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

September 18, 2018

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

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 3 – SAFETY EVALUATION FOR RELIEF REQUESTS IP3-ISI-RR-11, IP3-ISI-RR-12, AND IP3-ISI-RR-15 REGARDING APPROVAL OF ALTERNATIVES ASSOCIATED WITH EXTENSION OF FOURTH INTERVAL REACTOR VESSEL AND PIPING WELD INSPECTIONS (EPIDS: L-2017-LLR-0124 AND L-2017-LLR-0127)

Dear Sir or Madam:

By letter dated October 18, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17297A461), as supplemented by letter dated July 18, 2018 (ADAMS Accession No. ML18211A297), Entergy Nuclear Operations, Inc., (the licensee) submitted Relief Request IP3-ISI-RR-11, IP3-ISI-RR-12, and IP3-ISI-RR-15 for Indian Point Nuclear Generating Unit No. 3 to the U.S. Nuclear Regulatory Commission (NRC).

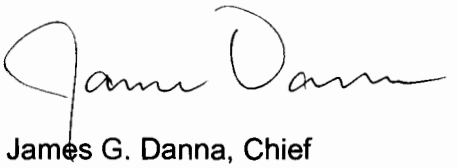
In IP3-ISI-RR-11 and IP3-ISI-RR-15, the licensee proposed an alternative to certain requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code) Section XI, Table IWB-2500- 1 to extend the inspection interval for IP3 from 20 to 22 years for Category B-A and B-D examinations and from 10 to 12 years for Category B-N-2 and B-N-3 examinations. Specifically, for Category B-A and B-D examinations, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative on the basis that the alternative provides an acceptable level of quality and safety. For Category B-N-2 and B-N-3 examinations, pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternative on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

In IP3-ISI-RR-12, the licensee proposed an alternative to certain requirements of 10 CFR 50.55a(g)(6)(ii)(F) and the ASME Code associated with inspection of reactor pressure vessel inlet cold leg nozzle to safe-end dissimilar metal butt welds at IP3. Specifically, pursuant to 10 CFR 50.55a(z)(1), the licensee proposed to defer the ASME Code Case N-770-2, Table 1, Inspection Category Item B cold leg weld inspections from the spring 2019 refueling outage (RFO) to the spring 2021 RFO on the basis that the proposed alternative would provide an acceptable level of quality and safety.

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

If you have any questions concerning this matter, please contact the IP3 Project Manager, Mr. Richard Guzman, at (301) 415-1030 or Richard.Guzman@nrc.gov.

Sincerely,



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

Docket No. 50-286

Enclosure:
Safety Evaluation

cc: Listserv

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

# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

# RELATED TO RELIEF REQUESTS IP3-ISI-RR-11 AND IP3-ISI-RR-15

# REGARDING REACTOR PRESSURE VESSEL WELD INSPECTIONS

# AND RELIEF REQUEST IP3-ISI-RR-12 REGARDING

# ASME CODE CASE 770-2 INSPECTION ITEM B COLD LEG WELDS

# FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

# ENTERGY NUCLEAR OPERATIONS, INC.

# INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

# DOCKET NO. 50-286

## 1.0 INTRODUCTION

By letter dated October 18, 2017 (Agencywide Document Access and Management System (ADAMS) Accession No. ML17297A461), as supplemented by letter dated July 18, 2018 (ADAMS Accession No. ML18211A297) Entergy Nuclear Operations, Inc. (Entergy, the licensee) submitted Relief Request IP3-ISI-RR-11, IP3-ISI-RR-12, and IP3-ISI-RR-15 for Indian Point Nuclear Generating Unit No. 3 (IP3) to the U.S. Nuclear Regulatory Commission (NRC).

In IP3-ISI-RR-11 and IP3-ISI-RR-15, the licensee proposed an alternative to certain requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code) Section XI, Table IWB-2500- 1 to extend the inspection interval for IP3 from 20 to 22 years for Category B-A and B-D examinations and from 10 to 12 years for Category B-N-2 and B-N-3 examinations. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative for the Category B-A and B-D examinations on the basis that the alternative provides an acceptable level of quality and safety. By letter dated July 18, 2018, the licensee revised IP3-ISI-RR-11 to remove the examination category B-N-2 and B-N-3 items and submitted IP3-ISI-RR-15 as Attachment 3 to the letter, in accordance with 10 CFR 50.55a(z)(2). Specifically, the licensee requested to use the proposed alternative for the Category B-N-2 and B-N-3 examinations on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety

In IP3-ISI-RR-12, the licensee proposed an alternative to certain requirements of 10 CFR 50.55a(g)(6)(ii)(F) and the ASME Code associated with inspection of reactor pressure vessel inlet cold leg nozzle to safe-end dissimilar metal (DM) butt welds at IP3. Specifically, pursuant

to 10 CFR 50.55a(z)(1), the licensee proposed to defer the ASME Code Case N-770-2, Table 1, Inspection Category Item B cold leg weld inspections from the spring 2019 refueling outage (RFO) to the spring 2021 RFO on the basis that the proposed alternative would provide an acceptable level of quality and safety.

## 2.0 REGULATORY EVALUATION

Alternatives to requirements under 10 CFR 50.55a(g) may be authorized by the NRC pursuant to 10 CFR 50.55a(z). In proposing alternatives or requests for relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The inservice inspection (ISI) of 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 Nuclear Regulatory Commission (NRC or Commission).

Pursuant to 10 CFR 50.55a(g)(6)(ii) the NRC 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. The regulation in 10 CFR 50.55a(g)(6)(ii)(F) requires, in part, augmented inservice volumetric inspection of Class 1 piping and nozzle DM butt welds of pressurized water reactor (PWRs) in accordance with ASME Code Case N-770-2, subject to the conditions specified in paragraphs (2) through (13) of 10 CFR 50.55a(g)(6)(ii)(F).

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the NRC to authorize, the proposed alternative requested by the licensee on the basis that the proposed alternative would provide an acceptable level of quality and safety. Accordingly, the staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(z)(1) and 10 CFR 50.55a(z)(2).

## 3.0 TECHNICAL EVALUATION

### 3.1 IP3-ISI-RR-11 and IP3-ISI-RR-15

#### 3.1.1 Background

The NRC staff's review of this proposed alternative assesses the consistency of the licensee's proposal withTopical Report WCAP-16168-NP-A, Rev. 3, "Risk-Informed Extension of the Reactor Vessel In- Service Inspection Interval" (ADAMS Accession No. ML11306A084). Henceforth, WCAP- 16168-NP-A, Rev. 3 will be referred to as WCAP-A. WCAP-A provides a basis for the acceptability of the proposed inspection intervals for Category B-A and B-D components at U.S. PWRs designed by Westinghouse, Combustion Engineering and Babcock and Wilcox through the use of risk-informed analyses and probabilistic fracture mechanics for a pilot plant of each design. WCAP-A also contains the NRC staff's safety evaluation (SE) of the Westinghouse proposal. The SE finds the proposal acceptable for use based on consistency with the principles contained in Regulatory Guide (RG) 1.174, Rev. 1, "An Approach For Using Probabilistic Risk Assessment In Risk-Informed Decisions On Plant-Specific Changes To The Licensing Basis." However, the SE imposes a condition that requires licensees to provide

plant-specific information in 6 areas to demonstrate the applicability of WCAP-A to the licensee's plant. The plant-specific information required by the condition is:

(1) Licensees must provide the 95th percentile total through-wall cracking frequency-total ($TWCF_{TOTAL}$) and its supporting material properties at the end of the proposed 20-year ISI interval. The 95th percentile $TWCF_{TOTAL}$ must be calculated using the methodology in NUREG-1874, "Recommended Screening Limits for Pressurized Thermal Shock (PTS)" (ADAMS Accession No. ML070860156), which is frequently referred as "the NRC PTS Risk Study." The $RT_{MAX-X}$[1] 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 latest revision of RG 1.99[2] 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 PWR Owners Group (PWROG) fatigue analysis as significant contributors to fatigue crack growth.

(3) Licensees must report the results of prior ISI of RPV [Reactor Pressure Vessel] welds and the proposed schedule for the next 20-year ISI interval. Each licensee shall identify the years in which future inspections will be performed, and 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 [Babcock & Wilcox] 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 bounds 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 $RT_{MAX-FO}$ [3] values exceeding 240 °F must submit a plant-specific evaluation because the analyses performed in the WCAP 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.

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[1] $RT_{MAX-X}$ is the reference temperature for any or all of the material properties for a particular reactor vessel which characterizes the reactor vessel's resistance to fracture initiating from flaws found along axial weld fusion lines ($RT_{MAX-AW}$), in plates remote from welds ($RT_{MAX-PL}$), in forgings remote from welds ($RT_{MAX-FO}$), or along circumferential weld fusion lines ($RT_{MAX-CW}$).

[2] Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," (ADAMS Accession No. ML003740284)

[3] $RT_{MAX-FO}$ is the material property reference temperature which characterizes the reactor vessel's resistance to fracture initiating from flaws in forgings remote from welds.

3.1.2 Components for Which Relief is Requested

The affected components are the subject plant RPV and its interior attachments and core support structure. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI, are addressed in this request:

| Examination Category | Item Number | Description |
|---|---|---|
| B-A | B 1.11 | Circumferential Shell Welds |
| B-A | B 1.12 | Longitudinal Shell Welds |
| B-A | B 1.21 | Circumferential Head Welds |
| B-A | B 1.22 | Meridional Shell Welds |
| B-A | B 1.30 | Shell-to-Flange Weld |
| B-A | B 1.40 | Head-to-Flange Weld |
| B-D | B 3.90 | Nozzle-to-Vessel Welds |
| B-D | B 3.100 | Nozzle Inner Radius Areas |
| B-N-2 | B13.60 | Interior Attachments Beyond Beltline Region |
| B-N-3 | B13.70 | Core Support Structure |

3.1.3 Applicable Code Edition and Addenda

For the fourth 10-year ISI interval at IP3, the Code of Record for the inspection of ASME Code Class 1, 2, and 3 components is the ASME Code, Section XI, 2001 Edition through 2003 Addenda.

3.1.4 Applicable Code Requirements

The ASME Code requires volumetric examination once each 10-year interval of essentially 100 percent of reactor vessel pressure-retaining welds identified in Table IWB-2500-1, Examination Categories B-A, "Pressure Retaining Welds in Reactor Vessel," B-D, "Full Penetration Welded Nozzles in Vessels," B-N-2, "Welded Core Support Structures and Interior Attachments to Reactor Vessels," and B-N-3, "Removable Core Support Structures."

3.1.5 Licensee's Proposed Alternative

By letter dated July 23, 2014 (ADAMS Accession No. ML14198A331), NRC staff had previously approved the licensee's request to extend the inspection interval for Examination Category B-A and B-D welds at IP3 to 20 years. In Relief Request IP3-ISI-RR-11, the licensee proposed to extend the required examinations for Examination Category B-A and B-D welds from 20 years to 22 years. In Relief Request IP3-ISI-RR-15, the licensee also requested to extend the required examinations for Examination Category B-N-2 and B-N-3 welds from 10 years to 12 years. The effect of these extensions will be to defer the ASME Code required Category B-A, B-D, B-N-2, and B-N-3 reactor vessel weld inspections for IP3 from spring 2019 until spring 2021.

3.1.6 Basis for Proposed Alternative

For Categories B-A and B-D, the licensee stated that the change in risk analysis, that was performed by the licensee in response to NRC staff requests for additional information (see ADAMS Accession Nos. ML090050020 and ML090400575) during the staff's review of

previously submitted relief request RR-3-43(I) (ADAMS Accession No. ML081980058), adequately bounds the 22 year extension for the ASME Code required inspections since the proposed inspection deferral remains within 48 effective full-power-years (EFPY) and 60 calendar years.

For Categories B-N-2 and B-N-3, the licensee stated that eliminating a core barrel removal in 2019 would result in significant savings in personnel radiation dose and outage duration. The licensee also expressed a desire to perform these inspections coincident with the Category B-A and B-D inspections, the ASME Code Case N-770-2 weld inspection, the Materials Reliability Program (MRP)-227-A reactor vessel internals inspections.

3.1.7 Duration of Proposed Alternatives

The licensee stated that this relief request is applicable to the ISI program for the 4th ISI interval at IP3. The licensee further stated that the duration of the proposed alternative is from the spring of 2019 to the spring of 2021 and that the required inspections must be performed if IP3 continues to operate beyond April 30, 2021.

3.1.8 NRC Staff Evaluation

By letter dated July 8, 2008 (ADAMS Accession No. ML081980058), as supplemented by letters dated December 23, 2008 (ADAMS Accession No. ML090050020) and January 20, 2009 (ADAMS Accession No. ML090400575), the licensee initially proposed to extend the inspection interval for the subject Examination Category B-A and B-D welds for up to 20 years based on methodology consistent with that in WCAP-16168-NP-A, Revision 2. By letter dated March 6, 2009 (ADAMS Accession No. ML090360460), NRC staff approved the extension of inspection interval for only 16 years, until the end of the then-current license period on December 12, 2015.

As justification for this extension, the NRC staff concluded that principles 1, 2, and 3 of RG 1.174 were met because the licensee used the methodology described in the WCAP-16168-NP-A, Revision 2. The NRC staff also concluded that principle 4 of RG 1.174 was met because the estimated increase in the TWCF value indicates that any core damage frequency and large early release frequency (LERF) caused by implementing the proposed alternative is expected to be less than the acceptance guideline for very small changes in LERF. Finally, the NRC staff concluded that principle 5 of RG 1.174 was met because the licensee's proposed monitoring program provided confidence that no adverse safety degradation would occur after the change has been implemented, with respect to any future operation following the next examination.

By letter dated January 13, 2014 (ADAMS Accession No. ML14017A055), as supplemented by letter dated April 7, 2014 (ADAMS Accession No. ML14106A372), the licensee proposed to extend the inspection interval for the subject Examination Category B-A and B-D welds from 16 years to 20 years based on methodology consistent with that in WCAP-A. By letter dated July 23, 2014 (ADAMS Accession No. ML14198A331), NRC staff approved the extension of inspection interval until July 20, 2019. As justification for this extension, the NRC staff concluded that plant specific information items 1, 2, and 3 of Section 3.4 of the revised final SE in WCAP-A were satisfactorily addressed by the licensee and were valid for the extended interval of 20 years. The NRC staff also concluded that plant specific information items 4, 5, and 6, did not need to be addressed by the licensee since they did not apply to IP3.

By letter dated October 18, 2017 (ADAMS Accession No. ML17297A461), as supplemented by letter dated July 18, 2018 (ADAMS Accession No. ML18211A297), the licensee requested to extend the required examinations for Examination Category B-A and B-D welds from 20 years to 22 years. The licensee also requested to extend the required examinations for Examination Category B-N-2 and B-N-3 welds from 10 years to 12 years. As justification, the licensee stated that prior relief request IP3-ISI-RR-06 (ADAMS Accession No. ML14017A055), which was approved by the NRC staff by SE dated July 23, 2014 (ADAMS Accession No. ML14198A331), and which extended the inspection interval for Examination Category B-A and B-D welds at IP3 to 20 years, demonstrated the following:

- The licensee "provided sufficient information as requested in Sections 3.4 and 4.0 of the SER for WCAP16168-NP-A" (see ADAMS Accession No. ML111600303).

- The licensee "provided a plant-specific change in TWCF analysis to demonstrate that the proposed change in the IP3 RPV ISI program meets the Regulatory Guide 1.174 guidelines discussed in the SER for WCAP16168-NP-A" (see ADAMS Accession No. ML111600303).

- The "plant specific change-in-risk analysis adequately bounds the requested 22 year extension to the spring of 2021 since the proposed inspection deferral remains within 48 EFPY and 60 calendar years".

- The licensee's proposed alternative provides an acceptable level of quality and safety.

In its 2014 SE which extended the inspection interval of Examination Category B-A and B-D welds to 20 years, the NRC staff stated that the licensee has, in essence, satisfactorily addressed Plant Specific Information 1 from WCAP-A through an approved plant-specific TWCF analysis, and that the embrittlement of the IP3 RPV was addressed appropriately in this analysis. The 2014 SE notes that the licensee's original TWCF calculation was not bounded by WCAP-A, but that the licensee provided a plant-specific TWCF analysis based on 48 EFPY which bounds the neutron fluence up to 20 years following the original license period. In the licensee's submittals, the licensee demonstrates that the assumptions of the 2014 SE remain valid for the requested extension from 20 to 22 years, since both the number of heatup/cooldown cycles and the accumulated EFPY that is to be expected for IP3 remain well below the limiting bounds of the analysis that is referenced in the 2014 SE. The NRC finds the licensee's request with respect the Examination Category B-A and B-D welds acceptable since it meets the requirements of 10 CFR 50.55a(z)(1) for acceptable level of quality and safety.

In its submittals, the licensee requests to defer the required visual examinations of Category B-N- 2 and B-N-3 components to allow the inspections to be scheduled coincident with the Category B-A and B-D inspections, the ASME Code Case N-770-2 weld inspection, the MRP-227-A reactor vessel internals inspections, and to eliminate the need to remove the core barrel in RFO 20 (spring 2019). The NRC staff notes that it is common practice for licensees to combine Category B-N-3 and MRP-227-A inspections, both of which require the core barrel to be removed. NRC staff also notes that, based on increased radiation dose to personnel and increased risk of damage to reactor components, it is a hardship for the licensee to perform core barrel removals on a more frequent basis than necessary to assure an adequate level of quality and safety. Finally, based on the results of the licensee's previous B-N-2 and B-N-3 inspections in 2009, and fleet operating experience with these components, the NRC staff considers that the requested inspection deferral would not result in a compensating increase in the level of quality

and safety. Therefore, the NRC staff finds the licensee's request with respect to the Examnination Category B-N-2 and B-N-3 welds acceptable because it meets the requirements of 10 CFR 50.55a(z)(2) and demonstrates that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

3.2 IP3-ISI-RR-12

3.2.1 Components Affected

The affected components are as follows:

Weld 1-4100-16(DM) Loop 31 cold leg nozzle to safe-end weld
Weld 1-4200-16(DM) Loop 32 cold leg nozzle to safe-end weld
Weld 1-4300-16(DM) Loop 33 cold leg nozzle to safe-end weld
Weld 1-4400-16(DM) Loop 34 cold leg nozzle to safe-end weld

3.2.2 Applicable Code Requirement

IP3 is currently in its fourth 10-year ISI interval, which will end in the spring 2019 (RFO 20), but is currently requested to be extended by IP3-ISI-RR-11 to the spring 2021 RFO. The ASME Section XI Code of Record is the 2001 Edition with Addenda through 2003.

3.2.3 Code Requirement for Which Relief is Requested

Paragraph 10 CFR 50.55a(g)(6)(ii)(F) requires, in part, a volumetric inspection of RPV inlet cold leg nozzle to safe-end DM welds of PWRs in accordance with ASME Code Case N-770-2 subject to the conditions specified in paragraphs (2) through (13) of 10 CFR 50.55a(g)(6)(ii)(F). Table 1 of ASME Code Case N-770-2 requires volumetric examination of essentially 100 percent of the above Inspection Item B (cold leg) welds once every second inspection period not to exceed 7 years.

3.2.4 Proposed Alternative

The licensee proposes a one-time extension to the Code Case N-770-2, Table 1, Inspection Item B, volumetric examinations from a period of "not to exceed 7 years" to the scheduled spring 2021 RFO, which is an extension of the previously NRC approved alternative for extension to the the spring 2019 RFO (ADAMS Assession Number ML14199A444). As the last volumetric examinations were performed on these welds in 2009, the proposed alternative would extend to a period of "not to exceed 12 years."

3.2.5 Licensee's Basis for Proposed Alternative

The licensee requests relief from the regulatory requirement which would require inspection during the scheduled spring 2019 RFO and allow the inspection to be performed during the scheduled spring 2021 RFO at IP3. This is a one-time extension inspection frequency request.

The licensee stated that examination of the ASME Code Case N-770-2 RPV inlet cold leg nozzle to safe-end welds at IP3 are performed from the inside surface diameter of the pipe due to the limited access from the outside surface diameter of the pipe. This requires access to the lower portion of the RPV to insert automated volumetric inspection equipment to perform the

examination. As such, it would be necessary to remove the core barrel and other RPV internals. The licensee stated that since inspection of the subject ASME Code Case N-770-2, Table 1, Inspection Item B, welds requires that the core barrel be removed from the reactor vessel, performing these inspections concurrently with the vessel shell weld inspections will result in an expected personnel radiation dose savings of 0.9 person-Roentgen equivalrnt man (Rem). Additionally, the licensee stated that volumetric inspection of the RPV inlet cold leg nozzle to safe-end welds from the outside surface cannot be performed due to the welds being located inside a "sandbox" (installed during the original plant construction after all welding was completed).

The licensee's technical basis for the relief request is based on the temperature dependence on the susceptibility of these welds to primary water stress corrosion cracking (PWSCC) and the previous inspection history at IP3. The licensee notes that the susceptibility to PWSCC of alloy 82/182 welds, such as those that are the subject of this relief request, is largely a function of time and temperature. The RPV inlet cold leg nozzle to safe-end welds operate at a temperature of less than 541.1 degrees Fahrenheit for a significant portion of their operating lifetime. Additionally, the licensee states that the welds would be ranked as moderately susceptible to PWSCC based on the susceptibility formula provided in previously required NRC Order EA-03-009 dated February 11, 2003 (ADAMS Accession No. ML030380470), as revised on February 20, 2004 (ADAMS Accession No. ML040220181) for the upper RPV head penetration nozzles and welds.

The licensee also states that since PWSCC is temperature dependent, it would be expected that hot leg temperature welds would show evidence of crack initiation before cold leg temperature welds, and no evidence of cracking has been identified in either hot leg and cold leg welds at IP3. Further, the cold leg temperature welds that are the subject of this relief request were inspected in March of 2009 with volumetric techniques which verified no indications in the welds.

The licensee provided a crack growth calculation for a hypothetical flaw that would have initiated just after the March 2009 inspection of a RPV inlet cold leg nozzle to safe-end weld at IP3. The licensee applied the recently created guidelines of EPRI Report MRP-287[4], "Primary Water Stress Corrosion Cracking (PWSCC) Flaw Evaluation Guidance," in their evaluation. The licensee stated that their analysis showed significant margin to ensure that ASME Section XI flaw size limits would not be exceeded during the extended period of inspection frequency. Therefore, the licensee found the technical basis sufficient to ensure public health and safety by extending the inspection frequency of the RPV inlet cold leg nozzle to safe-end DM welds at IP3 from a maximum of 7 years to a new maximum of 12 years.

3.2.6 NRC Staff Evaluation

The NRC staff notes that the generic rules for the frequency of volumetric examination of DM butt welds were established to provide reasonable assurance of the structural integrity of the reactor coolant pressure boundary. The NRC staff finds that a plant-specific analysis could be used to provide a technical basis for relief. Hence, the NRC staff reviewed the licensee's

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[4] MRP-287 , "Materials Reliability Program: Primary Water Stress Corrosion Cracking (PWSCC) Flaw Evaluation Guidance, December 2010" Web link from EPRI site: https://www.epri.com/#/pages/product/000000000001021023/?lang=en

proposed alternative under the requirements of 10 CFR 50.55a(z)(1), such that "the proposed alternative will provide an acceptable level of quality and safety."

The licensee's primary technical basis is that the proposed alternative provides reasonable assurance of structural integrity and leak tightness. The licensee also states that no flaw of a size that could have been potentially missed during the 2009 RFO inspection could reasonably grow to an unacceptable size during the period of increased inspection frequency. Therefore, the staff reviewed the licensee's inspection results and flaw analysis to assess the acceptability of RR-12.

The NRC staff reviewed the licensee's previous inspection methods and results to assess the licensee's basis for a maximum hypothetical initial flaw size assumption during the 2009 RFO. The licensee's 2009 examination included an ASME Code, Section XI, Appendix VIII demonstrated volumetric examination obtaining essentially 100 percent coverage that found no indications of surface connected flaws. The NRC staff found the licensee's qualified inspection techniques provide a reasonable basis that any flaw connected to the wetted surface with a depth size of 10 percent in depth or greater should have been identified. As such, the NRC staff found the licensee's data and supporting inspection results provided a reasonable basis for their initial flaw size assumptions.

The NRC staff reviewed the licensee's flaw analysis, which consisted of a stress analysis and a flaw evaluation. The NRC staff reviewed the licensee's stress analysis and found that it followed the recommendations of MRP-287 and numerous NRC public meeting discussions with industry since November 19, 2009, on effective weld residual stress calculations to address PWSCC flaw analysis. The NRC staff notes that the licensee simulated a 50 percent inside surface weld repair 360 degrees around the circumference in its analysis. The licensee also simulated the fabrication sequence based on information provided in the plant specific drawings. The NRC staff found that the use of the maximum stress path through the weld of the three stress paths calculated for hoop stresses was effective and consistent with NRC staff expectations. The NRC staff reviewed the final plant-specific proprietary stress analysis through the thickness of the weld and found both the hoop and axial residual stress curve contours were consistent with generic analyses using similar geometries and fabrication methods as that of IP3. Consequently, the NRC staff found the licensee's plant specific stress analysis for these welds to have adequate inputs and assumptions and, therefore, was acceptable to be used in the flaw evaluation.

The NRC staff found that the licensee's flaw evaluation used reasonable inputs and industry methodologies to determine maximum end-of-evaluation period flaw sizes for both axial and circumferential flaws. The NRC staff noted that the licensee's use of the maximum allowable flaw size of 75 percent of the wall thickness in accordance with the requirements of ASME Code, Section XI, Paragraph IWB-3640, is an adequate approach. The NRC staff found the licensee's use of the MRP-115[5] adequate for the analysis. Further, the NRC staff recognized the licensee's basis of the effect of temperature on the crack growth rates for PWSCC flaws at cold leg operating temperatures. For example, a PWSCC flaw grown in the same material and same environmental conditions will grow, on average, approximately 7 times slower at the cold leg operating temperature at IP3 versus a typical operating hot leg temperature at a U.S. PWR plant. The NRC staff found the use of the MRP-115 crack growth rate and supporting

[5] MRP-115 "Crack Growth Rates for Evaluating Primary Water Stress Corrosion Cracking (PWSCC) of Alloy 82, 182, and 132 Welds," Web link from EPRI site: https://www.epri.com/#/pages/product/000000000001006696/?lang=en

information on cold leg temperature effects were adequate to support the licensee's technical basis.

The last component of the NRC staff's review concerned the licensee's flaw analysis results and the licensee's conclusions to provide a technical basis to support the relief request. Figures 7-1 and 7-2 of the licensee's letter dated February 4, 2014[6], provide the PWSCC crack growth curves through the thickness of the welds for an axial and circumferential flaw, respectively. The NRC staff assessed that the licensee's flaw analysis shows that a flaw would be required to be at least 30 percent depth of the weld in the spring of 2009 in order to grow to the allowable ASME Code flaw size limit (75 percent through wall) in 12 years. The NRC staff finds that the licensee's assessment results support the conclusion that since no flaw was identified in the March 2009 inspection of each weld, the next inspection can be delayed to the spring 2021 RFO while maintaining reasonable assurance of the structural integrity and leak tightness of each weld.

The NRC staff performed independent flaw evaluations to assess the licensee's conclusion. As stated above, the NRC staff notes that the maximum flaw size which could have been unidentified by a qualified volumetric examination of each weld during the 2009 inspection at IP3 was only 10 percent in depth or 0.25-inches. Therefore, since no flaws were identified by the licensee during the 2009 inspection, the NRC staff's flaw evaluations postulated an initial flaw size with a depth of 10 percent of the pipe wall thickness. The staff's flaw evaluations support the finding that there is sufficient margin between the hypothetical maximum size of the postulated flaw after 12 years of growth and the code allowable flaw size to support the licensee's conclusion. Therefore, the NRC staff finds that the licensee has provided an adequate technical basis to support reasonable assurance of structural integrity and leak tightness for the extended inspection frequency requested in RR-12.

Therefore, given the licensee's flaw analysis demonstrating a sufficient safety margin and the supporting technical bases identified above, the NRC staff concludes that the licensee has provided adequate technical basis to demonstrate that the proposed alternative will provide an acceptable level of quality and safety, for the proposed volumetric inspection of the RPV inlet cold leg nozzle to safe-end DM welds at IP3.

## 4.0 CONCLUSION

As set forth above, the NRC staff has determined that the proposed alternative in Relief Request IP3-ISI-RR-11, for Category B-A and B-D examinations, provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the use of IP3-ISI-RR-11 at IP3 to extend the inspection interval from 20 to 22 years for Category B-A and B-D examinations.

The NRC staff has also determined that the proposed alternative in Relief Request IP3-ISI-RR-15, for Category B-N-2 and B-N-3 examinations, demonstrates that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR

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[6] Entergy letter dated February 4, 2014 (ADAMS Accession No.ML14051A166) provided supplemental information to Relief Request IP3-ISI-RR-07 for extension of Code Case N-770-1 weld inspection frequency.

50.55a(z)(2). Therefore, the NRC staff authorizes the use of IP3-ISI-RR-15 at IP3 to extend the inspection interval from 10 to 12 years for Category B-N-2 and B-N-3 examinations.

Finally, the NRC staff has determined that the proposed alternative in Relief Request IP3-ISI-RR-12 will provide an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1), and is in compliance with the *Code of Federal Regulation's* requirements. Therefore, the NRC staff authorizes the use of IP3-ISI-RR-12 at IP3 through the spring 2021 RFO outage.

All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: J. Jenkins
J. Collins

Date: September 18, 2018

SUBJECT: INDIAN POINT NUCLEAR GENERATING UNIT NO. 3 – SAFETY EVALUATION FOR RELIEF REQUESTS IP3-ISI-RR-12 AND IP3-ISI-RR-13 REGARDING APPROVAL OF ALTERNATIVES ASSOCIATED WITH EXTENSION OF FOURTH INTERVAL REACTOR VESSEL AND PIPING WELD INSPECTIONS (EPIDS: L-2017-LLR-0124 AND L-2017-LLR-0127) DATED SEPTEMBER 18, 2018

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