



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

July 23, 2014

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 – SAFETY EVALUATION  
FOR RELIEF REQUEST IP3-ISI-RR-06 FOR REACTOR VESEL WELD  
EXAMINATIONS (TAC NO. MF3345)

Dear Sir or Madam:

By letter dated January 13, 2014, as supplemented by letter dated April 7, 2014, Entergy Nuclear Operations, Inc., the licensee for Indian Point Nuclear Generating Unit No. 3 (IP3), proposed Relief Request IP3-ISI-RR-06 to extend the inservice inspection (ISI) interval requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, ISI Program. Specifically, Relief Request IP3-ISI-RR-06 proposes alternatives pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) to extend the ISI interval for examinations of the reactor pressure vessel welds (Category B-A) as well as the nozzle-to-vessel welds and inner radius sections (Category B-D) from 16 to 20 years.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the relief request and concludes that increasing the third ISI interval for Categories B-A and B-D components from 16 to 20 years will result in no appreciable increase in risk. This conclusion is based on the fact that the 2009 plant-specific through-wall cracking frequency analysis results provides adequate technical basis to extend the original third ISI interval to 20 years. Therefore, Relief Request IP3-ISI-RR-06 provides an acceptable level of quality and safety, and the alternative can be authorized for Categories B-A and B-D components pursuant to 10 CFR 50.55a(a)(3)(i) until the end of the third interval, which is now July 20, 2019, for IP3 for the subject components. Further, the staff accepts the alternative examination date for Categories B-A and B-D components for IP3 scheduled for March 2019, before the end of the third interval.

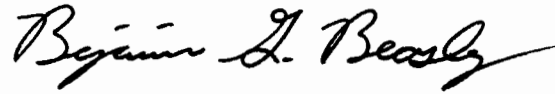
All other requirements of the ASME Code, Section XI, not specifically included in the request for the proposed alternatives, remain in effect. The NRC staff's safety evaluation is enclosed.

Vice President, Operations

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Please feel free to contact Douglas Pickett at 301-415-1364 or [Douglas.Pickett@nrc.gov](mailto:Douglas.Pickett@nrc.gov) if you have any questions.

Sincerely,

A handwritten signature in black ink that reads "Benjamin G. Beasley". The signature is written in a cursive style with a large, sweeping initial "B".

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

Docket No. 50-286

Enclosure:  
Safety Evaluation

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF IP3-ISI-RR-06 REGARDING  
THIRD INSERVICE INSPECTION PROGRAM INTERVAL  
ENTERGY NUCLEAR OPERATIONS, INC  
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3  
DOCKET NUMBER 50-286

1.0 INTRODUCTION

By letter dated January 13, 2014, as supplemented by letter dated April 7, 2014 (Agencywide Document Access and Management System (ADAMS) Accession Numbers ML14017A055 and ML14106A372, respectively), Entergy Nuclear Operations, Inc. (Entergy), the licensee for Indian Point Nuclear Generating Unit No. 3 (IP3), proposed an extension of the inservice inspection (ISI) interval requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, ISI Program. The submittal contains Relief Request IP3-ISI-RR-06, requesting to use an alternative to the requirements of the ASME Code, Section XI, Table IWB-2500-1.

Specifically, Relief Request IP3-ISI-RR-06 proposes alternatives pursuant to Section 50.55a(a)(3)(i) of Title 10 of the *Code of Federal Regulations* (10 CFR) to extend the ISI interval for examinations of the reactor pressure vessel (RPV) welds (Category B-A) as well as the nozzle-to-vessel welds and inner radius sections (Category B-D) from 16 to 20 years.

The third 10-year interval was supposed to end on July, 21, 2009, but was extended by the U.S. Nuclear Regulatory Commission (NRC) to 2015 as indicated in the safety evaluation (SE) dated March 6, 2009 (ADAMS Accession No. ML090360460), for Relief Request RR-3-43(l) based on the same alternative as presented in the current relief request.

2.0 REGULATORY EVALUATION

2.1 Regulations and Guidance

In accordance with 10 CFR 50.55a(g)(4), the licensee is required to perform ISI of ASME Code Class 1, 2, and 3 components and system pressure tests during the first 10-year interval and subsequent 10-year intervals that comply with the requirements of the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein.

For the third 10-year ISI interval at IP3, the Code of record for the inspection of ASME Code Class 1, 2, and 3 components is the 2001 Edition through the 2003 Addenda of the ASME Code, Section XI. The regulation in 10 CFR 50.55a(a)(3) states, in part, that the Director of the Office of Nuclear Reactor Regulation may authorize an alternative to the requirements of 10 CFR 50.55a(g). There are two justifications for an alternative to be authorized. The licensee must either (1) demonstrate that the proposed alternative would provide an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i), or (2) show that following the ASME Code 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(a)(3)(ii).

Regulatory Guide (RG) 1.99, Revision (Rev.) 2, "Radiation Embrittlement of Reactor Vessel Materials," describes general procedures acceptable to the NRC staff for calculating the effects of neutron radiation embrittlement of the low-alloy steels currently used for light-water-cooled RPVs.

RG 1.174, Rev. 1, "An Approach For Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes To The Licensing Basis," describes a risk-informed approach acceptable to the NRC staff for assessing the nature and impact of proposed licensing basis changes by considering engineering issues and applying risk insights.

RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," describes methods and assumptions acceptable to the NRC staff for determining the RPV neutron fluence.

The IP3 Operating License will expire on December 12, 2015, but an application for License Renewal was submitted to the NRC on April 30, 2007 (ADAMS Accession No. ML071210507). Under the provisions of 10 CFR 2.109(b), if the licensee of a nuclear power plant licensed under 10 CFR 50.21(b) or 50.22 files a sufficient application for renewal of either an operating license or combined license at least five years before the expiration of the existing license, the existing license will not be deemed to have expired until the application has been finally determined. The existing license for IP3 will not be deemed to expire in 2015 unless the application has been finally determined.

## 2.2 Background

The ISI of Categories B-A and B-D components consists of visual and ultrasonic examinations intended to discover whether flaws have initiated, whether pre-existing flaws have extended, or whether pre-existing flaws may have been missed in prior examinations. These examinations are required to be performed at regular intervals, as defined in Section XI of the ASME Code.

## 2.3 Summary of WCAP-16168-NP-A, Rev. 2

In June 2008, the Pressurized Water Reactor Owners Group (PWROG) issued the NRC approved topical report WCAP-16168-NP-A, Rev. 2, "Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval" (ADAMS Accession No. ML082820046), which supports the risk-informed assessment of extensions to the ISI intervals for Categories B-A and B-D components. Specifically, WCAP-16168-NP-A, Rev. 2 took data associated with three different PWR plants (referred to as the pilot plants), one designed by each of the three main vendors (Westinghouse, Combustion Engineering, and Babcock and Wilcox (B&W)) for PWR nuclear

power plants in the United States, and performed studies on these pilot plants to justify the proposed extension of the ISI interval for Categories B-A and B-D components from 10 to 20 years.

The analyses in WCAP-16168-NP-A, Rev. 2 used probabilistic fracture mechanics (PFM) tools and inputs from the work described in NUREG-1806, "Technical Basis for Revision of the Pressurized Thermal Shock (PTS) Screening Limit in the PTS Rule (10 CFR 50.61)" (ADAMS Accession No. ML061580318) and NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)" (ADAMS Accession No. ML070860156). The PWROG analyses incorporated the effects of fatigue crack growth and ISI. Design basis transient data was used as input to the fatigue crack growth evaluation. The effects of ISI were modeled consistent with a previously-approved PFM Code in WCAP-14572-NP-A, "Westinghouse Owners Group Application of Risk-Informed Methods to Piping Inservice Inspection" (ADAMS Accession Nos. ML012630327, ML012630349, and ML012630313, respectively). These effects were considered in the PFM evaluations using the Fracture Analysis of Vessels - Oak Ridge (FAVOR) computer code (ADAMS Accession No. ML042960391). All other inputs were identical to those used in the PTS risk re-evaluation underlying 10 CFR 50.61a, "Alternative Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events."

From the results of the studies, the PWROG concluded that the ASME Code, Section XI 10-year inspection interval for Categories B-A and B-D components in PWR RPVs can be extended to 20 years. Their conclusion from the results for the pilot plants was considered to apply to any plant designed by the three vendors as long as the critical, plant-specific parameters (defined in Appendix A of WCAP-16168-NP-A, Rev. 2) are bounded by the pilot plants.

#### 2.4 Summary of the July 26, 2011, NRC SE for WCAP-16168-NP-A, Rev. 2

The original SE in WCAP-16168-NP-A, Rev. 2 that was published in 2008, was superseded by the July 26, 2011, SE (ADAMS Accession No. ML111600303) to address the PWROG's request for clarification of the information needed in applications utilizing WCAP-16168-NP-A, Rev. 2. The NRC staff's conclusion in this latter SE indicates that the methodology presented in WCAP-16168-NP-A, Rev. 2 is consistent with RG 1.174, Rev. 1 and is acceptable for referencing in requests to implement alternatives to ASME Code inspection requirements for PWR plants in accordance with the limitations and conditions in the SE. In addition to showing that the subject plant parameters and inspection history are bounded by the critical parameters identified in Appendix A to WCAP-16168-NP-A, Rev. 2, the licensee's application must provide the following plant-specific information:

- (1) Licensees must demonstrate that the embrittlement of their RPV is within the envelope used in the supporting analyses. Licensees must provide the 95<sup>th</sup> percentile total through-wall cracking frequency ( $TWCF_{TOTAL}$ ) and its supporting material properties at the end of the period in which the relief is requested to extend the ISI from 10 to 20 years. The 95<sup>th</sup> percentile  $TWCF_{TOTAL}$  must be calculated using the methodology in NUREG-1874. The  $RT_{MAX-X}$  and the shift in the Charpy transition temperature produced by irradiation defined at the 30 ft-lb energy level,  $\Delta T_{30}$ , must be calculated using the methodology documented in the latest revision of RG 1.99 or other NRC-approved methodology.

- (2) Licensees must report whether the frequency of the limiting design basis transients during prior plant operation are less than the frequency of the design basis transients identified in the PWROG fatigue analysis that are considered to significantly contribute to fatigue crack growth.
- (3) Licensees must report the results of prior ISI of RPV welds and the proposed schedule for the next 20-year ISI interval. The 20-year inspection interval is a maximum interval. In its request for an alternative, each licensee shall identify the years in which future inspections will be performed. The dates provided must be within plus or minus one refueling cycle of the dates identified in the implementation plan provided to the NRC in PWROG letter OG-10-238 (ADAMS Accession No. ML11153A033).
- (4) Licensees with B&W plants must (a) verify that the fatigue crack growth of 12 heat-up/cool-down transients per year that was used in the PWROG fatigue analysis bound the fatigue crack growth for all of its design basis transients and (b) identify the design bases transients that contribute to significant fatigue crack growth.
- (5) Licensees with RPVs having forgings that are susceptible to underclad cracking and with  $RT_{MAX-FO}$  values exceeding 240 °F must submit a plant-specific evaluation to extend the inspection interval for ASME Code, Section XI, Category B-A and B-D RPV welds from 10 to a maximum of 20 years because the analyses performed in WCAP-A are not applicable.
- (6) Licensees seeking second or additional interval extensions shall provide the information and analyses requested in Section (e) of 10 CFR 50.61a.

WCAP-16168-NP-A, Rev. 3, which contains this latter SE for WCAP-16168-NP-A, Rev. 2, was issued in October 2011 (ADAMS Accession No. ML11306A084, referred to as WCAP-A in the rest of this SE).

### 3.0 PROPOSED ALTERNATES FOR IP3

#### 3.1 Description of Proposed Alternatives

In IP3-ISI-RR-06, the licensee proposed to defer the ASME Code required Categories B-A and B-D weld ISI for IP3 until 2019. This proposed schedule is not consistent with the schedule in the revision to PWR Owner Group Letter OG-10-238. Therefore, the NRC staff requested that the licensee assess the challenge to the industry's ability to provide ISI services caused by the proposed alternate for IP3 and to NRC's monitoring of any unexpected phenomenon of neutron embrittlement for RPVs experiencing high fluences in the next 20 years. The licensee's response dated April 7, 2014, is discussed in Section 4.0 of this SE under the staff's technical evaluation.

#### 3.2 Components for Which Relief is Requested

The affected components are the subject plant RPV welds and their interior attachments and core support structures. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI, are addressed in Relief Request IP3-ISI-RR-06:

<u>Exam Category</u>	<u>Item Number</u>	<u>Description</u>
B-A	B1.11	Circumferential Shell Welds
B-A	B1.12	Longitudinal Shell Welds
B-A	B1.21	Circumferential Head Welds
B-A	B1.22	Meridional Shell Welds
B-A	B1.30	Shell-to-Flange Weld
B-A	B1.40	Head-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Section

### 3.3 Basis for Proposed Alternatives

The licensee stated that deferral of the subject RPV full penetration pressure retaining welds (Examination Category B-A and B-D components) is based on WCAP-A. This methodology used the estimated TWCF as a measure of the risk of RPV failure, and it was demonstrated that if a plant is bounded by the WCAP-A TWCF results, the inspection interval for the affected components can be extended from 10 to 20 years, meeting the change in risk guidelines in RG 1.174. The licensee addressed the plant-specific information discussed in Section 2.4 of this SE as follows:

- (1) The prior Relief Request RR-3-43(l) confirmed the applicability of the plant-specific parameters defined in Appendix A of WCAP-16168-NP-A, Rev. 2 except for the TWCF parameter. To address the TWCF parameter deviation, an IP3 plant-specific change in risk analysis was performed to support Relief Request RR-3-43(l) using the same methodology as was used for the Westinghouse pilot plant, Beaver Valley, Unit 1, in WCAP-A. The current relief request used the same IP3 plant-specific change in risk analysis as its basis to demonstrate that the proposed alternative provides an acceptable level of quality and safety. As stated in the licensee's application dated January 13, 2014:

It was on the basis of the information provided in the original Relief Request RR-3-43(l) (Reference 3), and the plant specific change-in-risk analysis provided in Reference 5, and the amended change-in-risk results (Reference 6), that the Staff provided their Safety Evaluation (Reference 2) dated March 6, 2009[,] approving the deferral of the Indian Point Unit 3 examinations to 2015. The Safety Evaluation concluded: "(a) the licensee has provided sufficient information requested in Sections 3.4 and 4.0 of the SE for the WCAP Report, (b) the licensee has provided a plant-specific  $\Delta$ TWCF analysis to demonstrate that the proposed change in the IP RPV ISI program meets the RG 1.174 guidelines discussed in the SE for the WCAP Report, and (c) the licensee's proposed alternative provides an acceptable level of quality and safety." As indicated in Relief Request RR-3-43(l), the change-in-risk analysis was performed for 48 EFPY [effective full-power years] corresponding to 60 years of calendar operation but the NRC staff approval was limited to 2015. Since the inspection date of 2019 requested in this relief request is within 48 EFPY and 60 calendar years, the information provided was adequate for the full

20 year extension to 2019. Therefore, this requested change in date is bounded by the change in risk analysis and the 2019 date provides reasonable assurance of continued structural integrity of the subject welds.

- (2) As stated in (1), Relief Request RR-3-43(I) confirmed the applicability of the plant-specific parameters defined in Appendix A of WCAP-16168-NP-A, Rev. 2 except for the TWCF parameter, indicating other parameters such as the frequencies of the IP3's limiting design basis transients are bounded by the frequencies identified in the PWROG fatigue analysis.
- (3) Similar to (1) and (2) above, Relief Request RR-3-43(I) confirmed that previous RPV inspections for IP3 have been satisfactory. The RPV examination currently scheduled for 2015 for IP3 will be deferred until 2019. The date provided is not consistent with the schedule in PWROG letter OG-10-238, dated July 12, 2010. The impact of this inconsistency is discussed in Section 4.0 of this SE.

Plant-specific information items (4), (5), and (6) have not been addressed by the licensee because they do not apply to IP3. Based on the IP3 plant-specific change in risk analysis supporting the full 20 year extension to 2019 per the March 6, 2009, SE, the licensee concluded that use of this proposed alternative will provide an acceptable level of quality and safety. As such, the licensee requested that the NRC authorize the relief pursuant to 10 CFR 50.55a(a)(3)(i).

### 3.4 Duration of Proposed Alternatives

This request is applicable to the IP3 ISI program for the third interval for only the ASME Code, Section XI, Categories B-A and B-D RPV weld inspections. The proposed alternative is scheduled for March 2019.

## 4.0 STAFF TECHNICAL EVALUATION

As discussed in Section 3.3 of this SE, the licensee referenced the March 6, 2009, SE on prior Relief Request RR-3-43(I) to support the current relief request. The NRC staff revisited Relief Request RR-3-43(I) and confirmed that in Table 1 of Relief Request RR-3-43(I), the "Frequency and Severity of Design Transients" of IP3 was found to be bounded by WCAP-A. Therefore, the staff determined that the current relief request has addressed Plant-Specific Information 2 satisfactorily and confirmed that, regarding design transients, the WCAP-A methodology is applicable to IP3. Also, the IP3 RPV has a single-layer cladding on the inside like the assumption used in the WCAP-A analysis.

However, since the TWCF calculation results using inputs from Table 3 of Relief Request RR-3-43(I) exceeded the applicable pilot plant's (Beaver Valley, Unit 1) TWCF value in WCAP-A, indicating that the originally calculated TWCF parameter supporting Relief Request RR-3-43(I) is not bounded by WCAP-A, the NRC staff requested the licensee perform a plant-specific TWCF analysis (referred in Section 3.3 of this SE as plant-specific change in risk analysis) to support Relief Request RR-3-43(I). Evaluation and acceptance of this plant-specific TWCF analysis was documented in the March 6, 2009, SE. The current relief request quoted the March 6, 2009, SE conclusion (see Section 3.3 of this SE) as a basis for the proposed



alternative. The staff noted that the plant-specific TWCF analysis is based on 48 EFPY which bounds the IP3 neutron fluence up to 20 years following the current license period and provides adequate technical basis to extend the original third ISI interval from 10 years to 20 years. Hence, the NRC staff determined that the licensee has in essence satisfactorily addressed Plant-Specific Information 1, through an approved IP3 plant-specific TWCF analysis. The staff has also confirmed that the embrittlement of the IP3 RPV was addressed appropriately in the IP3 plant-specific TWCF analysis.

Plant-Specific Information 3 is information pertaining to previous RPV inspections and the schedule for future ones. Approval of Relief Request RR-3-43(I) is an indication that previous RPV inspections were addressed appropriately by the licensee. As to the schedule for future inspection, a request for information (RAI)-1 was issued because the proposed inspection date of March 2019 is not consistent with the dates in PWROG letter OG-10-238. The licensee's response dated April 7, 2014, to RAI-1 stated that the proposed inspection date for IP3 would result in five plants being inspected in 2015 and five plants in 2019, and will have no impact on the industry's ability to provide ISI services and the NRC's monitoring of any unexpected phenomenon of neutron embrittlement when more RPVs are experiencing high fluences in the next 20 years. This is acceptable to the NRC staff because the proposed schedule would make the RPV inspections more evenly distributed in 2015 and 2019. RAI-1 is resolved. Therefore, the staff concludes that the licensee has satisfactorily addressed Plant-Specific Information 3.

In summary, the NRC staff has reviewed the licensee's submittal and the responses to the staff's RAIs supplementing the relief request. The staff determined that the licensee has addressed all relevant plant-specific information as discussed above to support Relief Request IP3-ISI-RR-06 and, therefore, demonstrated that the proposed alternative provides an acceptable level of quality and safety.

It should be mentioned that, for Relief Request RR-3-43(I), although the IP3 plant-specific TWCF analysis supported extension of the third ISI interval from 10 years to 20 years for Categories B-A and B-D components, the NRC staff granted an extension of only 16 years in the March 6, 2009, SE for the relief request until the end of the current license for IP3 (i.e., to 2015). As stated in Section 2.1 of this SE, the IP3 Operating License will expire on December 12, 2015, but an application for License Renewal was submitted to the NRC on April 30, 2007. Since the licensee filed a sufficient application for license renewal 5 years before the expiration of the current license, under the provisions of 10 CFR 2.109(b), the current license will not be deemed to have expired until the application has been finally determined. Therefore, the NRC staff's granting of Relief Request IP3-ISI-RR-06 to extend the third ISI interval from 16 years (approved in the March 6, 2009, SE) to 20 years is in accordance with the above-mentioned NRC determination of the operating status of a plant with a license renewal application under review.

## 5.0 CONCLUSION

The NRC staff has completed its review of Relief Request IP3-ISI-RR-06. The staff concludes that increasing the third ISI interval for Categories B-A and B-D components from 16 to 20 years will result in no appreciable increase in risk. This conclusion is based on the fact that the 2009 plant-specific TWCF analysis results provide adequate technical basis to extend the original third ISI interval to 20 years. Therefore, Relief Request IP3-ISI-RR-06 provides an acceptable level of quality and safety, and the alternative can be authorized for Categories B-A and B-D

components pursuant to 10 CFR 50.55a(a)(3)(i) until the end of the third interval, which is now July 20, 2019, for IP3 for the subject components. Further, the NRC staff accepts the alternative examination date for Categories B-A and B-D components for IP3 scheduled for March 2019, before the end of the third interval.

All other requirements of the ASME Code, Section XI, not specifically included in the request for the proposed alternatives, remain in effect.

Vice President, Operations

- 2 -

Please feel free to contact Douglas Pickett at 301-415-1364 or [Douglas.Pickett@nrc.gov](mailto:Douglas.Pickett@nrc.gov) if you have any questions.

Sincerely,

*/RA/*

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

Docket No. 50-286

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