



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

October 26, 2018

Mr. Joel P. Gebbie  
Senior Vice President and  
Chief Nuclear Officer  
Indiana Michigan Power Company  
Nuclear Generation Group  
One Cook Place  
Bridgman, MI 49106

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1 – APPROVAL OF  
ALTERNATIVE TO THE ASME CODE REGARDING REACTOR VESSEL WELD  
EXAMINATION - RELIEF REQUEST ISIR-4-08 (EPID: L-2018-LLR-0106)

Dear Mr. Gebbie:

By letter dated August 1, 2018 (Agencywide Document Access and Management System (ADAMS) Accession No. ML18215A179), Indiana Michigan Power Company (I&M or the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1 for Category B-A and B-D examinations for Donald C. Cook Nuclear Plant (CNP), Unit 1 reactor pressure vessel (RPV) welds and full penetration welded nozzles.

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 to extend the fourth inservice inspection interval at CNP, Unit 1 for Category B-A and B-D examinations from 10 years to 20 years on the basis that the alternative provides an acceptable level of quality and safety.

The NRC staff reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, the licensee demonstrated that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the extended fourth inservice inspection interval (i.e., the existing 10-year fourth and fifth intervals) for ASME Categories B-A and B-D items. The proposed alternative is authorized until the end of the extended fourth interval, which is February 28, 2030.

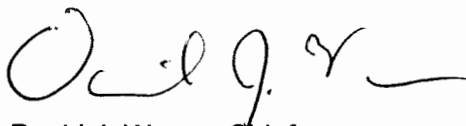
All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

J. Gebbie

- 2 -

If you have any questions, please contact Allison W. Dietrich at 301-415-3826, or via e-mail at Allison.Dietrich@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "D. J. Wrona", with a long horizontal flourish extending to the right.

David J. Wrona, Chief  
Plant Licensing Branch III  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-315

Enclosure:  
Safety Evaluation

cc: via ListServ



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST ISIR-4-08 REGARDING

REACTOR VESSEL WELD EXAMINATION

INDIANA MICHIGAN POWER COMPANY

DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1

DOCKET NO. 50-315

1.0 INTRODUCTION

By letter dated August 1, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18215A179), Indiana Michigan Power Company (I&M, or the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, Table IWB-2500-1 for Category B-A and B-D examinations for Donald C. Cook Nuclear Plant (CNP), Unit 1 reactor pressure vessel (RPV) welds and full penetration welded nozzles.

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 to extend the fourth inservice inspection (ISI) interval at CNP, Unit 1 for Category B-A and B-D examinations from 10 years to 20 years on the basis that the alternative provides an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components must meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in Section XI of the ASME Code.

Regulation 10 CFR 50.55a(z) states that alternatives to the requirements of paragraphs (b) through (h) of 10 CFR 50.55a or portions thereof may be used when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation. The licensee must demonstrate that: (1) the proposed alternatives 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.

Based on the above, and subject to the following technical evaluation, the U.S. Nuclear Regulatory Commission (NRC) staff finds that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

Enclosure

### 3.0 TECHNICAL EVALUATION

#### 3.1 Background

The NRC staff's review of this proposed alternative assessed the consistency of the licensee's proposal with WCAP-16168-NP-A, Revision (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. pressurized water reactors designed by Westinghouse, Combustion Engineering, and Babcock and Wilcox (B&W) 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 concludes that the proposal is acceptable 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" (ADAMS Accession No. ML023240437). However, the SE requires licensees to provide plant-specific information in six areas to demonstrate the applicability of WCAP-A to the licensee's plant. The required plant-specific information are:

- (1) 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 proposed 20-year ISI interval. The 95<sup>th</sup> 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 to as "the NRC PTS Risk Study." 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 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 Pressurized Water Reactor's Owners Group (PWROG) fatigue analysis as significant contributors 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. Licensees 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, "Revision to the Revised Plan for Plant Specific Implementation of Extended Inservice Inspection Interval per WCAP-16168-NP, Revision 1, 'Risk-Informed Extension of the Reactor Vessel In-Service Inspection Interval.' PA-MS-C-0120" (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 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  $RT_{MAX-FO}$  values exceeding 240 °F must submit a plant-specific evaluation because the analyses performed in the 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.

### 3.2 ASME Code Component Affected

The affected components are the CNP RPV welds and full penetration welded nozzles. The following examination categories and item numbers from IWB-2500 and Table IWB-2500-1 of the ASME Code, Section XI, are listed in the August 1, 2018, letter:

<u>Exam Category</u>	<u>Item Number</u>	<u>Description</u>
B-A	B1.10	Shell Welds
B-A	B1.11	Circumferential Shell Welds
B-A	B1.12	Longitudinal Shell Welds
B-A	B1.20	Head Welds
B-A	B1.21	Circumferential Head Welds
B-A	B1.22	Meridional Head Welds
B-A	B1.30	Shell-to-Flange Weld
B-D	B3.90	Nozzle-to-Vessel Welds
B-D	B3.100	Nozzle Inner Radius Section

### 3.3 Applicable Code Edition and Addenda

For the fourth 10-year ISI interval at CNP, Unit 1, the code of record for the inspection of ASME Code Class 1, 2, and 3 components is the 2004 Edition of the ASME Code, Section XI.

### 3.4 Applicable Code Requirements

ASME Code, Section XI, Paragraph IWB-2412, "Inspection Program B," requires volumetric examination of essentially 100 percent of the total number of RPV pressure-retaining welds identified in Table IWB-2500-1, once each 10-year interval.

### 3.5 Licensee's Proposed Alternative

In the August 1, 2018, letter the licensee proposed to perform the fourth ASME Code Category B-A and B-D examination items for CNP, Unit 1 in the fifth ISI interval in 2029, instead of 2019. This is permitted by WCAP-A for the ASME Code Category B-A and B-D examination items when the fourth ISI interval is extended from 10 years to 20 years. The licensee proposed the year 2029 to perform the ASME Code required examination of subject category items. Performing the required examination in year 2029 would be consistent with the schedule proposed in the PWROG letter OG-10-238.

### 3.6 Licensee's Basis for Alternative

The licensee stated that the alternative is based on a negligible change in risk, satisfying the risk criteria specified in RG 1.174. The licensee further stated that the methodology used to conduct this analysis is based on the study defined in WCAP-A. This study focused on risk assessments of materials within the beltline region of the RPV wall. Appendix A of the WCAP-A identifies the four parameters to be compared between an applicant's plant and the appropriate pilot plant. These items include:

1. Dominant PTS Transients in the NRC PTS Risk Study,
2. TWCF,
3. Frequency and Severity of Design Basis Transients, and
4. Cladding Layers (single/multiple).

Table 1 of the enclosure to the August 1, 2018, letter provides the CNP, Unit 1 specific information for the parameters listed above and for the Westinghouse pilot plant. Based on the information in Table 1, the licensee concluded that the parameters for CNP, Unit 1 are bounded by the results of the Westinghouse pilot plant and CNP, Unit 1 is qualified for the ISI interval extension.

For the TWCF parameter, the licensee's calculated value is 1.27E-09 events per year for CNP, Unit 1, as compared to the WCAP-A TWCF of 1.76E-08 events per year for the Westinghouse pilot plant. The details of the TWCF calculation are presented in Table 3, "Details of the TWCF Calculation for CNP Unit 1 at 48 Effective Full Power Years (EFPY)," of the August 1, 2018, letter.

Table 2 of the August 1, 2018, letter, provides the inspection results for CNP, Unit 1 showing that RPV examinations have been performed with satisfactory results.

### 3.7 Duration of Alternative

The licensee stated that the request is applicable to the CNP, Unit 1, ISI program for the fourth and fifth 10-year ISI intervals.

## 4.0 NRC STAFF EVALUATION

Since the WCAP-A methodology has already been accepted by the NRC staff, the current evaluation focused on the manner in which the licensee addressed the four critical parameters (Section 3.6 of this SE), in Table A-1 of WCAP-A, Appendix A, and the six plant-specific information items (section 3.1 of this SE) specified in the NRC SE in the WCAP-A.

The NRC staff reviewed the licensee's evaluation of the four critical parameters (PTS Transients, TWCF, Design Basis Transients, and Cladding Layers) provided in Section 5, "Proposed Alternative and Basis for Use," of the August 1, 2018, letter.

Regarding the PTS transients, the licensee identified the NRC letter report, "Letter Report, Generalization of Plant-Specific Pressurized Thermal Shock (PTS) Risk Results to Additional Plants" (ADAMS Accession No. ML042880482), as its plant-specific basis. NRC staff found that this is acceptable because the SE in WCAP-A concluded that PTS transient characteristics are generally applicable for plants from the same reactor vendor.

Regarding the cladding layers, the licensee reports "single layer" for CNP, Unit 1. This is also acceptable because it is consistent with the Westinghouse pilot plant.

The remaining two critical parameters (TWCF and Design Basis Transients) are among the six plant-specific information items discussed below.

#### 4.1 Plant-Specific Information Item 1

Licensees must provide the 95<sup>th</sup> percentile total through-wall cracking frequency (TWCF<sub>TOTAL</sub>) and its supporting material properties at the end of the proposed 20-year ISI interval.

Table 3 of the August 1, 2018, letter contains a summary of the input parameters for all CNP, Unit 1 RPV materials and the resulting TWCFs for the controlling materials, per Appendix A in WCAP-A. The licensee proposed that the negligible change in risk as indicated in Table 3 demonstrates that CNP, Unit 1 is bounded by WCAP-A and is, therefore, acceptable. Specifically, Table 3 provides chemistry data, unirradiated nil-ductility transition reference temperature (RT<sub>NDT</sub>), and neutron fluence values for all RPV materials, and output shift and TWCF for controlling RPV materials of the unit.

The NRC staff compared Table 3 information from the August 1, 2018, letter with that in WCAP-15878, "D.C. Cook Unit 1 Heatup and Cooldown Limit Curves for Normal Operation for 40 Years and 60 Years," December 2002 (ADAMS Accession No. ML023460503). WCAP-15878 supports the current pressure temperature limits for 32 effective full power years for CNP, Unit 1, as indicated in the CNP license amendment number 323, dated October 1, 2014 (ADAMS Accession No. ML14259A549). Based on this comparison, the NRC staff determined that (1) the chemistry data, chemistry factor, and unirradiated RT<sub>NDT</sub> in Table 3 of the August 1, 2018, letter are identical to those in WCAP-15878, (2) unlike WCAP-15878, Table 3 also contains material information for extended beltline materials with neutron fluence values between 3.24E+17 to 4.27E+17 n/cm<sup>2</sup> (E > 1.0 MeV), and (3) slight discrepancies (< 1.8 %) exist between the fluence values for the beltline materials in Table 3 and in WCAP-15878. Since the discrepancy in neutron fluence of less than 1.8 % is insignificant in  $\Delta RT_{NDT}$  or shift determination (in WCAP-16168, the corresponding symbol is  $\Delta T_{30}$ ), the NRC staff determined that the complete fluence values and the chemistry factors for beltline and extended beltline materials are acceptable.

Table 3, under the heading "Outputs," states that the calculated total TWCF is 1.27E-09 event per year for CNP, Unit 1. The TWCF value was obtained by the licensee using the WCAP-A methodology with inputs from Table 3 of the August 1, 2018, letter, titled "Inputs." RG 1.99, Rev. 2, Position 1.1 (without surveillance data) or Position 2.1 (with surveillance data) was used to calculate RT<sub>MAX</sub> ( $\Delta T_{30}$  + unirradiated RT<sub>NDT</sub> + 460 degrees °F) for 48 effective full power years for all RPV beltline and extended beltline materials for Table 3. Using Table 3 input values, the NRC staff verified the licensee's calculated  $\Delta T_{30}$  value and RT<sub>MAX</sub> value for each beltline material, and the resulting TWCF calculated by the NRC staff for CNP, Unit 1 beltline materials is essentially the same as the licensee's value. This indicates that the contribution to the TWCF due to extended beltline materials is negligible. Based on the above, the NRC staff determined that the TWCF can support the CNP request because it is an order of magnitude lower than the value of 1.76E-08 for the Westinghouse pilot plant in the WCAP-A. Hence, the NRC staff concludes that the licensee has satisfied the Plant-Specific Information Item 1 and the embrittlement of the CNP, Unit 1 RPV is within the envelope used in the Westinghouse pilot plant analysis.

#### 4.2 Plant-Specific Information Item 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 as significant contributors to fatigue crack growth.

The NRC staff reviewed plant-specific information regarding design basis transients provided in Table 1 of the August 1, 2018, letter. The information provided indicated that the heatup/cooldown cycles per year for CNP, Unit 1 are bounded by the heatup/cooldown cycles (7 per year) for the Westinghouse pilot plant. Table 4.1-10, "Design Thermal and Loading Cycles," of CNP, Unit 1 Updated Final Safety Analysis Report (ADAMS Accession No. ML18270A185) indicates that the design cycles for heatup or cooldown for CNP, Unit 1 are 200 (3.33 cycles/year for a period of 60 years), below the bounding value of 7 per year for the Westinghouse pilot plant. Furthermore, Table 4.3-1, "RCS Design Transient – Projection to 60 Years," of the license renewal application (ADAMS Accession No. ML033070182) indicates that the projected number of heatup or cooldown transients at 60 years of operation based on actual cycle counting is 110 for Unit 1 (1.83 per year). Therefore, the NRC staff concludes that the licensee has satisfied Plant-Specific Information Item 2.

#### 4.3 Plant-Specific Information Item 3

Licensees must report the results of prior ISI of RPV welds and the proposed schedule for the next 20-year ISI interval.

The NRC staff reviewed Plant-Specific Information Item 3, regarding the results of prior ISI of RPV welds and the proposed schedule for the extended ISI interval provided in Table 2 of the August 1, 2018, letter. Table 2 contained additional information pertaining to previous RPV inspections and the schedule for the future inspection. Specifically, Table 2 indicated that three 10-year ISIs have been performed for the unit, and no indications were identified in the beltline region of the RPV during the last ISI. Hence, the NRC staff determined that the licensee has satisfied the first part of Plant-Specific Information Item 3.

The licensee proposed to conduct the next RPV inspection in 2029 for the CNP, Unit 1. The NRC staff verified that 2029 is consistent with the RPV inspection date proposed in the PWROG letter OG-10-238. Therefore, the NRC staff determined that the licensee has satisfied the second part of Plant-Specific Information Item 3.

#### 4.4 Plant Specific Information Item 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 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.

The licensee did not address Plant-Specific Information Item 4. The NRC staff confirmed that Plant-Specific Information Item 4 is not applicable to CNP, Unit 1, because CNP, Unit 1 is not a B&W plant.

#### 4.5 Plant Specific Information Items 5

Licensees with RPVs having forgings that are susceptible to underclad cracking with  $RT_{MAX-FO}$  values exceeding 240 °F must submit a plant-specific evaluation because the analyses performed in the WCAP-A are not applicable.

The licensee did not address Plant-Specific Information Item 5. The NRC staff confirmed that Plant-Specific Information Item 5 is not applicable to CNP, Unit 1, because the CNP, Unit 1 RPV



does not have forgings that are susceptible to underclad cracking with  $RT_{MAX-FO}$  values exceeding 240 °F.

#### 4.6 Plant Specific Information Items 6

Licensees seeking second or additional interval extensions shall provide the information and analyses requested in Section (e) of 10 CFR 50.61a.

The licensee did not address Plant-Specific Information Item 6. The NRC staff confirmed that Plant-Specific Information Item 6 is not applicable to CNP, Unit 1, because the licensee is not seeking a second or additional interval extension.

#### 4.7 Clarification on Duration of Alternative

The licensee stated that the August 1, 2018, letter is applicable to the CNP, Unit 1, ISI program for the fourth and fifth 10-year ISI intervals. The NRC staff confirmed that after the fourth ISI interval is extended from 10 years to 20 years for the subject welds, the duration of alternative would be 20 years, with the later half of the duration of alternative overlapping with the existing fifth 10-year ISI interval. Therefore, the licensee's stated duration of alternative is acceptable. The licensee is required to continue performing the ASME Code inspection for the subject examination category items for the fifth 10-year ISI interval.

#### 4.8 Summary

The NRC staff reviewed the licensee's August 1, 2018, application and performed independent calculations to verify the results provided in Table 3 of the letter. The difference between the licensee's and staff's calculated  $TWCF_{95-TOTAL}$  was insignificant. The NRC staff determined that the proposed alternative is based on the WCAP-A methodology, and the  $TWCF_{95-TOTAL}$  values in Table 3 of the August 1, 2018, letter are bounded by the corresponding pilot plant parameter in the WCAP-A. Consequently, the NRC staff concludes that the licensee has demonstrated that the proposed alternative meets the guidance provided by RG 1.174, Rev. 1 for risk-informed decisions and, therefore, will provide an acceptable level of quality and safety.

#### 5.0 CONCLUSION

As set forth above, the NRC staff has determined that the licensee has demonstrated that the proposed alternative provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the extended fourth ISI interval (i.e., the existing 10-year fourth and fifth intervals) for ASME Categories B-A and B-D items. The proposed alternative is authorized until the end of the extended fourth interval, which is February 28, 2030.

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 Contributor: Simon Sheng

Date: October 26, 2018

SUBJECT: DONALD C. COOK NUCLEAR PLANT, UNIT NO. 1 – APPROVAL OF ALTERNATIVE TO THE ASME CODE REGARDING REACTOR VESSEL WELD EXAMINATION - RELIEF REQUEST ISIR-4-08 (EPID: L-2018-LLR-0106) DATED OCTOBER 26, 2018

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