L-PI-08-003
10 CFR 50.55a

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

Prairie Island Nuclear Generating Plant Unit 2
Docket 50-306
License No. DPR-60

Response to Request for Additional Information Regarding 10 CFR 50.55a Request for Relief from ASME Section XI Repair and Replacement Requirements: Proposed Alternatives for Application of Structural Weld Overlay to the Prairie Island Nuclear Generating Plant Unit 2 Pressurizer Surge Nozzle Weld (2-RR-4-8) (TAC MD5868)

Reference 1: Letter from MD Wadley (NMC) to Document Control Desk (NRC), L-PI-07-054, "10 CFR 50.55a Request: Proposed Alternatives for Application of Structural Weld Overlay to the Prairie Island Nuclear Generating Plant Unit 2 Pressurizer Surge Nozzle Weld (2-RR-4-8)," dated June 25, 2007 (ML071760332).

By letter dated June 25, 2007 (Reference 1), and pursuant to 10 CFR 50.55a(a)(3), Nuclear Management Company, LLC, (NMC) requested U.S. Nuclear Regulatory (NRC) staff review and approval of 10 CFR 50.55a Request 2-RR-4-8, Revision 0, for the Prairie Island Nuclear Generating Plant (PINGP). Request 2-RR-4-8 allows the installation of a full structural weld overlay on the pressurizer surge line nozzle-to-safe end dissimilar metal and safe end-to-reducer stainless steel butt welds. The overlay is a pre-emptive measure addressing primary water stress corrosion cracking (PWSCC) concerns identified by the industry for welds associated with Alloy 600/82/182 components exposed to primary coolant.

On November 15, 2007, the NRC staff notified NMC by electronic mail that additional information was necessary for the staff to complete the review. A conference call between NMC and NRC staff was held on December 4, 2007, to clarify the requests for additional information (RAI). On December 20, 2007, an additional conference call was held. Based on the RAIs and the conference calls, NMC has decided to revise the original 10 CFR 50.55a request as outlined

below. Enclosure 1 to this letter contains the NRC RAI and the NMC responses. Enclosure 2 contains 10 CFR 50.55a Request 2-RR-4-8, Revision 1.

Four changes have been made to the original 10 CFR 50.55a Request and are described below. The revisions are annotated by revision bars in the right hand margin of Enclosure 2. The revisions are:

1) The examination requirements of Q-4300 were modified in Table 2 of 2-RR-4-8, Revision 1 to incorporate the use of MRP-139 in lieu of Q-4300.
2) The interpass temperature in Table 3 was clarified to be "a maximum" interpass temperature. This clarification is also made in RAI response 2.0.
3) A typographical error in Section 5.5, "Conclusion," was corrected. NMC incorrectly made reference to Code Case N-504-1 rather than Code Case N-504-2. Throughout the technical portions of the Reference 1 request, NMC cited the use of Code Case N-504-2 for design of the weld overlay. NMC intended the conclusion to contain reference to Code Case N-504-2.
4) Reference 8.13 for Code Case N-638-3 was added to Section 8.0. Discussion regarding Code Case N-638-3 is located in Table 3. This discussion was in the original request; however, the code case was not formally referenced.

Reference 1, Enclosure 2, "Barrier Layer to Prevent Hot Cracking in High Sulfur Stainless Steel," and Reference 1, Enclosure 3, "Summary of Commitments," have not been revised and remain valid for 2-RR-4-8, Revision 1.

NMC continues to request approval of the 10 CFR 50.55a request by June 1, 2008, based on the next Prairie Island Unit 2 refueling outage scheduled for Fall 2008. A June 1, 2008, approval allows NMC to sufficiently plan and prepare the pre-emptive weld overlay activities in advance of the refueling outage. If you have questions regarding this 10 CFR 50.55a request, please contact Lynne Gunderson at 715-377-3430.

Summary of Commitments

This letter contains two new commitments. This letter does not revise any existing commitments. The new commitments are:

1. *In addition to the requirements of MRP-139 and the site Inservice Inspection program, the weldment will be ultrasonically examined in accordance with the requirements of MRP-139 at least once within ten years of application.*

2. *If PWSCC related flaws are detected in the weld overlay, a repair/replacement activity will be performed consisting of removal of the weld overlay and the original dissimilar metal weld.*

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Nuclear Management Company, LLC

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC
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Enclosure 1
Responses to Requests for Additional Information
10 CFR 50.55a Request No. 2-RR-4-8, Rev. 1

By letter dated June 25, 2007, Nuclear Management Company, LLC, (NMC) requested Nuclear Regulatory Commission (NRC) staff review and approval of 10 CFR 50.55a Request 2-RR-4-8, Revision 0, to allow the installation of a full structural weld overlay on the pressurizer surge line nozzle-to-safe end dissimilar metal and safe end-to-reducer stainless steel butt welds at Prairie Island Nuclear Generating Plant (PINGP) Unit 2. On November 15, 2007, the NRC staff notified the NMC by electronic mail that additional information was necessary for the staff to complete the review. A conference call between NMC and NRC staff was held on December 4, 2007, to clarify the questions. On December 20, 2007, an additional conference call was held. NRC requests for additional information (RAI) are repeated below with the NMC response following each RAI:

1.0 The U.S. Nuclear Regulatory Commission (NRC) understands that Alloy 82 material may be applied over the existing dissimilar metal weld, overlapping slightly onto the stainless steel safe end, and that E309L filler metal may be applied to the remaining stainless steel components. Please describe the sequence of welding when applying the barrier layer to prevent hot cracking. The NRC is concerned that if the correct sequence is not followed, cracking could occur when tying the E309L filler metal into the Alloy 82 material.

NMC Response:
The stainless steel ER309L layer will be deposited over the inboard portion of the stainless steel reducer, the reducer to pipe stainless steel weld, and over the stainless steel safe end to near the dissimilar metal weld. Alloy 82 will then be deposited over the nozzle terminal end stainless steel buttering, the Alloy 182 safe end to buttering dissimilar metal weld, and onto the inboard portion of the stainless steel safe end to tie in with the ER309L stainless steel layer.

2.0 Code Case N-638-1 Section 3.0(d) specifies that the maximum interpass temperature for field applications shall be 350°F regardless of the interpass temperature during qualification. In Table 3 of Request 2-RR-4-8, revision 0, the basis for use of temperbead welding when the component is drained, is that Code Case N-638-1 requires 350°F interpass temperature for the first three layers and all subsequent layers. It appears there is a discrepancy (maximum vs. required) in the use of the interpass temperature as required in Code Case N-638-1 and as specified in Request 2-RR-4-8. Please explain this apparent discrepancy, identify the interpass temperature parameters that will be maintained, and if a 350°F interpass temperature will not be maintained, identify any changes to the basis necessary for permitting draining of the component during temperbead welding.

NMC Response:
As stated in Code Case N-638-1, a maximum interpass temperature of 350°F shall apply for all welding layers. This has been clarified in the revised 10 CFR 50.55a request, 2-RR-4-8, Revision 1, which is attached as Enclosure 2.

3.0 Table 3 indicates that temperbead welding may only be required on the carbon steel nozzle taper where the thickness is greater than 1-1/2 inches depending on the final full structural weld overlay thickness. The NRC considers the thickness of the nozzle, not the thickness of the weld overlay, to be the appropriate thickness to use in determining if a component is exempt from post weld heat treatment requirements. Please identify:

3.1 The thickness of the nozzle

NMC Response:
The surge nozzle thickness is 1.26" at the thinner outer end.

3.2 The maximum carbon content of the nozzle

NMC Response:
Material specification for the nozzle requires 0.25 percent maximum for SA-216-GR-WCC.

3.3 Any preheat to be used

NMC Response:
A minimum 50°F preheat will be used.

3.4 Identify where temperbead welding is or is not required and justify any areas where temperbead welding will not be used over ferritic base material.

NMC Response:
Temper bead welding is required for the entire nozzle carbon steel surface.

4.0 Provide a basis for the statement that the conditions in NRC Regulatory Guide (RG) 1.147 for Code Case N-638-1 are not applicable. RG 1.147 requires that ultrasonic examinations shall be demonstrated for the repaired volume using representative samples which contain construction type flaws, and that the acceptance criteria of NB5330 of Section III apply to all flaws identified within the repaired volume.

NMC Response:
Code Case N-638-1 applies to any type of welding where a temper bead technique is to be used. It is not specifically written for a weld overlay repair. Code Case N-504-2 and Nonmandatory Appendix Q are applicable for weld overlay repairs. Therefore, the volumetric acceptance criteria for the required structural overlay weld metal and the outer 25 percent of the base material volume below the structural overlay weld metal will be per Nonmandatory Appendix Q, subarticle Q-4100(c). The required structural portion of the weld

overlay is defined in the pre-emptive full structural weld overlay sizing evaluations. Any repairs that are made to the carbon steel base material prior to the application of the weld overlay will follow the PINGP Section XI Repair Replacement Program.

5.0 Please describe any flaw evaluation that will be completed for the overlay.

NMC Response:
Seventy-five percent inside surface connected thru wall circumferential and axial flaws will be postulated in the original dissimilar metal weld for the flaw growth analyses.

6.0 The NRC understands the pressurizer surge nozzle-to-safe end weld was examined in November 2006. Will the weld be examined prior to the application of the overlay during the outage?

NMC Response:
A full Performance Demonstration Initiative (PDI) qualified ultrasonic examination will be performed prior to overlay installation. Additionally, prior to installing the overlay, the outer dissimilar metal weld will be examined by liquid penetrant examination method.

If not, will the weld be considered cracked or uncracked for future inservice inspection?

NMC Response:
As stated above, NMC will perform full PDI qualified ultrasonic examination prior to installing the weld overlay. Future inservice inspection interval (ISI) examinations will be consistent with the non-destructive examination (NDE) results obtained from the pre-overlay exam and will follow either the MRP-139 Category B criteria for uncracked primary water stress corrosion cracking (PWSCC) susceptible material reinforced by full structural weld overlay or the MRP-139 Category F criteria for cracked PWSCC susceptible material reinforced by full structural weld overlay.

Will the overlay be ultrasonically examined during the first or second refueling outage following application as specified in ASME Section XI, Appendix Q?

NMC Response:
Future inservice examinations as described in Q-4300 will be modified for this 10 CFR 50.55a request to incorporate MRP-139. Following the preservice examination, the weldment will be ultrasonically examined in accordance with the requirements and schedule of MRP-139. In the event the pre-overlay examination indicates cracks in the original 82/182 weld, the weldment will be considered Category F per MRP-139. Category F requires inspection once within the next five years. If no additional cracks are seen, or if no growth is

observed, inspection shall revert to the existing American Society of Mechanical Engineers (ASME) Code examination program for unflawed welds or an approved alternative. In the event the pre-overlay examination determines no crack indications exist in the original weld, the weldment will be considered Category B per MRP-139. Category B weldments shall be inspected according to a schedule consistent with the existing ASME Code examination program or its approved alternative. In addition to the requirements of MRP-139 and the site Inservice Inspection program, the weldment will be ultrasonically examined in accordance with the requirements of MRP-139 at least once within ten years of application.

Enclosure 2 provides the revised request 2-RR-4-8, Revision 1, with the modification to Q-4300.

7.0 When using Code Case N-504-2 and Appendix Q on material susceptible to primary water stress corrosion cracking (PWSCC), the NRC staff does not consider it appropriate to evaluate PWSCC flaws found in the weld overlay during inservice inspection examinations using IWB-3600 as provided in Appendix Q, Q-4300(c). Please, identify how PWSCC flaws will be dispositioned if identified in the weld overlay material during future inservice inspection examinations.

NMC Response:
If PWSCC related flaws are detected in the weld overlay, a repair/replacement activity will be performed consisting of removal of the weld overlay and the original dissimilar metal weld.

Enclosure 2
Prairie Island Nuclear Generating Plant Unit 2
10 CFR 50.55a Request No. 2-RR-4-8, Rev. 1

Proposed Alternative
in Accordance with 10 CFR 50.55a(a)(3)(i)
--Alternative Provides Acceptable Level of Quality and Safety--

1.0 ASME Code Components Affected

Description: Nozzle-to-safe end dissimilar metal (DM) Alloy 82/182 butt weld and safe end-to-reducer stainless steel (SST) butt weld on surge line connection to the pressurizer. See Table 1 for detail.

Table 1 : Pressurizer Surge Nozzle Safe End Welds

Code Class	Exam Category	Item Number	Code Category	Code Item	Weld Description	Weld ID Number
1	R-A	R1.15-2	B-F	B5.40	14" surge nozzle-to-safe end	W-17
1	R-A	R1.11-2	B-J	B9.11	14" surge nozzle safe end-to-reducer	W-16

2.0 Applicable Code Edition and Addenda

ASME Section XI:

The Prairie Island Nuclear Generating Plant (PINGP) Unit 2 Fourth Ten-Year Interval Inservice Inspection (ISI) program is based on the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code, Section XI, 1998 Edition with 2000 Addenda. The fourth ten-year interval began December 21, 2004 and ends December 20, 2014.

ASME Section III:

ASME Boiler and Pressure Vessel Code, Section III Class A, Nuclear Vessels, 1965 Edition Winter 1966 Addenda (PINGP Unit 2 Pressurizer original code of construction)

USAS-B31.1.0-1967, USA Standard Code for Pressure Piping - Power Piping (PINGP Unit 2 reactor coolant system (RCS) piping original code of construction)

3.0 Applicable Code Requirement

3.1 Applicable ASME Code Requirements

IWA-4420 and IWA-4520(a) of ASME Section XI (Ref 8.1) require repair/replacement activities to be performed in accordance with the Owner's Requirements and the original Construction Code for the affected component or system. IWA-4430 and IWA-4600 provide for alternative welding methods. As an alternative to existing ASME Section XI

requirements for piping weld selection and examination volumes, Nuclear Management Company (NMC) has implemented 10 CFR 50.55a request number 2-RR-4-5, "Risk Informed Examination of Class 1 and 2 Piping Welds (code case N-578 and EPRI TR-112657)," Revision 0. Request 2-RR-4-5 was approved by the Nuclear Regulatory Commission (NRC) on January 5, 2006 (reference 8.12). Request 2-RR-4-5 implements the risk informed inservice inspection (RI-ISI) program for PINGP Unit 2 in lieu of Table IWB-2500-1.

Section XI, Appendix VIII, Supplement 11 (reference 8.2) specifies the performance demonstration requirements for ultrasonic examination including requirements for ultrasonic testing (UT) procedures, equipment, and personnel for UT of completed weld overlays (WOLs).

3.2 Applicable ASME Code Cases

ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1," (reference 8.3) allows use of a WOL to enhance pipe integrity. This code case has been conditionally accepted in NRC Regulatory Guide (RG) 1.147, Revision 14 (reference 8.4), for use with the condition that the provisions of Section XI, Nonmandatory Appendix Q (reference 8.5) must also be met.

ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique, Section XI, Division 1," (reference 8.6) describes the process for welding similar and dissimilar metals using ambient temperature machine gas tungsten arc weld (GTAW) temperbead technique. This code case has also been conditionally accepted in NRC RG 1.147, Revision 14. However, based on the modifications proposed in this 10 CFR 50.55a request for application of N-638-1, the conditions imposed in RG 1.147 on use of this code case are not applicable for the intended application.

Code Cases N-504-2 and N-638-1 cannot be used without applying certain provisions and modifications. The provisions and modifications are explained in Section 5.0 and associated Tables 2 and 3 of this 10 CFR 50.55a request.

4.0 Reason for Request

Primary water stress corrosion cracking (PWSCC) of nickel alloy base materials and weld metals exposed to pressurized water reactor (PWR) primary coolant is a concern in the nuclear industry. In particular, Alloy 82/182 welds exposed to elevated temperatures, similar to the PINGP Unit 2 pressurizer surge line dissimilar metal nozzle-to-safe end weld, are believed to pose a heightened propensity to PWSCC.

Nuclear Management Company has concluded that the application of a full structural weld overlay (FSWOL) to the PINGP Unit 2 pressurizer surge nozzle DM weld is the

most appropriate course of action in order to ensure RCS pressure boundary integrity. The FSWOL of the DM nozzle-to-safe end weld would preclude future examination of the SST safe end-to-reducer weld due to the close proximity of the two welds. Therefore, the FSWOL will extend from the ferritic carbon steel nozzle across both butt welds to the SST pipe reducer to allow examination of both welds.

Weld overlays have been used for over 20 years for repair and mitigation of intergranular stress corrosion cracking in boiling water reactors and more recently for repair of PWSCC in pressurized water reactors. FSWOLs arrest propagation of existing flaws (if present) by inducing favorable residual compressive stress in the susceptible portion of the original DM weld.

The PINGP Unit 2 pressurizer nozzle-to-safe end weld was most recently examined in November 2006. The weld was examined per ASME Section XI, Appendix VIII, Supplement 10 using qualified procedures, personnel, and equipment. The examination had a composite coverage of 94.1 percent (91 percent axial scans, 97.3 percent circumferential scan). Per MRP-139 (reference 8.7) at least 90 percent is required for the axial scans. This PINGP Unit 2 examination met the ASME Section XI and MRP-139 requirements for exam coverage. No PWSCC indications were detected.

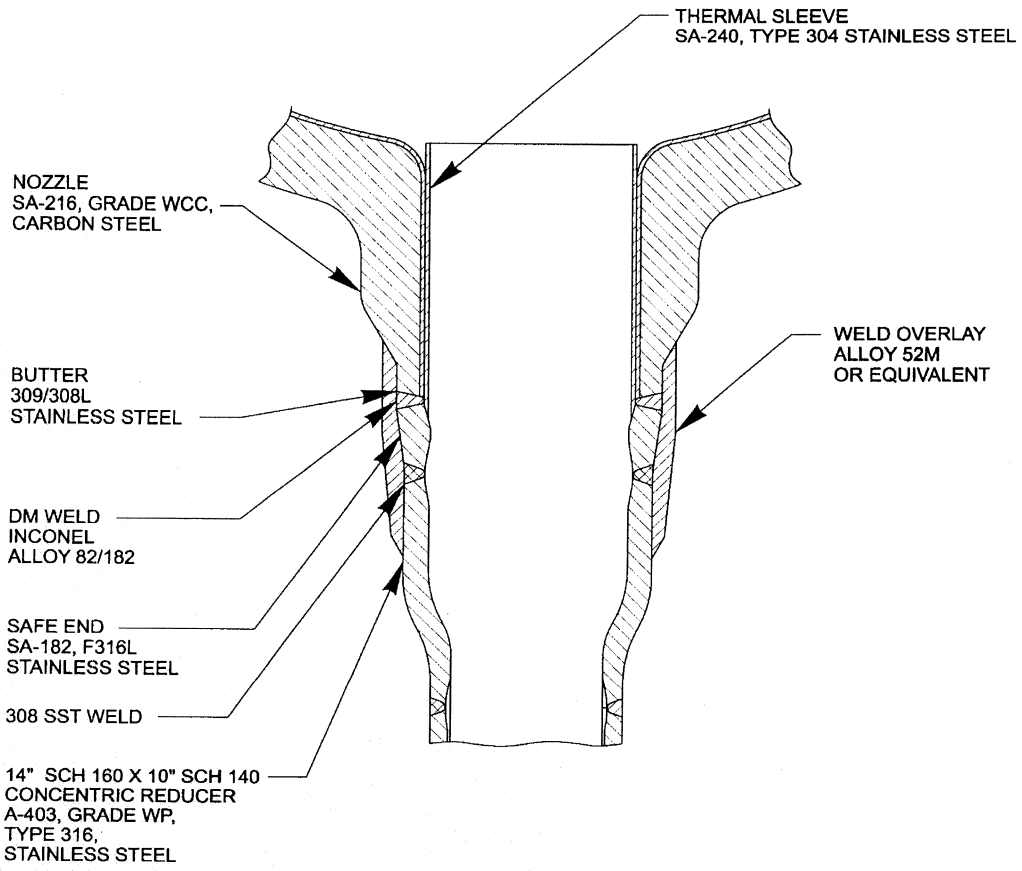
Currently, there are no generically accepted guidance or criteria for applying a nickel alloy FSWOL to a DM weld that is constructed of Alloy 82/182 weld material and is believed to be susceptible to PWSCC. Pursuant to 10 CFR 50.55a(a)(3)(i), NMC requests relief from the requirements of the ASME code and proposes alternative requirements for installation and examination of the pre-emptive FSWOL that is to be applied to the pressurizer nozzle-to-safe end DM weld. The proposed alternative uses methodologies and requirements similar to those in ASME Code Cases N-504-2 and N-638-1, but is requested with certain provisions and modifications.

5.0 Proposed Alternative and Basis for Use

NMC proposes to apply a FSWOL to the PINGP Unit 2 pressurizer nozzle-to-safe end DM weld using a high-chromium nickel alloy weld metal that is resistant to PWSCC. The FSWOL will extend around the full circumference of the existing nozzle safe end Alloy 82/182 and SST welds and will overlap the neighboring sections of the low-alloy ferritic steel nozzle and SST reducer. The PINGP Unit 2 pressurizer surge nozzle FSWOL configuration is shown in Figure 1.

Included as part of this request (Enclosure 2) is a discussion addressing recent industry experience concerning hot cracking of the Alloy 52M weld overlay on austenitic SST base materials with high levels of sulfur.

FIGURE 1
PINGP UNIT 2 PRESSURIZER SURGE NOZZLE OVERLAY DIAGRAM



5.1 Code Case N-504-2 and Section XI, Nonmandatory Appendix Q

ASME Section XI Code Case N-504-2 allows a flaw in austenitic SST piping to be reduced to an acceptable size through the deposition of weld reinforcement on the outside surface of the pipe without flaw removal. The provisions of Section XI Nonmandatory Appendix Q are imposed by NRC RG 1.147, Revision 14, as a condition for acceptance of Code Case N-504-2.

For the design of the FSWOL it is conservatively assumed that a 360 degree circumferential through-wall flaw is present in the original Alloy 82/182 weld and in the original SST weld. Thus, the FSWOL will extend around the full circumference of the nozzle-to-safe end weld location and the safe end-to-reducer weld location as required by ASME Code Case N-504-2. The weld reinforcement material is to be Alloy 52M, or equivalent, and applied as a FSWOL to the existing ferritic carbon steel nozzle, austenitic SST safe end, SST pipe reducer, and the Alloy 82/182 and austenitic SST weld material joining them.

The WOL will be designed as a FSWOL consistent with the requirements of ASME Code Case N-504-2 and Section XI Nonmandatory Appendix Q. The FSWOL design assumes there is no contribution to structural integrity from the original section of pipe. The FSWOL thickness and length will be designed according to the guidance provided in Code Case N-504-2.

The design and repair methodologies of Code Case N-504-2 and provisions of Nonmandatory Appendix Q will be followed with modifications. These modifications and their bases are summarized in Table 2. All other applicable requirements not listed in Table 2 will be met as described in Code Case N-504-2 and Nonmandatory Appendix Q.

Weld overlay examination, preservice of the completed repair, and inservice inspections will be performed in accordance with Code Case N-504-2, ASME Section XI, Nonmandatory Appendix Q, Subarticles Q-4100, Q-4200 and Q-4300, and ASME Section XI, Appendix VIII, Supplement 11 with the modifications noted in Section 5.3 and Table 4 of this 10 CFR 50.55a request. These examinations will meet the applicable code and code case requirements as modified by this request.

Any FSWOL preservice ultrasonic indications characterized as weld flaws in the FSWOL weld metal that exceed the acceptance standards of IWB-3514-2 will be removed or reduced to an acceptable size. Indications located in the outer 25 percent of the base metal that are characterized as cracks will meet the design analysis requirements as specified in Nonmandatory Appendix Q, Q-3000.

5.2 Code Case N-638-1

Application of the FSWOL requires welding on the ferritic steel nozzle material with Alloy 52M. Temperbead welding will be used for this purpose using the guidance of Code Case N-638-1. Code Case N-638-1 describes the process for welding similar and dissimilar metals using ambient temperature machine GTAW temperbead method. Gas tungsten arc welding will be performed in accordance with Code Case N-638-1, with some modifications. As noted previously, Code Case N-638-1 was conditionally accepted in NRC RG 1.147, Revision 14, and was developed for welding similar and dissimilar metals using ambient temperature machine GTAW temperbead technique. However, based on the additional modifications proposed for application of this code case (Table 3), the conditions imposed by RG 1.147 on use of this code case are not applicable for the intended application.

The methodology of Code Case N-638-1 will be followed for welding on ferritic material where the Construction Code requires post-weld heat treatment, with modifications. The proposed modifications to Code Case N-638-1 specifically address the draining requirement, weld area limit of 100 square inches, ultrasonic examination thickness, 48-hour post-weld hold criteria prior to nondestructive examination (NDE), and the use of nonattached temperature measuring devices for temperbead welding. These specific changes and the basis justifying each proposed modification to the methodologies specified in Code Case N-638-1 are addressed in Table 3. Applicable requirements not listed will be met as described in the code case.

5.3 ASME Section XI, Appendix VIII, Supplement 11

Ultrasonic testing of the completed FSWOLs will be accomplished in accordance with ASME Section XI, Appendix VIII, Supplement 11, modified to comply with the Performance Demonstration Initiative (PDI), as described in Table 4. PDI has developed a program for qualifying equipment, procedures, and personnel for WOL examinations in accordance with the UT criteria of ASME Appendix VIII, Supplement 11. Table 4 addresses the specific modifications made to the requirements of Appendix VIII, Supplement 11. The basis for each modification is provided as well.

ASME Section XI, Appendix VIII, Supplement 11 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 made revisions to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to cases 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 percent of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws.

Applicable requirements not listed or addressed in Table 4 will be met as described in ASME Section XI, Appendix VIII, Supplement 11.

5.4 Implementation

The FSWOL is currently planned for installation during the PINGP Unit 2 Fall 2008 refueling outage as a preventive measure against flaw development in the DM weld. NRC approval is requested by June 1, 2008 to support scheduling for completion of activities during the outage.

5.5 Conclusion

The pre-emptive FSWOL will be installed in accordance with Code Case N-504-2, ASME Section XI Nonmandatory Appendix Q, and Code Case N-638-1 as modified by Tables 2 and 3. Ultrasonic testing of the completed FSWOLs will be accomplished in accordance with ASME Section XI, Appendix VIII, Supplement 11, modified to comply with the PDI, as described in Table 4. NMC has determined the proposed alternative provides an acceptable level of quality and safety and requests the NRC staff authorize the proposed alternative in accordance with 10 CFR 50.55a(a)(3)(i).

6.0 Duration of Proposed Alternative

The proposed alternative is requested for the design life of the FSWOL, as determined by the required evaluation in Paragraph (g) of Code Case N-504-2 and the corresponding requirements in Nonmandatory Appendix Q. Inservice Inspection (ISI) requirements beyond the current interval will be evaluated and established by the PINGP Unit 2 RI-ISI Program.

7.0 Precedents

Similar 10 CFR 50.55a requests have been submitted to the NRC with several obtaining approval:

7.1 Letter from L. Raghavan, NRC, to Mano K. Nazar, "Donald C. Cook Nuclear Plant, Unit 2 (DDCNP-2) – Alternative Regarding Use Of Preemptive Weld Overlays On Certain Dissimilar Metal Welds (TAC No. MD9305)," dated March 1, 2007 (ML070460121).

7.2 Letter from L. Raghavan, NRC, to Mano K. Nazar, "Donald C. Cook Nuclear Plant, Unit 1 (DDCNP-1) – Alternative Regarding Use Of Preemptive Weld Overlays (PSOLs) On Certain Dissimilar Metal Welds (TAC No. MD2119)," dated April 26, 2007 (ML070720021).

7.3 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 No. MC8609)," dated January 20, 2006 (ML053260012).

7.4 Letter from Keith D. Young to NRC Document Control Desk, "Docket Number 50-483, Union Electric Company, Callaway Plant, 10 CFR 50.55a Request For Relief From ASME Section XI Repair And Replacement Requirements Proposed Alternatives For Application Of Structural Weld Overlays To Pressurizer Nozzle Welds," dated August 14, 2006 (ML062360200).

7.5 Letter from David T. Fitzgerald to NRC Document Control Desk, "Docket Number 50-483, Union Electric Company, Callaway Plant, Response To Request For Additional Information Regarding 10CFR 50.55a Request For Relief From ASME Section XI Repair And Replacement Requirements: Proposed Alternatives For Application Of Structural Weld Overlays To Pressurizer Nozzle Welds," dated March 26, 2007 (ML070990115).

7.6 Letter from Russell G. West to NRC Document Control Desk, "Relief Request No. 2007-TMI-01 – Structural Weld Overlays (SWOLs) of the Pressurizer Surge, Pressurizer Spray, and Hot Leg Decay Heat Drop Line Nozzle Dissimilar Metal Welds including the SWOL of Adjacent Welds," dated May 1, 2007 (ML071220466).

8.0 References

8.1 ASME Code, Section XI, 1998 Edition through 2000 Addenda, IWA-4000, "Repair/Replacement Activities."

8.2 ASME Code, Section XI, 1998 Edition through 2000 Addenda, Appendix VIII, Supplement 11 "Qualification Requirements For Full Structural Overlaid Wrought Austenitic Piping Welds."

8.3 ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1".

8.4 U.S. Nuclear Regulatory Commission Regulatory Guide 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," August 2005.

8.5 ASME Code Section XI, 2004 Edition through 2006 Addenda, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments."

8.6 ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique, Section XI, Division 1."

8.7 Electric Power Research Institute Technical Report 1010087, "Materials Reliability Program: Primary System Piping Butt Weld Inspection and Evaluation Guidelines (MRP-139)," August 2005.

8.8 Electric Power Research Institute Topical Report 1013036, "Topical Report Supporting an Expedited NRC Review of the Content of the Code Case Needed for Dissimilar Metal Weld Overlay Repairs," January 2006.

8.9 Electric Power Research Institute Technical Report 1003616, "Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles," March 2004.

8.10 Electric Power Research Institute GC-111050, "Ambient Temperature Preheat for Machine GTAW Temperbead Applications," November 1998.

8.11 Electric Power Research Institute Report 1013558, "Temperbead Welding Applications 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding," December 2006.

8.12 Letter from NRR to NMC, "Prairie Island Nuclear Generating Plant, Units 1 and 2 – Issuance of Relief Request for the Risk-Informed Inservice Inspection Program (TAC NOS. MC5644 and MC5645)," dated January 5, 2006 (ML053270079).

8.13 ASME Code Case N-638-3, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique, Section XI, Division 1."

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
Code Case N-504-2, Reply: It is the opinion of the Committee that, in lieu of the requirements of IWA-4120 in Editions and Addenda up to and including the 1989 Edition with the 1990 Addenda, in IWA-4170(b) in the 1989 Edition with the 1991 Addenda up to and including the 1995 Edition, and in IWA-4410 in the 1995 Edition with the 1995 Addenda and later Editions and Addenda, defect in austenitic stainless steel piping may be reduced to a flaw of acceptable size in accordance with IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe, provided the following requirements are met: *Nonmandatory Appendix Q, Scope:* This Appendix provides an alternative to the requirements of IWA-4420, IWA-4520, IWA-4530, and IWA-4600 for making repairs to, and subsequent examination of Class 1, 2, and 3 austenitic stainless steel pipe weldments with stress corrosion cracking, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe. After a weld overlay has been installed in accordance with this Appendix, the inservice examinations identified in Q-4300 shall be performed as long as the repair remains part of the pressure boundary.	*Modification:* Permit Code Case N-504-2 and Section XI Nonmandatory Appendix Q for the installation of a nickel alloy FSWOL to mitigate the potential of PWSCC in Pressurizer nozzle-to-safe-end DM weld as modified herein. Permit use of MRP-139 for inservice examinations. *Code Case N-504-2, Reply:* It is the opinion of the Committee that Code Case N-504-2 and Section XI Nonmandatory Appendix Q, 2005 Addenda, may be used for the application of Alloy 52/52M full structural weld overlays of the ferritic (P-No.1 Group 2) nozzle material, nickel alloy (F-No.43) weld material, and austenitic stainless steel (P-No. 8) safe end and pipe base material and (A-No.8) weld materials, to mitigate the potential of PWSCC in nozzle-to-safe-end DM weld as modified herein. *Nonmandatory Appendix Q, Scope:* This Appendix provides an alternative to the requirements of IWA-4420, IWA-4520, IWA-4530, and IWA-4600 for making repairs to, and subsequent examination of Class 1, 2, and 3 austenitic stainless steel pipe weldments with stress corrosion cracking, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe. After a weld overlay has been installed in accordance with this Appendix, the inservice examinations identified in Q-4300 shall be performed in accordance with the requirements of MRP-139 with the additional requirement of at least one ultrasonic examination within ten years of application. *Basis:* The FSWOL will be sized to meet all structural

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
	requirements without considering the structured component of the existing Alloy 82/182 and SST weldments. Industry operating experience has shown that propagation of PWSCC in Alloy 82/182 weld metal will arrest at the SST base metal, ferritic base metal, or Alloy 52/52M interface. The 360 degree FSWOL will thus control propagation of PWSCC and maintain joint integrity. Q-4300 requires the weld overlay examination volume be added to the inspection plan and ultrasonically examined during the first or second outage following application. Q-4300 also requires that weld overlays with no indication of new cracking be placed into a population in which 25 percent of the population is examined once every ten years. Compliance with MRP-139 and the site's risk-informed inservice inspection program, with the additional commitment to examine the weldment within ten years of application, provides essentially the same requirements with additional flexibility in the scheduling of the first examination.
Code Case N-504-2, 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. *Nonmandatory Appendix Q, Q-2000 Paragraph (a):* 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 using a Welding Procedure Specification for groove welding, qualified in accordance with the Construction Code and Owner's	*Modification:* Nickel alloy weld filler metal may be used in lieu of low carbon austenitic filler metal. *Code Case N-504-2, Paragraph (b):* Reinforcement weld metal shall be a PWSCC resistant nickel alloy filler material applied 360 degrees around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification. *Basis:* The FSWOL weld metal will be ERNiCrFe-7A (Alloy 52M, UNS N06054). Repairs, if required, may be ERNiCrFe-7A or

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
Requirements and identified in the Repair/Replacement Plan.	ERNiCrFe-7 (Alloy 52). ERNiCrFe-7A and ENiCrFe-7 are assigned F-No. 43 by ASME Section IX, 2006 Addenda. The requirements of ASME Section III, NB-2400 will be applied to all filler material as required by ASME Section XI. Alloys 52M and 52 contain about 30% Cr (significantly higher than Alloy 82/182), imparting excellent PWSCC resistance. Alloy 52M and 52 are fully austenitic and have ductile properties and toughness similar to austenitic SST piping welds at PWR operating temperature. Furthermore, these filler materials are suitable for welding to the ferritic nozzle, Alloy 81/182 weld, and the austenitic SST pipe, welds, and safe end materials.
Code Case N-504-2, 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. [Similar to Q-2000(d)] *Nonmandatory Appendix Q, Q-2000 Paragraph (d):* The weld reinforcement shall consist of at least 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 that may be credited toward the required thickness. Alternatively, first layers	*Modification:* Delta ferrite (FN) measurements will not be performed when using Alloy 52M/52 filler material. The FSWOL deposit shall instead meet the following requirements: *Code Case N-504-2, Paragraph (e):* 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%. The first layer of weld metal deposited may not be credited toward the required WOL structural design thickness. Alternatively, the as-deposited first layer may be credited toward the required structural design thickness, provided the diluted layer applied over the austenitic base material, austenitic weld metal and ferritic carbon steel base material contains at least 24% Cr. The Cr content of the first layer may be determined by chemical analysis of the production weld or may be demonstrated by a

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
of at least 5 FN are acceptable, provided the carbon content of the deposited weld metal is determined by chemical analysis to be less than 0.02%.	representative coupon taken from a mockup prepared in accordance with the production welding procedure specification (WPS). The welding parameters demonstrated on the mockup to achieve 24% Cr on the first layer shall be used for the production weld first layer. *Basis:* Alloy 52M/52 weld metal is fully austenitic and contains no delta ferrite due to the high nickel (~60%) content. As-deposited delta ferrite content is therefore not applicable for Alloy 52M/52 weld metal. Alloy 52M/52 with as-deposited first layer chromium content greater than or equal to 24% provides acceptable PWSCC resistance. EPRI Topical Report 1013036, Appendix B, "White Paper-Effect of Chromium Content on Nickel-Base Allow SCC Resistance," (Ref 8.8) shows that 24% Cr provides acceptable resistance to PWSCC in PWR applications. As-deposited first layer chemistry will be verified either by field chemistry measurements or by prior mockup demonstration using production WPS parameters. When first-layer chemistry meets or exceeds 24% Cr, this initial layer will be credited toward FSWOL design thickness. If the first-layer Cr is less than 24%, the first layer will be considered sacrificial and will not be credited toward FSWOL design thickness.
Code Case N-504-2 Paragraphs (f) and (g) *Nonmandatory Appendix Q, Q-3000 Paragraph (b):* The design	*Code Case N-504-2, Modifications:* The provisions of N-504-2 (f) and (g), Q-3000 in the 2005 Addenda of Section XI, and corrections to Q-3000 published in the 2006 Addenda of Section

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
of the weld overlay shall satisfy the requirements of the Construction Code and Owner's Requirements in accordance with IWA-4221 and the following, using the assumptions and flaw characterization restrictions in Q-3000(a). The design analysis required by Q-3000(b)(1) – (4) shall be completed in accordance with IWA-4311.	XI will be used, with the following modifications: *Nonmandatory Appendix Q, Q-3000 Paragraph (b):* The design of the weld overlay shall be in accordance with IWA-4221 and the following, using the assumptions and flaw characterization restrictions in Q-3000(a). The design analysis required by Q-3000(b)(1)-(4) shall be completed in accordance with IWA-4311. The analysis required under N-504-2(g)(2) and (g)(3) are currently in development and will be completed prior to entering Mode 4 Startup following the refueling outage FSWOL installation. *Nonmandatory Appendix Q, Q-3000 Paragraph (b) (3):* The overlay design thickness of items meeting Q-3000(a)(2), (3), or (4) shall be based on the measured diameter, using the thickness of the weld overlay as restricted by Q-2000(d). The wall thickness at the weld overlay, any planar flaws in the weld overlay and the effects of any discontinuity (e.g., another weld overlay or reinforcement for a branch connection) within a distance of 2.5 $\sqrt{Rt}$ from the toes of the weld overlay, shall be evaluated and shall meet the requirements of IWB-3640. *Basis:* The 2005 Addenda of Section XI incorporated Code Case N-504-2 as Nonmandatory Appendix Q. Unfortunately, inadvertent consequences of modified wording caused problems with implementation. Nonmandatory Appendix Q was revised in the 2006 Addenda to more accurately incorporate the provisions

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
	of Code Case N-504-2. A correction to Q-3000(b) deleted the requirement for the design of the WOL to satisfy the requirements of the Construction Code and Owner's requirements. There was no similar wording in Code Case N-504-2. This wording was inappropriate because meeting the requirements of the construction Code required the absence of cracks. A fundamental purpose of Code Case N-504-2 was to repair cracks (reduce to an acceptable size) by installation of a WOL. The appropriate requirements for maintaining Section III (i.e., the Construction Code) limits were properly transferred from Case N-504-2 into Q-3000(b)(1) in the initial issue of Nonmandatory Appendix Q and the deletion of Q-3000(b) in the 2006 Addenda of Nonmandatory Appendix Q resolved the problem. Regarding the correction in Q-3000(b)(3), "overlay design thickness" is more appropriate than "pressure design", which is incorrect and was not used in Code Case N-504-2. Overlay design thickness is based on other loads in addition to pressure.
*Code Case N-504-2, Paragraph (h): T*he 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	*Modification:* In lieu of a hydrostatic test, a system leakage test will be performed in accordance with Section XI, IWA-5000 of the 2000 Addenda. *Code Case N-504-2, Paragraph (h): T*he completed repair shall be pressure tested in accordance with IWA-5000. *Basis:* A system hydrostatic test at normal operating temperature

TABLE 2: MODIFICATIONS TO ASME CODE CASE N-504-2 AND SECTION XI, NONMANDATORY APPENDIX Q

Current Requirements	Modification and Basis
IWA-5000.	and at 1.02 times the Class 1 reactor coolant system operating pressure (as specified by IWA-5000 and IWB-5000) provides no more assurance of the structural condition of the FSWOL than a system leakage test performed at RCS operating pressure. The 1993 Addenda of ASME Section XI eliminated Class 1 system hydrostatic tests for inservice inspection. Furthermore, the 1999 Addenda of ASME Section XI, which is accepted in 10CFR50.55a, permits a system leakage test in lieu of a system hydrostatic test for all repair/replacement activities.

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
Reply: It is the opinion of the Committee that repair to P-No. 1, 3, 12A, 12B, and 12C[1], *except SA-302 Grade B,* material and their associated welds and welds joining P-No. 8 or P-No. 43 material to P-Nos. 1, 3, 12A, 12B, and 12C[1], *except SA-302 Grade B,* material may be made by the automatic or machine GTAW temperbead technique without the specified preheat or postweld heat treatment of the Construction Code, when it is impractical to drain the component or impractical for radiological reasons. The nondestructive examination requirements of the Construction Code need not be met, provided the requirements of paras. 1.0 through 5.0, and all other requirements of IWA-4000[2], are met.	*Modification:* Permit installation of the FSWOL with or without the Pressurizer and associated surge nozzle piping drained. *Reply:* It is the opinion of the Committee that repair to P-No. 1, 3, 12A, 12B, and 12C[1], *except SA-302 Grade B,* material and their associated welds and welds joining P-No. 8 or P-No. 43 material to P-Nos. 1, 3, 12A, 12B, and 12C[1], *except SA-302 Grade B,* material may be made by the automatic or machine GTAW temperbead technique without the specified preheat or postweld heat treatment of the Construction Code with or without draining the system or component. The nondestructive examination requirements… *Basis:* As part of plant refueling, the surge nozzle and associated piping will be drained below the overlay location for brief periods during FSWOL installation. Code Case N-638-1 requires a maximum 350°F interpass temperature for the first three layers and all subsequent layers. The 350°F interpass on the first three layers provides adequate control to ensure tempered martensite with adequate toughness in the ferritic carbon steel nozzle material, and the 350°F interpass for all subsequent layers ensures the SST weld and base material are not sensitized. The interpass temperature controls of N-638-1 are therefore adequate to ensure acceptable mechanical properties and structural integrity of the overlay weldment.

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
Paragraph 1.0(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.	*Modifications:* The area of the ferritic carbon steel nozzle base material covered by the FSWOL may exceed 100 sq. in. The one-half base metal thickness limitation applies to weld repair of base metal excavations and is not applicable to FSWOLs. *Paragraph 1.0(a):* The maximum ferritic carbon steel base material surface area covered by weld overlay shall be 300 sq. in. *Basis:* The requirements of N-638-1 are applied to the FSWOL material installed on the ferritic carbon steel nozzle base material. The area of the FSWOL covering the ferritic base material for the PINGP Unit 2 surge nozzle is approximately 140 sq. in. which will exceed the 100 sq. in. limit of surface covered by the FSWOL imposed by Code Case N-638-1. In order for the FSWOL to satisfy structural requirements, additional weld material may be necessary in the axial direction on the ferritic carbon steel nozzle to facilitate the required post-overlay ultrasonic examination and/or to achieve an acceptable overlay blend transition into the nozzle. The maximum ferritic carbon steel base material covered by the FSWOL will be limited to 300 sq. in. Extensive experience exists in BWR and PWR WOL applications where the ferritic base material covered by WOL exceeded the 100 sq. in. limitation without any damage or long-term detrimental effects. EPRI Technical Report 1003616, "Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles," (Ref. 8.9) provides justification for WOL areas up to 500 sq. in. Finite

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	element analyses of the ambient temperature temperbead repair process show that residual stresses are not detrimentally affected by increasing the allowable repair area. In fact, analyses show that in some cases increasing the allowable repair area improves the residual stress distribution in the weldment. ASME published Code Case N-638-3, which permits a repair area up to 500 sq. in., in Supplement 9 to the 2004 Edition of ASME Section XI. The Committee white paper basis for this N-638 revision indicates that the 100 sq. in. limitation was arbitrarily established and that repair areas up to 500 sq. in. would have no adverse effect.
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]. [3]Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda.	*Modification:* In lieu of the requirements of Paragraph 4.0(b), examination of the final FSWOL will be in accordance with the requirements of Code Case N-504-2 and Nonmandatory Appendix Q, as modified in this relief request. The 48-hour hold time prior to final NDE may start following completion of the third temperbead layer and is applied only to FSWOL section that covers and/or adjoins the ferritic carbon steel nozzle base material. *Paragraph 4.0(b):* The final weld overlay shall be examined in accordance with Code Case N-504-2 and Nonmandatory Appendix Q, as modified. The volume and area requiring examination by Code Case N-504-2 and Nonmandatory Appendix Q are adequate for detection of hydrogen delayed cracking that occurs in the ferritic carbon steel heat affected zone (HAZ). Examination of the weld overlay covering the ferritic base material and examination of the adjacent ferritic base material

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	shall be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic base material. *Basis:* Examination of a band width 1.5 times the component thickness or 5 in. which ever is less, around the repair area after 48 hours at ambient temperature is for detection of delayed HAZ cracking that may occur due to inadvertent introduction of deleterious monatomic hydrogen into a hardened base metal HAZ microstructure that was not adequately tempered. The ferritic nozzle base material HAZ due to the first Alloy 52M layer is the only region susceptible to potential hydrogen delayed cracking. The volume and area requiring examination by Code Case N-504-2 and Nonmandatory Appendix Q are therefore adequate for detection of hydrogen delayed cracking that occurs in vicinity of the first layer HAZ and the excessive examination band region specified by Paragraph 4.0(b) is not necessary. Hydrogen contamination to deleterious levels from outside sources is unlikely when applying the ambient temperature temperbead machine GTAW process with the associated methodologies specified for welding control, cleanliness, and examination. As compared to flux type welding processes, machine GTAW with argon shielding is an inherently low-hydrogen process that provides optimum temperbead welding controls to ensure adequately tempered base metal HAZ with high fracture toughness. The low hydrogen and tempering characteristics of the machine GTAW process are well documented in EPRI GC-111050, "Ambient Temperature Preheat for Machine GTAW Temperbead Applications," (Ref. 8.10).

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	Code Case N-504-2 and Nonmandatory Appendix Q require liquid penetrant examination (PT) prior to installation of the FSWOL. Cleaning the base metal for PT provides assurance, in addition to typical welding process controls, that deleterious hydrogen from surface contamination is not introduced in the first layer of the FSWOL. The high affinity of fully austenitic Alloy 52M filler metal for monatomic hydrogen combined with a low diffusion coefficient keeps diffusion of deleterious hydrogen into the ferritic carbon steel base material to negligible levels. Furthermore, only welding in contact with the ferritic carbon steel base material has potential of introducing deleterious monatomic hydrogen into a hardened untempered HAZ region. Each successive temperbead layer has a decreasing propensity for introducing hydrogen into the ferritic base material due to increasing distance from the susceptible base metal HAZ. After three layers the temperbead process adequately tempers the martensite formed in the ferritic base material by the first layer. Adequate tempering by the third weld layer decreases the hardness and increases the fracture toughness in the potentially susceptible ferritic base material HAZ thus mitigating susceptibility to delayed hydrogen cracking. In addition, the use of the machine GTAW temperbead process provides precise control of heat input, bead placement, bead size and contour. The very precise control over these factors afforded by the machine GTAW process provides effective tempering of the nozzle ferritic steel HAZ resulting in achievement of lower

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	hardness and tempered martensite. This further reduces susceptibility to hydrogen induced cracking. EPRI Report 1013558, Temperbead Welding Applications, 48 Hour Hold Requirements for Ambient Temperature Temperbead Welding, Technical Update, December, 2006 (Reference 8.11) 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 performing final NDE of the completed weld overlay and provides the technical justification therein. The 48 hour delay provides time after welding for delayed hydrogen cracking occurrence. The base materials studied in the EPRI report are primarily P-No. 3. The pressurizer surge nozzle ferritic carbon steel base material is P-No. 1 Group No. 2. The concerns associated with hydrogen assisted cracking are generally more significant for P-No. 3 than P-No.1 Group No. 2 base materials due to P-No. 3 base materials increased hardenability. Also, post weld heat treat exemptions shown in ASME Section III, Table NB-4622.7(b)-1 are provided for P-No. 1 Group No. 2 materials including temperbead welding, whereas no post weld

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	heat treat exemptions, other than temperbead welding, are permitted for P-No. 3 Group No. 3 materials. It is noted that temperbead welding may only be required on the carbon steel nozzle taper where the thickness is greater than 1-1/2 in. depending on the final FSWOL thickness. Based on past and recent NDE experience on temperbead weld overlays, hydrogen cracking of these welds was not identified during the initial NDE after a 48-hour hold time or subsequent inservice inspection examinations. In summary, the inherent low hydrogen nature of the prescribed ambient temperature temperbead machine GTAW process and methodology, the relatively low susceptibility of hydrogen induced cracking in ferritic base material HAZ when using nickel alloy filler metals, and performance of the Nonmandatory Appendix Q and N-504-2 final examination (as modified) 48 hours after completion of the third layer over the ferritic base material provides substantial assurance against the potential for delayed hydrogen cracking in the ferritic base material HAZ. Additionally, ASME published Code Case N-638-3, which does not require examination of the band around the repair area, in Supplement 9 to the 2004 Edition of ASME Section XI. Also, the Boiler and Pressure Vessel Main Committee in August 2006 approved a revision to N-638-3 which permits start of the 48 hour hold following completion of the third temperbead layer (Reference ASME Code Committee tracking no. BC06-134).

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	Therefore, final FSWOL examination will not include base metal at 1.5T distance beyond the overlay weld as specified in N-638-1. The final NDE of the temperbead portion of the weld over the ferritic carbon steel nozzle will be performed no sooner than 48 hours after completion of the third temperbead layer.
Paragraph 4.0(c): Areas from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method.	*Modification:* Provide for use of non-attached temperature measuring devices. *Paragraph 4.0(c):* Process temperatures may be monitored with non-attached type 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. If weld-attached thermocouples are used, the local area where thermocouples were attached shall be ground and examined using a surface examination method. *Basis*: Process temperature monitoring is performed to ensure compliance with the applicable Welding Procedure Specification preheat/interpass temperature requirements during overlay welding. Interpass temperature, temperature of a previously deposited weld pass prior to depositing a subsequent weld pass, must be measured at the start location of the successive weld pass prior to commencement of welding. Attached thermocouples are not practical for this application because they must be fixed at specific location(s). The accuracy of temperature measurements from a contact pyrometer and attached thermocouple are comparable. Use of non-attached temperature measuring devices is adequate for controlling and

TABLE 3: MODIFICATIONS TO ASME CODE CASE N-638-1

Current Requirements	Modification and Basis
	monitoring temperatures during ambient temperature temperbead machine GTAW.
NRC conditions for use of Code Case N-638-1 specified in Regulatory Guide 1.147	With the modifications described above, the NRC RG 1.147, Revision 14, conditions for use of N-638-1 are not applicable and therefore will not be applied.

Enclosure 2
Prairie Island Nuclear Generating Plant Unit 2
10 CFR 50.55a Request No. 2-RR-4-8, Rev. 1

Modifications to ASME Section XI Appendix VIII, Supplement 11 (Table 4)

Appendix VIII Supplement 11 of Section XI cannot be used without modification for nondestructive examination (NDE) qualifications of a FSWOL. Relief is requested to use the PDI program implementation of Appendix VIII Supplement 11. A detailed comparison of Appendix VIII Supplement 11 and PDI requirements is summarized below in Table 4. The bases for the proposed alternatives to Supplement 11 are noted in Table 4 except as described in the following paragraph (for broader alternatives affecting several Supplement 11 paragraphs).

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. The PDI program revised paragraph 2.0 to allow the overlay fabrication and base metal flaw tests to be performed separately. The PDI program also allows closer spacing of flaws provided they don't interfere with detection or discrimination. The specimens used to date for qualification to the Tri-party NRC, Boiling Water Reactor Owners Group (BWROG) and Electric Power Research Institute (EPRI) agreement have a flaw population density greater than allowed by current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI program has merged the Tri-party test specimens into their weld overlay program.

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
1.1 General. Paragraph (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	*1.1 General. Paragraph (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.

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
thickness within -0.1 in. to +0.25 in. of the maximum nominal overlay thickness for which the procedure is applicable.	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.
1.1 General. (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.	*1.1 General. (d) Flaw Conditions (1):* Base metal flaws. 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. 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: *Paragraph (d) (1)* (a): The use of Alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. *Paragraph (d) (1)* (b): Flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches. *Basis:* This paragraph requires that all base metal flaws be cracks. Implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
	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.
1.1 General. (e) Detection Specimens (1): At least 20% but less than 40% of the flaws shall be oriented within ±20 deg. 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.	*1.1 General. (e) Detection Specimens (1):* At least 20% but less than 40% of the base metal flaws shall be oriented within ±20 deg. 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 FSWOL fabrication flaws was excluded from the PDI Program as an improbable scenario. WOLs 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 FSWOL 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.

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
1.1 General. (e) Detection Specimens (2): Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types or grading units.	*1.1 General. (e) Detection Specimens (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.
1.1 General. (e) Detection Specimens (2) (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.	*1.1 General. (e) Detection Specimens (2) (a)(1):* A base metal grading unit includes the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 in. and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50" of the adjacent base material. *Basis:* The phrase, "and base metal on both sides," was inadvertently included in the description of a base metal grading unit. The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. This paragraph was also modified to require that a base metal grading unit include at least 1 inch of the length of the overlaid weld, rather than 3 inches.
1.1 General. (e) Detection Specimens (2) (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.	*1.1 General. (e) Detection Specimens (2) (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.
1.1 General. (e) Detection Specimens (2) (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	*1.1 General. (e) Detection Specimens (2) (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.

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
grading unit shall not be used in another base grading unit. Base grading units need not be uniformly spaced around the specimen.	*Basis:* This paragraph was also 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.
1.1 General. (e) Detection Specimens (2) (b)(1): An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 sq. in. The overlay grading unit shall be rectangular, with minimum dimensions of 2 in.	*1.1 General. (e) Detection Specimens (2) (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:* This paragraph is also modified to define an overlay fabrication grading unit as including the FSWOL material and the base metal-to-overlay interface for a length of at least 1 inch rather than the 6 sq. in. requirement.
1.1 General. (e) Detection Specimens (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 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.	*1.1 General. (e) Detection Specimens (2) (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 inch at both ends, rather than around its entire perimeter.

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
1.1 General. (e) Detection Specimens (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 overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	*1.1 General. (e) Detection Specimens (2) (b)(3):* 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.
1.1 General. (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.	*1.1 General. (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 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 General. (f) Sizing Specimen (3): Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	*1.1 General. (f) Sizing Specimen (3):* Base metal flaws used for length sizing demonstrations shall be oriented circumferentially.
1.1 General. (f) Sizing Specimen (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.	*1.1 General. (f) Sizing Specimen (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.
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	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

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
to the candidate. Divulgence of particular specimen results or candidate viewing of unmasked specimens after the performance demonstration is prohibited.	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.	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 metal or overlay fabrication) that are present for each specimen.
2.2 Length Sizing Test *(d):* For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	2.2 Length Sizing Test *(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.
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.	2.3 Depth Sizing Test: *(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.
3.1 Detection Acceptance Criteria.: Examination procedures, equipment, and personnel are qualified for detection when the	3.1 Detection Acceptance Criteria.: Examination procedures are qualified for detection when the

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	results of the performance demonstration satisfy the following criteria. *(a)* All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. *(b)* At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (c). *(c)* Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. *(d)* The criteria in (b) and (c) shall be satisfied separately by the demonstration results for base metal grading units and for overlay fabrication grading units. *Basis:* The PDI program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase this passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times

TABLE 4: MODIFICATIONS TO SECTION XI APPENDIX VIII, SUPPLEMENT 11

Current Requirements	Modification and Basis
	as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The personnel and equipment are still required to meet Supplement 11.
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.	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 flaws is measured at the 75% through-base-metal position.
3.2 Sizing Acceptance Criteria. *(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.	3.2 Sizing Acceptance *Criteria. (b)* This requirement is omitted. *Basis:* The requirement for reporting all extensions of cracking into the FSWOL is omitted from the PDI Program because it is redundant to the root mean squared (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 FSWOL program consistent with the Supplement 2 depth sizing criteria.
3.2 Sizing Acceptance Criteria. *(c):* The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 in.	3.2 Sizing Acceptance Criteria. *(b):* The RMS error of the flaw depth measurements, as compared to the true flaw depths, is less than or equal to 0.125 in. *Basis: By omitting the Paragraph 3.2 (b) requirement, Paragraph 3.2 (c) is reformatted and becomes 3.2 (b).*