April 26, 2007

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) - ALTERNATIVE REGARDING USE OF PREEMPTIVE WELD OVERLAYS (PWOLs) ON CERTAIN DISSIMILAR METAL WELDS (TAC NO. MD2119)

Dear Mr. Nazar:

By letter dated June 9, 2006, as supplemented by letters dated September 15, September 26, November 6, and December 7, 2006, Indiana Michigan Power Company requested relief from certain American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME) Code, Section XI, requirements at DCCNP-1. In its application, the licensee submitted Relief Request ISIR-21 and proposed alternatives to the ASME Code requirements in (1) Code Cases N-504-2 and N-638-1, and (2) Appendix VIII, Supplement 11, for the purpose of performing preemptive structural weld overlays on the pressurizer nozzle safe-end-to-nozzle dissimilar metal welds to mitigate the occurrence of primary water stress corrosion cracking (PWSCC) prior to detectable evidence of PWSCC. On September 27, 2006, the Nuclear Regulatory Commission (NRC) staff gave DCCNP-1 temporary verbal approval of the proposed alternatives.

Based on the enclosed safety evaluation, the NRC staff concludes that the alternatives to the ASME Code requirements in (1) Code Cases N-504-2 and N-638-1, and (2) Appendix VIII, Supplement 11, in Relief Request ISIR-21 for the preemptive full structural overlay at DCCNP-1 for the welds listed in the licensee's submittals cited above 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 alternatives to Code Cases N-504-2 and N-638-1 for the remaining service life of the subject welds. Secondly, pursuant also to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternatives to Appendix VIII, Supplement 11, for the remainder of the third 10-year ISI interval. 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.

If you have any questions regarding this approval, or need clarification of the enclosed safety evaluation, please contact the Project Manager, Mr. Peter Tam at 301-415-1451.

Sincerely,

/RA/

L. Raghavan, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-315

Enclosure:
Safety Evaluation

cc w/encl: See next page

If you have any questions regarding this approval, or need clarification of the enclosed safety evaluation, please contact the Project Manager, Mr. Peter Tam at 301-415-1451.

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DATE	3/21/07	3/21/07	2/28/07	4/6/07	4/26/07

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE INSPECTION PROGRAM RELIEF REQUEST ISIR-21

INDIANA MICHIGAN POWER COMPANY, LLC

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

DOCKET NO. 50-315

1.0 INTRODUCTION

By letter dated June 9, 2006 (Accession No. ML061710464), as supplemented by letters dated September 15, 2006 (Accession No. ML062630142), September 26, 2006 (2 letters, Accession Nos. ML062720122 and ML062780203), November 6, 2006, (Accession No. ML063190295), and December 7, 2006 (Accession No. ML063530335), Indiana Michigan Power Company (the licensee) submitted Relief Request ISIR-21 for DCCNP-1. The licensee proposed to modify the repair requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME 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), and Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1" (N-638-1). Relief Request ISIR-21 would be used to perform full structural preemptive weld overlays (PWOLs) on pressurizer spray, safety, relief, and surge nozzle safe-end-to-nozzle dissimilar metal welds and weld overlays for the elbow-to-safe-end welds. The subject welds were fabricated using NiCrFe Alloy 82/182 weld material to butter the nozzle weld geometry ends and to weld the safe ends. The licensee stated that this weld material has demonstrated a propensity for primary water stress corrosion cracking (PWSCC) in the licensee's nuclear fleet. The licensee intends to mitigate the effects of cracking on specific DCCNP-1 welds by applying full structural PWOLs prior to the onset of PWSCC.

On September 27, 2006, the Nuclear Regulatory Commission (NRC) staff provided temporary verbal approval of the proposed alternative in accordance with the provisions of NRR Office Instruction LIC-102, "Relief Request Reviews," Rev. 1. The NRC staff's review of the licensee's submittals is set forth below.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (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 (ISI) of Nuclear Power Plant Components," to the extent practical within the 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 DCCNP-1 for the third 10-year ISI interval is the 1989 Edition of the Code with no addenda.

In accordance with 10 CFR 50.55a(g)(6)(ii)(C)(1), the implementation of Supplements 1 through 8, 10, and 11 of Appendix VIII to Section XI, 1995 edition with the 1996 addenda of the ASME Code, was required on a phased schedule ending on November 22, 2002. Supplement 11 was required to be implemented by November 22, 2001. Additionally, 10 CFR 50.55a(g)(6)(ii)(C)(2) requires licensees implementing the 1989 edition and earlier editions of paragraph IWA-2232 of Section XI of the ASME Code to implement the 1995 edition with the 1996 addenda of Appendix VIII and supplements to Appendix VIII of Section XI of the ASME Code.

Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI Items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to NRC approval. Portions of editions and addenda may be used provided that related requirements of the respective editions and addenda are met.

Pursuant to 10 CFR 50.55a(a)(3) alternatives to requirements may be authorized by the NRC if the licensee demonstrates that: (i) the proposed alternatives provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee's Relief Request ISIR-21, submitted under 10 CFR 50.55a(a)(3)(i), proposed modifications to the implementation of the ASME Code, Section XI, Appendix VIII, Supplement 11, Code Cases N-638-1 and N-504-2, for the deposition of PWOLs for the remaining service life of the components including the period of extended operation.

3.0 TECHNICAL EVALUATION

3.1 Code Requirements for Which Relief is Requested

Under the rules of IWA-4120, repairs shall be performed in accordance with the licensee's design specification and the original Construction Code. Later editions and addenda of the Construction Code or of ASME Section III, either in their entirety or portions thereof, and Code Cases may be used. For Relief Request ISIR-21, the Code Cases are N-504-2 and N-638-1, to be modified as proposed by the licensee. Relief Request ISIR-21 is also concerned with ASME Section XI, 1995 Edition including Addenda through 1996, Appendix VIII, Supplement 11, which is required to be implemented per 10 CFR 50.55a(g)(6)(ii)(C).

3.2 Licensee's Proposed Modifications to N-504-2

The licensee proposed to use N-504-2 for full structural PWOLs for the subject components with the following modifications:

(1) Use of a nickel-based alloy weld material, Alloy 52/52M/152 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 52/52M/152 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), instead of the hydrostatic test requirement under N-504-2.

The proposed alternative to apply PWOLs over the welds identified in ISIR-21 is Cycle 21 refueling outage, which began on September 21, 2006. The duration of the proposed alternative for all PWOLs installed during the Cycle 21 refueling outage is for the life of the plant, including the period of extended operation.

3.2.1 Licensee's Basis for Relief

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee stated that the weld overlay has been designed to be 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 licensee stated that Alloy 52 material is highly resistant to PWSCC, and that industry operational experience has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52/52M/152. Alloy 52 (152) or Alloy 52M (152M) will be used if local repairs of weld defects are necessary or additional weld metal is required locally to form the final PWOL contour.

Paragraph (e) of N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 Ferrite Number for the weld reinforcement. The licensee proposed to not perform delta ferrite measurements for this overlay because the deposited Alloy 52/Alloy 52M is 100 percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60 percent nickel).

Paragraph (h) of 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. Instead of hydrostatic testing, the licensee proposed to perform a system pressure test and an ultrasonic examination of the weld overlay in accordance with the Third Interval ISI Program and N-416-1. This modification was previously approved by the NRC staff for use by the licensee on July 24, 1995 (Accession No. 9508030133) .

3.2.2 NRC Staff Evaluation of Modifications to N-504-2

Under the rules of IWA-4120, in editions and addenda up to and including the 1989 Edition with the 1990 Addenda, repairs shall be performed in accordance with the owner's design specifications and the original Construction Code of the component or system. Later editions and addenda of the Construction Code, or of Section III, either in their entirety or in part, and Code Cases may be used. In addition, 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 is not Section III. N-504-2 is being used by the licensee to perform PWOLs

for pressurizer spray, safety, relief, and surge nozzle safe-end-to-nozzle dissimilar metal welds and PWOLs for the elbow-to-safe-end welds. N-504-2 was conditionally approved by the NRC staff for use under Regulatory Guide 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1." Therefore, the licensee's use of N-504-2 as an alternative to the mandatory ASME Code repair provisions is acceptable to the NRC staff, provided that all conditions and provisions of the Code Case are complied with.

The first proposed modification to the N-504-2 provisions involves the use of a nickel-based alloy weld material, rather than the low carbon austenitic stainless steel. The licensee stated that Paragraph (b) of N-504-2 requires that the reinforcement weld material shall be low carbon (0.035 percemt maximum) austenitic stainless steel. Instead of the stainless steel weld material, Alloy 52/52M/152, a consumable welding wire highly resistant to PWSCC, was proposed for the overlay weld material. The NRC staff notes that the use of 52/52M/152 material is consistent with weld filler material used to perform similar weld overlays at operating boiling-water reactor (BWR) facilities. The NRC staff concludes, therefore, that the proposed use of Alloy 52/52M/152 weld material for the full structural PWOLs provides an acceptable level of quality and safety and is, therefore, acceptable.

The second proposed modification to the N-504-2 provisions involved Paragraph (e) of N-504-2, which requires as-deposited delta ferrite measurements of at least 7.5 Ferrite Number for the weld reinforcement. The licensee proposed not to perform delta ferrite measurements for this overlay because the deposited Alloy 52/52M/152 material is 100 percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60 percent nickel). N-504-2 allows the use of weld overlay repair by deposition of weld reinforcement on the outside surface of the pipe instead of mechanically reducing the defect to an acceptable flaw size. However, N-504-2 is designed for the weld overlay repair of austenitic stainless steel piping. Therefore, the material requirements regarding the carbon content limitation (0.035 percent maximum) and the delta ferrite content of at least 7.5 FN, as delineated in N-504-2, paragraphs (b) and (e), apply only to austenitic stainless steel weld overlay materials. These requirements are not applicable to Alloy 52/52M/152, a nickel-based material, which the licensee will use for the weld overlays.

The NRC staff notes that the licensee is performing full structural PWOLs on dissimilar metal welds made of Alloy 182 material. For material compatibility in welding, the NRC staff considers Alloy 52/52M/152 a better choice of filler material than austenitic stainless steel material for this weld joint configuration. Alloy 52/52M/152 contains about 30 percent chromium, which provides excellent resistance to PWSCC in the reactor coolant environment. This material is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 Filler Metal, and has been previously approved by the NRC staff for applications under similar circumstances (e.g., D. C. Cook Unit 2, March 1, 2007). Therefore, the licensee's proposed use of Alloy 52/52M/152 for the weld overlays as a modification to the requirements of N-504-2, paragraphs (b) and (e), is acceptable as it will provide an acceptable level of quality and safety.

Paragraphs (g)(2) and (g)(3) of N-504-2 require that evaluations of stress be conducted taking into consideration the residual stresses produced by the weld overlay (WOL) with other applied loads on the system, along with potential increases in loading (including shrinkage effects due to all the WOLs in the system). Specific acceptance criteria for the stresses will be met in accordance with the Construction Code. The licensee submitted the stress summaries in its December 7, 2006, letter, stating that the requirements of Paragraph (g)(2) of ASME Code Case N504-2 are met, and the repair has been shown to be acceptable for the remaining service life of DCCNP-1.

The licensee's proposed modification of Paragraph (h) of N-504-2 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 N-416-1. N-416-1 was approved for use by the staff in Regulatory Guide 1.147, Revision 12. The licensee indicated that 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 of Regulatory Guide 1.147 and noted no significant changes in the requirements between the two Code Cases, and that only the scope of applicability was changed in Revision 13. On the basis of its previous acceptance of the licensee's weld overlay qualification method (see letter to licensee regarding Performance Demonstrating Initiative (PDI) dated June 27, 2005; Accession No. ML051720006), the staff concluded that the use of N-416-1 provides an acceptable level of quality and safety.

N-416-1 requires that nondestructive examination be performed in accordance with the methods and acceptance criteria of the applicable subsection of the 1992 Edition of Section III. The acceptance criteria in Section III do not allow the presence of cracks, regardless of length, and are geared more towards construction type welds. The licensee's use of the post-repair nondestructive examination requirements of N-504-2 utilizing the appropriate PDI procedure as mentioned above is acceptable. 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 staff approved the use of the PDI's alternative implementation for weld overlay inspections instead of Appendix VIII, Supplement 11 requirements. Therefore, the licensee's proposed use of Code Case N-416-1, instead of the hydrostatic test requirement under Code Case N-504-2, is acceptable.

3.3 Licensee's Proposed Modifications to N-638-1

The licensee proposed to use N-638-1 for full structural PWOLs for the subject components with the following modifications:

(1) The maximum area of an individual weld, based on the finished surface over the ferritic material, shall be 300 sq. in., which is a modification to Paragraph 1.0(a) in N-638-1.

(2) For the application of the PWOLs, full ultrasonic examination (UT) of the 1.5T band will not be performed. This is a modification to Paragraph 4.0(b).

3.3.1 Licensee's Basis for Relief

The licensee stated that the PWOLs will require welding of more than 100 sq. in. of surface on the surge nozzle low alloy steel base material. The PWOLs will extend to the transition taper of the low alloy steel nozzle so that qualified UT of the required volume can be performed. The licensee also stated that there have been a number of temper bead WOL repairs applied to safe-end-to-nozzle welds in the nuclear industry, and that a WOL repair having a 300 sq. in. surface was recently approved by the NRC staff for the Susquehanna Steam Electric Station (NRC letter, June 22, 2005). The licensee indicated that ASME Code Case N-432-1 (N-432-1), which is approved for use in RG 1.147, allows temper bead welding on low alloy steel nozzles without limiting the temper bead weld surface area. The two additional conditions required by N-432-1 that are not required by N-638-1 are that temper bead welds have preheat applied and

that the procedure qualification be performed on the same specification, type, grade and class of material. The elevated preheat would present a radiation exposure burden when performing the repair.

For the application of the PWOL repair addressed in this request, it is not practical to perform a meaningful UT of the required band of base material because of the existing nozzle configuration. The licensee stated that Code Case N-638-1 applies to any type of welding where a temper bead technique is to be employed, and is not specifically written for a WOL repair. Experience from D.C. Cook Unit 2 (DCCNP-2) shows the 1.5T examination causes increased dose, outage time, and cost without a commensurate increase in safety. The base material is cast carbon steel and not subject to weld stress residual cracking. Indications in this type of material are generally casting inclusions which preclude meaningful examination. IWA-4534 requires UT of the weld region only. The Code Case requirements are based on repair of material with flaws that have been removed prior to welding. Therefore, there is a concern that other incipient or existing flaws in the immediate area may not have been properly cleared prior to welding, and possibly increased in size as a result of welding. The primary purpose of the examination is to detect flaws that may be revealed as a result of the repair. In this case, there are no known flaws in the ferritic steel base metal that is being repaired. For the PWOL, the primary potential concern would be flaws occurring in the heat-affected zone adjacent to and beneath the weld in the nozzle carbon steel base material due to welding. The licensee stated that UT examination of the PWOL (welded region) will be performed, and dye penetrant examination of both the weld and 1.5T band on the ferritic steel nozzle will be performed. Such examinations are sufficient to verify that defects have not been induced in the ferritic carbon steel nozzle material due to the welding process.

3.3.2 NRC Staff Evaluation of Modifications to N-638-1

The licensee is applying a 360-degree, full structural PWOL to reduce the susceptibility of the original weld to the initiation and growth of PWSCC and ultimately to maintain weld integrity. The full structural PWOL will fulfill all structural requirements, independent of the existing weld. Operational experience has also shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, carbon steel base metal, or Alloy 52/152 weld metal, if cracking were to occur.

To eliminate the need for preheat and post-weld heat treatment under the Construction Code, the industry developed a temper bead welding technique which was published as N-638-1. The NRC recently endorsed N-638-1 in RG 1.147, Revision 14. The temper bead technique carefully controls heat input and bead placement which allows subsequent welding passes to relieve stress and temper the heat-affected zones of the base material and preceding weld passes. The welding is performed with low hydrogen electrodes under a blanket of inert gas. The inert gas shields the molten metal from moisture and hydrogen. Therefore, the need for the preheat and post-weld heat treatment specified by the ASME Construction Code is not necessary to produce a sound weld using the temper bead process, as described in N-638-1.

The licensee intends to follow the methodology of N-638-1, except paragraph 1.0(a) which requires that the maximum area of an individual weld, based on the finished surface, be limited to 100 square inches, and the depth of the weld to exceed one-half of the ferritic base metal thickness. This condition is not being met because the design for the weld overlay covers an area up to approximately 300 square inches which exceeds the limitations of N-638-1. The licensee will perform an evaluation, as noted in Section 3.2.2 of this safety evaluation, in order

to determine the effect of exceeding the 100 square-inch area limitation for temper bead welding onto a low alloy steel nozzle. This evaluation will be conducted under the guidance of N-504-2. Paragraphs (g)(2) and (g)(3) require consideration of the residual stresses produced by the weld overlay in combination with other applied loads on the system. The evaluation of other welds and components in the system should consider potential increases in loading, including shrinkage effects, due to all weld overlays in the reactor coolant system. These welds and components must meet the applicable stress limits of the Construction Code. The NRC staff considers these evaluations important to assure that the reactor coolant system will not be adversely affected after PWOLs are deposited.

The NRC staff notes that several similar weld overlays have been applied to BWR facilities (e.g., D. C. Cook Unit 2, March 1, 2007; Duane Arnold, November 19, 1999) with similar geometry and overlay dimensions. The Electric Power Research Institute (EPRI) has performed studies to qualify weld overlays for application in BWRs, and in these applications, the studies have not identified any issues with shrinkage stresses or weld contraction stresses. The DCCNP-1 weld overlay design is generally similar to the design applied in BWR feedwater, core spray, and recirculation nozzles. Published literature shows that compressive stress remains on the inside surface near the weld, which supports mitigation of some degradation mechanisms, such as PWSCC. In some cases, the extended overlay results in higher compressive stress than is present in the 100 square-inch case. Thus, the residual stresses remain in compression on the inside surface of the weld as the nozzle overlay area increases. This observation supports mitigation of the degradation mechanism. Thus, increasing the overlay area is acceptable for this specific application, i.e., to support the mitigation of the PWSCC degradation mechanism and in this geometry (piping). Based on the preceding discussion and the NRC staff's review of the licensee's December 7, 2006, letter (addressing stress analysis, which is required by N-504-2), the NRC staff concludes that the modification to increase the PWOL to 300 sq. in. maximum will provide an acceptable level of quality and safety and is, therefore, acceptable.

The second modification requested by the licensee is that full UT of the 1.5T band will not be performed as required under Paragraph 4.0(b) of Code Case N-638-1. Using Code Case N-638-1, the temper bead weld technique is to be used for filling a cavity in the base metal. The licensee's application, however, is for a structural weld overlay above the base metal, which results in a contour that is UT inspectible except for the edge taper where the overlay transitions to the nozzle surface and on the curvature of the nozzle. The proposed weld edge configuration has the same UT examination difficulties as are considered under ASME Section XI, Appendix Q. Appendix Q only requires a surface examination of the tapered area of the weld overlay. In addition to verifying the soundness of the weld, an additional purpose of the ultrasonic examination is to assure that delayed cracking, which may be caused by hydrogen introduced during the temper bead welding process or cracking in unannealed ferritic material, does not occur. In the unlikely event that cracking does occur, it would be initiated on the surface on which the welding is actually performed or in the heat-affected zone immediately adjacent to the weld. As stated above, Appendix Q of ASME Section XI only requires a surface examination of the subject area, therefore, the NRC staff finds that use of a surface examination in the area of the weld overlay taper and band beyond the toe of the overlay on the ferritic material is acceptable in that it provides an acceptable level of safety and quality.

The use of the PDI protocol that modifies Supplement 11, instead of ASME Code Section XI, Appendix VIII, Supplement 11 is acceptable because the PDI methodology uses construction type flaws in the standards used to qualify equipment, procedures, and personnel. Therefore,

the guidance established in Reg. Guide 1.147 for the use of Code Case N-638-1 is met. ASME Code Section III flaw acceptance standards are based on the capability of radiography to detect and size flaws originating from the fabrication process used during new facility construction. The ASME Code Section III acceptance criteria do not allow for the presence of any cracks or crack-like indications, regardless of their size, and are geared more towards volumetric flaws. The capability of radiography is a function of the density differences such as 2 percent or greater changes in density. The density changes normally associated with cracks, depending on orientation, are much less than the detection capability of radiography. There is an inherent, unknown tolerance in the Section III acceptance criteria for radiography which encompasses tight cracks and densities below the detection capabilities of radiography. Flaws detected using radiography are not precise enough for applying Section XI crack growth analyses, as flaw depth cannot be measured with radiography. Section III radiography is not applicable for evaluating flaws for continued plant operations because of the difficulty associated with depth sizing flaws.

The weld overlays in this request are intended to mitigate PWSCC in dissimilar metal welds at DCCNP-1. The application of Code Case N-504-2 allows the use of austenitic (Alloy 52\52M) weld metal on austenitic base material. The application of Code Case N-638-1 allows the use of austenitic weld metal on ferritic base material using a controlled heat input that relieves welding stresses and prevents crack sensitive microstructures in the ferritic material. The purpose of N-638-1 is to establish an austenitic surface for the application of N-504-2 to complete the structural weld overlay. The N-638-1 applied weld metal is sandwiched between base metal and N-504-2 weld metal. Placing a flaw in N-638-1 weld metal using Section III radiography would be extremely difficult.

Many flaws that are not detected or accurately sized with radiography have a high likelihood of being detected and sized with UT, depending on orientation of the flaw. These flaws are normally detected with UT during the Section XI preservice inspection. Also the preservice UT is used to characterize flaws detected during the Section III radiography examination. The flaws of concern are the ones that cause failure immediately or grow to failure in the future. The Section XI preservice acceptable flaw standards were developed to consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately their potential structural impact of the flaw on the component. The flaws detected during preservice inspections are subjected to periodic inservice inspections as established in Appendix Q, Q-4300. This includes inspection frequencies for monitoring existing crack growth and identifying new cracks.

Thus, the established preservice NDE acceptance criteria in Code Case N-504-2 for weld overlays made with Alloy 52/52M weld metal also apply to the portion of the weld overlay made during the application of N-638-1 as modified by this safety evaluation. The established preservice NDE acceptance criteria in Code Case N-504-2 and Appendix Q for weld overlays made with Alloy 52/52M weld metal should also be applied to the portion of the weld overlay made during the application of N-638-1, as an acceptable level of safety and quality will be maintained.

3.4 ASME Code Section XI, 1995 Edition including Addenda through 1996, Appendix VIII, Supplement 11 Requirements for which Relief is Requested

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested relief from the weld overlay inspection qualification requirements in the following paragraphs to Section XI, Appendix VIII, Supplement 11 (only those items considered by the staff to be modifications to Appendix VIII Supplement 11 are listed below):

- Paragraph 1.1(b) limits the maximum thickness for which a procedure may be qualified. Also, the specimen set must include at least one specimen with overlay thickness within minus 0.10 inches to plus 0.25 inches of the maximum nominal overlay thickness for which the procedure is applicable.

- Paragraph 1.1(d)(1) requires that all base metal flaws be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending through at least 75 percent of the base metal wall.

- Paragraph 1.1(e)(1) requires that at least 20 percent but not less than 40 percent of the flaws shall be oriented within ±20 degrees of the axial direction.

- Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. Specimens shall be divided into base and overlay grading units with each specimen containing one or both types of grading units.

- Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld and the outer 25 percent of the overlaid weld and base metal on both sides.

- Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit.

- Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.

- Paragraph 3.1 requires examination procedures, equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.

- Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.1 in. are reported as being intrusions into the overlay material.In lieu of the requirements of ASME Code, Section XI, 1995 edition, 1996 Addenda, Appendix VIII, Supplement 11, the PDI program as described in Table 3 of the licensee's submittal shall be used. The duration of the relief is for the remainder of the third 10-year inservice inspection interval.

3.4.1 Licensee's Basis for Relief

The licensee stated that the ultrasonic examination of the completed preemptive weld overlays will be accomplished in accordance with ASME Code, Section XI, 1995 Edition with the 1996 Addenda, Appendix VIII, Supplement 11 with the modifications described in Table 3 of the submittal. These modifications were developed by the EPRI's PDI program to implement the requirements of Appendix VIII. These EPRI Supplement 11 modifications have previously been approved for use by the staff.

3.4.2 NRC Staff Evaluation of Licensee's Proposed Implementation of PDI Modifications to ASME Code Section XI, 1995 Edition Including Addenda through 1996, Appendix VIII, Supplement 11

The U.S. nuclear licensees created the PDI program to implement performance demonstration requirements contained in Appendix VIII of Section XI of the ASME Code. To this end, the PDI program has developed a program for qualifying equipment, procedures, and personnel in accordance with the UT criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, EPRI was maintaining a performance demonstration program (the precursor to the PDI program) for weld overlay qualification under the Tri-party Agreement with NRC in the NRC letter dated July 3, 1984 (ADAMS Accession No. 8407090122). This NRC letter to EPRI defined a coordination plan for training and qualification activities of NDE personnel employed in performance of ultrasonic examination of piping weldments during ISI of BWR power plants. Instead of having two programs with similar objectives, the NRC staff recognized the EPRI PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement in its letter dated January 15, 2002, to the PDI Chairman (ADAMS Accession No. ML020160532). As stated in the January 15, 2002, letter issued by the NRC, the purpose of the letter was to inform the PDI program that the PDI's performance demonstration program for weld overlays was an acceptable alternative to the performance demonstration recommendations of NRC Generic Letter (GL) 88-01, "NRC Position on IGSCC [Intragranular Stress-Corrosion Cracking] in BWR Austenitic Stainless Steel Piping," dated January 25, 1988.

Although the PDI program was developed during ISIs at BWR plants, it is applicable to weld overlay qualification for PWR plants, like DCCNP-1, because the weld overlays for BWRs are the same as weld overlays for PWRs.

Paragraph 1.1(b) of Supplement 11 limits the maximum thickness for which a procedure may be qualified. The Code states that "The specimen set must include at least one specimen with overlay thickness within minus 0.10-inch to plus 0.25-inch of the maximum nominal overlay thickness for which the procedure is applicable." The Code requirement addresses the specimen thickness tolerance for a single specimen set, but is confusing when multiple specimen sets are used. The PDI-proposed alternative states that "the specimen set shall include specimens with overlay not thicker than 0.10-inch more than the minimum thickness, nor thinner than 0.25-inch of the maximum nominal overlay thickness for which the examination procedure is applicable." The proposed alternative provides clarification on the application of the tolerance. The tolerance is unchanged for a single specimen set, however, it clarifies the tolerance for multiple specimen sets by providing tolerances for both the minimum and maximum thicknesses. The proposed wording eliminates confusion while maintaining the intent of the overlay thickness tolerance. Therefore, the staff finds this PDI Program revision acceptable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. PDI determined that certain Supplement 11 requirements pertaining to the location and size of cracks would be extremely difficult to achieve. For example, flaw implantation requires excavating a volume of base material to allow a pre-cracked coupon to be welded into the area. This process would add weld material to an area of the specimens that typically consists of only base material, and could potentially make ultrasonic examination more difficult and not representative of actual field conditions. In an effort to satisfy ASME Code requirements, PDI developed a process for fabricating flaws that exhibit crack-like reflective characteristics. Instead of all flaws being cracks as required by Paragraph 1.1(d)(1), the PDI weld overlay performance demonstrations contain at least 70 percent cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The fabricated flaws are semi-elliptical with tip widths of less than 0.002 inches. The licensee provided further information describing a revision to the PDI alternative to clarify when real cracks, as opposed to fabricated flaws, will be used; "The use of alternative flaws shall be limited to the cases where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws." The NRC staff has reviewed the flaw fabrication process, compared the reflective characteristics between actual cracks and PDI-fabricated flaws, and found the fabricated flaws acceptable for this application.

Paragraph 1.1(e)(1) requires that at least 20 percent but not less than 40 percent of the flaws shall be oriented within ±20 degrees of the axial pipe direction. Flaws contained in the original base metal heat-affected zone satisfy this requirement. However, PDI excludes axial fabrication flaws in the weld overlay material. PDI has concluded that axial flaws in the overlay material are improbable because the overlay filler material is applied in the circumferential direction (parallel to the girth weld), therefore, fabrication anomalies would also be expected to have major dimensions in the circumferential direction. The NRC staff finds this approach to the implantation of fabrication flaws to be reasonable; therefore, PDI's application of flaws oriented in the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases, this procedure permits flaws to be spaced closer than is allowed for classification as a multiple set of flaws by IWA-3300, thus potentially making the performance demonstration more challenging; on such basis, the NRC staff finds PDI's application for closely spaced flaws acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld, and that the base grading unit shall include the outer 25 percent of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to 1 inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The proposed change permits the PDI program to continue using test specimens from the existing weld overlay program, which have flaws on both sides of the welds. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. The weld overlay qualification is designed to be a near-side [relative to the weld] examination, and it is improbable that a candidate would detect a flaw on the opposite side of the weld due to the sound attenuation and re-direction caused by the weld microstructure. However, the presence of flaws on both sides of the original weld (outside the PDI grading unit) may actually provide a more challenging examination, as candidates must

determine the relevancy of these flaws, if detected. Therefore, PDI's use of the 1-inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld, as described in the revised PDI Program alternative, is acceptable.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least one inch of unflawed overlaid weld and base metal exist on either side of the base grading unit. This requirement is necessary to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exists on all sides of the grading unit and that flawed grading units must be free of interfering reflections from adjacent flaws, which addresses the same concerns as the Code. Hence, PDI's application of the variable flaw-free area adjacent to the grading unit is acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit include the overlay material and a base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of two inches. The PDI program reduces the base metal-to-overlay interface to at least one inch (instead of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow the use of existing examination specimens that were fabricated in order to meet the guidelines of NRC Generic Letter 88-01 (Tri-party Agreement, July 3,1984). This criterion is more challenging than that of the ASME Code because of the variability associated with the shape of the grading unit; on such basis, PDI's application of the grading unit is acceptable.

Paragraph 2.3 states that, for depth sizing tests, 80 percent of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. This paragraph requires detection and sizing tests to be separate. PDI revised the weld overlay program to allow sizing to be conducted either in conjunction with, or separately from, the flaw detection test. If performed in conjunction with detection, and the detected flaws do not meet the Supplement 11 range criteria, additional specimens will be presented to the candidate with the regions containing flaws identified. Each candidate will be required to determine the maximum depth of flaw(s) in each region. For separate sizing tests, the regions of interest will also be identified and the maximum depth and length of each flaw in five of the regions will similarly be determined. In addition, PDI stated that grading units are not applicable to sizing tests, and that each sizing region will be large enough to contain the target flaw, but small enough that candidates will not attempt to size a different flaw. The above clarification provides a basis for implementing sizing tests in a systematic, consistent manner that meets the intent of Supplement 11; as such, this method is acceptable to the NRC staff.

Paragraphs 3.1 and 3.2 of Supplement 11 state that procedures, equipment and personnel [as a complete ultrasonic system] are qualified for detection or sizing of flaws, as applicable, when certain criteria are met. The PDI program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase this passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The personnel and equipment are still required to meet Supplement 11. Therefore, the PDI program is acceptable because it exceeds ASME Code requirements for personnel, procedures, and equipment qualification.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.10 inches be reported as intrusions into the overlay material. The PDI program omits this criterion because of the difficulty in actually fabricating a flaw with a 0.10-inch minimum extension into the overlay, while still knowing the true state of the flaw dimensions. However, the PDI program requires that cracks be depth-sized to the tolerance of 0.125-inch as specified in Code. Since the Code tolerance is close to the 0.10-inch value of Paragraph 3.2(b), any crack extending beyond 0.10 inches into the overlay material would be identified as such from the characterized dimensions. The reporting of an extension in the overlay material is redundant for performance demonstration testing because of the flaw sizing tolerance; therefore, PDI's omission of highlighting a crack extending beyond 0.10 inches into the overlay material is acceptable.

4.0 CONCLUSION

Based on the discussion above, the staff concludes that the modifications proposed in Relief Request ISIR-21 for full structural PWOLs of pressurizer spray, safety, relief and surge nozzle safe end to nozzle dissimilar metal welds at DCCNP-1 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternatives for the installation of PWOLs over the welds identified in the relief request for DCCNP-1, Cycle 21 refueling outage which began on September 21, 2006.

Secondly, based on the discussion above, the staff concludes that the alternatives to ASME Code Appendix VIII, Supplement 11, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternatives for the remainder of the third 10-year ISI interval.

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.

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Date: April 26, 2007

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