January 20, 2006

Mr. David A. Christian
Sr. Vice President and Chief Nuclear Officer
Dominion Nuclear Connecticut, Inc.
Innsbrook Technical Center
5000 Dominion Boulevard
Glen Allen, VA 23060-6711

SUBJECT: MILLSTONE POWER STATION, UNIT NO. 3 - ISSUANCE OF RELIEF FROM CODE REQUIREMENTS (TAC NO. MC8609)

Dear Mr. Christian:

By letter dated October 19, 2005, as supplemented by letter dated October 20, 2005, Dominion Nuclear Connecticut, Inc. (DNC or the licensee) submitted Relief Request IR-2-39 pertaining to the repair and inspection of nozzle to safe end weld No. 03-X-5641-E-T at Millstone Power Station, Unit No. 3 (MPS3). In the relief request, the licensee proposed the use of weld overlay for repair and the Performance Demonstration Initiative (PDI) program for inspection, as alternatives to the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI.

The Nuclear Regulatory Commission (NRC) staff has reviewed and evaluated the information provided by the licensee in support of Relief Request IR-2-39, Revision 1. Based on the information provided, the NRC staff concludes that the proposed alternatives provide an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(a)(3)(i), alternatives to the ASME Code Section XI, Code Case N-504-2 and Code Case N-638-1, related to the welding repair of weld No. 03-X-5641-E-T are authorized at MPS3 for the fall 2005 refueling outage. Furthermore, pursuant to 10 CFR 50.55a(a)(3)(i), the licensee's proposal to use the PDI alternative qualification process to that of ASME Code Appendix VIII, Supplement 11, is authorized by the staff for the remainder of the second 10-year interval at MPS3.

On October 21, 2005, the NRC staff provided verbal authorization to the licensee for its use of the proposed alternatives. The results of this review are documented in the enclosed safety evaluation.

Sincerely,

/RA/

Darrell J. Roberts, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-423

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF FROM ASME CODE REQUIREMENTS

DOMINION NUCLEAR CONNECTICUT, INC.

MILLSTONE POWER STATION, UNIT NO. 3

DOCKET NO. 50-423

1.0 INTRODUCTION

By letter dated October 19, 2005, as supplemented by letter dated October 20, 2005, Dominion Nuclear Connecticut, Inc. (DNC or the licensee) submitted Relief Request IR-2-39 pertaining to the repair and inspection of weld No. 03-X-5641-E-T at Millstone Power Station, Unit 3 (MPS3) (References 1 and 2). In support of the licensee's request, additional information was also provided by letter dated October 19, 2005, from Westinghouse Electric Company (Reference 3). Weld RCS-517-FW-12 is adjacent to 03-X-5641-E-T and did not require repair, but the repair method selected resulted in RCS-517-FW-12 being weld overlayed as well due to its close proximity to 03-X-5641-E-T. The subject welds were weld overlay repaired during the fall 2005 refueling outage. In Relief Request IR-2-39, Revision 1, the licensee proposed the use of weld overlay for the repair which included temperbead welding for the ferritic portion of the weld overlay and the Performance Demonstration Initiative (PDI) program for inspection as an alternative to the requirements of American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI and Code Cases N-504-2 and N-638-1. The October 19, 2005, submittal was a complete revision to and superceded an October 13, 2005, request from the licensee (Reference 4).

During the fall 2005 refueling outage, unacceptable indications in weld 03-X-5641-E-T were found at MPS3. The examination of this weld used both radiographic testing (RT) and ultrasonic testing (UT), performed to the extent practical, using techniques and procedures approved under the PDI. The subject weld is made of Alloy 82/182 material which is susceptible to primary water stress-corrosion cracking (PWSCC).

2.0 REGULATORY EVALUATION

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(4), ASME Code Class 1, 2, and 3 components must meet the requirements set forth in ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plants Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that all inservice examinations and system pressure tests conducted during the first 10-year inservice inspection (ISI) interval, and subsequent intervals, comply with the requirements in the latest edition and addenda of ASME Code, Section XI,

incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 10-year ISI interval. For MPS3, the 1989 Edition with no Addenda of ASME Code, Section XI, is the applicable edition for the current second 10-year ISI and RI (risk-informed)-ISI interval. Section 50.55a(g)(4)(iv) of 10 CFR allows a licensee to use subsequent Editions and Addenda of ASME Code Section XI, provided that the Editions and Addenda are incorporated by reference in, and subject to the limitations and modifications of, 10 CFR 50.55a(b), and subject to Nuclear Regulatory Commission (NRC or the Commission) approval. In accordance with 10 CFR 50.55a(g)(4)(iv), the licensee requested and received NRC approval to use the 1998 Edition, with no Addenda, of the ASME Code, Section XI for repair/replacement activities for the remainder of second 10-year ISI interval for MPS3. Approval was granted by letter from the NRC to the licensee on September 13, 2005 (Reference 5).

In accordance with 10 CFR 50.55a(g)(6)(ii)(C), the implementation of Supplements 1 through 8, and 10 of Appendix VIII to Section XI, of the 1995 Edition with the 1996 Addenda of the ASME Code is required on a phased schedule ending on November 22, 2002. Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping welds" was required to be implemented by November 22, 2001.

Pursuant to 10 CFR 50.55a(a)(3), alternatives to these 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 submitted Relief Request IR-2-39, pursuant to 10 CFR 50.55a(a)(3)(i), as proposed alternatives to the requirements of ASME Code, Section XI.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirements

The ASME Code requirements for which the relief is requested are contained in the following:

1. 1998 Edition with no Addenda of the ASME Code, Section XI, Article IWA-4610(a).

2. 1995 Edition with the 1996 Addenda, of the ASME Code, Section XI, Appendix VIII, Supplement 11.

3 ASME Code Case N-504-2, "Alternative Rules for Repair of Classes 1, 2 and 3 Austenitic Stainless Steel Piping," with the 2005 Addenda, Nonmandatory Appendix Q.

4. ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [gas tungsten arc weld] Temper Bead Technique."

3.1.1 System/Component(s) for which Relief is Requested

The requested relief applies to the proposed weld overlay repair and ultrasonic examination of two ASME Code Class 1 welds. Weld 03-X-5641-E-T is a dissimilar metal weld that joins a stainless steel safe end to the ferritic pressurizer spray nozzle. Weld 03-X-5641-E-T is a high

safety significant (HSS) weld comprised of Alloy 82/182 weld metal. Weld RCS-517-FW-12 is adjacent to 03-X-5641-E-T and joins the stainless steel safe end to the stainless steel spray pipe.

3.2 Licensee's Proposed Alternative and Basis for Use (as stated)

[All references, tables and figures in Section 3.2 below refer to the licensee's submittal dated October 19, 2005]

> A full structural weld overlay repair is proposed for the pressurizer spray nozzle to safe end HSS dissimilar metal weld (Weld No. 03-X-5641-E-T) with unacceptable indications in the existing Alloy 82/182 weld material. The application of this relief request will include the adjacent acceptable stainless steel safe end to pipe weld (Weld No. RCS-517-FW-12). For (Weld No. 03-X-5641-E-T) the nozzle material is ferritic steel (P3). The pipe is austenitic stainless steel (P8). The existing weld filler material is Alloy 82/182 (F43 equivalent to P43). The overlay will be designed as a full structural overlay in accordance with ASME Section XI Code Case N-504-2 and Nonmandatory Appendix Q (Reference 3). The temper bead welding technique will be implemented in accordance with ASME Section XI Code Case N-638-1 (Reference 4) for that portion of the overlay applied over the ferritic base material for which the Construction Code requires post-weld heat treatment. Temperature monitoring requirements contained within this Code Case will be performed using contact pyrometers in lieu of thermocouples required by IWA-4610(a) of the ASME Code, Section XI 1998 Edition with no Addenda (Reference 1). This full structural weld overlay satisfies all the structural design requirements of the pipe as if the pipe were not there. As shown in Figure 1 below, this structural weld overlay (weld reinforcement) will completely cover the existing Alloy 82/182 weld metal and will extend onto the ferritic and austenitic stainless steel material on each end of the weld, including the adjacent acceptable weld (Weld No. RCS-517-FW-12). Although the weld overlay extends the full 360° around the nozzle, only half is shown in Figure 1 for clarity.
>
> Tables 1, 2, and 3, when used with the ASME Code, Section XI, 1998 Edition, no Addenda, Article IWA-4000 (Reference 1), provide a comprehensive package of proposed detailed criteria with requirements, proposed alternatives, methodologies, modifications, and the bases for these differences, to support this relief request. This MPS3 weld overlay repair of a piping weld with Alloy 82/182 weld material will be performed as a repair/replacement activity in accordance with IWA-4000 of the 1998 Edition, no Addenda, of ASME [Code] Section XI (Reference 1) with the exception of the requirements in IWA-4610(a). In lieu of the weld-attached thermocouple requirements and recording instruments in IWA-4610(a), DNC will use contact pyrometers and manual recording of the process temperatures at MPS3. These contact pyrometers will be calibrated in accordance with the DNC measuring and test equipment program and will be capable of monitoring the process temperatures from 50 °F, minimum preheat temperature to 350 EF, maximum interpass temperature. Additionally, the methodology of [ASME] Code Case N-504-2 (Reference 2), as modified and shown in Table 1, will be used.

The ultrasonic examination of the completed structural weld overlay will be accomplished in accordance with ASME [Code] Section XI, 1995 Edition with the 1996 Addenda, Appendix VIII, Supplement 11 (Reference 2) with the alternatives used to comply with the Performance Demonstration Initiative (PDI) program as shown in Table 2. The temper bead weld technique requirements in accordance with [ASME] Code Case N-638-1 (Reference 4) will be applied to the ferritic nozzle base material with the modification described in Table 3. Any applicable requirements not addressed by Tables 1, 2, and 3 will be met as described in Section XI, 1998 Edition, IWA-4000 (Reference 1); Appendix VIII, Supplement 11 (Reference 2); [ASME] Code Case N-504-2 (Reference 3); and [ASME] Code Case N-638-1 (Reference 4).

[ASME] Code Case N-504-2 (Reference 3) is approved for use for austenitic stainless steel material in NRC Regulatory Guide 1.147, Revision 14, August 2005, provided it is used with Nonmandatory Appendix Q, of ASME [Code] Section XI, 2005 Addenda. Provided in Table 1 are DNC's proposed modifications for weld overlay repair of nickel based and ferritic materials due to the specific construction of the MPS3 dissimilar metal welds. Therefore, DNC intends to follow the methodology of [ASME] Code Case N-504-2 (Reference 3), except for the modifications identified in Table 1.

3.3 NRC Staff Evaluation

During the fall 2005 refueling outage at MPS3, unacceptable indications were discovered in one HSS Class 1 reactor coolant system (RCS) pressurizer spray dissimilar metal nozzle to safe end weld (Weld No. 03-X-5641-E-T). The indications were discovered as a result of examinations performed in accordance with the MPS3 RI-ISI program and the licensee's response to NRC Bulletin 2004-01. The licensee stated that the examination of weld 03-X-5641-E-T included both RT and UT. The UT examination was performed to the extent practical, using techniques and procedures approved under the PDI. The adjacent stainless steel safe end to stainless steel spray pipe weld (RCS-517-FW-12) was determined by the licensee to be acceptable after receiving a PDI-qualified manual UT examination. The indications in weld No. 03-X-5641-E-T were initially discovered by RT and later fully characterized by PDI qualified automated UT. The licensee indicated that it located and characterized three flaws. Two of the flaws are circumferentially oriented and contain characteristics that indicate that they are fabrication flaws. The third flaw is axial, and although it could be a fabrication flaw according to the licensee, the NRC staff notes that PWSCC cannot be excluded as a possible cause of this flaw. The flaws were located in the Alloy 82/182 weld metal which is known to be susceptible to PWSCC. In the relief request, the licensee proposed a weld overlay repair plan which consists of the use of ASME Code Case N-504-2 with non-mandatory Appendix Q, with modification, and in lieu of the weld-attached thermocouple requirements and recording instruments in ASME [Code] Section XI 1998 Edition, no Addenda, IWA-4610(a), the licensee will use contact pyrometers and manual recording of the process temperatures. ASME Code Case N-638-1 will be used in its entirety with the exception that Section 4.0(b) will not be met. The weld overlay repair plan is proposed as an alternative to the ASME Code requirements in IWA-4000. For the inspection of the weld overlay, the licensee proposed the use of the PDI program as an alternative to the ASME Code requirements of Section XI, Appendix VIII, Supplement 11. The NRC staff has evaluated the licensee's bases for the proposed alternatives as provided in the licensee's submittal and supplemental information provided.

The NRC staff notes that both code cases are approved for use by the NRC in Regulatory Guide (RG) 1.147, Revision 14, with conditions. Although the licensee has requested to use the aforementioned code cases with modifications, it intends to adhere to the conditional requirements specified in RG 1.147, Revision 14. Both code cases, with conditions, provide acceptable alternatives to the ASME Code requirements. The licensee's proposed alternatives and their basis are provided in Tables 1, 2 and 3 of its relief request. A sketch of the overlay repair is shown below in Figure 1, which is taken from the DNC's October 19, 2005, submittal. The NRC staff's evaluation of the licensee's proposed alternatives relating to the relief/modifications to ASME Code, Section XI of IWA-4000, ASME Code Case N-504-2, ASME Code Case N-638-1 and ASME Code, Section XI, Appendix VIII, Supplement 11 are provided below:

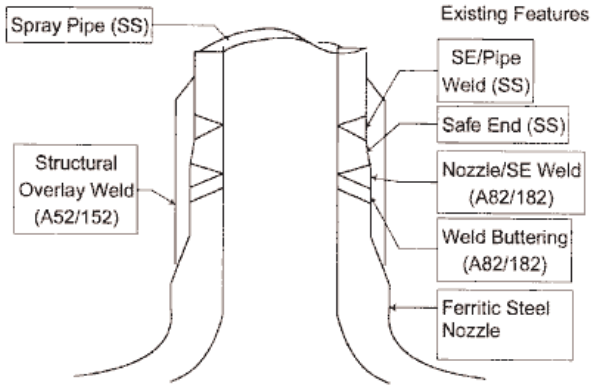

Figure 1 – MPS3 Typical Weld Overlay Repair Configuration

Alternative to IWA-4610(a)

In IWA-4610(a) thermocouples (TC) and recording instruments are required to be used to monitor the process temperatures for welding. In lieu of the weld-attached TC and recording instruments, the licensee proposed to use contact pyrometers and manual recording of the process temperatures. The licensee stated that contact pyrometers will be calibrated in accordance with the DNC measuring and test equipment program and will be capable of monitoring the process temperatures from 50 °F minimum preheat temperature, to 350 °F maximum interpass temperature. The NRC staff concludes that the licensee's use of contact pyrometers in lieu of TC is acceptable because the contact pyrometer used in this repair has the capability of monitoring the process temperatures (50 °F minimum preheat temperature and 350 °F maximum interpass temperature) and will be properly calibrated and thus provides an acceptable level of quality and safety.

Modifications to ASME Code Case N-504-2

ASME Code Case N-504-2 is listed as conditionally acceptable for use per RG 1.147, Revision 14. RG 1.147 allows use of the code case provided that the provisions of Section XI, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," are also met. The code case allows the use of weld overlay repair by

deposition of weld reinforcement on the outside surface of the pipe in lieu of mechanically reducing the defect to an acceptable flaw size. However, the subject code case is written for repairing austenitic stainless steel (SS) piping. ASME Code Case N-504-2 paragraph (b) requires a filler metal carbon content limitation of 0.035 percent maximum. This requirement is to ensure its resistance to intergranular stress-corrosion cracking (IGSCC). Paragraph (e) requires that the deposited weld metal has a delta ferrite content of at least 7.5 delta ferrite (FN). This requirement is to ensure that the primary solidification mode is ferrite (body-centered-cubic). Primary solidification as ferrite is important in austenitic stainless steel welds as it resists weld solidification cracking. The licensee intends to use Alloy 52 or Alloy 52M which solidifies as austenite, does not contain ferrite and remains fully austenitic as a result of its very high content of nickel. Therefore, the material requirements of carbon content limitation (0.035 percent maximum) and the minimum FN requirement as delineated in ASME Code Case N-504-2 paragraphs (b) and (e), respectively, apply only to austenitic stainless steel materials. These requirements are not applicable to Alloys 52/52M, the nickel-based material which the licensee proposes for weld overlay repair. For material compatibility in welding, the NRC staff considers Alloys 52/52M to be a better choice of filler material than austenitic stainless steel weld material for this weld joint/material configuration. Although stainless steel filler metal would be compatible with the ferritic nozzle material and the SS safe end and SS piping, it is not compatible to weld over Alloys 82/182 given that the dilution of Alloys 82/182 into stainless filler material could result in a shift in solidification mode due to its high nickel content, thus making the weld susceptible to cracking. Alloys 52/52M have been used extensively in dissimilar metal welds for the fabrication and repair of components made from ferritic materials, SS, Alloys 82/182, Alloy 600, and Alloy 690 used within the RCS.

Alloys 52/52M contain 28-31.5 percent chromium which provides excellent resistance to stress corrosion cracking (SCC) in the reactor coolant environment. Alloy 52M is identical to Alloy 52 in chemistry with the exception that Alloy 52M has a higher content of Niobium (0.5 - 1.0 percent versus 0.10 percent maximum) for the purpose of improving its weldability. Alloy 52 (ERNiCrFe-7 with classification UNS N06052) is listed in ASME Code, Section IX as an F-No. 43 filler metal and is acceptable for use under the ASME Code. Alloy 52M (ERNiCrFe-7A with classification UNS N06054) is identified as F-No. 43 filler metal per ASME Code Case 2142-2. Given that Alloy 52 is an acceptable filler material per ASME Section IX, Alloy 52M does not contain any significant changes in chemistry from Alloy 52, and is approved for use by ASME Code Case 2142-2, and both alloys are compatible with the materials involved in the repair, the staff concludes that the licensee's proposed use of Alloy 52 or Alloy 52M for the weld overlay repair as an alternative to the requirements of ASME Code Case N-504-2 paragraphs (b) and (e) are acceptable as it will provide an acceptable level of quality and safety.

Modifications to Appendix VIII, Supplement 11

The U.S. Nuclear Utilities created the PDI to implement performance demonstration requirements contained in Appendix VIII of Section XI of the ASME Code. To this end, PDI has developed a program for qualifying equipment, procedures, and personnel for examinations of weld overlays in accordance with the ultrasonic testing (UT) criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, Electric Power Research Institute (EPRI) maintained a performance demonstration program for weld overlay qualification under the Tri-party Agreement (Reference 6). Instead of having two programs with similar objectives, the

NRC staff recognized the PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement (Reference 7).

The PDI program does not fully comport with the existing requirements of Supplement 11. PDI presented the differences at public meetings in which the NRC participated (References 8 and 9). The differences are in flaw location within test specimens and fabricated flaw tolerances. The changes in flaw location permitted using test specimens from the Tri-party Agreement, and the changes in fabricated flaw tolerances provide UT acoustic responses similar to the responses associated with IGSCC.

There are differences between the PDI program and Supplement 11. The differences identified in the following Supplement 11 paragraphs: 1.1(b), 1.1(d)(1), 1.1(e)(1), 1.1(e)(2), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(2), 1.1(e)(2)(a)(3), 1.1(e)(2)(b)(1), 1.1(e)(2)(b)(2), 1.1(e)(2)(b)(3), 1.1(f)(1), 1.1(f)(3), 1.1(f)(4), 2.0, 2.1, 2.2(d), 2.3, 3.1, 3.2(a), 3.2(b) and 3.2(c) are evaluated below:

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 NRC 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 location and size of cracks in test specimens 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 this 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 the 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 PDI alternative also states that "the use of alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws." The NRC 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 pipe axial 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 finds this approach to 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 permits flaws to be spaced closer than what is allowed for classification as a multiple set of flaws by IWA-3300, thus potentially making the performance demonstration more challenging. Hence, PDI's application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2) requires that specimens be divided into base metal and overlay grading units. The PDI program adds clarification with the addition of the word "fabrication" and ensures flaw identification by ensuring all flaws will not be masked by other flaws with the addition of, "Flaws shall not interfere with ultrasonic detection or characterization of other flaws." PDI's alternative provides clarification and assurance that the flaws are identified. Therefore, the NRC staff finds the PDI alternative to the Supplement requirements is 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 the base grading unit includes 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 redirection 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 eliminating 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)(2) requires, when base metal cracking penetrates into the overlay material, that a portion of the base grading unit shall not be used as part of the overlay grading unit. The NRC staff finds that the PDI program adjusts for the changes in Paragraph 1.1(e)(2)(a)(2) and conservatively states that when base metal flaws penetrate into the overlay material, no portion of it shall be used as part of the overlay fabrication grading unit. The NRC staff finds that the PDI program also provided clarification by the addition of the term "flaws" for

"cracks" and the addition of "fabrication" to "overlay grading unit." The NRC staff concludes that the PDI Program alternative provides clarification and conservatism and, therefore, is acceptable.

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. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exist 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 ASME 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 shall 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 2 inches. The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01 (Tri-party Agreement, July 1984) (Reference 6). This criterion may be more challenging than the ASME Code because of the variability associated with the shape of the grading unit. Hence, PDI's application of the grading unit is acceptable.

Paragraph 1.1(e)(2)(b)(2) requires that unflawed overlay grading units shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch around its entire perimeter. The PDI program redefines the area by noting unflawed overlay fabrication grading units shall be separated by at least 1 inch of unflawed material at both ends and sufficient area on both sides to preclude interfering reflections from adjacent flaws. The NRC staff determined that the relaxation in the required area on the sides of the specimens, while still ensuring no interfering reflections, may provide a more challenging demonstration than required by the ASME Code because of the possibility for having a parallel flaw on the opposite side of the weld. Therefore, based on engineering judgement, the NRC staff concludes that the PDI's application is an acceptable alternative to the Supplement 11 requirements.

Paragraph 1.1(e)(2)(b)(3) requirements are retained in the PDI program. In addition, the PDI program requires that initial procedure qualification contain three times the number of flaws required for a personal qualification. To qualify new values of essential variables, the equivalent of at least one personal qualification set is required. The NRC staff concludes that PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides for a more stringent qualification criteria.

Paragraph 1.1(f)(1) requirements are retained in the PDI program, with the clarification change of the term "flaws" for "cracks." In addition, the PDI program includes the requirements that sizing sets shall contain a distribution of flaw dimensions to verify sizing capabilities. The PDI program also requires that initial procedure qualification contain three times the number of flaws required for a personal qualification. To qualify new values of essential variables, the equivalent of at least one personal qualification set is required. The NRC staff concludes that

PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides a more stringent qualification criterion.

Paragraphs 1.1(f)(3) and 1.1(f)(4) requirements are clarified by the PDI program by replacing the term "cracking" with "flaws" because of the use of alternative flaw mechanisms. The NRC staff concludes that this clarification in the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.0 requirements are retained in the PDI program alternative. In addition, the PDI program provides clarification that the overlay fabrication flaw test and the base metal flaw test may be performed separately. The NRC staff concludes that this clarification in the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraphs 2.1 and 2.2(d) requirements are clarified by the PDI program by the addition of the terms "metal" and "fabrication." The NRC staff determined that the clarifications provide acceptable classification of the terms they are enhancing. Therefore, the staff concludes that the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.3 requires 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 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 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 the region 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.

Paragraph 3.1 requires that examination 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 the Supplement 11 requirement; therefore, the PDI program criteria exceeds the ASME Code requirements for personnel, procedures, and equipment qualification. Therefore, the NRC staff concludes that the PDI program criteria are acceptable.

Paragraph 3.2(a) requirements are clarified by the PDI program by replacing the term "cracking" with "flaws" because of the use of alternative flaw mechanisms. The NRC staff concludes that this clarification in the PDI program maintains the intent of the ASME Code requirement and is acceptable.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.10 inch are reported as being 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 specified in the ASME Code which is 0.125 inches. Since the ASME Code tolerance is close to the 0.10-inch value of Paragraph 3.2(b), any crack extending beyond 0.10 inch into the overlay material would be identified as such from the characterized dimensions. The NRC staff determined that reporting of an extension in the overlay material is redundant for performance demonstration testing because of the flaw sizing tolerance. Therefore, the NRC staff concludes that PDI's omission of highlighting a crack extending beyond 0.10 inch into the overlay material is acceptable.

Paragraph 3.2(c) is renumbered to Paragraph 3.2(b) in the PDI program. The NRC staff concludes that this PDI program change is administrative in nature and is, therefore, acceptable.

Based on the above evaluation, the NRC staff has determined that the licensee's proposed alternative to use the PDI qualification program for the ultrasonic examination of overlay repaired piping welds is acceptable, because it will provide an acceptable level of quality and safety.

Modifications to ASME Code Case N-638-1

ASME Code Case N-638-1 is listed as being conditionally acceptable for use per RG 1.147, Revision 14. RG 1.147 allows use of the ASME Code Case provided that the following is satisfied. "UT examinations shall be demonstrated for the repaired volume using representative samples which contain construction type flaws. The acceptance criteria of NB-5330 of Section III edition and addenda approved in 10 CFR 50.55a apply to all flaws identified within the repaired volume." The licensee indicates that it will follow the ASME Code Case with the conditional requirement above with the exception of 4.0(b) which states, "the final weld surface and the band around the area defined in paragraph 1.0(d) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with Appendix I." Section 1.1(d) of ASME Code Case N-638-1 defines the band area to be 1.5 times the component thickness or 5 inches, whichever is less. The licensee states that it cannot perform the required UT examination of the required band of base material due to the existing nozzle configuration. Based on information supplied by the licensee, the NRC staff agrees that the taper transition at the edge of the weld overlay and the ferritic nozzle will not facilitate a UT examination of the ferritic nozzle material past the edge of the weld overlay as required by the ASME Code Case. Given that the area in question is not in close proximity to the flaws in the existing weld and that if the flaws do propagate, it is highly unlikely that they would propagate into the ferritic material

and would most likely blunt at the Inconel (82/182/52/52M)-ferritic interface and be contained in a volume of material that is subject to ISI examination, the NRC staff finds the licensee's proposal to perform only a surface examination of the area in question to be acceptable. The NRC staff, therefore, concludes that the licensee's proposed alternatives provide an acceptable level of quality and safety.

4.0 CONCLUSION

The NRC staff has reviewed the licensee's submittal and determined that the proposed alternatives will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the use of the proposed alternatives to IWA-4610(a), ASME Code Cases N-504-2 and N-638-1 for the weld overlay repair of weld 03-X-5641-E-T and adjacent weld RCS-517-FW-12, during the 2005 fall refueling outage at MPS3. In addition, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the use of the proposed alternative to use the PDI protocol of implementing of Appendix VIII, Supplement 11, in lieu of the ASME Code, Section XI, for the remainder of the second ISI interval at MPS3.

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.

5.0 REFERENCES

1. Letter from Leslie N. Hartz, Dominion Nuclear Connecticut, Inc., dated October 19, 2005, to the U.S. Nuclear Regulatory Commission, "Dominion Nuclear Connecticut, Inc., Millstone Power Station Unit 3, Second 10-year Inservice Inspection Interval Revision 1 to Relief Request IR-2-39, Use of Weld Overlay and Associated Alternative Repair Techniques."

2. Letter from Leslie N. Hartz, Dominion Nuclear Connecticut, Inc., dated October 20, 2005, to the U.S. Nuclear Regulatory Commission, "Dominion Nuclear Connecticut, Inc., Millstone Power Station Unit 3, Supplemental Information Regarding Weld Overlay Repair Related to Relief Request IR-2-39 Revision 1, Use of a Weld Overlay and Associated Alternative Repair Techniques."

3. Letter from B. F. Maurer, Westinghouse Electric Company, dated October 19, 2005, to the U.S. Nuclear Regulatory Commission, "Pressurizer Spray Nozzle Weld Overlay Design for Millstone Unit 3."

4. Letter from NRC to Dominion Nuclear Connecticut, Inc., "Millstone Power Station, Unit Nos. 2 and 3 Re Request to Use 1998 Edition, with No Addenda, of ASME Code Section XI for Repair/Replacement Activities (TAC Nos. MC7347 and MC7348)," dated September 13, 2005.

5. Letter from Leslie N. Hartz, Dominion Nuclear Connecticut, Inc., dated October 13, 2005, to the U.S. Nuclear Regulatory Commission, "Dominion Nuclear

Connecticut, Inc., Millstone Power Station Unit 3, Second 10-year Inservice Inspection Interval Relief Request IR-2-39, Use of Weld Overlay and Associated Alternative Repair Techniques."

6. The Tri-party Agreement is between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel, July 3, 1984.

7. U.S. NRC Letter from William H. Bateman to Michael Bratton, "Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations," January 15, 2002 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML020160532*).*

8. U.S. NRC Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held January 31 - February 2, 2001, with PDI Representatives," March 22, 2001 (ADAMS Accession No. ML010940402).

9. U.S. NRC Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives," November 29, 2001 (ADAMS Accession No. ML013330156).

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