

February 10, 2006

Mr. Mano K. Nazar
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 1 (DCCNP-1) - ALTERNATIVES
REGARDING REPAIR OF SAFE-END-TO-ELBOW WELD 1-RC-9-01F
(TAC NO. MC8807)

Dear Mr. Nazar:

By letter dated September 13, 2005, Indiana Michigan Power Company proposed an alternative under Relief Request ISIR-17 to the repair requirements of Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1", to perform a full structural weld overlay on safe-end-to-elbow weld 1-RC-9-01F. The Nuclear Regulatory Commission (NRC) staff reviewed the referenced submittal and documented its review results in the enclosed safety evaluation (SE).

As delineated in the SE, the NRC staff concludes that the alternatives proposed in Relief Request ISIR-17 for a full structural overlay of weld 1-RC-9-01F at DCCNP-1 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative for the life of the component.

If you have any questions, please call the Project Manager, Mr. Peter Tam at 301-415-1451.

Sincerely,

/RA/

Timothy J. Kobetz, Acting Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-315

Enclosure: As stated

cc w/encl: See next page

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Docket No. 50-315
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM RELIEF REQUEST ISIR-17

DONALD C. COOK NUCLEAR PLANT, UNIT 1 (DCCNP-1)

INDIANA MICHIGAN POWER

DOCKET NO. 50-315

1.0 INTRODUCTION

By letter dated September 13, 2005 (Agencywide Document Access and Management System (ADAMS) Accession No. ML052650326), Indiana Michigan Power Company (the licensee), proposed an alternative under Relief Request ISIR-17 for DCCNP-1 to the repair requirements of Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1" (N-504-2), to perform a full structural weld overlay on safe-end-to-elbow weld 1-RC-9-01F. By letter dated April 12, 2005, as supplemented by letters dated April 15, and April 22, 2005, the licensee proposed alternatives under Relief Request ISIR-15, for DCCNP-1 to the repair requirements of N-504-2 to perform a full structural weld overlay on nozzle to safe end weld 1-PRZ-23 (1-PRZ-23). Weld 1-RC-9-01F was included within the structural overlay performed on weld 1-PRZ-23, but was not included within the scope of Relief Request ISIR-15. Consequently, the weld procedure and qualification processes discussed in the Nuclear Regulatory Commission (NRC) staff's safety evaluation dated December 1, 2005 (ADAMS Accession No. ML053220019) for Relief Request ISIR-15 also apply to Relief Request ISIR-17.

2.0 REGULATORY EVALUATION

Inservice Inspection (ISI) of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Class 1, Class 2, and Class 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Among other things, 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the applicant demonstrates that: (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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the

ENCLOSURE

limitations of design, geometry, and materials of construction of the components. The 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 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ISI Code of record for the DCCNP-1 for the third 10-year ISI interval is the 1989 Edition of the Code with no Addenda.

Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," lists Code Cases approved by the NRC which provide an acceptable voluntary alternative to the mandatory ASME Code provisions. The licensee submitted the Relief Request ISIR-17, pursuant to 10 CFR 50.55a(a)(3)(i), as a proposed alternative to the implementation of N-504-2, for the remainder of the third 10-year ISI interval.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements for which Relief is Requested

IWA-4000 and IWB-4000 of ASME Section XI require repairs to be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system.

3.2 Licensee's Proposed Alternative to the ASME Code

The licensee proposed to use N-504-2 for repair of weld 1-RC-9-01F with the following alternatives:

- (1) Use of a nickel-based alloy weld material, Alloy 52, rather than the low carbon (0.035 percent maximum) austenitic stainless steel.
- (2) Relaxation from the requirement to perform delta ferrite measurements to meet the 7.5 Ferrite Number requirement of N-504-2. The Ferrite Number requirement cannot be met because the Alloy 52 weld material is 100 percent austenitic and contains no delta ferrite.
- (3) Performance of a system pressure test and an ultrasonic examination of the weld overlay using Code Case N-416-1, "Alternative Pressure Test Requirement for Welded Repairs or Installation of Replacement Items by Welding, Class 1, 2, and 3" (N-416-1), versus the hydrostatic test requirement under N-504-2.

3.3 Licensee's Basis for Relief

During the DCCNP-1 Cycle 20 refueling outage, an ultrasonic examination of a weld repair that encompassed weld 1-RC-9-01F identified a circumferential flaw within the stainless steel weld material. The licensee stated that the flaw was most likely related to original construction. Weld 1-RC-9-01F is a safe-end-to-elbow weld containing stainless steel weld material connecting an austenitic stainless steel safe end to a stainless steel elbow. The ASME Code-acceptable repair method would require complete removal of the flaw or acceptance via an ASME Code Section XI, IWB-3600 evaluation. Westinghouse Electric Company, LLC,

performed an evaluation of the flaw in accordance with IWB-3640, and concluded that the flaw size was acceptable for continued service and no repair was required. This was stated in a letter from the licensee dated June 3, 2005 (ADAMS Accession No. ML051650266).

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee stated that the weld overlay has been designed consistent with the requirements of N-504-2 with the specific thickness and length computed according to the guidance provided in the subject Code Case. The overlay will completely cover the indication with Alloy 52 material. The licensee stated that Alloy 52 material is highly resistant to primary water stress-corrosion cracking (PWSCC).

The licensee stated that Code Case N-504-2 was approved for generic use in Regulatory Guide 1.147, Revision 13, and was developed for austenitic stainless steel material. An alternate application for nickel-based and carbon materials is proposed due to the specific configuration of the subject weld. Therefore, the methodology of N-504-2 shall be followed with the following exceptions:

- Paragraph (b) of Code Case N-504-2 requires that the reinforcement weld material shall be low carbon (0.035 percent maximum) austenitic stainless steel. In lieu of the stainless steel weld material, a consumable welding wire highly resistant to PWSCC has been selected for the overlay weld material. This material is a nickel-based alloy weld material, commonly referred to as Alloy 52, and will be applied using a machine gas tungsten arc welding process. Alloy 52 contains about 30 percent chromium that imparts excellent corrosion resistance to this material. This material is suitable for welding over the carbon steel nozzle, Alloy 82/182 weld material, stainless steel safe end, stainless steel weld material, and stainless steel piping as it is compatible with the existing weldment and base materials. The licensee stated that this alternative provides an acceptable level of safety and quality.
- Paragraph (e) of Code Case N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 Ferrite Number for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52 is 100 percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60 percent nickel).
- Paragraph (h) of Code Case N-504-2 requires a system hydrostatic test of the completed repair if the flaw(s) penetrated the original pressure boundary or if there is any observed indication of the flaw penetrating the pressure boundary during repair. In lieu of hydrostatic testing, a system pressure test and an ultrasonic examination of the weld overlay shall be performed in accordance with the Third Interval ISI Program and Code Case N-416-1. This alternative requirement is sufficient to demonstrate that the overlay is of adequate quality to ensure the pressure boundary integrity. The repair, pre-service inspection, ISI examination of the weld overlay repair shall be performed in accordance with the ISI Program, NUREG-0313, Revision 2, Generic Letter 88-01, and approved plant procedures as specified by the ISI Repair/Replacement Program. The weld overlay shall be examined in accordance with the industry-developed Performance Demonstration Initiative procedure. As required by N-416-1, nondestructive examination

shall be performed to ASME Section III, 1992 Edition, Subsection NB requirements to the extent practical. The acceptance criteria for the volumetric examinations shall be ASME Section XI, Paragraph IWB-3514, "Standards for examination Category B-F, Pressure Retaining Dissimilar Metal Welds, and Category B-J, Pressure Retaining Welds In Piping."

The licensee stated that the use of overlay filler material that provides excellent resistance to PWSCC develops an effective barrier to flaw extension by corrosion processes. The design of the overlay for the nozzle-to-safe end weldment uses methods that are standard in the industry. There are no new or different approaches in this overlay design which are considered first-of-a-kind or inconsistent with previous approaches. The overlay has been designed as a full structural overlay in accordance with Code Case N-504-2. The licensee concluded that the alternative repair approach described above presents an acceptable level of quality and safety which meets the requirements of 10 CFR 50.55a(a)(3)(i).

3.4 NRC Staff's Evaluation

Under the provisions of IWA-4120, in editions and addenda up to and including the 1989 Edition with the 1990 Addenda, defects shall be removed or reduced in size in accordance with IWA-4300. Alternatively, the component may be evaluated and accepted in accordance with the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III. Code Case N-504-2 was used by the licensee to increase the wall thickness of weld 1-PRZ-23; the repair weld ultimately extended over 1-RC-9-01F. Code Case N-504-2 was unconditionally approved by the NRC staff for use under Regulatory Guide 1.147, Revision 13, therefore, the use of N-504-2 as an alternative to the mandatory ASME Code repair provisions is acceptable to the staff, provided that all provisions of the Code Case are complied with.

The first proposed alternative to the Code Case N-504-2 provisions involved the use of a nickel-based alloy weld material, rather than the low-carbon austenitic stainless steel. The licensee stated that Paragraph (b) of Code Case N-504-2 requires that the reinforcement weld material shall be low-carbon (0.035 percent maximum) austenitic stainless steel. In lieu of the stainless steel weld material, Alloy 52/152, a consumable welding wire highly resistant to PWSCC, was proposed for the overlay weld material. Operational experience and published data have shown that PWSCC in Alloy 82/182 welds will blunt at the interface with the stainless steel base metal, carbon steel base metal, or Alloy 52/152 weld metal. The licensee is applying a 360-degree, full structural weld overlay to control growth of the axial crack and ultimately maintain structural integrity of weld 1-PRZ-23. The weld overlay will put compressive stress around the weldment, thus impeding growth of the construction type flaw in weld 1-RC-9-01F and, therefore, will fulfill all structural requirements, independent of the existing flawed weld.

The NRC staff notes that the use of 52/152 material is consistent with weld filler material used to perform several similar weld overlays to operating boiling-water reactor (BWR) facilities with similar geometry and overlay dimensions. Studies have been performed by the Electric Power Research Institute in qualifying weld overlays for application in BWRs, and in these applications, the studies have not identified any issues with shrinkage stress or weld contraction stresses. The similarities of design between BWR nozzles and the weld overlay dimensions of weld 1-RC-9-01F provide assurance that there is a correlation in the performance of weld shrinkage and weld contraction stresses in the subject weld. The NRC staff concludes,

therefore, that the proposed use of Alloy 52/152 weld material for the structural overlay provides an acceptable level of quality and safety and is, therefore, acceptable.

The second proposed alternative to the N-504-2 provisions involved Paragraph (e) of Code Case N-504-2, which requires as-deposited delta ferrite measurements of at least 7.5 Ferrite Number for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52 material is 100 percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60 percent nickel). In its letter dated April 22, 2005 (ADAMS Access No. ML051290122), the licensee revised Relief Request ISIR-15 to welding a portion of Alloy 152 shielded metal arc welding manual welding over the newly deposited semi-automatic wire production weld (Alloy 52). During a telephone discussion, the licensee indicated that it was necessary to perform this welding over a portion of 1-PRZ-23 in order to achieve an as-welded contour that allowed for completing the post weld ultrasonic examination required by N-504-2 without losing ultrasonic contact. The licensee indicated in its April 22, 2005, letter, that heat input requirements were controlled and maintained at 22,000 joules/inch whereas the average heat input for the production weld was 27,174 joules/inch. Maintaining the heat input within certain parameters is a function of the weld procedure specification (WPS), and is necessary to maintain as-welded properties and minimize high residual stresses in the deposited weld. The licensee also indicated that its vendor had completed impact requirements (Charpy V-Notch) for the manual welding version of the Alloy 52/152 WPS. The licensee indicated that the vendor completed the required tests and documented them in a procedure qualification record (PQR). The licensee indicated that the revised PQR and WPS satisfactorily bound the parameters for the production weld.

Since the same WPS was used to overlay weld 1-RC-9-01F, the NRC staff concludes that, based upon the control of heat input properties, successful completion of the Charpy V-Notch tests, and the NRC staff's earlier conclusion that the use of Alloy 52/152 filler material provides an acceptable level of quality and safety, the licensee's alternative to eliminate the performance of the delta ferrite testing will provide an acceptable level of quality and safety for weld 1-RC-9-01F, and is, therefore, acceptable.

The third alternative proposed in relief request ISIR-17 is to perform a system pressure test and an ultrasonic examination of the weld overlay in accordance with the licensee's third interval ISI Program and Code Case N-416-1. Code Case N-416-1 was approved for use by the NRC staff in Regulatory Guide 1.147, Revision 12. As described in its safety evaluation for Relief Request ISIR-15, the NRC staff asked the licensee why it chose to use the Code Case N-416-1 version approved in Regulatory Guide 1.147, Revision 12, rather than the most current version which is approved in Regulatory Guide 1.147, Revision 13. The licensee indicated that Code Case N-416-1 was used because it was the version currently listed in its Third Interval ISI Program. The NRC staff reviewed the differences between Revisions 12 and 13 and noted no significant changes in the requirements between the two versions, and that only the scope of applicability was changed in Revision 13. On the basis of the acceptance of Revision 12 in a staff safety evaluation dated June 27, 2005 (ADAMS Accession No. ML051720006), the NRC staff concludes that the use of Code Case N-416-1 provides an acceptable level of quality and safety.

Code Case N-416-1 requires that nondestructive examination shall be performed in accordance with the methods and acceptance criteria of the applicable subsection of the 1992 Edition of

ASME Code Section III. The acceptance criteria in Section III do not allow the presence of cracks, regardless of length, and is geared more towards construction type welds. The licensee's use of the post-repair nondestructive examination requirements of Code Case N-504-2 utilizing the appropriate Performance Demonstration Initiative (PDI) procedure as mentioned above is acceptable. The post-repair examination volume includes the full thickness of the weld overlay plus 25 percent of the underlying base metal thickness. The specimen sets for PDI qualification for weld overlay examinations include construction type flaws. Therefore, use of PDI-qualified personnel and procedures for the examination of the weld overlay will result in the reliable detection of construction type flaws and meets the intent of compliance with the applicable subsection of the 1992 Edition of Section III. Finally, in its safety evaluation dated June 27, 2005, the NRC staff approved the use of PDI in lieu of Appendix VIII, Supplement 11, requirements for overlay welds at DCCNP-1.

4.0 CONCLUSION

Based on the discussion above, the NRC staff concludes that the alternatives proposed in Relief Request ISIR-17 for a full structural overlay of weld 1-RC-9-01F at DCCNP-1 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative for the life of the component.

All other ASME Code, Section XI 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.

Principal Contributor: T. Steingass

Date: February 10, 2006

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