Exelon Generation Company, LLC
Braidwood Station
35100 South Rt 53, Suite 84
Braceville, IL 60407-9619
Tel. 815-417-2000

www.exeloncorp.com

Exelon Nuclear

10 CFR 50.55a

February 23, 2007
BW070013

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

Braidwood, Units 1 and 2
Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Subject: Second 10-Year Inservice Inspection Interval, Relief Request I2R-48, Structural Weld Overlays on Pressurizer Spray, Relief, Safety and Surge Nozzle Safe-ends and Associated Alternative Repair Techniques

Pursuant to 10 CFR 50.55a(a)(3)(i), Exelon Generation Company, LLC (EGC), is proposing an alternative to the repair/replacement requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, 1989 Edition, with no Addenda, for the structural weld overlays on pressurizer spray, relief, safety and surge nozzle safe-ends.

During the next Braidwood Station Unit 1 refueling outage (Fall 2007, A1R13) and Braidwood Station Unit 2 refueling outage (Spring 2008, A2R13), EGC will be performing full structural weld overlays (SWOLs) on all pressurizer nozzle safe-end to nozzle welds where Alloy 82/182 was originally used to butter the nozzle face and used to weld the stainless steel safe-ends to nozzles.

The alternative is proposed under the provisions of 10 CFR 50.55a(a)(3)(i), an alternative that provides an acceptable level of quality and safety.

In accordance with this request, EGC is committing to provide the details of the ultrasonic examination results of the structural weld overlays on the Braidwood Station Units 1 and 2 pressurizer spray, relief, safety and surge nozzle safe-ends to the NRC within 14 days of the completion of the final ultrasonic examinations. EGC will notify the NRC Project Manager for Braidwood Station when the examinations of the final structural weld overlays are complete. The attachments to this letter provide the details of this EGC commitment.

EGC requests that the review of this relief request be completed by September 03, 2007. If you have any questions regarding this letter, please contact Dale Ambler, Regulatory Assurance Manager, at (815) 417-2800.

Respectfully,

Thomas Coutu
Site Vice President
Braidwood Nuclear Generating Station

TC/JP/vk
Attachments: Commitments Related to Braidwood Station Relief Request I2R-48
Braidwood Station Relief Request I2R-48

Attachment 1

EGC Commitments Related to Braidwood Station Relief Request I2R-48

Braidwood Station Units 1 and 2

Exelon Generation Company, LLC (EGC) Commitment
Related to Braidwood Station Relief Request I2R-48

Commitment	Committed Date or "Outage"	Commitment Type One-Time Action (Yes/No)	Commitment Type Programmatic Action (Yes/No)
EGC commits to providing the results of the ultrasonic examination of the structural weld overlays on the Braidwood Station Unit 1 pressurizer spray, relief, safety and surge nozzle safe-ends to the NRC (6 locations total). The results will include: • A listing of 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] Also 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. Subsequent inservice examination of the structural weld overlays on pressurizer will be in accordance with ASME Section XI, Appendix Q, Q-4300 or alternate schedules as/if mandated in future NRC regulations.	Within 14 days after the completion of the last ultrasonic examination of the weld overlays during the Fall 2007 Braidwood Station Unit 1 refueling outage (A1R13)	Yes	No

Exelon Generation Company, LLC (EGC) Commitment

[1] The recording criteria of the ultrasonic examination procedure to be used for the examination of the Braidwood Station 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.

Related to Braidwood Station Relief Request I2R-48

Commitment	Committed Date or "Outage"	Commitment Type One-Time Action (Yes/No)	Commitment Type Programmatic Action (Yes/No)
EGC commits to providing the results of the ultrasonic examination of the structural weld overlays on the Braidwood Station Unit 2 pressurizer spray, relief, safety and surge nozzle safe-ends to the NRC (6 locations total). The results will include: • A listing of 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] Also 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. Subsequent inservice examination of the structural weld overlays on pressurizer will be in accordance with ASME Section XI, Appendix Q, Q-4300 or alternate schedules as/if mandated in future NRC regulations.	Within 14 days after the completion of the last ultrasonic examination of the weld overlays during the Spring 2008 Braidwood Station Unit 2 refueling outage (A2R13)	Yes	No

[1] The recording criteria of the ultrasonic examination procedure to be used for the examination of the Braidwood Station 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.

Attachment 2

Braidwood Station Relief Request I2R-48

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Request for Relief for Alternative Requirements of Structural Weld Overlays (SWOLs) of the Pressurizer Surge, Spray, Safety and Relief Nozzles, Dissimilar Welds including the SWOLs of the Adjacent Safe-End to Pipe, Reducer and Elbow Welds on Pressurizer Surge, Spray, Safety and Relief Nozzles In Accordance with 10 CFR 50.55a(a)(3)(i)

1.0 ASME CODE COMPONENT(S) AFFECTED

Code Class:	1
Reference:	IWA-4000, *"Repair Procedures"*
Examination Category:	R-A
Item Number:	See Table 1 for listing
Description:	Structural Weld Overlays (SWOL) of the Pressurizer Surge, Spray, Safety and Relief Nozzles, Dissimilar Welds, Including the SWOL of the Adjacent Safe-End to Pipe, Reducer and Elbow Welds on Pressurizer Surge, Spray, Safety and Relief Nozzles
Component Number(s):	See Table 1 for listing
Drawing Number(s):	Unit 1: M-60 Sheet 5 Unit 2: M-135 Sheet 5

2.0 APPLICABLE CODE EDITION AND ADDENDA

1. American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, 1989 Edition with No Addenda.
2. ASME Section XI, 1995 Edition, including Addenda through 1996, Appendix VIII, *"Performance Demonstration for Ultrasonic Examination Systems"*
3. Pressurizer Code of Construction, ASME Section III 1971 Edition, through Summer 1973 Addenda, with Code Case 1528-3

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3.0 APPLICABLE CODE REQUIREMENT

1. ASME Section XI, 1989 Edition with No Addenda, IWA-4000, *"Repair Procedures"*
2. Nuclear Regulatory Commission (NRC) conditionally approved Code Case N-504-2, *"Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping"* with condition as specified in Regulatory Guide (RG) 1.147 Revision 14.
3. NRC conditionally approved Code Case N-638-1, *"Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique"* with condition as specified in Regulatory Guide (RG) 1.147 Revision 14.
4. ASME Code, Section XI, 1995 Edition including Addenda through 1996, Appendix VIII, Supplement 11, *"Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds"*.

4.0 REASON FOR REQUEST

The current existing configuration of the nozzle-to-safe end dissimilar metal welds (DMWs) associated with the Braidwood Station Units 1 and 2 (Braidwood Station) pressurizer (PZR) vessels does not allow the performance of a qualified ultrasonic inspection in accordance with the performance demonstration requirements contained in ASME Section XI Appendix VIII or the Performance Demonstration Initiative (PDI) program. DMWs, typically consisting of Alloy 82/182 weld are frequently used in PWR construction to connect stainless steel pipe and safe ends to vessel nozzles, which are generally constructed using carbon or low alloy ferritic steel. These welds have shown a propensity for primary water stress corrosion cracking (PWSCC) degradation, especially in components subjected to higher operating temperatures, such as the PZR.

Braidwood Station will install full structural weld overlays (SWOL) on all the PZR nozzle to safe-end welds DMWs and the adjacent similar metal welds.

The reason for the request for relief to apply weld overlays is twofold. Exelon Generating Company (EGC), Braidwood Station is taking a proactive approach on the Alloy 600 PWSCC mitigation of both PZRs by applying preemptive SWOL on all (six per unit) PZR nozzle safe-end DMWs to mitigate the occurrence of PWSCC. SWOL have been used for several years on both boiling water reactors (BWR) and pressurized water reactors (PWR) to arrest existing (or postulated) flaws from propagating while establishing a new structural pressure boundary. In some cases, SWOL have been used to reestablish structural integrity of the DMW containing through wall leaking flaws. In addition to proactively mitigating PWSCC in the DMW, the SWOL provide an acceptable geometry that can be ultrasonically examined in

accordance with demonstrated UT examination techniques performed by qualified examiners.

The welding will be performed using a remote mechanized Gas Tungsten Arc Welding (GTAW) process and using the ambient temperature temper bead method with ERNiCrFe-7A (Alloy 52M*) weld metal. Manual GTAW, using Alloy 52M, will only be permitted subsequent to the SWOLs being essentially completed. When temper bead welding is not required, manual GTAW may be used if local repairs of weld defects are necessary or if additional weld metal is required locally to form the final SWOL contour. Shielded metal arc welding (SMAW), using Alloy 152, would only be used to repair indications in the existing DMWs prior to overlay initiation.

> * The material supplier's weld wire designation may be either 52M or 52MS. The "S" designates the process route that converts the hot-rolled billet into finished cold-drawn wire. The material properties are not affected. For this reason, references herein to 52M are considered to encompass 52MS filler material as well.

As discussed herein, there is no comprehensive criterion for a licensee to apply a SWOL repair to a DMW that is constructed of Alloy 82/182 weld material and is believed to be susceptible to or contain PWSCC degradation. The American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, 1989 Edition, No Addenda, IWA-4000, is used for the Braidwood Station XI Repair/Replacement Program, but it does not contain the needed requirements for this type of weld overlay repair. Repair/replacement activities associated with weld overlays of this type are required to address the materials, welding parameters, personnel radiation exposure concerns, operational constraints, examination techniques, and procedural requirements.

5.0 PROPOSED ALTERNATIVE AND BASIS FOR USE

Pursuant to 10 CFR 50.55a(a)(3)i, EGC proposes applying SWOL designed in accordance with Code Case N-504-2 (Reference 1) and Section XI Nonmandatory Appendix Q (Reference 3) with the modifications proposed in Table 2 of this relief request, and Code Case N-638-1 (Reference 2) for temper bead welding with modifications proposed in Table 3 of this relief request. Final UT inspection of the finished SWOL will be performed using Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) ultrasonic examination (UT) demonstrated procedures and qualified examiners in lieu of the ASME Section XI Appendix VIII Supplement 11 (Reference 4) as proposed in Table 4 of this relief request.

Code Case N-504-2, currently approved for use in RG 1.147 with additional requirements of ASME Section XI, 2005 Addenda Appendix Q, allows a flaw to be reduced to an acceptable size by deposition of weld reinforcement on the outside

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surface of the pipe without flaw removal. The SWOL will extend around the full circumference of the applicable DMW as required by Code Case N-504-2. The specific thickness and length will be determined according to the guidance provided in Code Case N-504-2. The SWOL will completely cover the DMW and the adjacent stainless steel safe-end to pipe/fitting welds (similar metal welds) with Alloy 52M material that is highly resistant to PWSCC. The SWOL covers the adjacent similar metal welds to provide the weld geometry required to perform the final volumetric examinations and obtain the required examination coverage volume. A typical SWOL configuration is shown in Figure 1.

Prior to installation of the SWOL, Braidwood Station will complete a bare metal visual examination of all the PZR surge, safety, relief, and spray nozzles immediately after the mirror insulation is removed in the area around the nozzle and dissimilar metal weld area to ensure that no through wall cracks exist prior to applying the overlay. Prior to applying the overlay, the entire overlay base metal area will be cleaned, including a distance at least 1.5 times the nozzle end thickness beyond the overlay on the nozzle end and 1.5" beyond the overlay area on the pipe/fitting end.

At the completion of the cleaning, a liquid penetrant (PT) examination will be performed of the overlay area with an acceptance criteria that no indication greater than 1/16" is permitted. If any indication is found greater than 1/16", the indication will removed or reduced below the acceptance criteria, and the PT performed again. If any indication(s) do require repair, the repair will be completed and the area will again have a PT completed for final acceptance.

All scheduled second interval examinations of selected adjacent similar metal welds have been completed (see Table 1). There were no recordable indications noted during any of these weld examinations. Any sample expansion of the examination scope due to unacceptable flaws in the adjacent welds recorded during the associated SWOL examination will be based on an evaluation of the unacceptable flaw characteristics. This evaluation will include whether other elements in the segment or segments are subject to the same root cause conditions. No additional examinations will be performed if there are no additional elements identified as being susceptible to the same root cause conditions. If the evaluation does identify a common degradation mechanism, then further examinations would be performed on those elements. A review of past SWOL industry submittals indicates recordable flaws associated with the adjacent similar metal weld were attributed to initial construction and were not service induced.

Flaw evaluations in accordance with Code Case N-504-2(g) Item 2 and shrinkage stress effects analyses in accordance with Code Case N-504-2(g) Item 3 will be addressed through the approved overlay designs that are currently in development.

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These documents will be completed and approved for use prior to the Braidwood Station Unit 1 Fall 2007 refueling outage (A1R13) and the Braidwood Station Unit 2 Spring 2008 refueling outage (A2R13).

6.0 DURATION OF THE PROPOSED ALTERNATIVE

The duration of the proposed alternatives associated with the SWOL is the remaining service life of the components including future plant life extension. Relief from the Appendix VIII inspection requirements is requested through the end of the current ISI interval. The current ISI inspection interval for Braidwood Station Unit 1 ends on July 28, 2008. The current ISI inspection interval for Braidwood Station Unit 2 ends on October 16, 2008.

Subsequent inservice examinations (which would be performed starting in the third ISI inspection interval) will be scheduled and performed in accordance with the requirements of Nonmandatory Appendix Q or alternate schedules as/if mandated in future NRC regulations.

7.0 PRECEDENTS

Similar relief requests for SWOL of DMW (both PWR and BWR) have been approved for a number of units throughout the industry (see References 5 through 14). A number of units have submitted relief requests citing similar proposed relief request methodology. These relief requests were associated with welding over detected or postulated flaws outside the acceptance criteria of Section XI utilizing proposed modifications to existing Code Cases N-504-2 and N-638-1 and NRC conditions for use. As unconditionally approved through NRC safety evaluations (see References 5 through 15), all recent SWOL UT examinations have been performed using the EPRI PDI demonstration and qualification program in lieu of the mandated Section XI Appendix VIII requirements.

8.0 REFERENCES

1. ASME Code Case N-504-2, *"Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping,"* dated March 12, 1997.
2. ASME Code Case N-638-1, *"Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique,"* dated February 13, 2003.
3. American Society of Mechanical Engineers (ASME) Section XI Nonmandatory Appendix Q 2005 Addenda.

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4. ASME Code, Section XI, 1995 Edition including Addenda through 1996, Appendix VIII, Supplement 11, *"Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds"*.
5. Letter from Richard Laufer, NRC to Christopher M. Crane, AmerGen, *"Three Mile Island Nuclear Station, Unit 1 (TMI-1) Request for Relief From Flaw, Heat Treatment, and Nondestructive Examination Requirements for the Third 10 year Inservice Inspection (ISI) Interval (TAC No. MC101),"* dated July 21, 2004, ADAMS Accession Number ML041670510.
6. Letter from Richard J. Laufer, NRC to George Vanderheyden, Calvert Cliffs, *"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, ADAMS Accession Number ML051930316.
7. Letter from L. Raghavan, NRC to Mano K. Nazar, I&M, *"Donald C. Cook Nuclear Plant, Unit 1 (DCCNP-1) – Alternatives Regarding Repair of Weld 1-PZR-23 on Pressurizer Nozzle to Valve Inlet Line (TAC No. MC6704),"* dated December 1, 2005, ADAMS Accession Number ML053220019.
8. Letter from Darrell J. Roberts, NRC, to David A. Christian, Dominion Nuclear Connecticut, Inc., *"Millstone Power Station Unit No. 3 – Issuance of Relief from Code Requirements (TAC MC8609),"* dated January 20, 2006, ADAMS Accession Number ML053260012.
9. Letter from Richard J. Laufer, NRC, to Bryce L. Shriver, PPL Susquehanna, *"Susquehanna Steam Electric Station, Unit 1 – Relief from American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), Section XI Appendix VIII, Supplement 11, Requirements and Cases N-504-2 and N-638 Requirements (TAC Nos. MC2450 and MC2594),"* dated January 20, 2006, ADAMS Accession Number ML051220568.
10. L. Raghavan, NRC, to Paul A. Harden, Nuclear Management Company, LLC, *"Palisades Nuclear Plant – Request for Authorization of Relief Request No. 1 for Certain Requirements in ASME Code, Section XI, Code Case N-638-1 at Palisades Nuclear Power Plant (TAC No. MC7993),"* dated March 21, 2006, ADAMS Accession Number ML06058006.
11. Daniel S. Collins (NRR) letter to Mark B. Bezilla, First Energy Operating Company, *"Davis-Besse Nuclear Power Station, Unit No. 1 – Evaluation of Request for Relief Re: Full Structural Weld Overlay (TAC No. MD0683),"* dated October 19, 2006, ADAMS Accession Number ML062440478.
12. Richard J. Laufer (NRR) letter to James A. Spina, Calvert Cliffs Nuclear Power Plant Inc.,*"Calvert Cliffs Power Plant Units 1 and 2 – Relief Request to Use Weld Overlay And Associated Alternative Techniques (TAC Nos. MC8530 and MC8531),"* dated June 28, 2006, ADAMS Accession ML061300423.

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13. David Terao (NRR) letter to Richard M. Rosenblum, Southern California Edison Company, *"San Onofre Nuclear Generating Station, Unit 2 – Re: Request for Relief from the Requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, TAC No. MD0191,"* dated December 14, 2006, ADAMS Accession Number ML063240589.

14. Michael L. Marshall Jr. (NRR) letter to Christopher M. Crane, Exelon Generation Company, LLC, *"Byron Station, Unit No. 1 – Evaluation of Relief Request I3R-08 Pertaining to Structural Weld Overlays (TAC No. MD1761),"* dated January 29, 2007, ADAMS Accession ML062510169.

15. Richard J. Laufer, NRC, to Michael R. Kansler, Entergy Nuclear Operations, Inc., *"Pilgrim Nuclear Power Station Relief Request No. PRR-9 (TAC No. ML8292),"* dated March 22, 2006, ADAMS Accession Number ML060240055.

16. William H. Bateman (NRR) letter to Michael Bratton, PDI Chairman, Entergy Nuclear Southwest, *"Weld Overlay Performance Demonstration Administered By PDI as an Alternative for Generic Letter 88-01 Recommendations,"* dated January 15, 2002, ADAMS Accession ML020160532.

17. *Repair and Replacement Applications Center: Temperbead Welding Applications 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding.* EPRI, Palo Alto, CA: 2006. 1013558.

18. Regulatory Guide 1.147, *"Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1,"* Revision 14, August 2005.

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TABLE 1
COMPONENT IDENTIFICATION

For Unit 1 Pressurizer 1RY01S

NOZZLE	NOZZLE-TO-SAFE END WELD (*)	ITEM #	SIZE	ADJACENT WELD (Second Interval Exam)	CONFIGURATION	ITEM #
Surge	1PZR-01-SE-01	R1.11 R1.15	14"	1RC-05-01 (Not selected)	Safe-end to Pipe	R1.11
Spray	1PZR-01-SE-05	R1.11 R1.15	4"	1RC-16-01 (A1R07, Oct. 1992)	6"x4" Reducer to Safe-end	R1.11
Relief	1PZR-01-SE-06	R1.15	6"	1RC-35-01 (A1R07, Oct. 1992)	Safe-end to Cut 45° Elbow	R1.20
Safety A	1PZR-01-SE-02	R1.15	6"	1RC-32-01 (A1R12, April 2006)	Safe-end to Cut 90° Elbow	R1.20
Safety B	1PZR-01-SE-03	R1.15	6"	1RC-32-07 (A1R10, April 2003)	Safe-end to Cut 90° Elbow	R1.20
Safety C	1PZR-01-SE-04	R1.15	6"	1RC-32-13 (A1R10, April 2003)	Safe-end to Cut 90° Elbow	R1.20

For Unit 2 Pressurizer 2RY01S

NOZZLE	NOZZLE-TO-SAFE END WELD (*)	ITEM #	SIZE	ADJACENT WELD (Second Interval Exam)	CONFIGURATION	ITEM #
Surge	2PZR-01-SE-01	R1.11 R1.15	14"	2RC-05-01 (Not selected)	Safe-end to Pipe	R1.11
Spray	2PZR-01-SE-05	R1.11 R1.15	4"	2RC-16-01 (A2R07, April 1999)	6"x4" Reducer to Safe-end	R1.11
Relief	2PZR-01-SE-06	R1.15	6"	2RC-35-01 (Not selected)	Safe-end to Cut 45° Elbow	R1.20
Safety A	2PZR-01-SE-02	R1.15	6"	2RC-32-01 (Not selected)	Safe-end to Cut 90° Elbow	R1.20
Safety B	2PZR-01-SE-03	R1.15	6"	2RC-32-07 (Not selected)	Safe-end to Cut 90° Elbow	R1.20
Safety C	2PZR-01-SE-04	R1.15	6"	2RC-32-13 (A2R10, Nov. 2003)	Safe-end to Cut 90° Elbow	R1.20

Note: Item numbers reflect Risk-Informed classification per ASME Code Case N-578-1.
R1.11: Elements Subject to Thermal Fatigue.
R1.15: Elements Subject to Primary Water Stress Corrosion Cracking (PWSCC).
R1.20: Elements not Subject to a Damage Mechanism.

* Existing configuration (prior to SWOL) cannot be fully examined using Appendix VIII or EPRI PDI UT techniques.

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Figure 1
Typical SWOL Configuration

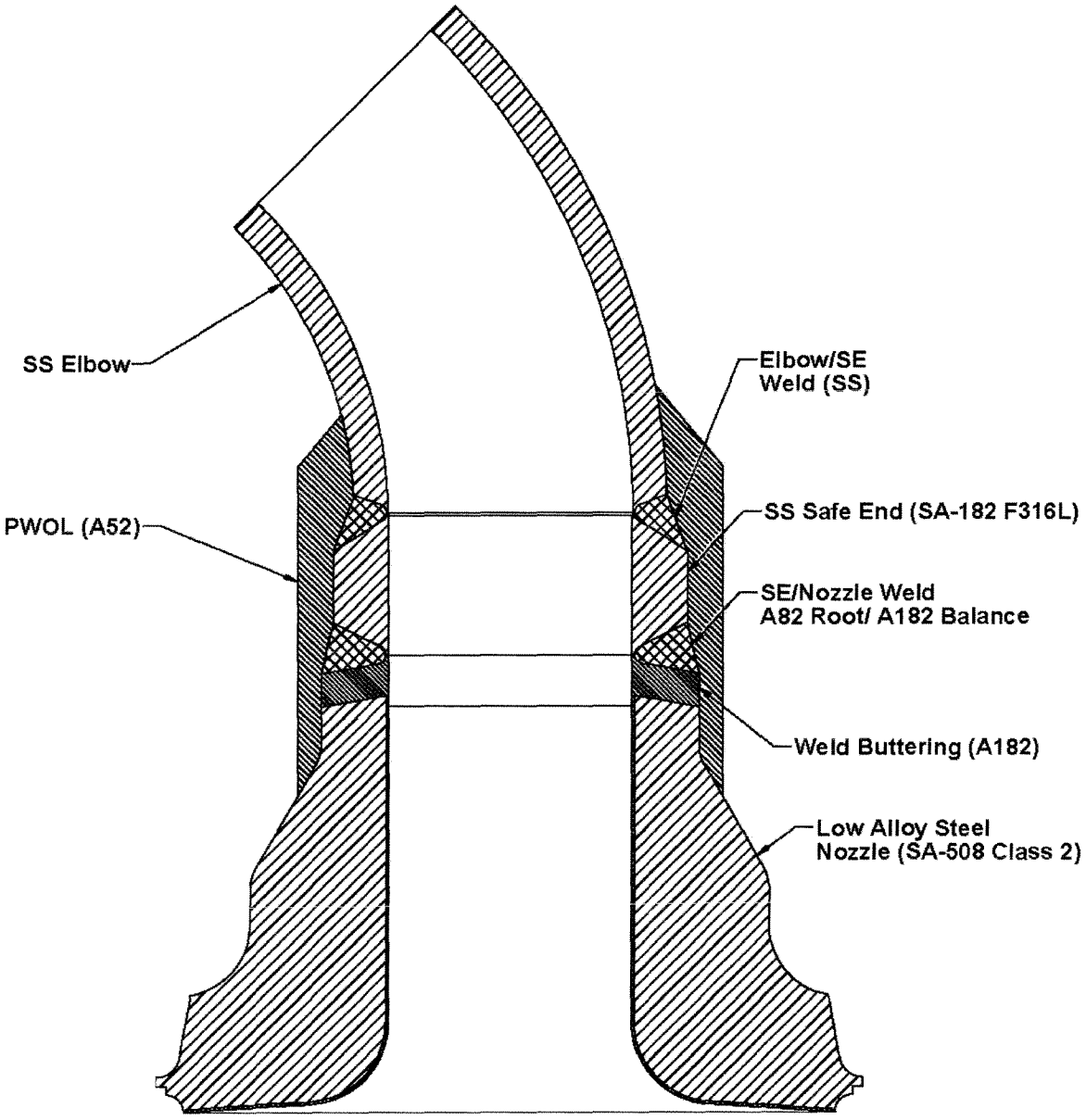

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TABLE 2 **DESIGN/MATERIAL/NONDESTRUCTIVE EXAMINATION** **Modifications to Code Case N-504-2 and ASME Section XI, Appendix Q**	
CODE CASE N-504-2 AND ASME SECTION XI APPENDIX Q	**PROPOSED MODIFICATIONS**
"*Reply:* It is the opinion of the Committee 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. A 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."	*Modification:* Code Case N-504-2 and Appendix Q will be used for the weld overlay of the ferritic (P3) nozzle material, nickel alloy (F43/P43) weld material, and austenitic stainless steel base (P8, safe end and pipe/fitting) 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 (with modifications approved under relief request submittals) has been applied to PWR applications for the weld overlay repair of dissimilar metal welds with known flaws or to apply SWOL as a PWSCC mitigation technique. Industry operating experience in the area has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52M weld metal. The 360° full structural weld overlay will control growth in any PWSCC crack and maintain weld integrity. The applied SWOL will also induce compressive stress in the existing welds (DMW or similar metal), thus potentially impeding growth of any reasonably shallow cracks. Furthermore, the SWOL will be sized to meet all structural requirements without considering the existing welds.

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TABLE 2 **DESIGN/MATERIAL/NONDESTRUCTIVE EXAMINATION** **Modifications to Code Case N-504-2 and ASME Section XI, Appendix Q**	
CODE CASE N-504-2 AND ASME SECTION XI APPENDIX Q	**PROPOSED MODIFICATIONS**
"(b) Reinforcement weld metal shall be low carbon (0.035% maximum) 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." **Note: This wording is essentially the same as Q-2000(a).**	Modification: Weld overlay filler metal shall be an austenitic nickel alloy (28% Cr min.) applied 360 deg. around the circumference of the item, and shall be deposited using a Welding Procedure Specification for groove welding, qualified in accordance with the Repair/Replacement Code and Owner's requirements and identified in the Repair/Replacement Plan. Basis: 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 52M weld metal and the austenitic stainless steel safe end, pipe/fitting, and weld.
"(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 at 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." **Note: This wording is essentially the same as Q2000(d) except if the deposited weld metal has a carbon content of <0.02% the first layers of at least 5 FN are acceptable.**	Modification: Delta ferrite measurements will not be performed for weld overlay repairs using Alloy 52M weld metal. Basis: The deposited Alloy 52M is 100% austenitic and contains no delta ferrite due to the high nickel composition (approximately 60% nickel). The austenitic nickel alloy weld overlay shall consist of at least two weld layers deposited from a filler material with a Cr content of at least 28%. When welding over an austenitic base material or austenitic filler material weld and the associated dilution zone from an adjacent ferritic base material, a diluted first layer of at least 24% Cr is acceptable, provided the Cr content of the deposited weld metal is determined by chemical analysis of a representative coupon. Alternatively, the first weld layer may be considered "sacrificial", and will not be credited towards the reinforcement design thickness.

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TABLE 2 **DESIGN/MATERIAL/NONDESTRUCTIVE EXAMINATION** **Modifications to Code Case N-504-2 and ASME Section XI, Appendix Q**	
CODE CASE N-504-2 AND ASME SECTION XI APPENDIX Q	**PROPOSED MODIFICATIONS**
"(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." Nonmandatory Appendix Q (mandated through Regulatory Guide 1.147 Revision 14 as a condition of using Code Case N-504-2) states, "Ultrasonic examination personnel shall be certified in accordance with the Owner's written practice. Procedures and personnel shall be qualified in accordance with Appendix VIII."	Modification: A system leakage test at system nominal operating pressure in accordance with IWA-5000 as modified by Code Case N-416-3 shall be performed in accordance with the Braidwood Station ISI Program. Prior to the system leakage test, ultrasonic examination (UT) of the finished SWOL using EPRI PDI demonstrated weld overlay examination procedures and qualified examiners shall be performed. Basis: The Braidwood Station Second interval ISI Program utilizes the 1989 Edition of Section XI along with Code Case N-416-3 (approved for use through Regulatory Guide 1.147 Rev. 14) for NDE and pressure testing of welded repairs/replacements. Code Case N-416-3 permits a system leakage test in lieu of a hydrostatic test provided NDE is performed in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 Edition of ASME Section III. The 1992 Edition of ASME Section III Subsection NB does not address the structural weld overlay configuration, so the NDE requirements of Nonmandatory Appendix Q performed using EPRI PDI demonstrated procedures with qualified examiners shall be used. At the time of relief request preparation there were no known flaws penetrating the pressure boundary that would require hydrostatic testing, and through-wall flaws are not expected. The bare metal visual and liquid penetrant examinations of the existing DMW and adjacent base metal prior to applying the SWOL will be used to confirm this assumption. The use of the EPRI PDI demonstration and qualification program in lieu of Appendix VIII is evaluated in Table 4 of this relief request.

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TABLE 3 **AMBIENT TEMPERATURE TEMPER BEAD WELDING** **Modifications to Code Case N-638-1**	
CODE CASE N-638-1	**PROPOSED MODIFICATIONS**
1.0 General Requirements "(a) The maximum area of an individual weld based on the finished surface shall be 100 sq. in., and the depth of the weld shall not be greater than one-half of the ferritic base metal thickness."	Modification: The maximum area of an individual weld based on the finished surface over the ferritic material shall not exceed 300 sq. in. If any of the Braidwood SWOL repairs exceed 300 sq. in. over the ferritic material, additional relief will be requested. The one half base metal thickness limitation applies only to excavation and repair and is not applicable to this application. Basis: Although the final design for the Braidwood SWOL was not been complete at the time of development of this relief request, it is anticipated that the SWOL will require welding on more than 100 sq. in. of surface on the low alloy steel base material. The SWOL will extend to the transition taper of the low alloy steel nozzle to provide an adequate weld geometry so that qualified UT of the required volume can be performed. There have been a number of temper bead SWOL repairs successfully applied to safe-end to nozzle welds in the nuclear industry, and a SWOL repair having a 300 sq. in. surface was approved for the Susquehanna Steam Electric Station (Reference 9). ASME Code Case N-432-1, which is approved for use in RG 1.147, allows temper bead welding on low alloy steel nozzles without limiting the temper bead weld surface area. The two additional conditions required by Code Case N-432-1 that are not required by Code Case N-638-1 are that temper bead welds have preheat applied and that the procedure qualification be performed on the same specification, type, grade and class of material. The elevated preheat would present a radiation exposure burden when performing the repair.

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TABLE 3 **AMBIENT TEMPERATURE TEMPER BEAD WELDING** **Modifications to Code Case N-638-1**	
CODE CASE N-638-1	**PROPOSED MODIFICATIONS**
4.0 Examination "(b) The final weld surface and the band around the area defined in para. 1.0(d) shall be examined using 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."	Modification: For the SWOLs, full UT of the 1.5T band will not be performed. UT will be performed on the actual weld overlay, meeting the requirements of ASME Section XI, Nonmandatory Appendix Q-4100. When austenitic filler materials are used, the SWOL will be examined using the surface and ultrasonic methods after three tempering weld layers (i.e., layers 1, 2, and 3) are completed and have been in place for at least 48 hours. Basis: Later editions of the code as well as later revisions to the code case (N-638-2 and later) removed the requirement for the 1.5T examination band. This is in line with the less restrictive requirements for UT of the ferritic nozzle because hydrogen cracking away from the temper bead weld is not considered a concern in later editions of the code and code case N-638. The code case applies to any type of welding where a temper bead technique is to be employed (which includes weld repairs of excavated flaws) and is not specifically written for a SWOL repair. However, it is believed that for this type of repair, any major 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 1.5T examination band of material out beyond the overlay. If this type of cracking were to occur it should be detected by the UT of the SWOL using PDI demonstrated procedures with PDI qualified inspectors. As supported by EPRI's white paper (Reference 17) providing the technical basis for Code Case N-638-4, the 48 hour hold time prior to final NDE examinations will start upon completion of the third temper bead weld overlay layer.

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TABLE 3 **AMBIENT TEMPERATURE TEMPER BEAD WELDING** **Modifications to Code Case N-638-1**	
CODE CASE N-638-1	**PROPOSED MODIFICATIONS**
	Braidwood Station will be applying the alternate hold time to weld overlays only, this alternative will not be applied to excavations requiring repair by temper bead welding. The referenced EPRI white paper addresses previous concerns regarding the 48-hour hold time prior to final NDE examinations. Areas of concern imposing the 48-hour hold time addressed through this report include: material microstructure; sources for hydrogen introduction; tensile stress and temperature; and diffusivity and solubility of hydrogen in steels. The report concludes there is no technical basis for waiting 48 hours after the weld overlay cools to ambient temperature before beginning to perform final NDE of the completed weld overlay. Past and recent experience performing NDE on temper bead weld overlays has not found any indication of hydrogen cracking of these welds either during initial NDE after the 48-hour hold time or subsequent inservice inspection examinations. Appendix I does not specifically address weld overlay ultrasonic examinations. Ultrasonic examinations shall be performed using EPRI PDI weld overlay demonstrated examination procedures with PDI qualified inspectors.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
1.0 SPECIMEN REQUIREMENTS	
1.1(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 inches or larger, the specimen set must include at least one specimen 24 inches or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within –0.11 inches to +0.25 inches of the maximum nominal overlay thickness for which the procedure is applicable.	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 inches or larger, the specimen set must include at least one specimen 24 inches or larger but need not include the maximum diameter. The specimen set shall include specimens with overlays not thicker than 0.1 inches more than the minimum thickness, nor thinner than 0.25 inches of the maximum nominal overlay thickness for which the procedure is applicable.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
(d) Flaw Conditions	
1.1(d)(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 percent through the base metal wall. Flaws may extend 100 percent through the base metal and the overlay; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC [intergranular stress corrosion cracking] shall be used when available.	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 percent through the base metal wall. Intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing IGSCC shall be used when available. At least 70 percent 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.
(e) Detection Specimens	
1.1(e)(1) At least 20 percent but less than 40 percent of the flaws shall be oriented within +/- 20 degrees 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.	At least 20 percent but less than 40 percent of the base metal flaws shall be oriented within +/- 20 degrees 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.
1.1(e)(2) Specimens shall be divided into base and over-lay grading units. Each specimen shall contain one or both types of grading units.	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.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
1.1(e)(2)(a)(1) A base grading unit shall include at least 3 inches of the length of the overlaid weld. The base grading unit includes the outer 25 percent of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75 percent of the overlaid weld and base metal overlay material, or base metal-to-overlay interface.	A base metal grading unit includes the overlay material and outer 25 percent of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 inch and shall start at the centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50 inch of the adjacent base material.
1.1(e)(2)(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 inch of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	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.
1.1(e)(2)(a)(3) When a base grading unit is designed to be unflawed, at least 1 inch 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.	Sufficient unflawed overlaid weld and base shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws.
1.1(e)(2)(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.	An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 inch.
1.1(e)(2)(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 inch 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.	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 inch at both ends. Sufficient unflawed overlaid weld and base metal shall exist on both sides of the overlay fabrication grading unit to prelude 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 specimen.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
1.1(e)(2)(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 grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	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 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	
1.1(f)(1) The minimum number of flaws shall be ten. At least 30 percent of the flaws shall be overlay fabrication flaws. At least 40 percent of the flaws shall be cracks open to the inside surface.	The minimum number of flaws shall be ten. At least 30 percent of the flaws shall be overlay fabrication flaws. At least 40 percent 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.
1.1(f)(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	Base metal flaws used for length sizing demonstrations shall be oriented circumferentially.
1.1(f)(4) Depth sizing specimen's sets shall include at least two distinct locations where cracking in the base metal extends into the overlay material by at least 0.1 inch in the through-wall direction.	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 inch in the through-wall direction.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
2.0 CONDUCT OF PERFORMANCE DEMONSTRATION	
The specimen inside surface and identification shall be concealed form 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 review of unmasked specimens after the performance demonstration is prohibited.	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.
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.	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.
2.2 Length Sizing Test	
2.2(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 percent of the base wall thickness.	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 percent of the base metal wall thickness.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
2.3 Depth Sizing Test	
For the depth sizing test, 80 percent 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.	(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 each 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.
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 VII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	a) Examination procedures are qualified for detection when; 1) All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VII-S2-1 for false calls. (a) At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (b). (b) Examination equipment and personnel are qualified for detection when the results of the performance when the results of the performance demonstration satisfy the acceptance criteria of Table VII-S2-1 for both detection and false calls. (c) The criteria in (a), (b) shall be satisfied separately by the demonstration results for base metal grading units and for overlay fabrication grading units.

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TABLE 4 **MODIFICATIONS TO APPENDIX VIII, SUPPLEMENT 11**	
Appendix VIII, Supplement 11	**PDI Modification**
3.2 Sizing Acceptance Criteria	
3.2(a) The RMS error of the flaw length measurements, as compared to the true flaw length, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75 percent through-base-metal position.	The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal 0.75 inch. The length of base metal flaws is measured at the 75 percent through-base-metal position.
3.2(b) All extensions of base metal cracking into the overlay material by at least 0.1 inch are reported as being intrusions into the overlay material.	This requirement is omitted.
(c) The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 inch.	(c) The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 inch.