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March 8, 2007
L-07-039

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Subject: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334, License No. DPR-66
Proposed Alternative to American Society of Mechanical Engineers Code Section XI Repair Requirements
(Request No. BV1-PZR-01)

During the Beaver Valley Power Station (BVPS) Unit No. 1 maintenance and refueling outage scheduled for September 2007, FirstEnergy Nuclear Operating Company (FENOC) intends to apply structural weld overlays on pressurizer nozzle welds. The modifications are necessary due to increased inspection requirements and difficulties associated with application of ultrasonic inspection technology to the current weld geometry.

The ASME Code of record for the current inservice inspection interval is the 1989 Edition, no addenda. Paragraph IWA-4000 of ASME Section XI contains requirements for welded repairs performed on ASME components. In lieu of these ASME Code requirements, an alternative weld repair is proposed. Additionally, Supplement 11 of Appendix VIII of the 1995 Edition, 1996 Addenda of ASME Section XI, which is required to be implemented by 10 CFR 50.55a(g)(6)(ii)(C), establishes requirements for nondestructive examination of weld overlays. In lieu of these requirements, alternative use of the Electric Power Research Institute, Performance Demonstration Initiative (PDI) is proposed. The proposed alternatives provide an acceptable level of quality and safety.

Pursuant to 10 CFR 50.55a(a)(3)(i), FENOC hereby requests NRC approval to use the above alternatives to the requirements of 10 CFR 50.55a. The details of the 10 CFR 50.55a request are enclosed. FENOC requests approval by August 2007 to support the BVPS Unit No. 1 maintenance and refueling outage, scheduled for September 2007.

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The regulatory commitments contained in this submittal are listed in the attachment. If there are any questions concerning this matter, please contact Mr. Henry L. Hegrat, Supervisor, FENOC Fleet Licensing at 330-374-3114.

Sincerely,

James H. Lash

Attachment:
Commitment List

Enclosure:
10 CFR 50.55a Request No. BV1-PZR-01

c: Ms. N. S. Morgan, NRR Project Manager
Mr. P. C. Cataldo, NRC Senior Resident Inspector
Mr. S. J. Collins, NRC Region I Administrator
Mr. D. A. Allard, Director BRP/DEP
Mr. L. E. Ryan (BRP/DEP)

ATTACHMENT TO LETTER L-07-039

Commitment List

The following list identifies those actions committed to by FirstEnergy Nuclear Operating Company (FENOC) for Beaver Valley Power Station (BVPS) Unit No. 1 in this document. Any other actions discussed in the submittal represent intended or planned actions by FENOC. They are described only as information and are not regulatory commitments. Please notify Mr. Henry L. Hegrat, Supervisor, FENOC Fleet Licensing at 330-374-3114 of any questions regarding this document or associated regulatory commitments.

Commitment	Due Date
The installed weld overlay will be added to the Beaver Valley Power Station Unit No. 1 ISI Plan in accordance with Subarticle Q-4300 of Nonmandatory Appendix Q for at least one inservice examination.	To be completed within the next two refueling outages but no later than the end of 1R20. Maintenance and refueling outage 1R20 is currently scheduled to end October 28, 2010.
The following information will be submitted in a report that summarizes the examination results of the pressurizer spray nozzle, relief nozzle, and three safety nozzle weld overlays for safe end-to-pipe and nozzle-to-safe end locations implemented during the 1R18 refueling outage: • A listing of all indications detected[1], • The disposition of all indications using the standards of ASME Section XI, IWB 3514-2 and/or IWB 3514-3 criteria, and, if possible, • The type and nature of the indications[2]. Included in the results will be a discussion of any repairs to the overlay material and/or base metal and the reason for the repair.	Within 14 days of completion of the last ultrasonic examination of the 1R18 refueling outage.

1. The recording criteria of the ultrasonic examination procedure to be used for the examination of the Beaver Valley Power Station Unit No. 2 pressurizer overlays (PDI-UT-8) requires that all indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, and location. Additionally, the procedure requires that all indications, regardless of amplitude, that cannot be clearly attributed to the geometry of the overlay configuration be considered flaw indications.
2. Ultrasonic examination procedure PDI-UT-8, requires that all suspected flaw indications are to be plotted on a cross sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.

10 CFR 50.55a REQUEST No. BV1-PZR-01

1.0 ASME CODE COMPONENTS AFFECTED

Component Numbers: 1RC-TK-1 (Pressurizer Vessel)

Nozzle	Nozzle-to-Safe End Weld ID	Safe End-to-Pipe Weld ID
Safety "A"	RC-97-1-E-01	RC-97-1-F-01
Safety "B"	RC-98-1-E-02	RC-98-1-F-01
Safety "C"	RC-99-1-E-03	RC-99-1-F-01
Relief	RC-104-1-E-01	RC-104-1-F-01
Spray	RC-72-7-E-01	RC-72-7-F-09

Code Class: Class 1
Examination Categories: B-F
Item Number: B5.40
Description: Alternative Welded Repair for the Pressurizer Safety, Relief, and Spray Nozzle-to-safe end welds
References: ASME Section XI, 1989 Edition, no addenda
ASME Section XI, 1995 Edition, 1996 Addenda
ASME Section XI, 2005 Addenda, Nonmandatory Appendix Q
ASME Section XI, Code Case N-504-2
ASME Section XI, Code Case N-638-1
ASME Section XI, Code Case N-416-2
ASME Section III, 1965 Edition through Winter 1966 Addenda
ANSI B31.1, 1967 Edition through Summer 1971 Addenda

NOTE: The Beaver Valley Power Station (BVPS) Unit No. 1 pressurizer surge nozzle-to-safe end weld is stainless steel and, as such, is not within the scope of this request.

2.0 APPLICABLE CODE EDITION AND ADDENDA

BVPS Unit No. 1 Code of Construction (Pressurizer Vessel): ASME Section III, 1965 Edition through Winter 1966 Addenda

BVPS Unit No. 1 Code of Construction (RCS Piping): ANSI B31.1, 1967 Edition through Summer 1971 Addenda

BVPS Unit No. 1 In-Service Inspection and Repair/Replacement Programs: ASME Section XI, 1989 Edition, No addenda

Additional Requirements: ASME Section XI, 1995 Edition, 1996 Addenda, Appendix VIII, Supplement XI (as required by 10CFR50.55a(g)(6)(ii)(C))

3.0 APPLICABLE CODE REQUIREMENTS

IWA-4000 of ASME Section XI contains requirements for welded repairs performed on ASME components. The specific Code requirements for which use of the proposed alternative is being requested are as follows:

ASME Section XI, IWA-4120(a) states that "Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system."

ASME Section XI, IWA-4310 states that "Defects shall be removed or reduced in size in accordance with this Article."

ASME Section XI, IWA-4533(b) states that "Thermocouples and recording instruments shall be used to monitor the preheat and interpass requirements and the 450°F to 550°F heat treatment. Thermocouples may be attached by welding or by mechanical methods."

ASME Section XI, Appendix VIII, Supplement 11 (1995 Edition, 1996 Addenda) contains nondestructive examination requirements for structural weld overlays and is required to be implemented by 10CFR50.55a(g)(6)(ii)(C).

The applicable requirements of the Construction Code required by ASME Section XI, IWA-4120(a) for which use of the proposed alternative is being requested are as follows:

ASME Section III, Subsection N-528 states that "Unacceptable defects . . . shall be removed by mechanical means or by thermal gouging processes . . ." and that "The post-weld heat-treating rules in N-532 shall apply to all weld repairs."

ASME Section III, Subsection N-532.1 states that " . . . all welded pressure vessels or pressure vessel parts shall be given a postweld heat treatment at a temperature not less than specified in table N-532."

4.0 REASON FOR REQUEST

Primary Water Stress Corrosion Cracking (PWSCC) of Alloy 600/82/182 components exposed to Pressurized Water Reactor (PWR) primary coolant has become a growing concern in the nuclear industry over the past decade. In particular, base metal and weld metal components exposed to elevated temperatures, like the pressurizer, have been shown to pose a heightened propensity to PWSCC. As a result, increased inspection requirements have been applied to these locations via several mechanisms, including 10CFR50.55a, the ASME Code, the recently issued NEI 03-08 Mandatory Guidance, "Primary System Piping Butt Weld Inspection & Evaluation Guideline (MRP-139)," and internal utility Alloy 600 programs.

Many of these requirements call for dramatically improved ultrasonic examination coverage (> 90% of the inner 1/3t of the dissimilar metal weld) and inspection frequencies far in excess of those required by the existing Inservice Inspection (ISI) program. In many cases, these examination coverage requirements are difficult or impossible to meet using current ultrasonic inspection technology due the short lengths of the stainless steel safe end between the dissimilar metal and stainless steel welds and of the nozzle between the dissimilar metal weld and the nozzle transition.

Due to the combination of inspectability issues and a reduced ability to validate the integrity of these welds prior to the observation of leakage, FirstEnergy Nuclear Operating Company (FENOC) has concluded that the application of preemptive structural weld overlays to the susceptible pressurizer nozzle locations is the most appropriate course of action to ensure Reactor Coolant System (RCS) pressure boundary integrity and improve future inspectability.

Pursuant to 10 CFR 50.55a(a)(3)(i), an alternative is requested on the basis that the proposed alternative will provide an acceptable level of quality and safety. The Code of Construction (ASME Section III,

Subsection N-528.1) and ASME Section XI, IWA-4310 do not allow unacceptable flaws to be reduced to an acceptable size through the application of a structural weld overlay. Furthermore, the Code (ASME Section III, Subsection N-528.2) requires that components that have been repaired by welding be post-weld heat treated in accordance with ASME Section III, Subsection N-532 following the repair. IWA-4533(b) of ASME Section XI further requires that inprocess thermocouples be attached by welding or mechanical methods. Finally, Appendix VIII, Supplement 11 of the 1995 Edition, 1996 Addenda of ASME Section XI establishes nondestructive examination requirements for weld overlays. The proposed alternatives to these requirements, as discussed in Section 5.0 of this request, provide an acceptable level of quality and safety utilizing processes better suited to in-service field applications.

5.0 PROPOSED ALTERNATIVES AND BASIS FOR USE

Proposed Alternative to ASME Section XI, IWA-4120(a), IWA-4310, and ASME Section III, Subsection N-528

A preemptive full structural weld overlay is proposed for each Alloy 82/182 nozzle-to-safe end weld. ASME Code Case N-504-2 allows a flaw to be reduced to an acceptable size through the deposition of weld reinforcement (weld overlay) on the outside surface of the pipe without flaw removal. In this case, the existence of (or lack of) any flaws is not known due to the inability to perform a qualified ultrasonic examination prior to application of the overlays. As such, assumptions are required to be made as to the size and location of flaws which may be present in the original dissimilar metal weld, as discussed below.

Figure 1 shows the generic configuration of the nozzle-to-pipe assemblies. Table 1 identifies the materials of construction for the pressurizer nozzle-to-pipe assemblies within the scope of this proposed alternative. In order that both the dissimilar metal nozzle-to-safe end weld and the stainless steel safe end-to-pipe weld are inspectable per the ASME Code post-overlay, the weld overlays will extend from the carbon steel nozzle to the stainless steel pipe.

Figure 1: Generic Pressurizer Nozzle Configuration

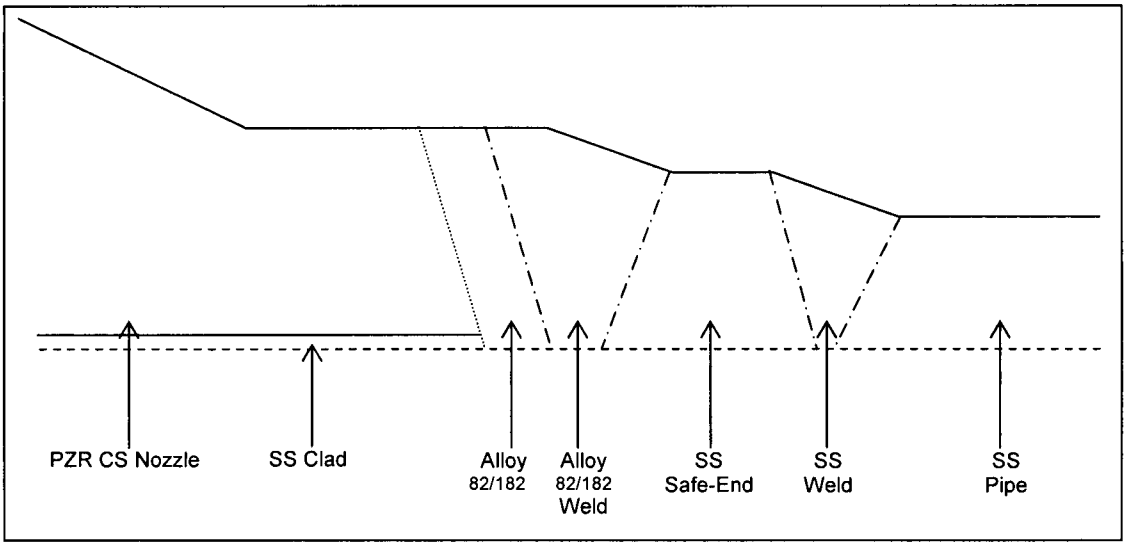

Table 1: Beaver Valley Unit No. 1 Pressurizer Nozzle Material Identification

Nozzle Type	NPS	N-SE Weld ID (82/182)[1] SE-P Weld ID (SS)[1]	Material Identification				
			Nozzle	N-SE Weld[1]	Safe End	SE-P Weld[1]	Pipe
Spray	4"	RC-72-7-E-01 RC-72-7-F-09	SA-216, Gr. WCC	Ni-Cr-Fe Weld Metal, F-Number 43	SA-182 or 376, Type 316 or 316L	SS Field Weld	Schedule 120, SA-376, Type 316
Safety	6"	RC-97-1-E-01 RC-97-1-F-01	SA-216, Gr. WCC	Ni-Cr-Fe Weld Metal, F-Number 43	SA-182 or 376, Type 316 or 316L	SS Field Weld	Schedule 160, SA-376, Type 316
Safety	6"	RC-98-1-E-02 RC-98-1-F-01	SA-216, Gr. WCC	Ni-Cr-Fe Weld Metal, F-Number 43	SA-182 or 376, Type 316 or 316L	SS Field Weld	Schedule 160, SA-376, Type 316
Safety	6"	RC-99-1-E-03 RC-99-1-F-01	SA-216, Gr. WCC	Ni-Cr-Fe Weld Metal, F-Number 43	SA-182 or 376, Type 316 or 316L	SS Field Weld	Schedule 160, SA-376, Type 316
Relief	6"	RC-104-1-E-01 RC-104-1-F-01	SA-216, Gr. WCC	Ni-Cr-Fe Weld Metal, F-Number 43	SA-182 or 376, Type 316 or 316L	SS Field Weld	Schedule 160, SA-376, Type 316

[1]N-SE refers to Nozzle-to-Safe End and SE-P refers to Safe End-to-Pipe

The weld overlay will be designed consistent with the requirements of ASME Code Case N-504-2, "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping," with the modifications noted in Table 2. The weld overlay will extend around the full circumference of the nozzle-to-safe end weld location as required by Code Case N-504-2. The specific thickness and length will be calculated according to the guidance provided in Code Case N-504-2.

The design of each overlay will assume that a 360° circumferential through-wall flaw is present in the original Alloy 82/182 weld. Fatigue crack growth evaluations will be performed for the dissimilar metal butt welds to demonstrate that the weld overlay thickness is sized adequately to satisfy the requirements in the flaw evaluation procedures of IWB-3640. The initial flaw size assumed in the fatigue crack growth calculations will be consistent with the post-overlay ultrasonic examination requirements (i.e. a minimum of the outer 25% of the original Alloy 82/182 weld will be inspectable post-overlay). If the crack growth analysis shows that fatigue crack growth will not cause a flaw to exceed the design basis depth for the normal ASME Code Section XI inspection interval, the existing Code interval will be used for subsequent inservice inspections. If the crack growth analysis shows that the assumed crack will grow to the allowable flaw size, the inservice inspection interval will be established based on the crack growth analysis. Preservice inspections will be performed in accordance with Code Case N-504-2, Nonmandatory Appendix Q, Subarticle Q-4200, and ASME Section XI, 1995 Edition, 1996 Addenda, Appendix VIII, Supplement 11, as modified by this request.

Flaw evaluations and shrinkage stress effects analyses required to demonstrate that the overlays meet the design and structural requirements of Code Case N-504-2 will be performed prior to entry into Mode 4.

1. Nozzle specific stress analyses will be performed to establish a residual stress profile in the nozzle. Severe ID weld repairs have been assumed that effectively bound any actual weld repairs to the nozzle. The weld overlay is subsequently applied to simulate the final residual stress profile. Post weld overlay residual stresses at normal operating conditions will then be shown to result in beneficial compressive stresses on the inside surface of the components, further assuring that crack growth into the overlay is highly unlikely.
2. Fracture mechanics analyses will also be performed to predict crack growth, assuming that cracks exist that are equal to or greater than the thresholds of the NDE techniques to be used on the nozzles. Potential crack growth will be evaluated due to PWSCC as well as due to fatigue crack growth in the original DMW. The crack growth analyses will consider all design loads and transients, plus the post weld overlay residual stress distributions, and will demonstrate that cracks will not grow beyond the original DMW thickness for the time period until the next scheduled inservice inspection.
3. The analyses will demonstrate that application of the weld overlays does not impact the conclusions of the existing nozzle Stress Reports. ASME Code, Section III stress and fatigue criteria will be met, as spelled out in ASME Code Case N-504-2.
4. Shrinkage will be measured during the overlay application. Shrinkage stresses at other locations in the piping systems arising from the weld overlays will be demonstrated not to have an adverse effect on the systems. Clearances of affected support and restraints will be checked after the overlay repair, and will be reset within the design ranges as required.
5. The total added weight on the piping systems due to the overlays will be evaluated for potential impact on piping system stresses and dynamic characteristics.
6. The as-built dimensions of the weld overlays will be measured and evaluated to demonstrate that they equal or exceed the minimum design dimensions of the overlays.

Code Case N-504-2 is approved for use for austenitic stainless steel material in Regulatory Guide 1.147, Revision 14, provided that it is used with Nonmandatory Appendix Q of the 2005 Addenda of ASME Section XI. An alternate application for nickel-based and carbon materials is proposed due to the configuration of the subject welds, and the lack of an approved code case for these applications. The methodology of Code Case N-504-2 shall be followed with the modifications detailed in Table 2.

Due to the short length of the safe end between the Alloy 82/182 nozzle-to-safe end weld and the stainless steel safe end-to-pipe weld, a pre-overlay ultrasonic examination using PDI-qualified procedures is not possible, and will not be performed. As the overlays being applied are full-structural, the post-overlay ultrasonic examinations of the overlay and outer 25% of the original Alloy 82/182 weld will ensure that the inspected volume of the overlay and base material supports the conditions analyzed in the design and analysis of the overlays. Bare Metal Visual (BMV) examinations for leakage in accordance with BVPS commitments to NRC Bulletin 2004-01 will be performed prior to application of the overlays. Details regarding the in-process, pre-service, and inservice examinations that will be applied to the proposed weld overlays are shown in Table 3. These examinations meet the requirements of the applicable Codes, as modified by this request.

The above proposed alternative will be implemented during the Beaver Valley Power Station Unit No. 1 1R18 Refueling Outage (Fall 2007) and provides an acceptable level of quality and safety.

Proposed Alternative to ASME Section XI, IWA-4120(a) and ASME Section III, Subsection N-532

Application of the structural weld overlays will require welding to the carbon steel nozzle material. The Code of Construction does not permit welding to the carbon steel nozzle without pre-heat or post-weld heat treatment. In lieu of these requirements, the requirements of ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," will be met, with the modification detailed in Table 4.

The ambient temperature temper bead welding technique permits applications of the structural weld overlay without the need for elevated preheat or post-weld heat treatment required by ASME Section III. The technique has been qualified and will be performed using the methodology described in ASME Code Case N-638-1. Welding will commence when the base materials exhibit a minimum preheat of 50 degrees Fahrenheit. The interpass temperature during weld installation will not be permitted to exceed a maximum value of 350 degrees Fahrenheit. During the welding, heat input will be precisely controlled to conform to the welding procedure specification.

The above proposed alternative will be implemented during the Beaver Valley Power Station Unit No. 1 1R18 Refueling Outage (Fall 2007) and provides an acceptable level of quality and safety.

Proposed Alternative to ASME Section XI, IWA-4533(b)

IWA-4533(b) requires that inprocess thermocouples and recording instruments be attached by welding or mechanical means. In lieu of attached thermocouples and recording instruments, process temperatures will be monitored with non-attached devices, such as contact pyrometers, which will enable manual recording of process temperatures. Instruments used will be calibrated in accordance with approved calibration and control program requirements.

The above proposed alternative will be implemented during the Beaver Valley Power Station Unit No. 1 1R18 Refueling Outage (Fall 2007) and provides an acceptable level of quality and safety.

Proposed Alternative to ASME Section XI, Appendix VIII, Supplement 11

Appendix VIII of Section XI cannot be used for nondestructive examination of a structural weld overlay repair. The proposed alternative is to use the Performance Demonstration Initiative (PDI) program. A detailed comparison of Appendix VIII and PDI requirements is summarized below.

The proposed alternative will allow closer spacing of flaws provided they do not 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. Specific details regarding the PDI program's alternative to the requirements of Supplement 11 are contained in Table 5.

The above proposed alternative will be implemented during the Beaver Valley Power Station Unit No. 1 third In-Service Inspection (ISI) interval (ending April 2, 2008) and provides an acceptable level of quality and safety.

Ultrasonic Examination Report

Within 14 days of completion of the last ultrasonic examination of the 1R18 refueling outage, the following information will be submitted in a report that summarizes the examination results of the pressurizer spray nozzle, relief nozzle, and three safety nozzle weld overlays for safe end-to-pipe and nozzle-to-safe end locations implemented during the 1R18 refueling outage:

- A listing of all indications detected[1],
- The disposition of all indications using the standards of ASME Section XI, IWB 3514-2 and/or IWB 3514-3 criteria, and, if possible,
- The type and nature of the indications[2].

Included in the results will be a discussion of any repairs to the overlay material and/or base metal and the reason for the repair.

6.0 DURATION OF THE PROPOSED ALTERNATIVES

Use of the proposed alternatives is requested for the Beaver Valley Power Station Unit No. 1, third In-Service Inspection (ISI) interval (ending April 2, 2008). The resulting repairs are requested for the design life of the repairs, as determined by the required evaluation in Paragraph (g) of Code Case N-504-2 and the corresponding requirements in Nonmandatory Appendix Q.

The installed weld overlay will be added to the Beaver Valley Power Station Unit No. 1 ISI Plan in accordance with Subarticle Q-4300 of Nonmandatory Appendix Q for at least one inservice examination to be completed within the next two refueling outages.

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1. The recording criteria of the ultrasonic examination procedure to be used for the examination of the Beaver Valley Power Station Unit No. 2 pressurizer overlays (PDI-UT-8) requires that all indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, and location. Additionally, the procedure requires that all indications, regardless of amplitude, that cannot be clearly attributed to the geometry of the overlay configuration be considered flaw indications.
2. Ultrasonic examination procedure PDI-UT-8, requires that all suspected flaw indications are to be plotted on a cross sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.

7.0 PRECEDENT

Similar requests have been approved for pre-emptive repairs of similar PWR locations at Beaver Valley Power Station, Unit No. 2 and Oconee Nuclear Station, Unit No. 1; and contingency repair of similar PWR locations at Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2. Use of the Performance Demonstration Initiative (PDI) program for the inspection has also been authorized by the NRC for Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2; Donald C. Cook Nuclear Plant, Unit No. 1; and Millstone Power Station, Unit No. 3. NRC letters authorizing the alternatives and docketed letters to the NRC documenting verbal NRC authorization of alternatives are referenced below.

- Beaver Valley Power Station, Unit No. 2
  Docket No. 50-412, November 20, 2006 Letter to U. S. NRC
  During a teleconference on October 5, 2006 the NRC provided verbal authorization to apply alternative flaw removal, heat treatment, and nondestructive examination requirements, and full structural weld overlays on nozzle-to-safe end welds.
- Oconee Nuclear Station, Unit No. 1
  Docket No. 50-269, November 27, 2006 letter to the U. S. NRC
  The NRC granted temporary verbal approval of an alternative approach to support application of preemptive full structural weld overlays on October 30, 2006.
- Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2
  Docket Nos. 50-317 and 50-318, TAC Nos. MC8530 and MC8531, dated June 28, 2006
  Authorized use of a full structural weld overlay as a contingency to repair welds and the Performance Demonstration Initiative (PDI) program for the inspection as alternatives to the ASME Code requirements.
- Calvert Cliffs Nuclear Power Plant, Unit No. 2
  Docket No. 50-318, TAC Nos. MC6219 and MC6220, dated July 20, 2005
  Authorized use of a weld overlay to repair welds and the Performance Demonstration Initiative (PDI) program for the inspection as alternatives to the ASME Code requirements.
- Donald C. Cook Nuclear Plant, Unit No. 1
  Docket No. 50-315, TAC No. MC6751, dated June 27, 2005
  Authorized use of PDI Program for weld overlay qualifications in lieu of Supplement 11 to Appendix VIII of Section XI of the Code
- Millstone Power Station, Unit No. 3
  Docket No. 50-423, TAC No. MC8609, dated January 20, 2006
  Authorized use of a weld overlay for repair and the Performance Demonstration Initiative (PDI) program for inspection as alternatives to the ASME Code requirements.

Table 2: Modifications to Code Case N-504-2

Code Case N-504-2 Section	Modification and 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, defects 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.	*Modification:* Code Case N-504-2 will be used for the weld overlay of the ferritic (P-No. 1) nozzle material, nickel alloy (F-No. 43/P-No. 43) weld material, and austenitic stainless steel base (P-No. 8, safe end and pipe) and weld materials. *Basis:* Code Case N-504-2 is accepted for use in the current NRC Regulatory Guide 1.147 Rev. 14, and has been used extensively in BWR primary system piping. More recently, N-504-2 has been applied to PWR applications, with modifications, for the weld overlay repair of dissimilar metal welds with known flaws. Industry operating experience in the area has shown that PWSCC in Alloy 82/182 will arrest at the interface with stainless steel base metal, ferritic base metal, or Alloy 52/52M/152 weld metal. The 360° full structural weld overlay will control growth in any PWSCC crack and maintain weld integrity. The weld overlay will also 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 without considering the existing 82/182 weld.
Paragraph (b): Reinforcement weld metal shall be low carbon (0.035% max.) austenitic stainless steel applied 360 deg. around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification identified in the Repair Program.	*Modification:* A nickel alloy, specifically Alloy 52/52M, will be used as the reinforcement weld metal in lieu of austenitic stainless steel filler material. *Basis:* The weld metal used will 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 Alloys 52 and 52M is 28-3 1.5%. Alloy 52M contains higher Niobium content (0.5- 1 %) than Alloy 52, which 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 2: Modifications to Code Case N-504-2 (Continued)

Code Case N-504-2 Section	Modification and Basis
	These filler materials are selected for their improved resistance to PWSCC. Alloys 52, 52M and 152 all contain about 30% chromium (roughly twice that of Alloy 82/182), imparting 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 PWR operating temperature. Furthermore, these filler materials are suitable for welding over the ferritic nozzle, Alloy 82/182 weld, and the austenitic stainless steel pipe, welds, and safe ends.
Paragraph (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.	*Modification:* Delta ferrite (FN) measurements will not be performed when using Alloy 52/52M/152 weld metal. *Basis:* Welds composed of Alloy 52/52M/152 are 100% austenitic and contain no delta ferrite due to the high nickel (approximately 60%) content. The Alloy 52/52M filler material selected for these repairs is fully austenitic and is, therefore, exempt from delta ferrite content requirements. Alternatively, deposit chromium content provides a suitable alternate basis for first layer deposit acceptance in PWSCC-resistant structural weld overlays. N-504-2 does not identify first-layer acceptance criteria for fully austenitic deposits; however, ASME Code Case N-740 (and its accompanying technical justification) identifies 24% chromium as an acceptable measure of first-layer deposit acceptability in PWR applications. For structural weld overlay repairs, verification of first layer acceptability will be accomplished using N-740 methodology. To accomplish this, first layer overlay deposit chemistry will be verified either by field chemistry measurements or by prior mockup demonstration using comparable welding parameters. When first-layer surface chemistry meets or exceeds 24% chromium, this initial layer may be credited toward structural overlay deposit thickness. When first-layer surface chemistry chromium is less than 24% chromium, the first layer will be considered sacrificial and will not be credited toward structural overlay deposit thickness.

Table 2: Modifications to Code Case N-504-2 (Continued)

Code Case N-504-2 Section	Modification and Basis
Paragraph *(h):* The completed repair shall be pressure tested in accordance with IWA-5000. If the flaw penetrated the original pressure boundary prior to welding, or if any evidence of the flaw penetrating the pressure boundary is observed during the welding operation, a system hydrostatic test shall be performed in accordance with IWA-5000. If the system pressure boundary has not been penetrated, a system leakage, inservice, or functional test shall be performed in accordance with IWA-5000.	*Modification:* If a flaw or evidence of a flaw penetrating the pressure boundary is observed, in lieu of a hydrostatic test, a system pressure test will be performed in accordance with approved Code Case N-416-2. *Basis:* Because the proposed alternative is for the application of preemptive weld overlays, it is not anticipated that any flaws will have penetrated the pressure boundary prior to welding. This being the case, Code Case N-504-2, Paragraph (h) would only require a system pressure test in accordance with IWA-5000, and the use of Code Case N-416-2 would not be required. If a flaw or evidence of a flaw penetrating the pressure boundary is observed, Code Case N-504-2 requires a system hydrostatic test in accordance with IWA-5000. In this case, a system pressure test and an ultrasonic examination of the weld overlay are proposed, in accordance with the Third Interval ISI Program and ASME Code Case N-416-2. This alternative requirement is sufficient to demonstrate that the overlay is of adequate quality to ensure the pressure boundary integrity. Code Case N-416-2 is currently implemented within the BVPS Unit No. 1 In-Service Inspection program.

Table 3: Weld Overlay Examination Requirements

PRE-OVERLAY EXAMINATION				
Examination Description	**Method**	**Technique**	**Reference**	**Acceptance Standards**
360° around the Alloy 82/182 Nozzle-to-Safe End weld	Visual	Bare Metal Visual	BVPS Commitment to NRC Bulletin 2004-01 in letter dated July 27, 2004 (L-04-081)	No Evidence of Leakage
IN-PROCESS EXAMINATIONS				
Examination Description	**Method**	**Technique**	**Reference**	**Acceptance Standards**
Safe end, welds, nozzle, and pipe pre-overlay surface preparation	Surface	Liquid Penetrant	N-504-2 and Q-2000	N-504-2, Paragraph (c) and Q-2000, Paragraph (b)
Initial layers of weld metal not associated with the structural weld overlay	Surface	Liquid Penetrant	N-504-2 and Q-2000	N-504-2, Paragraph (d) and Q-2000, Paragraph (c)
Thickness measurement for final deposited weld reinforcement	Volumetric	UT-0°L	N-504-2 and Q-3000	Per weld overlay design requirements and Q-3000
PRE-SERVICE EXAMINATION REQUIREMENTS				
NOTE: The pre-service examinations identified below will be performed following the 48-hour hold period (when the completed weld has been at ambient temperature for at least 48 hours) as required by Code Case N-638-1, Paragraph 4.0(b).				
Examination Description	**Method**	**Technique**	**Reference**	**Acceptance Standards**
Completed weld overlay for assurance of complete bonding, minimum overlay design thickness, and detection of welding flaws	Volumetric	UT-0°L and angle beam UT per PDI-qualified procedure	N-504-2 and Q-4100	Per weld overlay design requirements, Q-3000, and Q-4100, Paragraph (c)
Examination of the completed weld overlay and examination of a band at least 0.50 inches outward from the toe of the weld overlay around the entire circumference of the nozzle and pipe	Surface	Liquid Penetrant	N-504-2 and Q-4100	Q-4100, Paragraph (b)

Table 3: Weld Overlay Examination Requirements (Continued)

PRE-SERVICE EXAMINATION REQUIREMENTS (CONTINUED)				
NOTE: The pre-service examinations identified below will be performed following the 48-hour hold period (when the completed weld has been at ambient temperature for at least 48 hours) as required by Code Case N-638-1, Paragraph 4.0(b).				
Examination Description	**Method**	**Technique**	**Reference**	**Acceptance Standards**
The outer 25 percent of the original nozzle, safe end and weld thickness at least 0.5-inch beyond the toes of the original weld and butter and the completed weld overlay coincident with this region	Volumetric	UT angle beam per PDI-qualified procedure	N-504-2 and Q-4200	N-504-2, Paragraph (i) and Q-4200
The outer 25 percent of the safe end, pipe and weld thickness at least 0.5-inch beyond the toes of the original weld and the completed weld overlay coincident with this region	Volumetric	UT angle beam per PDI-qualified procedure	N-504-2 and Q-4200	N-504-2, Paragraph (i) and Q-4200
INSERVICE EXAMINATION REQUIREMENTS				
Examination Description	**Method**	**Technique**	**Reference**	**Acceptance Standards**
Weld overlay and outer 25 percent of the original nozzle, safe end and weld thickness at least 0.5-inch beyond the toes of the original weld and butter within the next two refueling outages.	Volumetric	UT angle beam per PDI procedure	ASME Section XI, Appendix VIII and Q-4300	IWB-3514-2 and Q-4300(c), re-examination frequency and follow-up actions per Q-4300(d), (e), and (f) and Q-4310.

Table 4: Modifications to Code Case N-638-1

Code Case N-638-1 Section	Modification and Basis
Paragraph 4.0(b): The final weld surface and the 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]. *Paragraph 1.0(d) (by reference in 4.0(b)):* Prior to welding the area to be welded and a band around the area of at least 1-1/2 times the component thickness or 5 in., whichever is less shall be at least 50°F. [3]Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda.	Modification: A surface examination of a band at least 0.50 inches outward from the toe of the weld overlay around the entire circumference of the nozzle and pipe will be performed in accordance with Q-4100(b). In lieu of the required ultrasonic examination, ultrasonic examinations will be performed in accordance with N-504-2 and Appendix Q. Basis: With respect to the weld overlay process on Pressurizer nozzle dissimilar metal welds, the ASME Code Case N-638-1 defined band and examination volume would encompass the nozzle base metal volume below the outer diameter nozzle tapered surface and a part of the nozzle outer diameter blend region. Being that the inner diameter of the nozzle cannot be reasonably accessed, these outer diameter surfaces must be used as the ultrasonic test probe scanning surfaces. The outer diameter surfaces do not permit meaningful coverage of the examination volume due to non-coupling of the ultrasonic test probes over the surface; obstructions causing this non-coupling include the edge of the weld overlay, the transition between the outside diameter nozzle taper and the nozzle outer blend area, and the nozzle outer blend area. Appendix I of the ASME Code Section XI, 1998 Edition through the 2000 Addenda requires that the ultrasonic examination be conducted in accordance with ASME Code Section V, Article 4 and all supplements of Appendix I except Supplement 9 – Scan Angles. The most applicable examination requirements fall under Article 4 T-440 Vessel Examinations. These requirements include straight beam scanning for laminar and planar reflectors and angle beam scanning for planar reflectors. The straight beam scanning is not likely to detect any delayed hydrogen cracking due to mis-orientation of the cracking with respect to the beam and to the anticipated near surface location of such cracking. Essentially the straight beam is a repeat of the nozzle material examination required by the Construction Code. The angle beam examinations will be largely impacted by the outer diameter surface configuration. To maximize angle beam examination coverage will entail a series of special transducers to be applied even though the most

Table 4: Modifications to Code Case N-638-1 (Continued)

Code Case N-638-1 Section	Modification and Basis
	effective angle beam transducers would be those configured to detect near surface breaking planar reflectors. However, the most effective NDE method for detection of near surface breaking planar reflectors is not a volumetric method but a surface examination method. The Section III criteria required by the condition imposed in Regulatory Guide 1.147 for the generic use of Code Case N-638-1 address concerns relating to deep cavity base material repairs that are not applicable to its use in weld overlay applications. Acceptance criteria of ASME Section XI Code Case N-504-2 and Nonmandatory Appendix Q in lieu of those of NB-5330 of ASME Section III are the most appropriate for weld overlay applications of Code Case N-638-1 and provide an acceptable level of quality and safety. Code Case N-638-1 applies to any type of welding in which a temper bead technique is employed and is not specifically written for a weld overlay repair. For a weld overlay, any base material cracking would take place in the Heat Affected Zone directly below the weld overlay or in the underlying Alloy 82/182 weld deposit and not in the required band of material out beyond the overlay. Therefore, any cracking that occurs would be identified by the ultrasonic examination of the weld overlay in accordance with N-504-2 and Nonmandatory Appendix Q. The acceptance criteria required by Code Case N-504-2 and Nonmandatory Appendix Q are specifically tailored to the design and application of structural weld overlays to ensure that the overlay and underlying piping are capable of performing their design function, as specified in the design requirements of the Code Case and corresponding Appendix. ASME Section XI pre-service acceptance standards, as specified in Appendix Q, are the appropriate standards for pre-service ultrasonic examinations of weld overlay repairs to nuclear plant components. These standards are consistent with the highly sensitive examination procedures being used, which are qualified in accordance with ASME Section XI, Appendix VIII, Supplement 11, as implemented via the Performance Demonstration Initiative (PDI). The post-repair inspection volume

Table 4: Modifications to Code Case N-638-1 (Continued)

Code Case N-638-1 Section	Modification and Basis
	includes the full thickness of the weld overlay plus 25% of the underlying base metal/weldment thickness. The specimen sets for PDI qualification of weld overlay examinations include construction type flaws in the overlays in addition to simulated service flaws in the underlying base metal and weldment. Therefore, use of PDI-qualified personnel and procedures will result in the reliable detection of construction type flaws. The ASME Section XI flaw acceptance standards are based on fracture mechanics principles that evaluate the potential effect of flaw indications on the safe operation of a component. ASME Section III ultrasonic standards, on the other hand, are derived from radiographic standards in earlier construction codes and tend to be workmanship-based, addressing flaws occurring in the original construction process that are likely to be detected by radiography. The ASME Section III acceptance criteria do not allow the presence of any cracks or cracklike indications, regardless of their size, and are geared more towards construction-type welds. Many indications that are detectable by PDI qualified ultrasonic techniques, and thus require evaluation, would not be detected by the radiographic examinations required by the original construction code or Section III. It is therefore not reasonable, nor technically logical, to reject such indications based on out-dated, workmanship-based standards when found by much more sensitive examination techniques that are not required by the construction codes. The Section XI pre-service examination standards were developed for the above stated reasons, and consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately their potential structural impact on the component. They are the logical choice for evaluation of potential flaw indications in post-overlay examinations, in which unnecessary repairs to the overlay would result in additional personnel radiation exposure without a compensating increase in safety and quality, and could potentially degrade the effectiveness of the overlays by affecting the favorable residual stress field they could produce.

Table 5: PDI Program Alternative 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).
(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) All flaws must be 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 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.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	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 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 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

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. **Basis:** Inclusion of "metal" and "fabrication" provides clarification. Flaw identification is improved by ensuring flaws are not masked by other flaws.
(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.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	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.
(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. **Basis:** Substituted terms provide clarification and are consistent with 1d(1) above. The PDI program adjusts for this conservative change for excluding this type 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. **Basis:** 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.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(b)(1) 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)(1)* 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. **Basis:** 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. This criterion may be more challenging than the ASME Code because of the variability associated with the shape of the grading unit.
(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.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(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:** Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed 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. **Basis:** Clarified the guidance for initial procedure qualifications versus qualifying new values of essential variables.
(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 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 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. **Basis:** Clarified the guidance for initial procedure qualifications versus qualifying new values of essential variables and is consistent with 1d(1) above.
(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	**Alternative:** (3) Base metal flaws used for length sizing demonstrations shall be oriented circumferentially. **Basis:** Clarified wording to be consistent with 1d(1) above.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(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. **Basis:** Clarified wording to be consistent with 1d(1) above.
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 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. The overlay fabrication flaw test and the base metal flaw test may be performed separately. **Basis:** Clarified wording to describe process.
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.... 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 metal or overlay fabrication) that are present for each specimen. **Basis:** Clarified wording similar to 1(e)2 above.
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 flaws in base metal grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base metal wall thickness. **Basis:** Clarified wording for consistency.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
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. **Basis:** Clarified wording to better describe process.
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 Vlll-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 Vlll-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.

Table 5: PDI Program Alternative to Appendix VIII, Supplement 11 (Continued)

SUPPLEMENT 11 - Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	Basis: Clarified wording to better describe the difference between procedure qualification and equipment and personnel qualifications.
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 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 flaws is measured at the 75% through-base-metal position. **Basis:** Clarified wording to be consistent with 1d(1) above.
(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.