September 18, 2007

Mr. Michael A. Balduzzi
Sr. Vice President & COO
Regional Operations, NE
Entergy Nuclear Operations, Inc.
440 Hamilton Avenue
White Plains, NY 10601

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 2 - RELIEF REQUEST NO. RR-02 (TAC NO. MD4696)

Dear Mr. Balduzzi:

By letter dated February 28, 2007, as supplemented July 19, 2007, Entergy Nuclear Operations, Inc. (the licensee), submitted a relief request for the Fourth 10-Year Inservice Inspection Interval. The request proposed an alternative to the examination requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI for the regenerative heat exchanger welds at Indian Point Unit No. 2.

Inservice inspection of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Also, 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (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 the enclosed safety evaluation, the NRC staff concludes that the proposed request is acceptable and approves the request to implement the alternative examination requirements for all regenerative heat exchanger welds that are within the scope of relief request RR-02.

If you have any questions regarding this approval, please contact the Indian Point Project Manager, John Boska, at (301) 415-2901.

Sincerely,

/RA/

Mark G. Kowal, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-247

Enclosure:
Safety Evaluation

cc w/encl: See next page

If you have any questions regarding this approval, please contact the Indian Point Project Manager, John Boska, at (301) 415-2901.

Sincerely,

/RA/

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cc w/encl: See next page

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ADAMS ACCESSION NUMBER: ML072410267 *See memo dated August 21, 2007

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Indian Point Nuclear Generating Unit No. 2

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF NO. RR-02

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

DOCKET NO. 50-247

1.0 INTRODUCTION

By letter dated February 28, 2007, Agencywide Documents Access and Management System (ADAMS) Accession No. ML070640101, as supplemented by letter dated July 19, 2007, ADAMS Accession No. ML072080472, Entergy Nuclear Operations, Inc. (the licensee), submitted the Indian Point Nuclear Generating Unit No. 2 (IP2) Fourth 10-year Interval Inservice Inspection (ISI) Program Plan. The application proposed relief request RR-02, alternatives to selected American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI requirements that relate to examination of the regenerative heat exchanger welds at Indian Point Unit No. 2.

2.0 REGULATORY REQUIREMENTS

ISI of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(g), except where specific relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Also, 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (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.

Pursuant to 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 pre-service examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulation requires 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 incorporated by reference in 10 CFR 50.55a(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of record for the fourth 10-year interval ISI program at IP2 is the 2001 Edition through the 2003 Addenda. The

fourth 10-year interval ISI program at Indian Point 2 began on March 1, 2007, and ends on April 3, 2016.

3.0 EVALUATION

RR-02

Component Identification

Request RR-02 proposed alternative examination requirements for the following pressure-retaining and nozzle-to-vessel welds in the Regenerative Heat Exchanger (RHX) at Indian Point 2 (RHX 21):

RHX 21			
Welds Nos.	Description	ASME Code Category/Item	ASME Code Class
RGX C-1-1	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-1-4	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-2-1	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-2-4	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-3-1	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-3-4	RHX Tubesheet-to-Head Weld	B-B/B2.60	1
RGX C-1-2	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX C-1-3	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX C-2-2	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX C-2-3	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX C-3-2	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX C-3-3	RHX Tubesheet-to-Shell Weld	B-B/B2.80	1
RGX –1-1	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –1-2	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –1-3	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –1-4	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –2-1	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –2-2	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1

RGX –2-3	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –2-4	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –3-1	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –3-2	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –3-3	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1
RGX –3-4	RHX Nozzle-to-Vessel Weld	B-D/B3.150	1

ASME Code, Section XI Requirements

The 2001 Edition through the 2003 Addenda of the ASME Code, Section XI, Table IWB-2500-1, Examination Categories B-B and B-D require volumetric examinations for all welds listed above. The required examination volume is specified in Figure IWB-2500-6 for Item Nos. B2.60 and B2.80, and Figure IWB–2500-7 for Item No. B3.150. Volumetric examinations shall include essentially 100% of the weld length.

Licensee's Proposed Alternative and Basis for Use (as stated)

> It is proposed that the provisions of Code Case N-706, Rev. 0 be used as an alternative to performing the [ASME] Code required examination. Specifically, a VT-2 examination will be performed in lieu of the volumetric or surface examinations.
>
> The subject welds are [listed] in [the table provided on the previous page]. [RHX 21] provides preheat for the normal charging water flowing into the reactor coolant system (RCS). Preheat is derived from normal letdown water coming from the RCS. [RHX 21] is actually three heat exchangers or sub-vessels of similar design and function. Each heat exchanger has an outside shell diameter of 9.25 inches. The shells were manufactured with austenitic stainless steel material. The nozzles are 3-inch schedule 160 of similar material. [***]
>
> On October 11, 2005, the ASME Boiler and Pressure Vessel Standards Committee approved Code Case N-706, "Alternative Examination Requirements of Table IWB-2500-1 and Table IWC-2500-1 for PWR [Pressurized-Water Reactor] Stainless Steel Residual and Regenerative Heat Exchanger, Section XI, Division 1." Westinghouse provided the technical justification for the Code Case for eliminating the surface and volumetric inspections of the Residual [Heat Exchangers (RHR)] and Regenerative Heat Exchangers [(RHX)] under the Westinghouse Owner's Group (WOG) project, "Technical Basis for Revision of Inspection Requirements for Regenerative and Residual Heat Exchangers," August, 2004. The components at Indian Point 2 are typical of the heat exchangers described in the Westinghouse report by fabrication, geometric design, inspection requirements and geometric restrictions.

As stated in the Westinghouse report, these components were designed and installed before the imposition of the [ISI] requirements by ASME Section XI and are not designed for conducive performance of ultrasonic and surface examination. The small diameter of the vessel and nozzles of the [RHX] makes a meaningful ultrasonic examination very time consuming and dose intensive. The physical limitations would substantially diminish the ability to discriminate flaw indications from geometry existing around the joint.

Furthermore, these components are located in high radiation fields. The estimated personnel dose to perform interval [ASME] Code inspections on [RHX 21] is 9.655 man-rem. In view of the dose expended for limited examination providing questionable results, the value of performing the [ASME] Code required exams is minimal.

Two other factors presented in the Westinghouse report for these components were considered by the ASME committee: flaw tolerance and risk assessment. Fracture evaluations were performed for the components using finite element models and fracture calculations. It was concluded that the [RHXs] have a large flaw tolerance and that significant leakage would be expected long before any failure occurred. Fatigue crack growth was determined to be extremely slow even in the most highly stressed region. Thus, detailed inspections are not required to ensure heat exchanger integrity.

A risk evaluation was performed using the accepted methodology applied for Risk Informed ISI piping inspection programs. The following conclusions were made:

- Safety equipment required to respond to the potential event is unaffected.
- Potential for loss of pressure boundary integrity is negligible.
- No safety analysis margins are changed.
- Leakage before full break is expected (no core damage consequences associated with leakage).

Consequently, elimination of the subject inspections would not be expected to result in a significant increase in risk.

The pressure retaining welds in [RHX 21] had received at least one volumetric pre-service examination, as required in note 2 of table 1 in ASME Code Case N-706.

There have been no through-wall leaks in these components or components of similar design as reported in industry and as discussed in the Westinghouse report. The only related leak in the United States occurred in January 2004 at San Onofre Unit 3 on the letdown line exiting the [RHX]. This failure was caused by excessive vibration on the piping line and is not an indication of failure on the actual heat exchanger.

Therefore, Entergy believes the proposed alternative would provide an acceptable level of quality and safety.

Staff Evaluation

The 2001 Edition through the 2003 Addenda of the ASME Code, Section XI, Article IWB-2500 requires that components be examined and tested as specified in Table IWB-2500-1 of ASME Code, Section XI. Table IWB-2500-1, Examination Category B-B requires a volumetric examination of all pressure-retaining welds in the RHX, with essentially 100% volumetric coverage of the examination volume specified in Figures IWB-2500-2 and IWB-2500-6 of the ASME Code, Section XI for the entire length of the weld. Table IWB-2500-1, Examination Category B-D requires a volumetric examination of all nozzle-to-vessel welds in the RHX, with essentially 100% volumetric coverage of the examination volume specified in Figure IWB-2500-7 of the ASME Code, Section XI, for the entire length of the weld.

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested authorization to use the alternative provisions of ASME Code Case N-706, Rev. 0, "Alternative Examination Requirements of Table IWB-2500-1 and Table IWC-2500-1 for PWR Stainless Steel Residual and Regenerative Heat Exchangers, Section XI, Division 1," in lieu of the ASME Code, Section XI volumetric examination requirements of Table IWB-2500-1, Examination Categories B-B and B-D, for the subject welds in RHX 21 at Indian Point 2. ASME Code Case N-706 would allow for the pressure-retaining welds in RHX 21 to receive a VT-2 visual examination while undergoing the system leakage test, as required by Examination Category B-P, to be performed every refueling outage, in lieu of volumetric examinations required by Examination Categories B-B and B-D. These alternative provisions are listed in Table 1 of the code case for each of the examination categories that may be considered for application of the code case provisions.

ASME Code Case N-706 states that the alternative provisions of the code case may not be applied to any heat exchanger, nor to any heat exchanger design or configuration, that has experienced a through-wall leak, such as heat exchangers with an inner shell. The code case specifies that the plant owner shall evaluate industry experience to determine which heat exchanger designs or configurations have leaked. If any leakage is detected, the code case specifies that its use shall be discontinued for that heat exchanger design or configuration, and the affected heat exchanger, as well as all others of the same design or configuration, shall be examined in accordance with the requirements of ASME Code, Section XI, Table IWB-2500-1 or Table IWC-2500-1, as applicable. In addition, Table 1 of the code case includes several notes. Note (1) states that the application of the provisions of the table is limited to those welds that are part of the as-received heat exchanger assembly. The RHX assembly may be formed from multiple smaller heat exchanger subcomponents connected by sections of piping. All of the smaller heat exchanger subcomponents and the connecting piping are within the boundary of the heat exchanger assembly. The licensee stated, in Section E of RR-02, that RHX 21 is actually three heat exchangers or sub-vessels of similar design and function. Therefore, application of the code case provisions to RHX 21 must account for all smaller heat exchanger subcomponents and connecting piping; the provision of Examination Category B-B, which states that the volumetric examination may be limited to only one vessel among the group of vessels performing a similar function, is no longer applicable in the context of the alternative provisions of the code case. Note (2) of Table 1 of the code case states that all welds shall have previously received at least one volumetric examination, and the preservice or construction code volumetric examination may be used to meet this requirement.

ASME Code Case N-706 has been approved by the ASME Boiler and Pressure Vessel Standards Committee. The technical justification for the elimination of the volumetric

examinations required by the ASME Code, Section XI, Table IWB-2500-1 for RHXs was provided under the Westinghouse Owner's Group (WOG) project, "Technical Basis for Revision of Inspection Requirements for Regenerative and Residual Heat Exchangers," August 2004. RHX 21 at Indian Point 2 is typical of the heat exchangers described in the WOG report. The WOG report noted that the RHXs were designed and installed before the ISI requirements of the ASME Code, Section XI, were required to be implemented by industry. As a result, the design of the RHXs does not accommodate the successful performance of meaningful ultrasonic testing (UT) examinations. The examinations are very time consuming and result in high dose rates to the personnel and technicians preparing and performing the examinations since these components are located in high radiation fields. The licensee estimated that a dose of 9.655 man-rem would be expended to meet the ASME Code, Section XI, examination requirements for the RHX. Therefore, in consideration of the limited examinations providing questionable results and dose expended, the value of performing the ASME Code-required examinations is minimal. The WOG report concluded that elimination of the subject inspections would not be expected to result in a significant increase in risk.

In anticipation of proposed ASME Code Case N-706, the NRC staff previously contracted Pacific Northwest National Laboratory (PNNL) to perform a study regarding the issues of inspection and the value of continued volumetric and/or surface examinations of pressure-retaining shell welds from the exterior surface of the RHX and RHR heat exchangers. In the study, PNNL concluded that the WOG evaluations agree with the PNNL risk evaluation to the extent that both predict relatively small contributions to risk (Core Damage Frequency of 2.38×10^{-10} or less). The PNNL study further concluded that, with respect to the RHX, the failure probability for the RHX shell is low; however, some nozzle locations may be sensitive to thermal fatigue and a higher failure potential would be expected. The consequence of failure for the RHX is moderate (conditional core damage probability between 1×10^{-6} and 1×10^{-4}). Ordinarily the resulting risk categorizations would suggest that some selected RHX nozzles be considered for inspection. However, the radiation burden associated with the nozzles is very high. The thermal fatigue loading was accounted for in the design of the RHX nozzles, and plant operators monitor the number of occurrences of letdown and charging design thermal transients. In addition, the number and magnitude of the actual thermal transient events seen by these nozzles is less than the conservative values assumed in the design analysis. In this light, the challenges to component integrity and inspection benefits (reductions in failure probability and risk) do not appear to offset the high radiation burden associated with performing volumetric examinations of these components.

Based on the PNNL study, the NRC staff previously determined that the technical basis for implementation of the provisions of ASME Code Case N-706 is acceptable, provided that RHX components meet all provisions specified in the code case. As discussed previously, these provisions specify that only those RHX designs with no leakage history are eligible for the alternative examination requirements of the code case. Additionally, Notes (1) and (2) from Table 1 of the code case specify, respectively, the required examination boundary of an RHX assembly (as RHX 21 is so defined in RR-02) and the requirement that all welds shall have previously received at least one volumetric examination, preservice or otherwise. In order to authorize the implementation of the code case at Indian Point 2, the NRC staff required additional information from the licensee regarding the applicability of all code case provisions to RHX 21 at Indian Point 2. In request for additional information Question 1 (RAI 1), the NRC staff noted that Section E of RR-02 states that a leak occurred in January 2004 at San Onofre Nuclear Generating Station, Unit 3 (SONGS 3) in the letdown line exiting the RHX. Therefore,

the NRC staff requested that the licensee indicate whether the design or configuration of the RHX at SONGS 3 corresponds to that of RHX 21 at Indian Point 2. If the design or configuration of the RHX at SONGS 3 does correspond to the design or configuration of RHX 21 at Indian Point 2, the staff requested that the licensee provide additional detail regarding how the leak that occurred in the SONGS 3 RHX letdown line was determined to be outside the scope of Code Case N-706, taking into consideration the provisions of Note (1) under Table 1 of the code case and the definition of RHX 21 at Indian Point 2 as an RHX assembly, which includes all of the smaller heat exchanger subcomponents and the connecting piping. In its response to RAI 1, the licensee stated that RHX 21 at Indian Point 2 was designed and manufactured by Atlas Industrial Manufacturing Corp. and is oriented horizontally, whereas the SONGS 3 RHX is a Whitlock design, with a vertical orientation. The licensee further stated that the SONGS 3 RHX leak was caused by excessive vibrations in the letdown line exiting the SONGS 3 RHX. The excessive vibrations in the letdown line were caused by the operation of positive displacement charging pumps with inadequate discharge pressure pulsation dampeners. Indian Point 2 has installed suction stabilizers and discharge pulsation dampeners on each of its charging pumps to reduce vibration-induced fatigue on any associated piping. The staff determined that the licensee's response resolved RAI 1 because the response adequately demonstrated that the design and configuration of RHX 21 does not correspond to the design and configuration of the RHX at SONGS 3, with respect to the leakage that was detected in the letdown line exiting the SONGS 3 RHX.

In RAI 2, the NRC staff requested that the licensee verify that all welds in RHX 21 that are within the scope of the RR-02 had previously received a volumetric examination, as specified in Note (2) from Table 1 of ASME Code Case N-706. Furthermore, the staff requested that the licensee indicate whether these examinations included only the preservice examinations required by Subarticle IWB-2200 or additional successive inspections during previous ISI intervals required by Subarticle IWB-2400 and whether any relevant conditions were found during these examinations. In its response to RAI 2, the licensee indicated that a preservice volumetric examination was performed on all welds that are within the scope of RR-02. Additional successive volumetric and surface examinations were performed on these welds during the second and third ISI intervals in accordance with Subarticle IWB-2400 and previously approved relief requests for these ISI intervals. For both the preservice examinations and the successive ISI program examinations, no relevant indications were identified. The NRC staff determined that the licensee's response resolved RAI 2 because the licensee adequately demonstrated that the provision of Note (2) from Table 1 of ASME Code Case N-706 has been satisfied for all the welds that are within the scope of RR-02.

In RAI 3, the NRC staff requested that the licensee discuss the programs that are currently in place for RCS leakage monitoring in the vicinity of RHX 21. In its response to RAI 3, the licensee stated that unidentified leakage is monitored in accordance with the Indian Point 2 Technical Specifications (TS). Additionally, the containment atmosphere particulate radioactivity is monitored in accordance with TS. The NRC staff determined that this response resolved RAI 3 because any RCS leakage from RHX 21 during normal operation would be detected by monitoring unidentified leakage and containment atmosphere particulate radioactivity in accordance with TS requirements. The applicant further stated that all RHX 21 components will receive the alternative VT-2 examination during the system leakage test as required by the provisions of ASME Code Case N-706. The corresponding piping and component supports will continue to be inspected in accordance with the normal ASME Code, Section XI requirements, as they were not included within the scope of the RR-02.

Based on the above discussion, the NRC staff determined that the licensee will meet all provisions specified in ASME Code Case N-706 for all RHX 21 welds that are within the scope of RR-02. Therefore, the NRC staff found that the licensee has adequately demonstrated that the proposed alternative in RR-02 will provide an acceptable level of quality and safety for RHX 21 at Indian Point 2.

4.0 CONCLUSION

The NRC staff concludes that the licensee's request to implement the alternative examination requirements of ASME Code Case N-706 in lieu of the requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Categories B-B and B-D, pertaining to the specified RHX 21 welds will provide an acceptable level of quality and safety at Indian Point 2. Therefore, the licensee's proposed alternative in RR-02 is authorized pursuant to 10 CFR 50.55a(a)(3)(i) for the fourth 10-year ISI interval at Indian Point 2. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Christopher R. Sydnor

Date: September 18, 2007