensee's relief request states that impracticalities are based on documented limitations in accessibility, the NRC staff may determine that relief cannot be granted if there is no impracticality associated with examination of the accessible regions.

3.0 TECHNICAL EVALUATION

3.1 Licensee's RR-20, RR-21, and RR-22

Applicable Code Edition/Addenda

The Code of Record for the fourth 10-year ISI interval at IP2 was the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, as conditioned by 10 CFR 50.55a. The fourth 10-year ISI interval began on March 1, 2007, and ended on May 31, 2016.

Applicable Code Requirements

Vessel Components Covered by the Relief Requests

The following tables list the ASME Code, Section XI, Code Class 1, 2, and 3 vessel components that are addressed in RR-20, RR-21, and RR-22, respectively. The components are listed based on the nomenclature in Tables IWB-2500-1, IWC-2500-1, and IWD-2500-1, "Examination Categories," of the ASME Code, Section XI, for ASME Code Class 1, 2, and 3 components, respectively, and they include the plant-specific component identifications provided in the relief requests. The limited scope volumetric examinations for Class 1 and 2 vessel items were performed using ultrasonic testing (UT) method.

Table 1: IP2-RR-20 – Class 1, Table IWB-2500-1, Examination Category B-A, Pressure Retaining Welds in the Reactor Pressure Vessel (RPV), Item Nos. B1.11, B1.21, B1.22, and B1.40

ASME Code Item, Licensee Component Inner Diameter (ID)	**Description of Items with Limited Coverage**	**Examination Method, Reported Coverage %**	**Examination Limitations**
Item No. B1.11, Weld No. RPVC4	RPV Lower Shell-to-Head Circumferential Weld	UT, 79.5%	Scanning Obstruction
Item No. B1.21, Weld No. RVHC1	RPV Upper Head Circumferential Weld	UT, 0%	No Access for Scanning*
Item No. B1.21, Weld No. RPVC5	RPV Lower Head Circumferential Weld	UT, 69.97%	Scanning Obstruction*
Item No. B1.22, Weld No. RPVM2	RPV Lower Head Meridional Weld at 90 degrees (°)	UT, 72.56%	Scanning Obstruction*
Item No. B1.22, Weld No. RPVM4	RPV Lower Head Meridional Weld at 330°	UT, 81.92%	Scanning Obstruction*
Item No. B1.40, Weld No. RVHC2	RPV Upper Head-to-Flange Weld	UT, 85.7%	Weld Geometry

* Table IWB-2500-1, Item Nos. B1.21 and B1.22, require examination of the "accessible length" of all RPV circumferential and meridional head welds.

Table 2: IP2-RR-21 – Class 2, Table IWC-2500-1, Examination Category C-A, Pressure Retaining Welds in Pressure Vessels, Item Nos. C1.10, C1.20, and C5.21

ASME Code Item, Licensee Component ID	Description of Items with Limited Coverage	Examination Method, Reported Coverage %	Examination Limitations
Item No. C1.10, RHXC 22-1	Residual Heat Removal (RHR) HX Shell Circumferential Weld	UT, 66.5%	Scanning Obstruction
Item No. C1.20, RHXC 22-2	RHR HX Head Circumferential Weld	UT, 81%	Scanning Obstruction
Item No. C5.21, 56 170	Safety Injection Valve to Pipe Circumferential Weld	UT, 50%	Scanning Obstruction

Table 3: IP 2-RR-22 – Class 3, Table IWD-2500-1, Examination Category D-A, Welded Attachments for Pressure Vessels, Item No. D1.10

ASME Code Item, Licensee Component ID	Description of Items with Limited Coverage	Examination Method, Reported Coverage %	Examination Limitations
Item No. D1.10, NRHE-21-W	Non-Regenerative HX Welded Attachments	VT-1 Visual Exam, 0%	No Access for VT-1

Class 1 Piping Welds Background

By letters dated January 29, 2008, and March 19, 2004 (ADAMS Accession Nos. ML073190264 and ML040860006, respectively), the NRC-approved implementation of the IP2 risk-informed (RI) ISI program for the Class 1 piping welds (Examination Category B-F and B-J) in the fourth and third 10-year ISI intervals, respectively. The licensee developed the RI-ISI program in accordance with NRC-approved methodology of Electric Power Research Institute (EPRI) Topical Report (TR)-112657, Revision B-A, "Revised Risk-Informed Inservice Inspection Evaluation Procedure" (ADAMS Accession No. ML013470102).

Components Affected

ASME Code Class 1 piping welds are affected. The licensee stated that the ISI of piping welds listed in Tables 1 and 2 of RR-20 have been governed by the IP2 RI-ISI program. The licensee described the piping welds as follows:

- Weld Nos. 351 4 and 353 4 are pipe to valve welds of 10 inches in diameter and 1-inch in wall thickness in the safety injection system (SIS) piping. The two welds are classified as Examination Category R-A, Item No. R1.11 (elements subject to thermal fatigue), Risk Category 3 (medium consequence and high failure potential category), in accordance with EPRI TR-112657, Revision B-A (Table 1 and I-3.3.2 of ASME Code Case N-578-1, "Risk-Informed Requirements for Class 1, 2, or 3 Piping, Method B, Section XI").

The licensee stated that the above welds are stainless steel (SS), which join SS A-376 TP-316 pipes to SS A-351 Gr CF-8 valves and are subject to operating pressure of 2,235 pounds per square inch gauge (psig) and temperature of 555 degrees Fahrenheit (°F).

- Weld No. 351 2 is an elbow to sweep-o-let (boss/nozzle) weld of 10 inches in diameter and 1 inch in wall thickness (Figure 1 of Attachment 2 to letter dated November 1, 2017), and Weld No. 353 1 is a branch connection weld of 10 inches in diameter and 2.325 inches in wall thickness in the SIS piping. The welds are classified as Examination Category R-A, Item No. R1.16 (elements subject to thermal stratification, cycling, and striping and intergranular stress corrosion cracking), Risk Category 1 (high consequence and high failure potential category), in accordance with EPRI TR-112657, Revision B-A (Table 1 and I-3.3.2 of ASME Code Case N-578-1).

  The licensee stated that Weld No. 351 2 is an SS weld, which joins a 10-inch SS A-403 WP-316 elbow to an SS A-182 F-316 boss/nozzle, and Weld No. 353 1 is an SS weld, which joins a 10-inch SS A-182 F-316 boss/nozzle to a 32¼-inch SS A-376 TP-316 pipe. The above welds are subject to operating pressure of 2,235 psig and temperature of 555 °F.

- Weld Nos. RCC24-14, RCC22-14, RCC21-14, and RCC23·14 are elbow to safe-end welds with inner diameter (ID) of 27.5 inches and wall thickness of 2.5 inches on the reactor pressure vessel (RPV) inlet nozzles upstream of the dissimilar metal (DM) welds. The welds are classified as Examination Category R-A, Item No. R1.20 (elements not subject to damage mechanism), Risk Category 1 (high consequence and high failure potential category), in accordance with EPRI TR-112657, Revision B-A (Table 1 and I-3.3.2 of ASME Code Case N-578-1).

The licensee stated that the above four SS welds join the cast austenitic stainless steel (CASS) A351 Gr CF8M elbows to the SS TP-316 SA-182 safe-ends. The ID surface of the safe-end and pipe butt weld is clad with SS 304 (Figure 2 of Attachment 2 in letter dated November 1, 2017). The above welds are subject to operating pressure of 2,235 psig and temperature of 555 °F.

Code Requirements and NRC-Approved Code Cases

The ASME Code, Section XI, Table IWB-2500-1, Item Nos. B1.11 and B1.40, and Table IWC-2500-1, Item Nos. C1.10 and C1.20, require essentially 100 percent volumetric examination of the entire length of the Class 1 RPV and Class 2 residual heat removal (RHR) HX vessel welds using the specified examination volumes. Table IWB-2500-1, Item Nos. B1.21 and B1.22, require essentially 100 percent volumetric examination of the "accessible length" of all RPV circumferential and meridional head welds where significant access restrictions caused by numerous RPV head penetrations generally limit the amount of weld length that can be inspected using UT. Table IWD-2500-1, Item No. D1.10, requires VT-1 visual examination of essentially 100 percent of the required areas of each welded attachment for Class 3 pressure vessels. The licensee stated that it applied ASME Code Case N-460, which is unconditionally approved by the NRC staff for implementation in plant-specific ISI programs per Table 1 of Regulatory Guide 1.147, Revision 17, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1" (ADAMS Accession No. ML13339A689). Code Case N-460 specifies

that examination coverage of greater than 90 percent is considered acceptable for meeting the "essentially 100" percent ASME Code-required examination coverage.

The IP2 RI-ISI program that was developed by the licensee in accordance with the NRC-approved methodology in EPRI TR-112657, Revision B-A, and authorized by the NRC staff in a safety evaluation dated January 29, 2008 (ADAMS Accession No. ML073190264), provides an alternative to the ASME Code requirements. In both the ASME Code and the NRC's safety evaluation, the Class 1 pipe 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 from "100 percent" 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.

Licensee's Basis for Requesting Relief

The licensee determined that compliance with ASME Code requirements for achieving essentially 100 percent examination coverage of the items listed above is impractical, considering the limitations it experienced when attempting to comply with these examination requirements.

The licensee stated that IP2 systems and components were designed and fabricated before the ISI requirements of the ASME Code, Section XI, were published. The licensee identified that the construction permit for IP2 was issued on October 14, 1966, prior to the January 1, 1971 effective implementation date for ISI. Accordingly, the plant was not specifically designed to meet the 100 percent examination coverage requirements for ISI, and full compliance with ASME Code, Section XI, examination requirements are not practical within the limits of the plant design. Accordingly, the licensee determined that the 10 CFR 50.55a(g)(4) requirement for ISI in accordance with the language in the ASME Code, Section XI, "to the extent practical within the limitations of design, geometry and materials of construction of the components," is specifically applicable to IP2.

The licensee provided descriptions of component access restrictions and calculations of the limited examination coverages. In all cases, the limited coverage (or lack of coverage for certain exams) was due to physical obstructions and design configuration, which restricted access for performing inservice examinations using qualified UT or VT-1 visual examination methods. The licensee stated that major modifications to plant hardware would have to be made in order achieve greater than 90 percent examination coverage. The licensee reported that the limited scope examinations have been performed to the maximum extent possible, with no unacceptable indications.

The licensee reported that volumetric examination of welds was performed to the maximum extent practical using UT methods that satisfy the requirements of 10 CFR 50.55a(g)(6)(ii)(C), which require the implementation of applicable sections of Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," of the ASME Code for qualification of UT examination procedures, equipment, and personnel. The licensee identified that the limited examination coverages were credited based only on those areas that were examined using the qualified procedures.

For pipe welds in RR-20, the licensee stated that it was not possible to obtain greater than 90 percent of the ASME Code-required examination volume due to limitations imposed by component design, geometry, configuration, and materials of construction. These limitations are described in detail and shown in sketches in Attachment 1 to the relief request.

- For pipe to valve Weld Nos. 351 4 and 353 4, the outside diameter surface geometry of the valve limited the ultrasonic scan to only the pipe side of the weld.

- For elbow to sweep-o-let (boss/nozzle) Weld No. 351 2, the radius of the fitting on the sweep-o-let side of the weld allowed only partial scan of this side, while the opposite side of the weld was fully scanned since that side was accessible.

- For branch connection to pipe Weld No. 353 1, the geometry of the branch connection limited the scan to only the pipe side of the weld.

- For RPV inlet nozzle safe-end to elbow Weld Nos. RCC21-14, RCC22-14, RCC23-14, and RCC24-14, the elbow's material of construction limited scan of the elbow side of the weld (i.e., the limited coverage area includes any area that requires the sound to pass through the CASS material).

The licensee stated that the burden caused by compliance includes major modification of plant components, which includes redesign and replacement of the welds and associated components.

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested that NRC grant relief from the subject ASME Code examination requirements on the basis that achieving essentially 100 percent examination coverage is impractical for the above components due to physical obstructions and limitations imposed by design and geometry.

Licensee's Proposed Alternative and Basis for Use

In addition to limited scope volumetric exams for Class 1 and 2 components identified above, the licensee also reported that periodic system pressure tests and associated VT-2 visual examinations for pressure boundary leakage are performed in accordance with the ASME Code, Section XI, as follows:

- For Class 1 pressure-retaining components, Examination Category B-P requires VT-2 visual examination for leakage during system leakage tests each refueling outage.

- For Class 2 pressure-retaining components, Examination Category C-H requires VT-2 visual examination for leakage during system leakage tests every 3- to 4-year inspection period.

- For Class 3 pressure-retaining components, Examination Category D-B requires VT-2 visual examination for leakage during system leakage tests every 3- to 4-year inspection period.

In addition, for the Class 3 pressure-retaining components addressed in RR-22, the licensee stated that a VT-3 visual examination was also performed for the nonregenerative heat exchanger base support.

The licensee concluded that its limited scope volumetric examinations with no unacceptable indications, as well as the ASME Code-required system leakage tests and technical specification-required leakage monitoring systems, provide for an acceptable level of quality and safety and reasonable assurance of component structural integrity at IP2.
For the piping welds, the licensee stated in RR-20 that in the fourth 10-year ISI interval, it performed the UT to the maximum extent possible, utilizing personnel qualified and procedures demonstrated in accordance with Appendix VIII of Section XI of the ASME Code.

Weld Nos. 351 4 and 353 4:

The licensee stated that the UT performed on the above welds in the fourth 10-year ISI interval did not identify any unacceptable indications in the volume scanned.

Weld Nos. 351 2 and 353 1:

The licensee stated that the UT performed on the above welds in the fourth 10-year ISI interval did not identify any unacceptable indications in the volume scanned.

The licensee stated that during the third 10-year ISI interval, it performed both the UT and the penetrant testing on Weld No. 351 2 in 1997 and on Weld No. 353 1 in 2000. No unacceptable indications were identified in the volume scanned and the area inspected. Weld geometry was the cause of limited coverage, and a similar percent of coverage of the required examination volume was obtained in the third ISI interval.

Weld Nos. RCC21-14, RCC22-14, RCC23-14, and RCC24-14:

The licensee stated that the UT performed from the safe-end side of the above welds in the fourth 10-year ISI interval did not identify any unacceptable indications in the volume scanned. For single-sided access, the licensee extended the beam path into the far side of the weld centerline to examine, to the extent practical, the other side of weld as a "best effort" examination. Essentially 100 percent coverage was obtained of the CASS material, including the weld root area and the heat affected zone of the base materials. However, no credit was claimed for the "best effort" examination because a UT procedure must be qualified with flaws on the inaccessible side of the weld. Currently, there are no qualified single-side examination procedures, and the existing UT technology is not capable of reliably detecting or sizing flaws on the far side of an austenitic weld. No unacceptable indications were identified.

Furthermore, the eddy current testing was performed from the ID surface to supplement the UT in the fourth interval. No ID surface connected indications were detected in any of the above welds.

The licensee stated that in 2006, during the third 10-year ISI interval, the UT performed on the above welds did not identify any unacceptable indications in the volume scanned.

The licensee stated that during development of the IP2 RI-ISI program, the welds under consideration were screened and determined not susceptible to high cycle thermal fatigue due to their location to the reactor coolant system.

The licensee stated that fatigue analysis was performed for a limited number of piping locations as part of the development of the license renewal application. In Table A of Attachment 1 (letter dated November 1, 2017), the licensee provided the available cumulative usage factor for the subject Class 1 piping welds that had the examination coverage of less than or equal to 50 percent. The licensee noted that this cumulative usage factor is the most limiting value for the entire vessel cold leg nozzle, and it is not necessarily at the exact weld location.

The licensee stated that use of the radiographic testing is not practical due to component thickness and/or geometric configurations or the system being water filled. Other restrictions making radiography impractical are the physical barriers prohibiting access for placement of the source and film.

The licensee stated that the piping welds under consideration have been subjected to the ASME Code-required system leakage test and associated VT-2 visual examinations. No sign of through wall leakage has been identified in any of the welds.

For the piping welds in Table 2 of Attachment 1 of RR-20, the licensee reported the aggregate percent coverage achieved for each weld examined. This is summarized below.

Weld No. 351 4	50 percent
Weld No. 353 4	50 percent
Weld No. 351 2	70 percent
Weld No. 353 1	50 percent
Weld No. RCC21-14	42.89 percent
Weld No. RCC22-14	42.89 percent
Weld No. RCC23-14	42.89 percent
Weld No. RCC24-14	42.89 percent

The licensee proposed the above alternative coverage in lieu of the ASME Code-required essentially 100 percent coverage.

Duration of Proposed Alternative

The proposed alternative would apply to the fourth 10-year ISI interval at IP2, which was effective from March 1, 2007, through May 31, 2016.

3.2 NRC Staff Evaluation

In accordance with 10 CFR 50.55a(g)(6)(i), the NRC staff independently evaluated the licensee's determination under 10 CFR 50.55a(g)(5)(iii) that the ASME Code, Section XI volumetric and visual examination requirements are impractical for the subject ASME Code Class 1, 2, and 3 vessel components addressed in RR-20, RR-21, and RR-22 for IP2. The staff's technical review specifically addressed information provided in the relief requests regarding the following:

(a) Information describing specific access restrictions such as scanning obstructions, component geometry, or other configurational issues, which limited UT or visual examination coverages;

(b) Figures illustrating UT scan directions, beam angles, and calculation of the limited examination coverages; and

(c) Reporting of limited scope examination results (i.e., relevant indications or lack thereof).

The staff's technical evaluation for each of the subject components follows the ASME Code, Section XI, nomenclature (e.g., "Examination Category B-A, Item No. B1.11," etc.) for ASME Code Class 1, 2, and 3 components and includes the plant-specific component identifications provided in the relief request, consistent with Tables 1, 2, and 3 in Section 3.1 of this safety evaluation.

Limited Examination Coverages for Class 1, Examination Category B-A, Item Nos. B1.11 and B1.40, RPV Circumferential Shell and Head-to-Flange Welds (RR-20)

Item Nos. B1.11 and B1.40 require essentially 100 percent volumetric examination of the entire length of the RPV circumferential shell and head-to-flange welds using the examination volumes specified in Figures IWB-2500-1 and IWB-2500-5 of the ASME Code, respectively. The licensee reported limitations in the examination coverages for the RPV lower shell-to-head circumferential weld (IP2 Weld No. RPVC4) and the RPV upper head-to-flange circumferential weld (IP2 Weld No. RVHC2) of 79.5 percent and 85.7 percent of the ASME Code-required examination volumes, respectively.

The licensee described how the UT scans for the subject RPV welds were limited based on component design and/or plant configuration. The staff reviewed this information and verified that for the Item No. B1.40 RPV head-to-flange weld, the inherent geometry of the welded joint restricted coverage by the UT probe. The staff determined that the licensee's information and figures showing UT scan directions and beam angles adequately demonstrated how the sharp contour of the head-to-flange surface restricted access for scanning, thereby limiting the volumetric examination coverage to 85.7 percent of the ASME Code-required volume. For the Item No. B1.11 RPV lower shell-to-head circumferential weld, the staff verified that actual scanning obstructions caused by the six core support lugs restricted examination coverage by the UT probe. The staff determined that the licensee's information and figures showing UT scan directions and beam angles adequately demonstrated how these obstructing core support lugs restricted access for scanning, thereby limiting volumetric examination coverage to 79.5 percent of the ASME Code-required volume.

Per 10 CFR 50.55a(g)(1), the staff also verified that the IP2 RPV was not specifically designed to satisfy the ISI examination coverage requirements of the ASME Code, Section XI, because the ASME Code, Section III, design-basis edition for the IP2 RPV predates the earliest ASME Code, Section XI, requirements for ISI. Therefore, the staff determined that the ASME Code, Section XI, requirement for essentially 100 percent examination coverage (equivalent to greater than 90 percent per ASME Code Case N-460) is impractical for the subject RPV welds at IP2.

Limited Scope Examination Results

The licensee reported that no unacceptable indications were observed based on the limited scope UT exams of the subject RPV welds. The staff verified that there is no history of age-related degradation for these types of low alloy steel RPV welds. There are no known aging mechanisms that would result in the initiation of new flaws during plant service for these welds because these components are well below the design-basis cumulative fatigue usage limits, and they are not susceptible to any forms of stress corrosion cracking. Therefore, the

NRC staff determined that the limited examination coverages of 79.5 percent and 85.7 percent for the subject RPV welds with acceptable results provide reasonable assurance of structural integrity for the RPV and continued safe operation at IP2.

Examination of Accessible Length of Class 1, Examination Category B-A, Item Nos. B1.21 and B1.22, RPV Circumferential and Meridional Head Welds (RR-20)

Item Nos. B1.21 and B1.22 require essentially 100 percent volumetric examination of the "accessible length" of all RPV circumferential and meridional head welds using the examination volume specified in Figure IWB-2500-3 of the ASME Code. The staff reviewed the licensee's documented limitations in accessibility for performing the subject weld exams and determined that such access limitations are not a basis for relief from ASME Code requirements that specify coverage of accessible regions. Since there is not any demonstrated impracticality under 10 CFR 50.55a(g)(5)(iii) for covering accessible weld lengths required by the ASME Code, the NRC staff cannot grant relief under 10 CFR 50.55a(g)(6)(i) from the RPV circumferential and meridional head weld exams required by Item Nos. B1.21 and B1.22.

As described and demonstrated in Attachments 1 and 2 of the RR-20 license amendment request, the predominant limitations that prevented the licensee's UT from achieving essentially 100 percent coverage of the ASME Code-required volume were the valve geometry for Weld Nos. 351 4 and 353 4, the sweep-o-let and branch connection geometry for Weld Nos. 351 2 and 353 1, and the CASS elbow for Welds Nos. RCC21-14, RCC22-14, RCC23-14, and RCC24-14.

> For Weld Nos. 351 4 and 353 4, the licensee was able to scan the welds only from the pipe side (single-sided scan) due to the valve geometry that prevented scanning from the valve side. The NRC staff confirms that combination of valve geometry and materials of construction prevented the licensee from obtaining the required coverage.
>
> For Weld No. 351 2, the licensee was able to partially scan the weld from the sweep-o-let side due to the radius of the fitting, but the weld was fully scanned from the opposite side. The NRC staff confirms that achieving the required coverage was not possible due to the weld's particular design configuration.
>
> For Weld No. 353 1, the licensee performed the UT from one side of the welds (single-sided scan) due to branch connection geometry. The NRC staff confirms that the weld's particular design configuration prevented the licensee from scanning the weld from both sides.
>
> For Weld Nos. RCC21-14, RCC22-14, RCC23-14, and RCC24-14, the CASS elbow limited scanning from the elbow side of the weld (single-sided scan). The NRC staff confirms that combination of the materials of construction of elbow and its geometry were the reason for not achieving the required coverage.

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. From review of the submittal and sketches in Attachments 1 and 2 to the relief request, the NRC staff confirms that:

- The piping 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 limited access for scanning), geometry, and/or materials of construction;
- No unacceptable indications were identified.

Therefore, the NRC staff finds that a technical justification exists to support the determination that achieving essentially 100 percent coverage is impractical and 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. From a review of the submittal and sketches in Attachments 1 and 2 to the relief request, the NRC staff verified that:

- The licensee's UT has covered, to the extent possible, the regions (i.e., the weld root and the head affected zone of the base material near the ID surface of the joint) that are typically susceptible to higher stresses and, therefore, potential degradation.

- The cumulative fatigue usage factor provided by the licensee does not exceed the limit of Section III of the ASME Code. Therefore, this provides reasonable assurance that the potential for initiation of fatigue cracks is low.

- During the fourth 10-year ISI interval, several of the subject piping welds were inspected by surface examinations. No unacceptable surface connected indications were detected in any of the piping welds inspected.

- During the third 10-year ISI interval, several of the subject piping welds were inspected by volumetric or surface examinations, or both. No unacceptable indications were detected in any of the piping welds inspected.

Therefore, the NRC staff determined that based on the coverage achieved by the qualified UT, the examination of the weld root and its heat affected zone, to the extent possible, and bounding cumulative fatigue usage, 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 found that, in addition to the required volumetric examinations, these piping welds have received the required system leakage test according to Table IWB-2500-1, Examination Category B-P, during each refueling outage. Despite reduced coverage of the required examination volume, the NRC staff finds 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 corrective actions.

Therefore, the NRC staff finds that the volumetric examinations performed, to the extent possible, provide a reasonable assurance of structural integrity and leaktightness of the subject piping welds. Additionally, compliance with the ASME Code requirements for these pipe welds would be an unjustified burden on the licensee.

Limited Examination Coverages for Class 2, Examination Category C-A, Item Nos. C1.10 and C1.20, RHR HX Shell and Head Welds, and Item No. C5.21, Safety Injection Circumferential Pipe Weld (RR-21)

Item Nos. C1.10, C1.20, and C5.21 require essentially 100 percent volumetric examination for Class 2 pressure vessel welds using the examination volume specified in Figure IWC-2500-1 of the ASME Code. The licensee reported limitations in the examination coverages for the RHR HX shell circumferential weld (IP2 Weld No. RHXC 22-1), the RHR HX head circumferential weld (IP2 Weld No. RHXC 22-2), and the safety injection circumferential pipe weld (IP2 Weld No. 56 170) of 66.5 percent, 81 percent, and 50 percent of the ASME Code-required examination volume, respectively.

RHR HX Shell Circumferential Weld; RHXC 22-1

The RHR HX shell circumferential weld RHXC 22-1 is 108.4 inches long and attaches the HX shell to a flange. ASME Code coverage of the Code required volume (CRV) was credited for those areas that were ultrasonically examined in accordance with the procedure requirements. The ASME Code, Section XI, requirement is to examine essentially 100 percent of the weld. Due to the proximity of the HX flange-to-weld RHXC 22-1, the weld could not be scanned from the flange side. This physical limitation resulted in approximately 66.5 percent coverage, which is less than the required coverage of the CRV. Weld RHXC 22-1 was inspected using 45 degree (°) shear and 70° longitudinal wave transducers, 0 percent axial coverage from the flange side, and 66 percent axial coverage on the shell side (due to inlet/outlet nozzles) was obtained, and 100 percent circumferential coverage was obtained on both sides. The weld is further limited by the inlet and outlet nozzle reinforcing pads. The total coverage for the entire weld was calculated as 66.5 percent.

RHR HX Head Circumferential Weld; RHXC 22-2

The RHR HX head circumferential weld RHXC 22-2 is 108.3 inches long. ASME Code coverage of the CRV was credited for those areas that were ultrasonically examined in accordance with the procedure requirements. The ASME Code, Section XI, requirement is to examine essentially 100 percent of the weld. The examination was limited in one direction on the HX shell side by the integrally welded component supports. The total length of the limitation is 63.3 inches (31'.5 inches on one side and 31.8 inches on the other side). Due to the integrally welded supports, which are used to support the RHR HX, the head-to-shell weld could not be scanned from the supports side. This physical limitation resulted in approximately 81 percent coverage, which is less than the required coverage of the CRV.

Safety Injection Circumferential Pipe Weld; 56 170

Weld 56 170 was ultrasonically examined using 45°, 60°, and 70° shear wave transducers, with 100 percent axial and circumferential coverage obtained from the pipe side of the weld. The weld is a valve-to-pipe weld, and it is not possible to perform the ultrasonic examination from both sides of the weld, since one side of the weld was not suitable for scanning due to the outer diameter surface geometry of the valve. Therefore, the weld only received a single-sided

examination resulting in less than 90 percent coverage of the required examination volume. This physical limitation resulted in approximately 50 percent coverage, which is less than the required coverage of the CRV. The required surface exam was determined to be not needed by evaluation per Code Case N-663.

The licensee described how the UT scans for the subject RHR HX welds were limited based on component design and/or plant configuration. The staff reviewed this information and verified that the proximity of the RHR HX flange to the HX shell circumferential weld prevented access for performing an axial scan from the flange side of the weld. Also, the presence of the HX inlet and outlet nozzles resulted in an axial scanning obstruction that limited the axial coverage from the shell side of the weld. The staff determined that the licensee's information and figures showing the UT scan directions adequately demonstrated how these physical obstructions restricted access for scanning, thereby limiting the volumetric examination coverage to 66.5 percent of the ASME Code-required volume. For the RHR HX head weld, the staff verified that actual scanning obstructions caused by the integrally welded supports restricted examination coverage from the support side of this weld. The staff determined that the licensee's information and figures showing UT scan directions adequately demonstrated how the obstructing welded supports restricted access for scanning, thereby limiting volumetric examination coverage to 81 percent of the ASME Code-required volume.

The staff also verified that the IP2 RHR components were not specifically designed to satisfy the ISI examination coverage requirements of the ASME Code, Section XI, because the design requirements for the IP2 RHR system predate the earliest ASME Code, Section XI, requirements for ISI. Therefore, the staff determined that the ASME Code, Section XI, requirement for essentially 100 percent examination coverage (equivalent to greater than 90 percent per ASME Code Case N-460) is impractical for the subject RHR HX and safety injection circumferential pipe welds at IP2.

Limited Scope Examination Results

The licensee reported that no unacceptable indications were observed based on the limited scope UT exams of the subject RHR HX and safety injection circumferential pipe welds. Therefore, the NRC staff determined that the limited examination coverages of 66.5 percent, 81 percent, and 50 percent for the subject RHR HX and safety injection circumferential pipe welds with acceptable results provide reasonable assurance of structural integrity for the RHR HX and safety injection circumferential pipe and continued safe operation at IP2.

Visual Examinations for Class 3, Examination Category D-A, Non-Regenerative HX Welded Attachments (RR-22)

Item No. D1.10 requires a VT-1 visual examination of 100 percent of welded attachment areas specified in Figure IWD-2500-1 of the ASME Code for Class 3 pressure vessels.

Licensee Determination of Impracticality for VT-1 Visual Exams

The licensee identified that the welded attachments of the base support to the nonregenerative HX vessel are covered with asbestos insulation and cannot be accessed for VT-1 visual examination without removal of the insulation. The licensee also stated that these base support welded attachments are located in a high dose area, and attempting to remove the insulation to gain access for performing the VT-1 exams is impractical based on an estimated personnel

exposure of 2.6 roentgen equivalent man (rem). The licensee reported that attempts were made to perform visual exams with the insulation in place, but the interference from the insulation prevented the performance of VT-1 exams of the welded attachments. However, the licensee indicated that it was able to perform VT-2 visual examination for leakage during the system leakage test and VT-3 visual examination of the base support. The licensee identified no unacceptable conditions based on these exams.

Staff Evaluation of Impracticalities and Alternative Visual Exams

The staff reviewed the licensee's reported access restrictions and determined that removal of the insulation for gaining access to achieve the higher-resolution VT-1 exams is impractical and not warranted based on the high personnel radiation exposure that would result. The staff noted that the licensee's alternative visual examinations consisted of VT-2 exams for pressure boundary leakage per Examination Category D-B during system leakage tests every three to four 4-year inspection period and VT-3 exams of the base support for general mechanical and structural condition. These exams have identified no unacceptable conditions. The staff determined that VT-2 examination for leakage is sufficient for ensuring pressure-retaining integrity for these Class 3 cooling water vessels, and any leakage detected by VT-2 would adequately indicate the presence of through-wall flaws requiring corrective action. Therefore, the staff determined that the licensee's alternative visual exams provide reasonable assurance of structural integrity and functionality for the nonregenerative HX vessel.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the proposed alternatives provide an acceptable level of quality and safety. The NRC staff has determined that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest, given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The NRC staff finds that the licensee has adequately addressed the regulatory requirements in 10 CFR 50.55a(g)(5)(iii) for the specific components discussed in the technical evaluation above. Therefore, with the exception of the Item No. B1.21 and B1.22 RPV head welds discussed above, the NRC grants relief from the full-scope volumetric examination requirements of the ASME Code, Section XI, for the Class 1, 2, and 3 components addressed in RR-20, RR-21, and RR-22 for the fourth 10-year ISI interval at IP2, which began on March 1, 2007, and concluded on May 31, 2016.

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

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Date: January 23, 2018

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 2 – SAFETY EVALUATION REGARDING RELIEF REQUESTS IP2-ISI-RR-20, IP2-ISI-RR-21, AND IP2-ISI-RR-22 REGARDING THE FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM (EPID L-2017-LLR-0052, L-2017-LLR-0050, AND L-2017-LLR-0051) DATED JANUARY 23, 2018

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