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

July 8, 2009

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. 3 - RELIEF REQUESTS RR-3-45 AND RR-3-46 FOR REACTOR VESSEL HEAD PENETRATIONS EXAMINATION (TAC NOS. ME0411 AND ME0412)

Dear Sir or Madam:

By letter dated January 22, 2009, Entergy Nuclear Operations, Inc. (the licensee), requested Nuclear Regulatory Commission (NRC) authorization for relief from two requirements regarding reactor pressure vessel head penetration nozzles. Relief Requests 3-45 and 3-46 (RR-3-45, RR-3-46) propose alternatives to the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(6)(ii)(D) for the third 10-year inservice inspection interval at Indian Point Nuclear Generating Unit No. 3 (IP3), which concludes on July 21, 2009. RR-3-45 requests a change to the minimum volumetric inspection distance in the non-pressure-boundary section of each nozzle. RR-3-46 requests to use a previously NRC-authorized volumetric leak path technique used under the requirements of the First Revised NRC Order EA-03-009, dated February 20, 2004, which was revoked by NRC rulemaking published in the *Federal Register* on September 10, 2008 (73 FR 52742). The new rule is now listed as 10 CFR 50.55a(g)(6)(ii)(D)(3). To support the licensee's outage schedule, verbal authorization of the subject relief requests was granted on March 3, 2009.

Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the proposed alternatives in RR-3-45 and RR-3-46 for the third 10-year ISI interval at IP3, which ends July 21, 2009, as the alternatives provide reasonable assurance of structural integrity of the reactor pressure vessel upper head and implementation of additional requirements would result in hardship without a compensating increase in the level of quality and safety. The NRC safety evaluation is provided in the enclosure.

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

Sincerely,

Nancy L. Salgado

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

Docket No. 50-286

Enclosure:
As stated

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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NOS. RR-3-45 AND RR-3-46

ENTERGY NUCLEAR OPERATIONS, INC.

INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

DOCKET NO. 50-286

1.0 INTRODUCTION

By letter dated January 22, 2009 (Ref. 1), Entergy Nuclear Operations, Inc. (the licensee), requested Nuclear Regulatory Commission (NRC) authorization for relief from two requirements regarding reactor pressure vessel (RPV) head penetration nozzles. Relief Requests 3-45 and 3-46 (RR-3-45, RR-3-46) propose alternatives to the requirements of Title 10 of the *Code of Federal Regulations* (CFR) 50.55a(g)(6)(ii)(D) for the 2009 spring refueling outage at Indian Point Nuclear Generating Unit No. 3 (IP3). RR-3-45 requests a change to the minimum volumetric inspection distance in the non-pressure-boundary section of each nozzle. RR-3-46 requests to use a previously NRC authorized volumetric leak path technique used under the requirements of the First Revised NRC Order EA-03-009, dated February 20, 2004 (Order) (Ref. 2), which was revoked by NRC rulemaking published in the *Federal Register* on September 10, 2008 (73 FR 52742). The licensee requested approval of these relief requests on an expedited basis by March 9, 2009, to support the IP3 Refueling Outage 3R15. To support the licensee's outage schedule, verbal authorization of the subject relief requests was granted on March 3, 2009.

2.0 REGULATORY REQUIREMENTS

The inservice inspection (ISI) of 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 Section XI, "Rules for Inservice Inspection of Nuclear Power Plant 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 pressurized water nuclear power facility, components which are classified ASME Code Ciass 1, 2, and 3 must meet the requirements, except the design and access provisions and 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.

Further, these regulations require 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 paragraph (b) of 10 CFR 50.55a on the date 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. At IP3, the ASME Code of record for the facility's current third 10-year ISI interval, which will conclude on July 21, 2009, is the 1989 Edition with no Addenda.

10 CFR 50.55a(g)(6)(ii) states that the Commission may require the licensee to follow an augmented inservice inspection program for systems and components for which the Commission deems that added assurance of structural reliability is necessary. Under this section, 10 CFR 50.55a(g)(6)(ii)(D) defines the requirements for reactor vessel head inspections. 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. The licensee, in accordance with 10 CFR 50.55a(a)(3), has requested relief, RR-3-45 and RR-3-46, from the inspection requirements of 10 CFR 50.55a(g)(6)(ii)(D).

3.0 TECHNICAL EVALUATION

3.1 Components for Which Relief Was Requested

78 ASME Code Class 1 vessel head penetration nozzles and associated welds identified by item number B4.20 of ASME Code Case N-729-1, Table 1.

3.2 Regulatory Requirements

3.2.1 RR-3-45

10 CFR 50.55a(g)(6)(ii)(D)(3) requires, in part, that a pressurized-water reactor (PWR) 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 notes that the inspection should be performed on the nozzle for a distance "a" below the J-groove weld where "a" equals 1 inch for nozzles with an incidence angle to the horizontal plane, Θ, of greater than 30 degrees or 1.5 inch for nozzles with Θ less than or equal to 30 degrees.

3.2.2 RR-3-46

10 CFR 50.55a(g)(6)(ii)(D)(3) requires, in part, that a PWR licensee perform a demonstrated volumetric or surface leak path assessment through all vessel head penetration nozzle J-groove welds.

3.3 Proposed Alternatives

3.3.1 RR-3-45

The licensee's proposed alternative is to perform a volumetric examination (ultrasonic inspection) from the inside surface of each penetration nozzle from 1 inch and 1.5 inch above

the J-groove weld, as applicable, (i.e., the upper boundary limit defined in Figure 2 of ASME Code Case N-729-1) and extending down the nozzle to at least the top of the threaded region. This inspection coverage will extend below the toe of the J-groove weld to at least the distances identified in Table 1 below.

Table 1

Nozzle Penetration No.	Angle of Incidence (Degree)	Minimum Required Volumetric Coverage (inches)	Time (Effective Full Power Years) to Reach the Toe of the J-groove Weld
1 through 29	0 to 24.8	0.4	3.0
30 through 37	26.2	0.4	2.7
38 through 69	30.2 to 38.6	0.4	2.7
70 through 73	44.3	0.3	3.0
74 through 78	48.7	0.3	4.2

3.3.2 RR-3-46

The licensee's proposed alternative is to perform a volumetric leak path assessment using the same techniques used to satisfy the requirements of the First Revised NRC Order EA-03-009, dated February 20, 2004.

3.4 Licensee's Basis

3.4.1 RR-3-45

Similar to the licensee's previously approved relaxation request (Ref. 3) from the volumetric inspection requirements of NRC Order EA-03-009, the licensee has identified that the design of the RPV upper head penetration nozzles include a threaded section approximately 3/4–inch long, at the bottom 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 inch and 1.5 inch lower boundary limit as defined by Figure 2 of ASME Code Case N-729-1.

The proposed alternative would be for the licensee to perform a volumetric examination to the maximum extent possible to at least the top of the threaded region meeting the minimum required volumetric coverage of Table 1 of this document. Table 1 provides the minimum inspection coverage required to ensure that a postulated axial through wall flaw in the un-inspected region of the penetration nozzle would not propagate into the pressure boundary formed by the J-groove weld prior to a subsequent inspection, which is conservatively estimated to be 2 effective full-power years (EFPY) for IP3. In addition, the licensee shows that the operational stress of each nozzle decreases down the length of the nozzle. The licensee states that the length below the lowest point at the toe of the J-groove weld that has an operating stress level of 20 ksi is 0.86 inch for nozzles 1 through 29, 0.5 inch for nozzles 30 through 69, and 0.35 inch for nozzles 70 through 78. Operational experience has shown almost no crack initiation in primary water stress-corrosion cracking susceptible materials with 20 ksi or lower operational stresses.

In a March 30, 2005, letter from Entergy to the NRC (Ref. 4) in support of a previous relaxation request, the licensee confirmed through a stress analysis that the operating stress levels

(including all residual and normal operating stresses), in the region at and below the proposed lower boundary limit of the inspection volume, are less than 20 ksi tension except for one penetration, number 71, which is bounded by a flaw analysis calculation. In the same letter, the licensee identified that additional surface examination of the threaded region of the nozzles would be in a high radiation area and would, in some cases, require the removal of a collar/guide funnel which are welded to the bottom of some nozzles. Significant radiological dose would be incurred for this manual inspection activity, and this task represents a hardship without a compensating increase in the effectiveness of the non-visual non-destructive examination.

In a March 15, 2006, letter from Entergy to the NRC (Ref. 5) the licensee stated that based on previous IP2 experience, a dye-penetrant surface test of a similar area performed under the RPV head would result in a very large dose to personnel of approximately 1.7 rem. Therefore, a volumetric inspection from the inside surface of the threaded region of the nozzle is the primary method at IP3 to remotely inspect the portion of the nozzle below the J-groove weld to minimize radiation exposure to inspection personnel.

3.4.2 RR-3-46

The licensee notes that while industry has initiated efforts to accomplish a generic demonstration of the volumetric leak path assessment technique, the extent of remaining tasks will likely preclude successful completion in time to support the upcoming spring 2009 refueling outage at IP3. The licensee also states that performance of alternative surface examinations of each J-groove weld would be a significant hardship due to the personnel exposure associated with the inspections in a locked high radiation area and high contamination area without a compensating increase in the level of quality and safety. The licensee provided details on several enhancements to the volumetric leak path inspection technique which have been developed over the past 5 years, including the previously completed baseline inspection data available for assessment comparison.

3.5 NRC Staff Evaluation

3.5.1 RR-3-45

The NRC regulation for the inspection of the RPV upper head penetration nozzles has been changed from the First Revised NRC Order EA-03-009, dated February 20, 2004, (Order) (Ref. 2) to the requirements of 10 CFR 50.55a(g)(6)(ii)(D) for all U.S. PWRs by December 31, 2008. Previously, in a July 17, 2006, letter from the NRC to Entergy (Ref. 6), the NRC approved a similar proposed alternative to that described by RR-3-45 for the Order inspection requirements of RPV upper head penetration nozzles below the toe of the J-groove weld. By the invocation of this rule, all previous NRC authorized relaxation requests from the requirements of the Order were withdrawn due to the change in requirements. However, it is noted that the specific inspection requirements of the penetration nozzle below the J-groove weld have not significantly changed between the two regulatory requirements.

Full volumetric inspection coverage is not achievable at IP3 for all RPV upper head penetration nozzles due to the installation of threads on the bottom outside diameter of each nozzle. In some cases, a funnel is attached at the end of a nozzle by these threads and is secured by a weld. 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 technique

is an available option to meet the current regulatory requirements. However, the licensee has documented the hardship imposed by conducting a surface examination of the areas around the threaded regions. Further, the licensee has performed a hypothetical flaw analysis to show that performance of a surface examination in this area would not provide a compensating increase in safety considering the hardship imposed. Therefore, the NRC staff reviewed the licensee's proposed alternative in accordance with 10 CFR 50.55a(a)(3)(ii) such that alternatives to the requirements of paragraph 10 CFR 50.55a(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.

Table 1 of the licensee's proposed alternative identifies the minimum volumetric inspection coverage for each penetration nozzle. The licensee performed a flaw analysis that postulated a through-wall crack in the unexamined area below these minimum inspection depths and calculated the time for this flaw to grow to the pressure boundary. The purpose of this analysis was to show that the time for a worse case flaw to grow from the uninspected region to the pressure boundary would be longer than the time to the volumetric reinspection of the penetration nozzle. The licensee has estimated the time in-between volumetric inspections to be 2 EFPY. The NRC staff has reviewed the licensee's reported time to reach the lowest point of the toe of the J-groove weld data in Table 1, and finds the minimum inspection coverage of Table 1 provides reasonable assurance of structural integrity of the reactor coolant pressure boundary for each of the nozzles. The same data was also previously reviewed and accepted by the NRC in the July 17, 2006, letter (Ref. 6).

The licensee generated a stress profile of representative penetration nozzles at IP3 to support the flaw evaluation. The stress analysis shows that residual stresses decrease significantly with distance from below the J-groove weld. In a letter dated March 30, 2005, from Entergy to the NRC (Ref. 4), the licensee stated that in an effort to add additional assurance of structural integrity beyond the flaw analysis results for each nozzle, the operating stress levels (including all residual and normal operation stresses), in the region at and below the achievable inspection volume, are less than 20 ksi in tension for all except one nozzle (however this nozzle is still bounded by the flaw analysis detailed above). Because of these low stress levels and operating experience indicating that locations with these low of levels of stress have been much less susceptible to cracking, the NRC staff finds, for these uninspected areas of less than 20 ksi stress of these nozzles, that initiation of a crack is unlikely. Therefore, the NRC staff finds this stress analysis provides additional support, beyond the flaw analysis, for the overall basis of a reasonable assurance of structural integrity finding for these nozzles.

In the March 30, 2005, letter (Ref. 4), the licensee also identified that additional surface examination of the threaded region of the nozzles would be in a high radiation area and would, in some cases, require the removal of a collar/guide funnel which is welded to the bottom of some nozzles. The licensee noted that significant radiological dose would be incurred for this manual inspection activity. In a March 15, 2006, revised relaxation request from the Order (Ref. 5), the licensee provided additional information to support this assertion, stating that a similar surface examination under the reactor pressure vessel head incurred 1.7 rem; therefore, performing a surface examination of the threaded area for each nozzle would generate significant total radiological dose accumulations. Therefore, the NRC staff finds that the licensee has provided sufficient information to show that requiring a surface examination of each nozzle to achieve 100% coverage of the inspection requirement would constitute a hardship

without a compensating increase in the effectiveness of the proposed alternative's volumetric examination.

Given the physical limitation preventing full volumetric inspection of each penetration nozzle at IP3, the NRC staff finds that the licensee's flaw and stress analysis provide sufficient information to show that the proposed alternative of RR-3-45 provides reasonable assurance of the structural integrity of the reactor coolant pressure boundary. Further, the NRC staff finds, based on review of licensee radiological dose estimates to perform additional surface examinations, that compliance with the full inspection requirements of Figure 2 of ASME Code Case N-729-1 would result in hardship without a compensating increase in safety.

3.5.2 RR-3.46

10 CFR 50.55a(g)(6)(ii)(D)(3) requires, in part, a PWR licensee to perform a demonstrated volumetric or surface leak path assessment through all vessel head penetration nozzle J-groove welds. The licensee has chosen to perform a volumetric leak path assessment. However, the licensee notes that while industry has initiated efforts to accomplish a generic demonstration of the volumetric leak path assessment technique, the extent of remaining tasks would preclude successful completion in time to support the spring 2009 refueling outage at IP3. Therefore, the licensee has proposed an alternative to perform a volumetric leak path assessment using the same techniques previously used to satisfy the requirements of the First Revised NRC Order EA-03-009, dated February 20, 2004.

By rule dated September 10, 2008, 10 CFR 50.55a(g)(6)(ii)(D) established inservice inspection requirements for the RPV upper head and associated penetration nozzles by requiring licensees to implement ASME Code Case N-729-1 with certain NRC conditions. ASME Code Case N-729-1 did not include a volumetric leak path assessment as part of its inspection requirements. The NRC staff believed this omission was, in part, due to the difficulty for ASME members to establish qualification requirements for the volumetric leak path assessment. The NRC staff, therefore, determined that the surface examination of all associated penetration J-groove welds was necessary as a defense-in-depth approach to detect leakage through the J-groove weld. The NRC staff presented this position in the proposed 10 CFR 50.55a update rule to mandate upper head inspections in accordance with ASME Code Case N-729-1. During the public comment period, several stakeholders noted significant radiological dose hardships in performing a surface examination of each J-groove weld, and some stakeholders requested the option of performing a volumetric leak path assessment which would provide a similar defense-in-depth inspection to detect leakage through the J-groove weld. The NRC staff found the stakeholders' request had merit and incorporated the stakeholders' request into the final rule. However, due to the question regarding the effectiveness of the volumetric leak path assessment raised during the development of ASME Code Case N-729-1, the NRC staff included, in the final rule, that the volumetric leak path assessment must be demonstrated to ensure effectiveness.

On November 24, 2008, the NRC staff held a public meeting with representatives from NEI and industry to discuss generic activities going forward to demonstrate the volumetric leak path assessment. A meeting summary with presentation slides is available in ADAMS under document accession number ML090560434. During the meeting, industry representatives provided a presentation on advances in the volumetric leak path assessment over the past 5 years. The industry described a living program being run by major inspection vendors to ensure

effective examinations were being performed. The industry representatives noted that recent concerns raised by the NRC contractors, including questions regarding the interpretation of signal data, were being incorporated into a generic standards document for use by inspectors in the field. The industry representatives explained that since baseline examinations have been performed on all RPV upper head penetration nozzles throughout the U.S. PWR fleet, that there would be significant enhancement in analyzing future inspection results. The industry representatives also stated their intention to provide details of each of these enhancements to the NRC in a guideline in the spring of 2009, but that this information was already being put into use by vendors in the field. Further, industry representatives discussed activities to complete an industry generic demonstration of the volumetric leak path assessment, but they did not expect to complete the project in time to support the spring 2009 outage at IP3.

The licensee's proposed alternative is to perform a volumetric leak path assessment using the advances available at the time of the inspection during the spring 2009 outage at IP3 that were described in the November 24, 2008, public meeting. The licensee noted that these advancements in the volumetric leak path assessment are the same that were used to satisfy the requirements of the First Revised NRC Order EA-03-009, dated February 20, 2004.

Surface examination of the entire wetted surface of each J-groove weld is an option for the licensee under the requirements of 10 CFR 50.55a(g)(6)(ii)(D)(3). However, the licensee notes that dose rates under the head near the J-groove weld areas are expected to be in the range of 2 to 3 Rem/hour based on previous survey data. In addition, the area under the head is posted as a Locked High Radiation Area and a High Contamination Area. The licensee notes that the complicated geometry and surface condition of the J-groove welds would require significant preparation work and inspection time in these radiation and contamination areas. Therefore, the NRC staff finds that the licensee has provided sufficient plant-specific information regarding the unfavorable weld surface condition and personnel radiological dose exposure to show that compliance with the surface examination requirement constitutes a hardship upon the licensee.

Given the delay in implementation of a generic demonstration of the volumetric leak path assessment, the NRC staff finds that the volumetric leak path assessment as described in the licensee's proposed alternative provides a best effort defense-in-depth inspection beyond the required bare metal visual inspection to identify leakage through each J-groove weld. Further, the NRC staff concludes that the licensee's proposed alternative provides reasonable assurance of public health and safety, and compliance with the additional requirements would result in hardship without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's bases for RR-3-45 and RR-3-46 and concludes that the licensee's proposed alternatives provides reasonable assurance of public health and safety, and compliance with the requirements of 10 CFR 50.55a(g)(6)(ii)(D) would result in hardship without a compensating increase in the level of quality and safety. Therefore, in accordance with 10 CFR 50.55a(a)(3)(ii) the NRC authorizes RR-3-45 and RR-3-46 for the remainder of the current third 10-year ISI interval, which is scheduled to conclude on July 21, 2009.

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

5.0 REFERENCES

1. Letter from Walpole, R., Entergy, to Document Control Desk (DCD), NRC, "Requests For Relief 3-45, 3-46, 3-47(I) and 3-48 to Support the Unit 3 Refueling Outage 15 Inservice Inspection Program," dated January 22, 2009. ADAMS Accession Number ML090420062.

2. First Revised NRC Order EA-03-009, dated February 20, 2004, ADAMS Accession Number ML040220181.

3. Letter from Holden, C., NRC, to Kansler, M., Entergy, "Relaxation of First Revised Order on Reactor Vessel Nozzles, Indian Point Nuclear Generating Unit No. 3 (TAC No. MC3195)," dated March 18, 2005. ADAMS Accession Number ML050770010.

4. Letter from Dacimo, F., Entergy, to the DCD, NRC, "NRC First Revised Order EA-03-009; Revised Relaxation Request for Inspection of IP3 Reactor Pressure Vessel Head," dated March 30, 2005, ADAMS Accession No. ML050900405.

5. Letter from Dacimo, F., Entergy, to the DCD, NRC, "NRC First Revised Order EA-03-009; Revised Relaxation Request for Inspection of IP3 Reactor Pressure Vessel Head," dated March 15, 2006, ADAMS Accession No. ML060960068.

6. Letter from Haney, C., NRC, to Kansler, M., Entergy, "Relaxation of First Revised Order on Reactor Vessel Nozzles, Indian Point Nuclear Generating Unit No. 3 (TAC No. MD0501)," dated July 17, 2006, ADAMS Accession No. ML061010115.

Principal Contributor: Jay Collins

Date: July 8, 2009

If you have any questions regarding this approval, 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. 50-286

Enclosure:
As stated

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