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U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No. 05-708A
NLOS/PRW R0
Docket No. 50-423
License No. NPF-49

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

Pursuant to 10 CFR 50.55a(a)(3)(i), Dominion Nuclear Connecticut, Inc. (DNC), requests approval to use alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, 1998 Edition with no Addenda, IWA-4000, for repair/replacement activities related to the performance of a needed weld overlay repair at Millstone Power Station Unit 3 (MPS3) for the second 10-year inservice inspection (ISI) interval. MPS3 is now in its Cycle 10 refueling outage and examinations have been performed in accordance with the MPS3 Risk-Informed Inservice Inspection (RI-ISI) program[1] and the DNC response to NRC Bulletin 2004-01.[2] These examinations have identified one high safety significant (HSS) Class 1 reactor coolant system (RCS) pressurizer spray, dissimilar metal, nozzle to safe end weld (Weld No. 03-X-5641-E-T) with unacceptable indications. The indications were found in the Alloy 82/182 weld material which is known to be subject to primary water stress corrosion cracking (PWSCC). Changes are as discussed in the phone conversation with the NRC on October 18, 2005. This request supercedes the previous submittal dated October 13, 2005. Changes are indicated by change bars in the right-hand margin.

The indications detected in the pressurizer spray nozzle have been characterized, to the extent practical, given the limitations associated with the current weld geometry. In this regard, the indications have been preliminarily assessed as circumferentially oriented and of unknown depth.

MPS3 is in its second 10-year ISI interval, which started on April 23, 1999 and is scheduled to end on October 23, 2008. The 1989 Edition of Section XI with no Addenda applies to the ISI program and the RI-ISI program. The 1998 Edition of Section XI with no Addenda is used as the primary ASME Code Edition for Section XI Repair/Replacement program activities. The 1995 Edition of Section XI with the 1996 Addenda is used for the requirements associated with Appendix VIII, Performance Demonstration for Ultrasonic Examination Systems.

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(1) NRC letter, "Safety Evaluation of Relief Request For A Risk-Informed Inservice Inspection Program, Millstone Power Station, Unit No. 3 (TAC No. MA9740)," dated March 12, 2002.

(2) DNC Letter, Virginia Electric and Power Company and Dominion Nuclear Connecticut, Inc., Sixty Day Response to NRC Bulletin 2004-01, dated July 27, 2004.

The ASME approved Code Cases N-504-2 and N-638-1 are listed as acceptable for use in NRC Regulatory Guide 1.147, Revision 14, with the following conditions that will be met for the purposes of this request:

N-504-2 – The provisions of Section XI, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," must also be met. (This appendix is now published in the 2005 Addenda of ASME Section XI.)

N-638-1 – 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 required volume.

These Code Cases and the 1998 Edition of Section XI contain some of the criteria needed to apply a structural weld overlay repair for unacceptable indications in dissimilar metal piping welds with Alloy 82/182 weld material including the use of temper bead welding without preheat or post weld heat treatment. However, alternatives to these ASME Code requirements and modifications to the methodologies contained in Code Case N-504-2 and Code N-638-1 will be used to apply an acceptable weld overlay repair with NRC approval of this request. Additionally for MPS3, DNC is required in accordance with 10 CFR 50.55a(g)(6)(ii)(c) to implement Appendix VIII of the ASME Code, Section XI, 1995 Edition with the 1996 Addenda, which contains ultrasonic examination performance qualification requirements under Supplement 11 for a completed structural weld overlay repair. In lieu of these ASME Code ultrasonic requirements, DNC proposes to use alternative techniques for the ultrasonic examination of the full structural weld overlay repair, and the examination of the dissimilar metal weld with unacceptable indications in an existing Alloy 82/182 weld. Use of the proposed alternative is based on the Performance Demonstration Initiative (PDI) approved techniques and procedures also contained in this request.

The detailed relief request IR-2-39 is provided in the Attachment to this letter. It contains a comprehensive set of criteria that includes three tables that outline the proposed MPS3 weld overlay repair criteria for the pressurizer nozzle to safe end weld. The adjacent acceptable stainless steel safe end to pipe weld has to be included with this weld overlay repair due to the size of the weld overlay that must be applied. The attachment also consists of alternatives and modifications to the ASME Code requirements, Code Cases N-504-2 and N-638-1, that DNC has determined will be necessary to perform this repair to provide an acceptable level of quality and safety.

A similar relief request has been previously approved for AmerGen Energy Company for its Three Mile Island Nuclear Station, Unit 1 on July 21, 2004[3] and at Constellation

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[3] NRC letter, "Safety Evaluation of Request For Relief From Flaw Removal, Heat Treatment and Nondestructive Examination (NDE) Requirements For The Third 10-Year Inservice Inspection Interval, Three Mile Island Nuclear Station, Unit 1 (TMI-1), (TAC No. MC1201), dated July 21, 2004.

Energy's Calvert Cliffs Nuclear Power Plant, Unit 2 on July 20, 2005[4]. DNC is requesting approval of this request by October 21, 2005, to support start-up from the current refueling outage.

If you have any questions regarding this submittal, please contact Mr. Paul R. Willoughby at (804) 273-3572.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

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[4] NRC Letter, "Safety Evaluation for Calvert Cliffs Nuclear Power Plant, Unit No. 2, Relief Request for Use Weld Overlay and Associated Alternative Inspection Techniques (TAC Nos. MC6219 and MC6220), dated July 20, 2005.

Attachments

(1) Relief Request IR-2-39, Use Of Weld Overlay And Associated Alternative Repair Techniques

Commitments made in this letter: None.

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT

REVISION 1 TO RELIEF REQUEST IR-2-39, USE OF WELD OVERLAY AND ASSOCIATED ALTERNATIVE REPAIR TECHNIQUES

MILLSTONE POWER STATION UNIT 3
DOMINION NUCLEAR CONNECTICUT, INC.

REVISION 1 TO RELIEF REQUEST IR-2-39, USE OF WELD OVERLAY AND ASSOCIATED ALTERNATIVE REPAIR TECHNIQUES

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REVISION 1 TO RELIEF REQUEST IR-2-39, USE OF WELD OVERLAY AND ASSOCIATED ALTERNATIVE REPAIR TECHNIQUES

Proposed Alternative
In Accordance with 10 CFR 50.55a(a)(3)(i)

- Alternative Provides Acceptable Level of Quality and Safety -

1.0 REASON FOR THE REQUEST

Currently, there is no comprehensive criteria for a licensee to apply a weld overlay repair to a dissimilar metal weld that is constructed of Alloy 82/182 weld material and is believed to contain primary water stress corrosion cracking (PWSCC). Although the ASME Code, Section XI, 1998 Edition, no Addenda, IWA-4000 (Reference 1), is used for the Millstone Power Station Unit 3 (MPS3) Section XI repair/replacement program,[1][2] it does not have the needed requirements for this type of repair. The latest NRC approved ASME Code also does not have the needed requirements for this type of repair. Repair/replacement activities associated with a weld overlay repair of this type are required to address the materials, welding parameters, ALARA concerns, operational constraints, examination techniques, and procedure requirements. Thus, this is the reason for this relief request.

2.0 CODE COMPONENTS FOR WHICH RELIEF IS REQUESTED

Group: High safety significant (HSS) Class 1 dissimilar metal piping welds with Alloy 82/182 weld metal are believed to be susceptible to PWSCC as a result of examinations performed under the DNC Risk-Informed Inservice Inspection (RI-ISI) Program.

For the current Cycle 10 refueling outage, one weld with unacceptable indications was identified in material that is susceptible to PWSCC. The examination of this weld used both radiography and UT, performed to the extent practical, using techniques and procedures approved under the Performance Demonstration Initiative (PDI).

a) Name of Components:

1. Pressurizer spray nozzle to safe end HSS dissimilar metal weld (Weld No. 03-X-5641-E-T) with Alloy 82/182 weld material subject to PWSCC.
2. The adjacent acceptable safe end to pipe weld (Weld No. RCS-517-FW-12).

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(1) DNC letter, "Request to Use a Later Edition and Addenda of the ASME Section XI Code for the Repair / Replacement Program in Accordance with 10 CFR 50.55a(g)(4)(iv) [consistent with considerations in RIS 2004-16], dated June 20, 2005.

(2) NRC Letter, "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.

b) ASME Code Class:
Both welds are ASME Code Class 1 welds located within the reactor coolant pressure boundary and subject to the steam space environment of the pressurizer.

c) System:
Reactor Coolant System (RCS)

d) Code Category:
Examination Category R-A, "Risk-Informed Piping Examinations"

e) Code Item No.:
R1.15, "Elements subject to PWSCC" (Weld No. 03-X-5641-E-T)
R1.11, "Elements subject to Thermal Fatigue" (Weld No. RCS-517-FW-12)

3.0 CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED

1. 1998 Edition with no Addenda of the American Society of Mechanical Engineers (ASME) Code Section XI, (Reference 1), IWA-4610(a).
2. 1995 Edition with the 1996 Addenda, of the ASME Code, Section XI, Appendix VIII, Supplement 11 (Reference 2).
3. Modification to the Nuclear Regulatory Commission (NRC) approved Code Case N-504-2 with the 2005 Addenda, Nonmandatory Appendix Q (Reference 3)
4. Code Case N-638-1 (Reference 4).

4.0 PROPOSED ALTERNATIVES AND SUPPORTING INFORMATION

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.

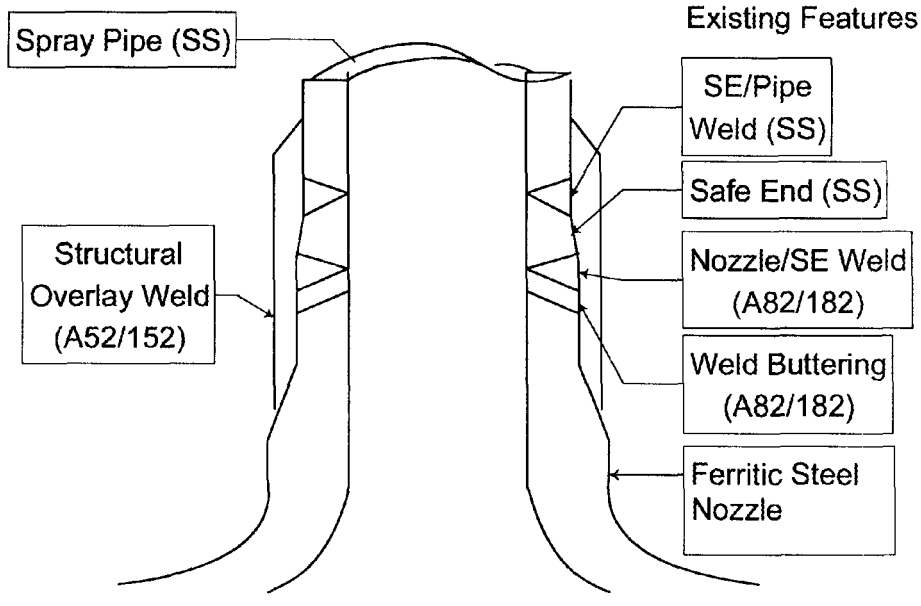

Figure 1 – MPS3 Typical Weld Overlay Repair Configuration

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 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°F, maximum interpass temperature. Additionally, the methodology of 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 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 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); Code Case N-504-2 (Reference 3); and Code Case N-638-1 (Reference 4).

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 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 Code Case N-504-2 (Reference 3), except for the modifications identified in Table 1.

5.0 DURATION OF PROPOSED RELIEF REQUEST

This request will be applied for the remainder of the current MPS3 second 10-year ISI interval that started on April 23, 1999. Once a weld overlay is installed it will remain in place for the design life of the repair that is defined by the evaluation required in paragraph (g) of Code Case N-504-2 and corresponding requirements in Nonmandatory Appendix Q (Reference 3). The weld overlay is also subject to the satisfactory examination requirements of Article Q-4000 for inservice inspection. Those requirements include adding any installed weld overlay repair into the MPS3 ISI plan per Subarticle Q-4300 for at least one inservice examination to be completed within the next 2 refueling cycles.

6.0 PRECEDENTS

A similar relief request was previously approved on July 21, 2004[3] for AmerGen Energy Company for its Three Mile Island Nuclear Station, Unit 1. That relief request was for a single weld overlay repair on the pressurizer surge line safe end to RCS nozzle weld. Additionally, a relief request for weld overlay repairs on two, 2-inch nozzle to safe end welds was approved for Constellation Energy's Calvert Cliffs Nuclear Power Plant, Unit 2.[4]

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(3) NRC letter, "Safety Evaluation of Request For Relief From Flaw Removal, Heat Treatment and Nondestructive Examination (NDE) Requirements For The Third 10-Year Inservice Inspection Interval, Three Mile Island Nuclear Station, Unit 1 (TMI-1), (TAC No. MC1201), dated July 21, 2004.

(4) NRC Letter, "Safety Evaluation for Calvert Cliffs Nuclear Power Plant, Unit No. 2, Relief Request for Use Weld Overlay and Associated Alternative Inspection Techniques (TAC Nos. MC6219 and MC6220), dated July 20, 2005.

7.0 REFERENCES

(1) 1998 Edition, ASME Code, Section XI, no Addenda, IWA-4000.
(2) 1995 Edition, ASME Code, Section XI, with the 1996 Addenda, Appendix VIII, Supplement 11.
(3) ASME Code Case N-504-2, Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Section XI, Division 1, March 12, 1997, including ASME Code Section XI, 2005 Addenda, Nonmandatory Appendix Q, Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments.
(4) ASME Code Case N-638-1, Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique Section XI, Division 1, February 13, 2003.
(5) NRC letter, dated September 13, 2005, Millstone Power Station, Units 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).

8.0 CONCLUSION

DNC has determined that the approach described in this relief request includes available operating experience (OE) related to previously approved NRC requirements that have been used to produce acceptable weld overlay repairs when applied to a dissimilar metal weld with Alloy 82/182 weld material. The basis for this determination is the application of this same type of weld overlay repair at Three Mile Island and Calvert Cliffs. Those weld overlay repairs were based on, and this relief request includes, the NRC approved ASME Code requirements and Code Cases. Therefore, considering that this relief request includes those referenced criteria, DNC believes that the use of this relief request for a weld overlay repair at MPS3 will result in an acceptable level of quality and safety that meets the requirements of 10 CFR 50.55a(a)(3)(i).

Request IR-2-39, Use Of Weld Overlay And Associated Alternative Repair Techniques

ENCLOSURE

MILLSTONE UNIT NO. 3, COMPREHENSIVE CRITERIA FOR WELD OVERLAY REPAIR OF WELDS - CONTAINS SPECIFIC MODIFICATIONS AND ALTERNATIVES FOR THE USE OF RELIEF REQUEST IR-2-39

TABLES 1, 2 and 3

Table 1
Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

Code Case N-504-2	Modification/Basis
Reply: It is the opinion of the Committee that, in lieu of the requirements of IWA-4120 in Editions and Addenda up to and including the 1989 Edition with the 1990 Addenda, in IWA-4170(b) in the 1989 Edition with the 1991 Addenda up to and including the 1995 Edition, and in IWA-4410 in the 1995 Edition with the 1995 Addenda and later Editions and Addenda, defect in austenitic stainless steel piping may be reduced to a flaw of acceptable size in accordance with IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe, provided the following requirements are met. **[Essentially same as Scope of Appendix Q]:**	**Modification.** Code Case N-504-2 will be used for weld overlay repairs to the ferritic (P3) and nickel alloy (F43/P43) base material as well as the austenitic stainless steel (P8) base material. **Basis:** *Code Case N-504-2 is accepted for use along with Nonmandatory Appendix Q in the current NRC Regulatory Guide 1.147 Rev.14. For the weld overlay of the flawed weld at MPS3 the base material will be ferritic material (P3) with existing nickel alloy weld metal (F43/P43) to which an austenitic stainless steel (P8) safe end is welded. 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 weld metal. MPS3 plans to apply a 360°, full structural weld overlay to control growth in any PWSCC crack and maintain weld integrity. The weld overlay will induce compressive stress in the weld, thus potentially impeding growth of any reasonably shallow cracks. Furthermore, the overlay will be sized to meet all structural requirements independent of the existing weld.*
(b) Reinforcement weld metal shall be low carbon (0.035% max.) austenitic stainless steel applied 360° around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification identified in the Repair Program. **[Same as Q-2000(a)]**	**Modification.** In lieu of austenitic stainless steel filler material, the reinforcement weld metal will be a nickel alloy. **Basis:** *The weld metal used may be ERNiCrFe-7A (Alloy 52M, UNS N06054) or ERNiCrFe-7 (Alloy 52 UNS N06052). This weld metal is assigned F43 by ASME per Code Case 2142-2. The requirements of ASME Section III, NB-2400 will be applied to all filler material.* *The chromium content of Alloy 52M is 28-31.5%, identical to that of Alloy 52. The main difference in Alloy 52 vs. Alloy 52M is a higher Niobium content (0.5-1%). The difference in chemical composition between Alloy 52 and Alloy 52M improves the weldability of the material and pins the grain boundaries thus preventing separation between the grains and hot tearing during weld puddle solidification.*

Table 1
Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

Code Case N-504-2	Modification/Basis
	These filler materials were selected for their improved resistance to PWSCC. Alloys 52, 52M, and 152 all contain about 30% chromium that imparts excellent corrosion resistance. The existing Alloy 82/182 weld and the Alloy 52/52M overlay are austenitic and have ductile properties and toughness similar to austenitic stainless steel piping welds at pressurized water reactor operating temperature. These filler materials are suitable for welding over the ferritic nozzle or pipe, Alloy 82/182 weld and the austenitic stainless steel pipe or safe ends.
(e) The weld reinforcement shall consist of a minimum of two weld layers having as-deposited delta ferrite content of at least 7.5 FN. The first layer of weld metal with delta ferrite content of least 7.5 FN shall constitute the first layer of the weld reinforcement design thickness. Alternatively, first layers of at least 5 FN may be acceptable based on evaluation. **[Same as Q-2000(d)]**	**Modification:** Delta ferrite (FN) measurements will not be performed for weld overlay repairs made of Alloy 52/52M/152 weld metal. **Basis:** *Welds of Alloy 52/52M/152 are 100% austenitic and contain no delta ferrite due to the high nickel composition (approximately 60% nickel).*

Appendix VIII of Section XI cannot be used for NDE of a structural weld overlay repair. Relief is requested to use the PDI program implementation of Appendix VIII. A detailed comparison of Appendix VIII and PDI requirements is summarized below.

Relief is requested to allow closer spacing of flaws provided they don't interfere with detection or discrimination. The specimens used to date for qualification to the Tri-party (NRC/BWROG/EPRI) agreement have a flaw population density greater than allowed by current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI program has merged the Tri-party test specimens into their weld overlay program.

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
1.0 SPECIMEN REQUIREMENTS	
1.1 General. The specimen set shall conform to the following requirements.	
(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 in. or larger, the specimen set must include at least one specimen 24 in. or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 in. to +0.25 in. of the maximum nominal overlay thickness for which the procedure is applicable.	**Alternative:** *(b)* The specimen set shall include specimens with overlays not thicker than 0.1 in. more than the minimum thickness, nor thinner than 0.25 in. of the maximum nominal overlay thickness for which the examination procedure is applicable. **Basis:** *To avoid confusion, the overlay thickness tolerance contained in the last sentence was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence in paragraph 1.1(d)(1).*

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(d) Flaw Conditions	
(1) Base metal flaws. All flaws must be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Flaws may extend 100% through the base metal and into the overlay material; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.	**Alternative:** (1) ...must be in or... intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing intergranular stress corrosion cracking shall be used when available. At least 70% of the flaws in the detection and sizing tests shall be cracks and the remainder shall be alternative flaws. Alternative flaw mechanisms, if used, shall provide crack-like reflective characteristics and shall be limited by the following: (a) The use of alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. (b) Flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches. **Basis:** *This paragraph requires that all base metal flaws be cracks. Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches, and at least 70% of the flaws in the detection and sizing test shall be cracks and the*

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	remainder shall be alternative flaws. *To avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b) last sentence, was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence.* *Paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws.*

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(e) Detection Specimens	
(1) At least 20% but less than 40% of the flaws shall be oriented within ±20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.	**Alternative:** (1) At least 20% but less than 40% of the base metal flaws shall be oriented within ±20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. **Basis:** *The requirement for axially oriented overlay fabrication flaws was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated GTAW techniques with the filler metal applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic.* *The requirement for using IWA-3300 for proximity flaw evaluation was excluded, instead indications will be sized based on their individual merits.*
(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.	**Alternative:** (2) Specimens shall be divided into base metal and overlay fabrication grading units. Each specimen shall contain one or both types of grading units. Flaws shall not interfere with ultrasonic detection or characterization of other flaws.

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(a)(1) A base grading unit shall include at least 3 in. of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal-to-overlay interface.	**Alternative:** *(a)(1)* A base metal grading unit includes the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 in. and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50" of the adjacent base material. **Basis:** *The phrase "*and base metal on both sides," *was inadvertently included in the description of a base metal grading unit. The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. To avoid confusion several instances of the term "cracks" or "cracking" were changed to the term "flaws" because of the use of alternative Flaw mechanisms.* *Modified to require that a base metal grading unit include at least 1 in. of the length of the overlaid weld, rather than 3 inches.*

Table 2
Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 in. of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	**Alternative:** (a)(2) When base metal flaws penetrate into the overlay material, the base metal grading unit shall not be used as part of any overlay fabrication grading unit.
(a)(3) When a base grading unit is designed to be unflawed, at least 1 in. of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. The segment of weld length used in one base grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.	**Alternative:** (a)(3) Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws. *Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement.*
(b)(l) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 in^2. The overlay grading unit shall be rectangular, with minimum dimensions of 2 in.	**Alternative:** *(b)*(l) An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 in. *Modified to define an overlay fabrication grading unit as including the overlay material and the base metal-to-overlay interface for a length of at least 1 in, rather than the 6 in^2 requirement.*

Table 2
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(b)(2) An overlay grading unit designed to be unflawed shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. around its entire perimeter. The specific area used in one overlay grading unit shall not be used in another overlay grading unit. Overlay grading units need not be spaced uniformly about the specimen.	**Alternative:** (b)(2) Overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to preclude interfering reflections from adjacent flaws. The specific area used in one overlay fabrication grading unit shall not be used in another overlay fabrication grading unit. Overlay fabrication grading units need not be spaced uniformly about the specimen. **Basis:** *Paragraph 1.1(e)(2)(b)(2) states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 in. at both ends, rather than around its entire perimeter.*

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(b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	**Alternative:** ...base metal grading units, ten unflawed base metal grading units, five flawed overlay fabrication grading units, and ten unflawed overlay fabrication grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units. For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(f) Sizing Specimen	
(1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.	**Alternative:** (1) The .... least 40% of the flaws shall be open to the inside surface. Sizing sets shall contain a distribution of flaw dimensions to assess sizing capabilities. For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required.
(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	**Alternative:** (3) Base metal flaws used ... circumferentially.
(4) Depth sizing specimen sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 in. in the through-wall direction.	**Alternative:** (4) Depth sizing specimen sets shall include at least two distinct locations where a base metal flaw extends into the overlay material by at least 0.1 in. in the through-wall direction.

Table 2
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SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
2.0 CONDUCT OF PERFORMANCE DEMONSTRATION	
The specimen inside surface and identification shall be concealed from the candidate. All examinations shall be completed prior to grading the results and presenting the results to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.	**Alternative:** The specimen.....prohibited. The overlay fabrication flaw test and the base metal flaw test may be performed separately.
2.1 Detection Test.	
Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.	**Alternative:** Flawed.... (base metal or overlay fabrication) ... each specimen.
2.2 Length Sizing Test	
(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	**Alternative:** *(d)* For ... base metal grading ... base metal wall thickness.

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2.3 Depth Sizing Test.	
For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	**Alternative:** (a) The depth sizing test may be conducted separately or in conjunction with the detection test. (b) When the depth sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. (c) For a separate depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.

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SUPPLEMENT 11 – QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
3.0 ACCEPTANCE CRITERIA	
3.1 Detection Acceptance Criteria	
Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-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.	**Alternative:** Examination procedures are qualified for detection when: a. All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. b. At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (c). c. Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. d. The criteria in (b) and (c) shall be satisfied separately by the demonstration results for base metal grading units and for overlay fabrication grading units.

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3.2 Sizing Acceptance Criteria	
(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position.	**Alternative:** *(a)* The ... base metal flaws is ... position.
(b) 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.	**Alternative:** This requirement is omitted. **Basis:** *The requirement for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the Supplement 2 depth sizing criteria.*

Table 3
Modification To Code Case N-638-1

Code Case N-638-1	Modification/Basis
(Referenced below in 4.0(b)1.0(d) Prior to welding the area to be welded and a band around the area of at least 11/2 times the component thickness or 5in., whichever is less shall be at least 50°F.) 4.0(b) The final weld surface and a band around the area defined in para. 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.[3] [3] Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda	**Modification.** In lieu of the required ultrasonic examination of 4.0(b) only the required liquid penetrant examination will be performed. **Basis:** *For the application of the weld overlay repair addressed in this request it is not possible to perform a meaningful ultrasonic examination of the required band of base material because of the existing nozzle configuration shown in Figure 1. This Code Case applies to any type of welding where a temper bead technique is to be employed and is not specifically written for a weld overlay repair. However, it is believed that for this type of repair that any major base material cracking would take place in the HAZ directly below the weld overlay or in the underlying Inconel 82/182 weld deposit and not in the required band of material out beyond the overlay. Therefore, it is assumed that if this cracking were to occur it would be identified by the ultrasonic examination of the weld overlay and not performing the required base material ultrasonic examination should be considered acceptable.*