



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

March 1, 2010

RA-10-024  
3/2/10

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 - RELIEF FROM THE  
EXAMINATION AREA FOR REACTOR VESSEL HEAD PENETRATION  
NOZZLES (TAC NO. ME1658)

Dear Sir or Madam:

By letter dated July 1, 2009, as supplemented by letters dated September 24, 2009, and December 22, 2009, Entergy Nuclear Operations, Inc. (the licensee) submitted a request to the Nuclear Regulatory Commission (NRC) for relief from the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(6)(ii)(D)(3). The relief request pertains to volumetric and surface examinations of reactor vessel (RV) upper head penetration nozzles at Indian Point Nuclear Generating Unit No. 2 (IP2). The relief is requested for the remainder of the fourth 10-year inservice inspection (ISI) interval, which began on March 1, 2007, and is scheduled to end on April 3, 2016.


Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. The proposed alternative is an examination of the J-groove weld area with a reduction in the minimum volumetric inspection distance in the non-pressure boundary section of each nozzle due to a threaded section at the end of each nozzle.

Although the licensee requested relief pursuant to 10 CFR 50.55a(a)(3)(i), the NRC authorizes this alternative pursuant to 10 CFR 50.55a(a)(3)(ii), for the remainder of the fourth 10-year ISI interval or until the RV head is replaced for IP2. The NRC staff reviewed the request and concludes, as set forth in the enclosed safety evaluation, that the proposed examination provides reasonable assurance of structural integrity of the RV upper head and implementation of additional requirements would result in hardship without a compensating increase in the level of quality and safety.

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If you have any questions, please contact the Indian Point project manager, John Boska, at (301) 415-2901.

Sincerely,

A handwritten signature in black ink, reading "Nancy L. Salgado". The signature is written in a cursive style with a large, stylized 'N' and 'S'.

Nancy L. Salgado, Chief  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-247

Enclosure:  
As stated

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UNITED STATES  
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. RR-09

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 2

DOCKET NO. 50-247

1.0 INTRODUCTION

By letter dated July 1, 2009, (Reference 1), as supplemented by letters dated September 24, 2009, (Reference 2), and December 22, 2009, (Reference 3), Entergy Nuclear Operations, Inc. (the licensee) submitted Relief Request (RR)-09 for Nuclear Regulatory Commission (NRC) review and approval. The licensee requested to implement an alternative to the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(6)(ii)(D)(3). The request pertains to the volumetric and/or surface examinations of reactor vessel (RV) upper head nozzles, most of which are used to house control rod drive mechanisms (CRDMs), of the pressurized water reactor (PWR) at Indian Point Nuclear Generating Unit No. 2 (IP2). The duration of RR-09 is for the remainder of the fourth 10-year inservice inspection (ISI) interval which began on March 1, 2007, and is scheduled to end on April 3, 2016.

Previously, the licensee submitted a relaxation request by letter NL-05-136 dated December 14, 2005, (Reference 4) requesting to use an alternative to a similar requirement of the First Revised NRC Order EA-03-009 dated February 20, 2004, (Order) (Reference 5). The NRC authorized this relaxation from the requirements of the Order by letter dated February 27, 2006, (Reference 6). Subsequently, the requirements for the ISI of RV upper head penetration nozzles was changed from the Order to 10 CFR 50.55a(g)(6)(ii)(D) by the NRC (73 FR 52742, dated September 10, 2008). The licensee, by submitting the current RR-09, has requested to use the alternative examination technique previously authorized by the NRC for ISI of the IP2 RV upper head penetration nozzles (NRC letter dated February 27, 2006, (Reference 6)) used under the similar requirements of the Order. The request for authorization of the alternative was made pursuant to the provisions of 10 CFR 50.55a(a)(3)(i).

2.0 REGULATORY REQUIREMENTS

The ISI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Class 1, 2 and 3 components is to be performed in accordance with the requirements of Section XI, "Rules for In service Inspection of Nuclear Power Plant

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Components," of the ASME Code and applicable editions and addenda as required by 10 CFR 50.55a(g), except where specific written relief has been granted by the Commission.

Pursuant to 10 CFR 50.55a(g)(4), throughout the service life of a PWR, components which are classified as ASME Code Class 1, 2, and 3 must meet the requirements, except design and access provisions and pre-service 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. Further, the regulations under 10 CFR 50.55a(g)(4)(i) require that the ISI of components and system pressure tests conducted during the first 10-year ISI interval and subsequent intervals shall comply with the requirements in the latest edition and addenda of the ASME Code, Section XI, incorporated by reference in paragraph (b) of 10 CFR 50.55a on the date 12 months prior to the start of the 120-month ISI interval, (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147, Revision 15, that are incorporated by reference in 10 CFR 50.55a(b)), subject to the limitations and modifications listed therein. The ASME Code of record for IP2 for the fourth 10-year ISI interval, which began on March 1, 2007, and is scheduled to end on April 3, 2016, is the 2001 Edition through the 2003 Addenda.

In addition, 10 CFR 50.55a(g)(6)(ii) states that the Commission may require the licensee to follow an augmented ISI program for systems and components for which the Commission deems that added assurance of structural reliability is necessary. Further, the regulatory requirements in 10 CFR 50.55a(g)(6)(ii)(D) define the requirements for reactor vessel head inspections.

Pursuant to 10 CFR 50.55a(a)(3), proposed alternatives to the requirements of paragraph (g) may be used when authorized by the Commission 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. The licensee submitted RR-09 in accordance with 10 CFR 50.55a(a)(3)(i) and requested relief from the inspection requirements of 10 CFR 50.55a(g)(6)(ii)(D)(3).

### 3.0 TECHNICAL EVALUATION

#### 3.1 Applicable Code Edition and Addenda

The 2001 Edition through 2003 Addenda to the ASME Code, Section XI, is the code of record for the fourth 10-year ISI program at IP2. The fourth 10-year ISI interval began on March 1, 2007, and is scheduled to end on April 3, 2016.

#### 3.2 Components for Which Relief is Requested

Component:	97 RV Upper Head CRDM Nozzles Having Pressure Retaining Partial Penetration Welds
Code Class:	Class 1
Examination Category:	PWR RV Upper Head in Table 1 of ASME Code Case N-729-1
Code Item No.:	B4.20 in Table 1 of ASME Code Case N-729-1

The susceptibility of nickel based alloys to the primary water stress-corrosion cracking (PWSCC) in PWR plants is a safety concern. The susceptible materials in the RV upper head penetration nozzles include Alloy 600 base material and Alloy 182/82 weldments.

### 3.3 Applicable Code Requirements

The regulatory requirements in 10 CFR 50.55a(g)(6)(ii)(D) define the requirements for RV head inspections. All licensees of existing operating PWR plants shall augment their ISI program with ASME Code Case N-729-1 subject to the conditions specified in paragraphs (g)(6)(ii)(D)(2) through (6) of this section by December 31, 2008. Once a licensee implements this requirement, the First Revised NRC Order EA 03 009 no longer applies to that licensee and shall be deemed to be withdrawn.

10 CFR 50.55a(g)(6)(ii)(D)(3) requires, in part, that the licensee perform a volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the nozzle tube, as identified by Figure 2 of ASME Code Case N-729-1. Figure 2 identifies the required volume of tube to be inspected, a distance "a" above the highest point of the root of the J-groove weld to a distance "a" below the lowest point of the toe of the J-groove weld. Distance "a" is equal to 1.5 inches for incidence angle less than or equal to 30° to the horizontal plane, or 1.0 inch for incidence angle greater than 30° to the horizontal plane.

### 3.4 Proposed Alternative

The licensee stated that the volume of base material of each nozzle tube and the associated weld is scanned by ultrasonic testing (UT) from the tube inside diameter (ID) surface from the applicable point above the root of the J-groove weld (per ASME Code Case N-729-1, 1.5 inches for nozzles with an incidence angle less than or equal to 30°, and 1.0 inch for nozzles with an incidence angle greater than 30° on a horizontal plane perpendicular to the nozzle axis) to at least the top of the threaded region. The dimensional configuration at some nozzles is such that the inspectable distance from the lowest point of the toe of the J-groove weld to the top of the threaded region is less than the lower boundary limit defined in Figure 2 of ASME Code Case N-729-1. The licensee stated that the inspection coverage will extend below the toe of the J-groove weld to at least the distances identified in Table 1.

Table 1. Minimum Inspection Coverage Requirement (Table 1 of Reference 1)

<b>Nozzle Penetration No.</b>	<b>Nozzle Angle of Incidence (degree)</b>	<b>Minimum Required UT Coverage Below J-Groove Weld (inch)</b>	<b>Time, Effective Full-Power Years (EFPY), to Reach Toe of J-Groove Weld (year)</b>
1 through 25	0 to 23.3	0.55	4.6
26 through 69	24.8 to 38.6	0.45	4.4
70 through 81	44.3	0.25	8.4
82 through 89	45.4	0.25	6.8
90 through 97	48.7	0.18	5.0

### 3.5 Licensee's Basis

Similar to the previously approved relaxation request for IP2 (NRC letter dated February 27, 2006, (Reference 6)) from the volumetric inspections requirement of the Order (Reference 5), the licensee has identified that the geometric limitations of the RV upper head penetration nozzles include a threaded guide cone connection section of approximately 0.75-inch long at the bottom end of the nozzles. The dimensional configuration at some nozzles is such that the inspectable distance from the lowest point of the toe of the J-groove weld to the bottom of the scanned region is less than the 1.0-inch and 1.5-inch lower boundary limit as defined in Figure 2 of ASME Code Case N-729-1.

The licensee's proposed alternative essentially only differs from the regulatory requirements in the volumetric examinations of the CRDM nozzles to the minimum required volumetric coverage below the J-groove weld of Table 1. Table 1 also provides the time for a postulated axial through-wall flaw below the minimum inspection coverage obtainable to propagate into the pressure boundary formed by the J-groove weld. The licensee notes that these calculated times are all longer than the time to the next inspection, which is conservatively estimated to be 2 EFPY for IP2. In addition, the licensee's stress analysis (documented in Reference 2) shows that the operational stress of each nozzle decreases down the length of the nozzle. The licensee showed that the length below the lowest point at the toe of the J-groove weld (downhill side) that has an operating stress level of 20 ksi is 0.86 inch for nozzles 1 through 25, 0.40 inch for nozzles 26 through 69, 0.32 inch for nozzles 70 through 81, 0.34 inch for nozzles 82 through 89, and 0.32 inch for nozzles 90 through 97. The licensee stated that their review of operational experience has shown crack initiation in PWSCC susceptible materials with 20-ksi or lower operational stress is unlikely.

In addition, the licensee stated that its vendor who performs UT examinations of the CRDM nozzles has verified that its UT system is qualified in accordance with 10 CFR 50.55a for circumferential and axial flaw detection below the J-groove weld extending to the distance specified in Table 1.

The licensee also stated that its proposed alternative (i.e. limited UT inspections and flaw analysis) provides reasonable assurance that structurally significant flaws will not exist at the J-groove welds and assures that operation between refueling outages can be accomplished without pressure boundary leakage from the examined nozzles.

### 3.6 Duration of Relief

RR-09 is submitted for the remaining of the fourth 10-year ISI interval of IP2, which began on March 1, 2007, and is scheduled to end on April 3, 2016.

### 4.0 Staff Evaluation

The susceptibility of RV upper head penetration nozzles in PWR plants to PWSCC is a safety concern. The nozzles are welded with partial penetration J-groove welds to the RV upper head and nickel-based alloys are used in the nozzles and the associated welds. Primary coolant water and the operating conditions of PWR plants can cause cracking of the nickel-based alloys due to PWSCC in the areas of the highest tensile stress. The subject CRDM nozzles at IP2

meet the conditions for PWSCC, and thus may be susceptible to cracking in the nozzles and associated welds which could cause nozzle ejection or leakage of boric acid causing corrosion of the low-alloy steel head.

The regulation 10 CFR 50.55a(g)(6)(ii)(D)(3) requires the licensee to perform a volumetric and/or surface examination of essentially 100 percent of the required volume or equivalent surfaces of the CRDM nozzle tubes, as identified by Figure 2 of ASME Code Case N-729-1. The required volume is a distance "a" above the highest point of the root of the J-groove weld to a distance "a" below the lowest point of the toe of the J-groove weld. Distance "a" is equal to 1.5 inches for incidence angle less than or equal to 30° to the horizontal plane, or 1.0 inch for incidence angle greater than 30° to the horizontal plane. 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 ID and OD 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.

Consistent with the evaluation of the licensee's previous IP2 relaxation request by letter NL-05-136, dated December 14, 2005 (Reference 4), the NRC staff has reviewed RR-09 pursuant to 10 CFR 50.55a(a)(3)(ii), such that proposed alternatives to the requirements of paragraph 10 CFR 50.55a(a)(g) may be used when authorized by the NRC if compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff assessed whether the compliance with the specified requirements of 10 CFR 50.55a(a)(g) or portions thereof would result in hardship or unusual difficulty. Within the context of RR-09, the NRC staff has determined that the licensee identified the limitations preventing the volumetric and/or surface inspections of the required volume or equivalent surfaces of the nozzle tube below the toe of J-groove weld, as identified by Figure 2 of ASME Code Case N-729-1. The limitations include the threaded guide cone connection section of approximately 0.75-inch long at the bottom end of the nozzles. There is no current qualified volumetric inspection technique to interrogate the physical geometry of the threaded region at the nozzle end. Inspection by surface examination techniques is an available option to meet the current regulatory requirements. However, the licensee has documented the hardship imposed by conducting the surface examinations of the areas around the threaded regions. The hardship includes personnel radiation exposure and the additional risk of heat stress to the inspection personnel. Radiation dose rates under the head near the J-groove weld areas are expected to be in the order of 3 to 5 Rem/hour range. In addition, the area under the head is posted as a locked high radiation area and a high contamination area. Therefore, the NRC staff finds the licensee has provided sufficient basis to demonstrate a hardship.

Further, the NRC staff determined whether there is a compensating increase in the level of quality and safety despite the hardship. The licensee stated that the inspectable distance from the toe of the J-groove weld to the bottom of the scanned region is less than required as defined in Figure 2 of Code Case N-729-1. Therefore, the licensee performed a stress analysis and flaw growth evaluation below the J-groove weld as a technical justification to demonstrate that any undetected flaws in the uninspected region of the nozzle below the J-groove weld would not propagate into the pressure boundary formed by the J-groove weld prior to a subsequent inspection, which is estimated to be 2 EFPY. Table 1 summarizes the results of the licensee's

analysis, which includes the minimum volumetric inspection coverage required for each penetration nozzle below the toe of J-groove weld and the time for a postulated crack to reach the lowest point at the toe of the J-groove weld. The NRC staff finds that the time for a postulated crack to reach the lowest point at the toe of the J-groove weld is greater than 4 EFPY (per Table 1), which provides reasonable assurance of structural integrity of the reactor coolant pressure boundary for each of the nozzles since the subsequent inspection would be performed at approximately 2 EFPY. The same data was also previously reviewed and accepted by NRC in the February 27, 2006, letter (Reference 6).

The licensee also showed the length below the lowest point at the toe of the J-groove weld (downhill side) that has an operating stress level of 20 ksi is 0.86 inch for nozzles 1 through 25, 0.40 inch for nozzles 26 through 69, 0.32 inch for nozzles 70 through 81, 0.34 inch for nozzles 82 through 89, and 0.32 inch for nozzles 90 through 97. Operational experience has shown crack initiation in PWSCC susceptible materials with 20 ksi or lower operational stresses is unlikely. The NRC staff finds that the licensee's stress analysis provides additional support for the overall basis that the licensee's proposed alternative provides reasonable assurance of structural integrity.

In summary, the NRC staff concludes that the licensee's proposed alternative provides reasonable assurance of structural integrity and public health and safety. With these considerations, compliance with the requirements of 10 CFR 50.55a(g)(6)(ii)(D)(3) would result in hardship without a compensating increase in the level of quality and safety.

## 5.0 CONCLUSION

The NRC staff has reviewed the licensee's bases for RR-09 and concludes that the licensee's proposed alternative provides reasonable assurance of structural integrity and public health and safety; and that compliance with the requirements of 10 CFR 50.55a(g)(6)(ii)(D)(3) would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Although the licensee has requested relief pursuant to 10 CFR 50.55a(a)(3)(i), the request was reviewed and the NRC staff authorizes this alternative pursuant to 10 CFR 50.55a(a)(3)(ii), for the remainder of the fourth 10-year ISI interval or until the RV head is replaced for IP2.

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

## 6.0 REFERENCES

1. Entergy letter NL-09-090 to NRC dated July 1, 2009, "Relief Request 08 and 09 for Fourth 10 Year In service Inspection Interval Indian Point, Unit No. 2," Agencywide Documents Access and Management System (ADAMS) Accession No. ML091950333.
2. Entergy letter NL-09-130 to NRC dated September 24, 2009, "Response to Request for Additional Information Regarding Relief Request 09 for Fourth 10 Year In service Inspection Interval (TAC No. ME1658), Indian Point, Unit Number 2," ADAMS Accession No. ML092800242.



3. Entergy letter NL-09-164 to NRC dated December 22, 2009, "Response to Request for Additional Information Regarding Relief Request 09 (TAC No. ME1658), Indian Point, Unit Number 2," ADAMS Accession No. ML093631143.
4. Entergy letter NL-05-136 to NRC dated December 14, 2005, "NRC First Revised Order EA-03-009; Relaxation Request for Inspection of Indian Point Nuclear Generating, Unit Number 2, Reactor Pressure Vessel Head," ADAMS Accession No. ML053570382.
5. First Revised NRC Order EA-03-009, dated February 20, 2004, ADAMS Accession No. ML040220181.
6. NRC Letter to Entergy dated February 27, 2006, "Relaxation of First Revised Order on Reactor Vessel Nozzles, Indian Point Nuclear Generating, Unit 2, (TAC No. MC9230)," ADAMS Accession No. ML060090142.

Principal Contributor: A. Rezai

Date: March 1, 2010

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If you have any questions, please contact the Indian Point project manager, John Boska, at (301) 415-2901.

Sincerely,

/RA/

Nancy L. Salgado, Chief  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-247

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\*See memo dated 2/23/10

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