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March 12, 2007

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

Subject: Duke Power Company LLC d/b/a Duke Energy Carolinas, LLC (Duke)
Oconee Nuclear Station, Units 2, 3
Docket Nos. 50-270,-287
Fourth Ten Year Inservice Inspection Interval
Request for Relief No. 07-ON-001

Pursuant to 10 CFR 50.55a(a)(3)(i), Duke hereby requests NRC approval to use alternatives to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI inservice inspection (ISI) requirements for the Oconee Nuclear Station, Units 2, and 3. This proposed alternative approach is to support application of full structural weld overlays on various pressurizer nozzle to flange, nozzle-to-safe end, and surge line welds and will provide an acceptable level of quality and safety.

This request is needed to support work beginning with the Oconee Unit 2 EOC 22 refueling outage, which is scheduled to start April 28, 2007.

This request is virtually identical to request for relief 06-ON-004, which was originally submitted August 24, 2006. Several additional letters were submitted to address NRC comments and requests for additional information and a revised version of 06-ON-004 received verbal approval on October 30, 2006.

Units 2 and 3 were removed from the scope of request for relief 06-ON-004 by letter dated October 5, 2006 in response to a position of the NRC staff that they would not approve the requested relief for outages beyond fall 2006.

The difference between this relief and the final approved version of 06-ON-004 relates to a commitment in 06-ON-004 to submit, prior to entry into Mode 4 from the Oconee Unit 1 outage in the fall of 2006, a summary of the results of the stress analyses demonstrating that the preemptive full structural weld overlay will not hinder the components from performing their design function. That summary was submitted on November 27, 2006. Duke considers that summary to be

A047

bounding for Units 2 and 3; therefore no additional summary report on stress analyses is planned for those units.

On October 5, 2006, an RAI response modified 06-ON-004 to include a commitment to submit, within 14 days from completion of UT examination of the weld overlays, a report that summarizes the results of the UT examinations. This relief makes the same commitment for the Unit 2 and 3 weld overlays. This commitment is the only regulatory commitment contained in this relief request.

Duke requests verbal approval of this relief request prior to April 28, 2007 to support the Oconee Unit 2 spring 2007 refueling outage. Duke wishes to note that the weld overlays addressed by this request for relief are associated with the inspection and mitigation of Alloy 600/82/182 welds on Pressurizer lines per MRP-139. By a teleconference on February 14, 2007, the NRC requested Duke to commit to an inspection and mitigation schedule contained in a Duke letter dated January 31, 2007. A commitment letter to that effect was submitted on February 22, 2007. Approval of this relief is critical to the ability of Duke to meet that schedule.

If there are any questions or further information is needed you may contact R. P. Todd at (864) 885-3418.

Very truly yours,

for Bruce Hamilton

B. H. Hamilton
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Proposed Alternative
In Accordance with 10 CFR 50.55a(a)(3)(i)
- Alternative Provides Acceptable Level of Quality and Safety -

Duke Energy Corporation
Oconee Units 2 & 3
Request for Alternative 07-ON-001

CONTENTS

List of Figures

1.0 ASME CODE COMPONENTS AFFECTED

System: Reactor Coolant System

Component Number:

Oconee Unit 2	Description	Size	Weld Number	Comment[1]
Pressurizer	Surge nozzle to safe end	11.5" OD	2-PZR-WP23	CS nozzle/Alloy 82-182 weld/SS safe end
Pressurizer	Spray nozzle to safe end	4.5" OD	2-PZR-WP-45	CS nozzle/Alloy 82-182 weld/A600 safe end
Pressurizer	Relief nozzle to flange	4.5" OD	2-PZR-WP91-1	CS nozzle/Alloy 82-182 weld/SS flange
Pressurizer	Safety nozzle to flange	4.5" OD	2-PZR-WP91-2	CS nozzle/Alloy 82-182 weld/SS flange
Pressurizer	Safety nozzle to flange	4.5" OD	2-PZR-WP91-3	CS nozzle/Alloy 82-182 weld/SS flange
RC Pipe	Spray safe end to pipe	4.5" OD	2-PSP-1	A600 safe end/ Alloy 82-182 weld SS pipe
RC Pipe	Surge line to Hot leg Nozzle	11.5" OD	2-PSL-10 2-PHB-17	Alloy 82-182 butter/ Alloy 82-182 weld/SS pipe CS Nozzle/alloy 82-182 butter

Oconee Unit 3	Description	Size	Weld Number	Comment[1]
Pressurizer	Surge nozzle to safe end	11.5" OD	3-PZR -WP23	CS nozzle/Alloy 82-182 weld/SS safe end
Pressurizer	Spray nozzle to safe end	4.5" OD	3-PZR-WP-45	CS nozzle/Alloy 82-182 weld/A600 safe end
Pressurizer	Relief nozzle to flange	4.5" OD	3-PZR-WP91-1	CS nozzle/Alloy 82-182 weld/SS flange
Pressurizer	Safety nozzle to flange	4.5" OD	3-PZR-WP91-2	CS nozzle/Alloy 82-182 weld/SS flange
Pressurizer	Safety nozzle to flange	4.5" OD	3-PZR-WP91-3	CS nozzle/Alloy 82-182 weld/SS flange
RC Pipe	Spray safe end to pipe	4.5" OD	3-PSP-1	A600 safe end/ Alloy 82-182 weld SS pipe
RC Pipe	Surge line to Hot leg Nozzle	11.5 OD	3-PSL-10 3-PHB-17	Alloy 82-182 butter/ Alloy 82-182 weld/SS pipe CS Nozzle/alloy 82-182 butter

(1) CS = A-508 Class 1-PZR nozzles; A105 Gr 2 – Hot leg nozzle.
SS = Type 316 or type 304 austenitic stainless steel

Code Class: Class 1

Examination Category: B-F; B-J

Code Item Number: B5.40; B9.11

2.0 APPLICABLE CODE EDITION AND ADDENDA

Inservice Inspection:
ASME Boiler and Pressure Vessel Code, Section XI, 1998 Edition through 2000 Addenda

Pressurizer Design and Fabrication:
ASME Boiler and Pressure Vessel Code, Section III, Subsection A, 1965 Edition through 1967 Addenda

Duke Welding Program:
ASME Boiler and Pressure Vessel Code, Section III, 1989 Edition No Addenda

3.0 APPLICABLE CODE REQUIREMENTS

ASME Boiler and Pressure Vessel Code, Section XI, 1998 Edition through 2000 Addenda, Article IWA-4000, "Repair/Replacement Activities"

ASME Boiler and Pressure Vessel Code, Section XI, 1998 Edition through 2000 Addenda, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds"

Code Case N-504-2 with requirements of ASME Code, Section XI, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments"

Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique".

4.0 REASON FOR THE REQUEST

Dissimilar metal welds (DMW) made with nickel alloys 82 and 182 have been shown to be susceptible to primary water stress corrosion cracking (PWSCC) degradation in components that are subjected to higher operating temperatures. Structural weld overlays have been used for several years on piping of both boiling water reactors and pressurized water reactors to arrest the growth of existing flaws while establishing a new structural pressure boundary. No evidence of PWSCC has been found in the welds of the Oconee pressurizer; however, PWSCC is difficult to detect in DMW except when the inspection is performed in accordance with the stringent requirements of ASME Section XI, Appendix VIII. Some of the DMW included in this request for relief have been evaluated and found not to meet the surface or geometric requirements of Appendix VIII. The feasibility of modifying the geometry to an acceptable configuration has not been established. Rather than risk multiple cycles of inspection and modification, Duke is proposing to take a proactive approach to apply a preemptive full structural weld overlay (PWOL) to the dissimilar metal welds of the pressurizer components listed in Section 1.0 of this request.

Currently, there are no comprehensive criteria for a licensee to apply a full structural weld overlay to DMW constructed of Alloy 82/182 weld material. Neither the latest NRC approved edition nor the edition of ASME Section XI used for the Oconee Units 1, 2, & 3 repair/replacement program, contains the needed requirements for this type of repair. Repair/replacement activities associated with a full structural weld overlay repair of this type are required to address the materials, welding parameters, ALARA concerns, operational constraints, examination techniques, and procedure requirements. Similar nozzle-to-safe end weld overlays have been applied to other plants since 1986 with no problems identified.

5.0 PROPOSED ALTERNATIVES AND BASIS FOR USE

Pursuant to 10CFR 50.55a(a)(3)(i), an alternative to the requirements listed in Section 3.0 above is requested on the basis that the proposed alternative will provide an acceptable level of quality and safety. Attachment 1, Tables A1, A2 and A3, included as a part of this request for relief, provides details of relief requested from each of these requirements.

A full structural PWOL is proposed for each of the pressurizer and hot leg welds identified in Section 1.0 above. The overlays will extend around the full circumference of the nozzle to flange welds, the nozzle-to-safe end welds, and safe end to piping welds, as illustrated in Figures A1 through A4. The entire safe end for the Spray line is included since the safe end is fabricated from Alloy 600. The full structural weld overlays are sized to satisfy the ASME Code, Section III requirements without crediting the existing welds.

The proposed weld overlay design is consistent with the requirements of ASME Code Case N-504-2 and Section XI, Nonmandatory Appendix Q, with the modifications noted in Table A1. The provisions of Appendix Q must be met as a condition of acceptance of the Code Case by NRC Regulatory Guide 1.147, Revision 14. The specific thickness and length are computed according to the guidance provided in Code Case N-504-2 and Appendix Q. The overlay will completely cover the Alloy 82/182 welds and adjacent Alloy 600 safe end for the Spray line with alloy 52M/52MS material that is highly resistant to PWSCC.

The length of the full structural weld overlay is sized for inspection of the volume shown in Appendix Q, Fig Q-4300-1. This volume extends ½-inch beyond the susceptible weld and includes the outer 25% of the original wall thickness. The length of the PWOL is extended and blended into the carbon steel (CS) nozzle outer diameter to permit ultrasonic testing (UT) of the weld and to minimize stress concentration on the nozzle outer diameter. The outside diameter of the nozzle is larger than that of the adjacent component; therefore, the PWOL thickness on the component is increased to allow a smooth transition surface for UT. The final structural weld overlay length and thickness after taking into consideration the UT requirements will exceed the length required for a full structural weld overlay repair in accordance with Case N-504-2 and Appendix Q.

Appendix Q, Section 4000 requires ultrasonic procedures and personnel to be qualified in accordance with ASME Code, Section XI, Appendix VIII. Ultrasonic examination of the completed PWOL will be accomplished in accordance with Section XI, Appendix VIII, Supplement 11, with alternatives to comply with the Performance Demonstration Initiative (PDI) program as shown in Table A2.

Implementation of Section XI, Subsection, IWA-4540(a)(2) for a system leakage test requires performance of NDE in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 or later Edition of ASME Section III. These requirements were formerly included in Code Case N-416-2 that is not listed within the current ISI Program Plan for Oconee. The requirements of Code Case N-416-2 were incorporated into Section XI and are implemented in ASME Boiler and Pressure Vessel Code Section XI 1998 Edition through 2000 Addenda applicable to the fourth inspection interval for both Units 2 and 3 for which relief is requested. As an alternative to the Section XI NDE requirements, Duke will follow the NDE requirements of Appendix Q for the required NDE. The bases for these alternatives are shown as needed in Table A1.

The PWOL will be applied over portions of the CS nozzles. The Construction Code requires either pre-heat or post-weld heat treatment after welding depending on the carbon content or base material thickness. As an alternative to pre-heat or post-weld heat treatment, the overlay will be implemented in accordance with Code Case N-638-1 with the modifications noted in Table A3 of Attachment 1. Code Case N-638-1 was conditionally approved for generic use in NRC Regulatory Guide 1.147, Revision 14, and was developed for welding similar and dissimilar metals using the ambient temperature machine GTAW temper bead technique. This Code Case specifies a limit of 100 square inches for the surface area of temper bead weld over the ferritic material. The weld surface areas over ferritic material for the subject weld overlays are expected to be approximately 125 square inches, 70 square inches, 30 square inches, and 30 square inches, for the pressurizer surge line nozzle, hot leg surge line nozzle, safety and relief line nozzles, and spray line nozzles, respectively.

An ASME white paper describes the technical justification for allowing increased overlay areas up to 500 square inches. This white paper was also submitted to the NRC as a part of a relief request by Constellation Energy Generation Group (Adams Accession Number, ML060240110). The white paper indicates the original limit of 100 square inches in Code Case N-638-1 was an arbitrary limit and goes on to justify the application of overlays up to 500 square inches on ferritic low alloy steel. The white paper cites evaluations of a 12 inch diameter nozzle weld overlay to demonstrate adequate tempering of the weld heat affected zone (Section 2a of the white paper), residual stress evaluations demonstrating acceptable residual stresses in weld overlays ranging from 100 to 500 square inches (Section 2b of the white paper), and service history in which weld repairs exceeding 100 square inches were NRC approved and applied to DMW nozzles in several BWRs and three PWRs (Section 3c of the white paper). Some of the cited repairs are greater than 15 years old, and have been inspected several times with no evidence of any continued degradation. The revised limit far exceeds the estimated 125 square inches to be applied to the Oconee surge nozzles and so provides a conservative basis for application of the proposed PWOL.

There are three potential technical concerns that the 100 square inches limitation may have been intended to prevent: residual stresses, tempering of the weld heat affected zone (HAZ), and the possible (but unlikely) development of delayed hydrogen cracking in the underlying ferritic base material. These potential concerns are addressed below:

(a) Residual Stresses – Using as an example a BWR Feedwater Nozzle, the white paper cites EPRI sponsored analyses [8] of an overlay that just equaled 100 square inches coverage over the ferritic steel base metal. Two axisymmetric finite element models were created, one with the 100 square inches weld overlay and the other with the weld overlay extended on the nozzle side until it blended into the nozzle taper surface (approximately 126 square inches). Figure 5.1 shows the post overlay residual stress on the nozzle inside surface for both models. It is seen that the extended overlay configuration did not significantly alter the residual stress results, and if anything, made the axial stresses even more compressive.

The Feedwater nozzle configuration modeled in [8] was roughly similar to the ONS surge nozzles; however it is not necessary to rely on this similarity, since nozzle specific residual stress analyses are being conducted as part of the Duke PWOL project. The resulting post-overlay inside surface residual stress distributions for the ONS surge nozzles are shown in Figure 5.2. It is seen from this figure that the ONS surge nozzle weld overlay design, with its approximately 125 square inches coverage over the ferritic steel base metal, creates favorable compressive residual stresses on the inside surface of the nozzle.

(b) HAZ Tempering – The white paper cites past programs which have demonstrated that temper bead welding using automatic GTAW provides adequate tempering of the HAZ in P-1 and P-3 materials and does not degrade strength or fracture toughness for temper bead weld overlays. Reference [9] presents results of a bimetallic weld overlay mockup of a 12 inch diameter, SA-508 Class 2 low alloy steel nozzle. The overlay applied to this nozzle covered ~119 square inches of the low alloy steel nozzle (approximately the same as the ONS surge nozzle overlay). Microstructure and microhardness measurements were performed on the HAZ of this overlay, as well as mechanical property tests (Charpy and Tensile) of a groove weld in the same nozzle with similar coverage area. The mechanical property results verified that the weld overlay repair did not degrade the strength or toughness of the low alloy steel HAZ. Microstructure and microhardness results demonstrated adequate tempering of the material, such that Hydrogen embrittlement would not be expected. This demonstration was conducted on a weld overlay geometry with material similar to that for the ONS surge nozzle overlay.

(c) Delayed Hydrogen Cracking – Inspections of the above described mockup, as well as extensive inspections of temper bead weld overlays in mockups and in the field, have been performed, of overlays with LAS coverages ranging from less than 10 square inches up to and including 325 square inches. These have shown that hydrogen induced cracking has not been a problem with repairs produced by the automatic GTAW temper bead process. The process is by its nature a low hydrogen process, and diffusion of hydrogen is very rapid for low alloy steels. Nonetheless, the post weld soaks specified in the Code are intended as post hydrogen bake outs permitting NDE after the repair has returned to ambient temperature. N-638, since it does not impose the post weld bake, requires a 48-hour hold time prior to NDE, to verify that the unlikely event of hydrogen induced cold cracking has not occurred. The Duke weld overlay procedure will conform to the 48-hour hold time requirement prior to performing NDE. Furthermore, the metallurgical aspects discussed above are independent of the surface area of the repair but related to parameters of the qualified welding procedure.

Finally, it is important to note that the above theoretical arguments have been proven in practice by extensive field experience with temper bead weld overlays, with coverage ranging from less than 10 square inches up to and including 325 square inches. Table 5.1 below provides a partial list of such applications. It is seen from this table that the original DMW weld overlay was applied over 20 years ago, and WOLs with LAS coverage in the 100 square inches range have been in service for 5 to 15 years. Several overlays have been applied with LAS coverage significantly greater than the 100 square inches. Relief requests for these large overlays have been previously approved. These overlays have been examined with PDI qualified techniques, in some cases multiple times, and none have shown any signs of new cracking or growth of existing cracks.

Temperature monitoring required by Code Case N-638-1 will be performed using temporarily attached or contact pyrometers and manual data recording in lieu of thermocouples and recording equipment required by IWA-4610(a) of Section XI. The thermocouple pyrometers proposed for use are calibrated in accordance with the suppliers QA program approved by Duke and will provide temperature information equivalent to that obtained from weld attached thermocouples. Control of interpass temperature as required by N-638-1 will be met by the proposed technique. This exception has been permitted by the NRC in the past (see precedent 6 in Para. 8.0 below). As described in Table A3, use of pyrometers will provide acceptable temperature monitoring for application of the PWOL.

In addition to the ultrasonic examination of a 1.5T band of material on each end of the weld, the conditional approval of Code Case N-638-1 imposes a condition that the ultrasonic examination be qualified on samples using construction type flaws and that the acceptance criteria be in accordance with NB-5330 of Section III of the ASME Boiler and Pressure Vessel Code. In lieu of this requirement, Duke proposes to use a PDI qualified ultrasonic examination procedure that is designed and qualified to examine the entire volume of the overlay weld as well as the region of the carbon steel material containing the weld HAZ and a volume of unaffected base material beyond the HAZ (see Figures 5.3, 5.4, 5.5 and 5.6)

Code Case N-638-1 addresses the use of the temper bead welding technique including those welds made in deep cavities in ferritic material. In the case of weld overlays to be applied at ONS, this technique will be used to apply a non-ferritic overlay to the ferritic nozzle base material adjacent to the dissimilar metal weld (DMW). In addition to verifying the soundness of the weld, a purpose of these examinations is to assure that delayed cracking that may be caused by hydrogen introduced during the temper bead welding process is not present. In the unlikely event that this type of cracking does occur, it would be initiated on the surface on which the welding is actually performed or in the HAZ immediately adjacent to the weld. The most appropriate technique to detect surface cracking is the surface examination technique that Duke will perform on the weld overlay and the adjacent base material in a band at least 1.5 times the thickness of the base material on either side of the overlay. As shown in Figures 5.3, through 5.6, a significant fraction of the 1.5T band will be included in the proposed PDI inspection. The combined UT and surface inspection will cover 100% of the area susceptible to weld induced defects. While it would be possible with additional expenditure of time and equipment to extend the examination volume to a larger extent on either side of the weld overlay, it would not be possible with current technology to ultrasonically inspect 100% of the volume within 1.5 times the thickness of the base material because of geometric considerations. Inspection of an increased volume would result in increased dose to inspection personnel without a compensating increase in safety or quality because there is no plausible mechanism for formation of new flaws or propagation of existing flaws into the region. That is, any expanded inspection would be performed on material that would not otherwise be inspected as part of an ASME Section XI or

ASME Section III required weld examination. The overlay volume is small relative to the volume of the underlying pipe and does not present the same concerns as those related to welds in deep cavities contemplated by the requirements of Code Case N-638-1. Therefore, the examinations tailored for overlay inspection and required by Code Case N-504-2 and Appendix Q as modified in the request for relief provide full assurance that the weld and adjoining base material are fully capable of performing their intended function.

ASME Section XI pre-service acceptance standards, as specified in Appendix Q, are the appropriate standards for pre-service ultrasonic examinations of weld overlay repairs to nuclear plant components. These standards are consistent with the highly sensitive ultrasonic examination procedures being used, which are qualified in accordance with ASME Section XI, Appendix VIII, Supplement XI, as implemented via the EPRI Performance Demonstration Initiative (PDI). The post-repair inspection volume includes the full thickness of the weld overlay plus 25% of the underlying base metal/weldment thickness. The specimen sets for PDI qualification of weld overlay examinations include construction type flaws in the overlays in addition to simulated service flaws in the underlying base metal and weldment. Therefore, use of PDI-qualified personnel and procedures will result in the reliable detection of construction type flaws.

The ASME Section XI flaw acceptance standards are based on fracture mechanics principles that evaluate the potential effect of flaw indications on the safe operation of a component. ASME Section III ultrasonic standards, on the other hand, are derived from radiographic standards in earlier construction codes and tend to be workmanship-based, addressing flaws occurring in the original construction process that are likely to be detected by radiography. The ASME Section III acceptance criteria do not allow the presence of any cracks or crack-like indications, regardless of their size, and are geared more towards construction-type welds. Many indications that are detectable by PDI qualified ultrasonic techniques, and thus require evaluation, would not be detected by the radiographic examinations required by the original construction Code or Section III. It is therefore not reasonable, nor technically logical, to reject such indications based on out-dated, workmanship-based standards when found by much more sensitive examination techniques that are not required by the construction Codes.

The Section XI pre-service examination standards were developed for exactly the above-stated reasons, and consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately their potential structural impact on the component. They are the logical choice for evaluation of potential flaw indications in post-overlay examinations, in which unnecessary repairs to the overlays would result in additional personnel radiation exposure without a compensating increase in safety and quality, and could potentially degrade the effectiveness of the overlays by affecting the favorable residual stress field that they produce.

Acceptance of ultrasonic indications in weld overlay repairs using Section XI acceptance criteria has been approved by NRC in past weld overlay applications (e.g. References 9, 10).

The following information will be submitted to the NRC within fourteen days of completion of the final UT on each unit included in this relief request.

- a listing of flaw 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

In summary, this letter requests relief from portions of the applicable ASME Code and Code Cases approved for use by the NRC. There are no new or different approaches in this overlay design that are considered first of a kind or inconsistent with previous applications. The overlay is designed as a full structural overlay in accordance with ASME Code Case N-504-2 and Section XI, Nonmandatory Appendix Q.

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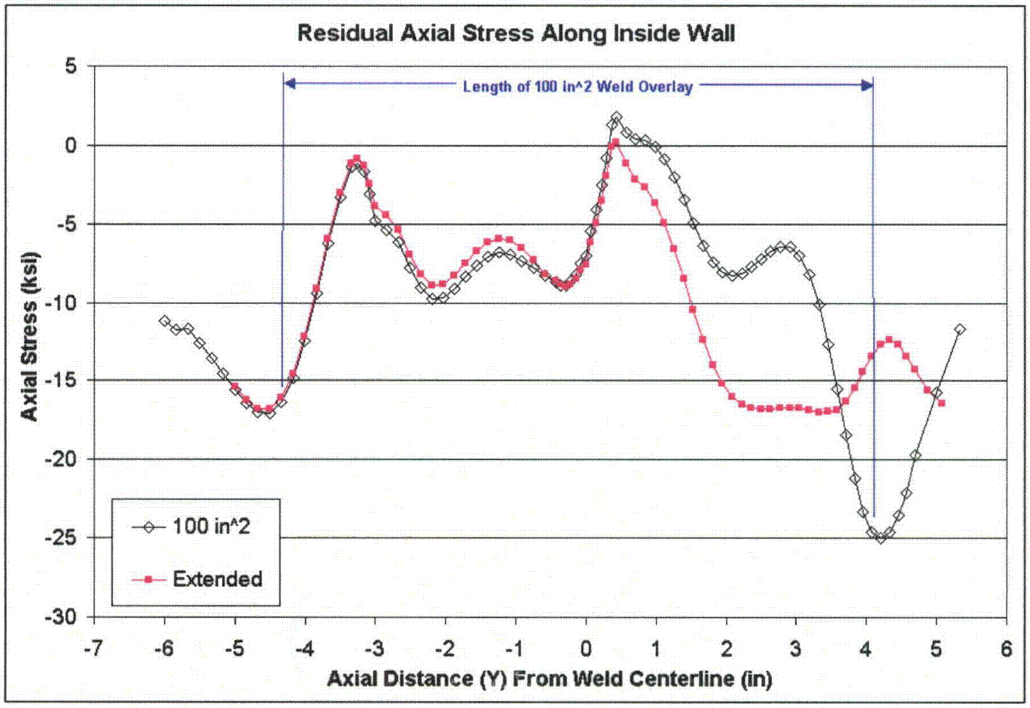
[1] The recording criteria of the ultrasonic examination procedure to be used for the examination of the Oconee pressurizer overlays (SI-UT-126 Rev.0) requires that all suspected flaw indications, regardless of amplitude, be investigated to the extent necessary to provide accurate characterization, identity, 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. SI-UT-126, Rev. 0, is our supplier's procedure for phased array ultrasonic inspection of weld overlays. This procedure is based on the EPRI procedure for manual conventional ultrasonic inspection of weld overlays (PDI-UT-8) and has the same requirements for procedure and personnel qualification.

[2] The ultrasonic examination procedure states that all suspected flaw indications should be plotted on a cross sectional drawing of the weld and that the plots should accurately identify the specific origin of the reflector.



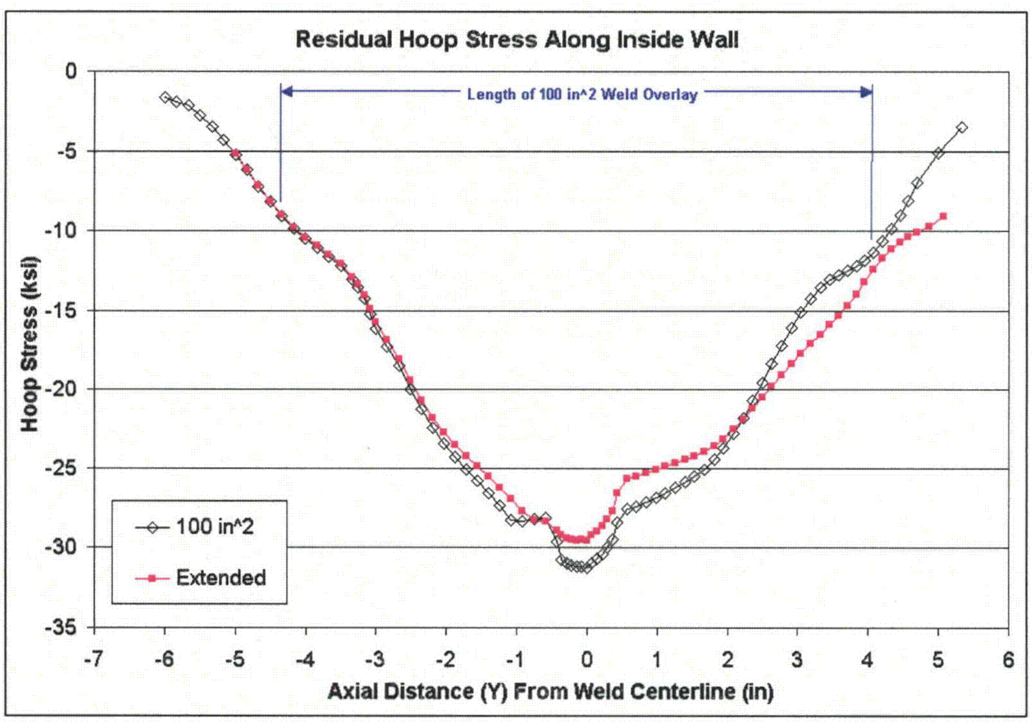
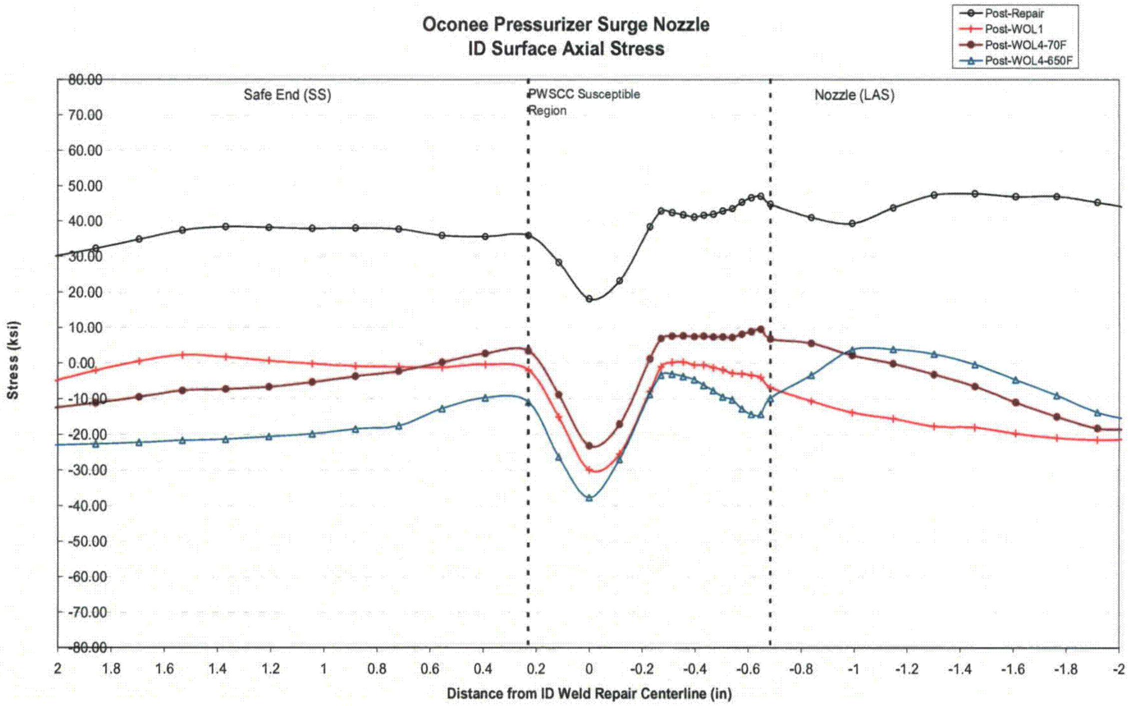


Figure 5.1 Residual Stress Distribution from ASME White Paper (see Text)



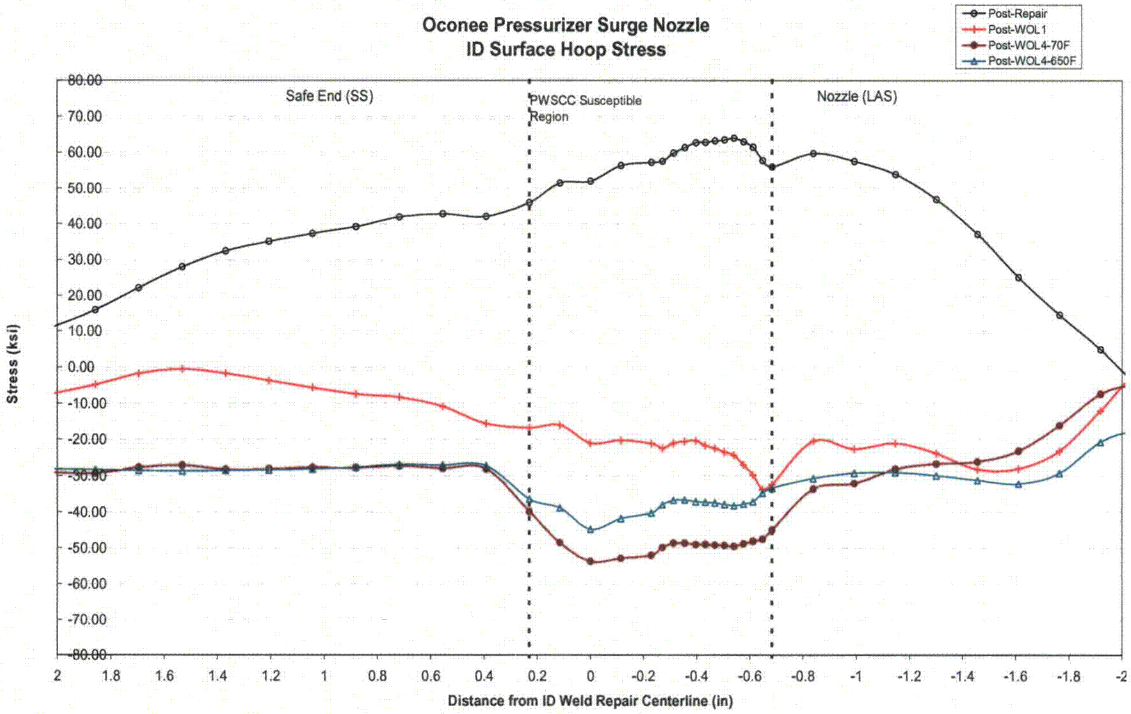


Figure 5.2 Calculated Residual Stress Distribution for Oconee (see Text)

Table 5.1– Dissimilar Metal Weld Overlay Experience

Date	Plant	Component	Nozzle Diameter (in)	Approx. LAS Coverage (in^2)
September 2006	McGuire Unit 2	Spray nozzle Safety/relief nozzles Surge nozzle	6 8 15	33 55 120
December 2006	Catawba Unit 1	Spray nozzle Safety/relief nozzles Surge nozzle	6 8 15	33 55 120
October 2006	Oconee Unit 1	Spray nozzle Safety/relief nozzles PZR surge nozzle Hot leg surge nozzle	4.5 4.5 11.5 11.5	30 30 125 70
April 2006	Davis Besse	Hot leg drain nozzle	4	16
February 2006	SONGS Unit 2	PZR spray nozzle safety/relief nozzles	8 6	50 28
November 2005	Kuosheng Unit 2	Recirculation outlet nozzle	22	250
April 2004	Susquehanna Unit 1	Recirc. inlet nozzle Recirc. outlet nozzle	12 28	100 325
November 2003	TMI Unit 1	Surge line nozzle	11.5	75
October 2003	Pilgrim	Core spray nozzle CRD return nozzle	10 5	50 20
October 2002	Peach Bottom Units 2 & 3	Core spray nozzle Recirc. outlet nozzle CRD return nozzle	10 28 5	50 325 20
October 2002	Oyster Creek	Recirc. outlet nozzle	26	285
December 1999	Duane Arnold	Recirc. inlet nozzle	12	100
June 1999	Perry	Feedwater nozzle	12	100
June 1998	Nine Mile Point Unit 2	Feedwater nozzle	12	100
March 1996	Brunswick Units 1 & 2	Feedwater nozzle	12	100
February 1996	Hatch Unit 1	Recirc. inlet nozzle	12	100
January 1991	River Bend	Feedwater nozzle	12	100
March 1986	Vermont Yankee	Core spray nozzle	10	50

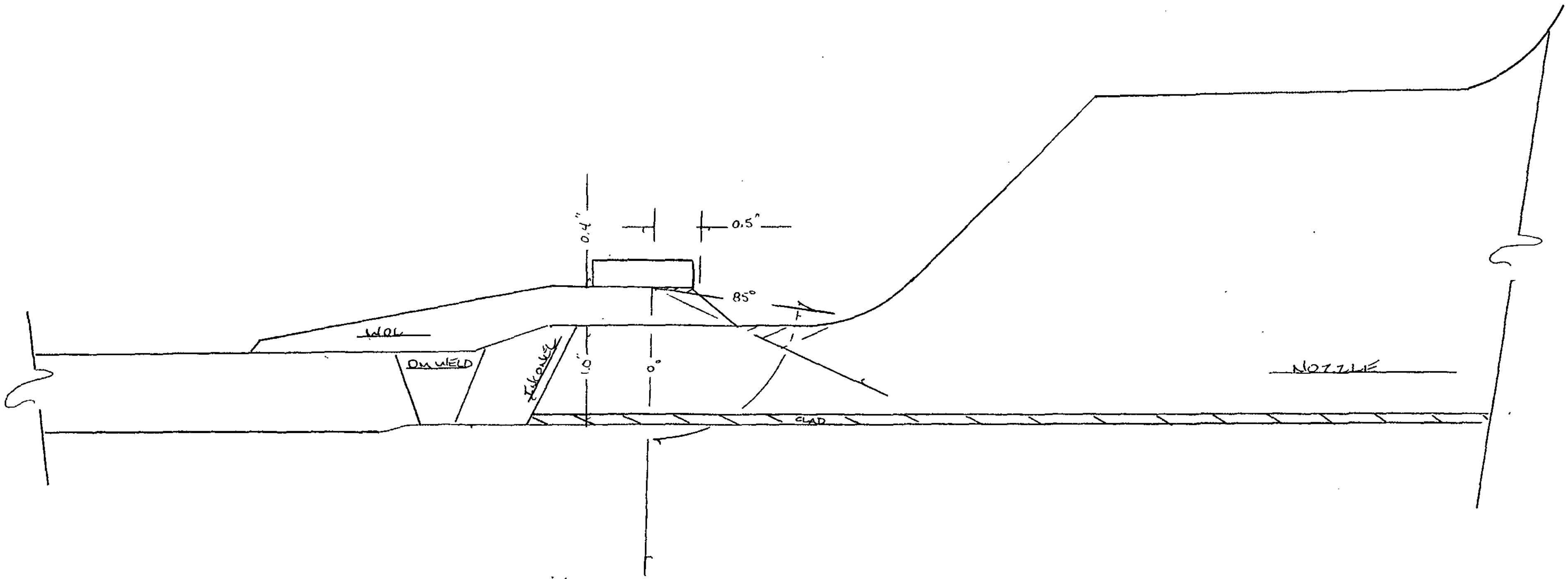


Figure 5.3 Phased array UT coverage for ONS Pressurizer hot leg surge line nozzle.

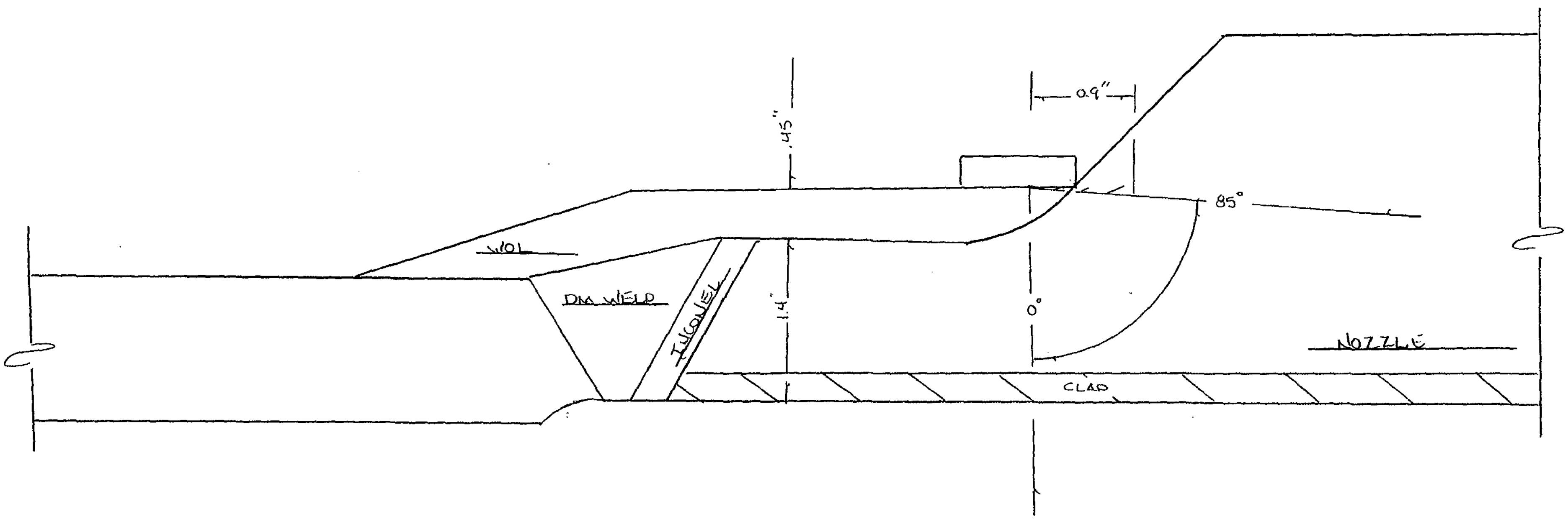


Figure 5.4 Phased array UT coverage for ONS Pressurizer surge line nozzle.

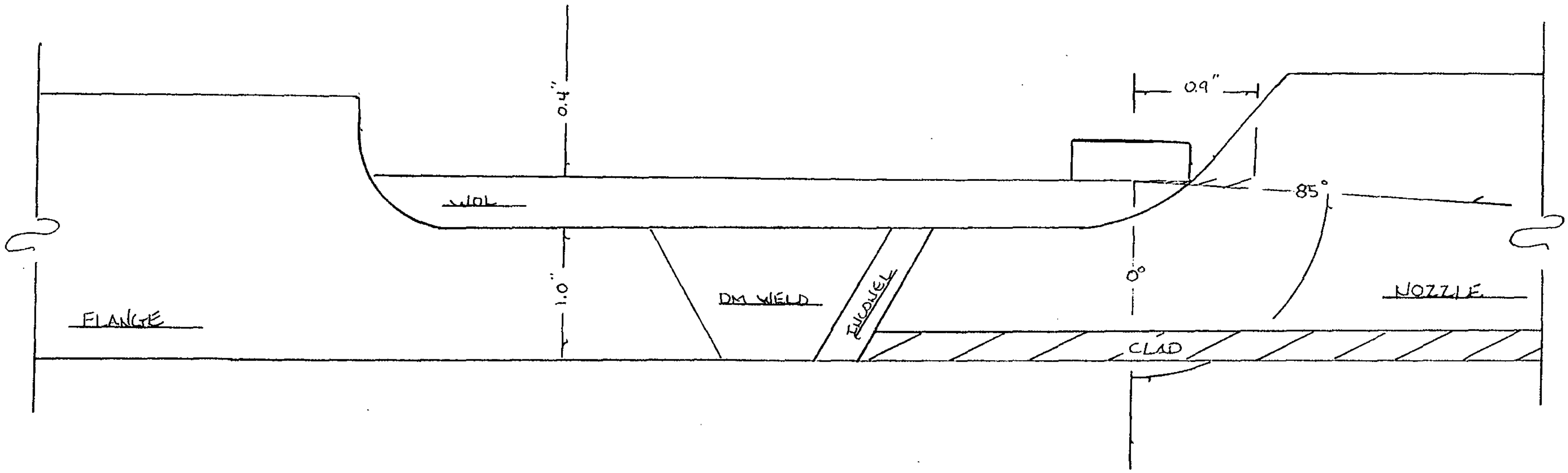


Figure 5.5 Phased array UT coverage for ONS Pressurizer Safety & Relief Nozzles.

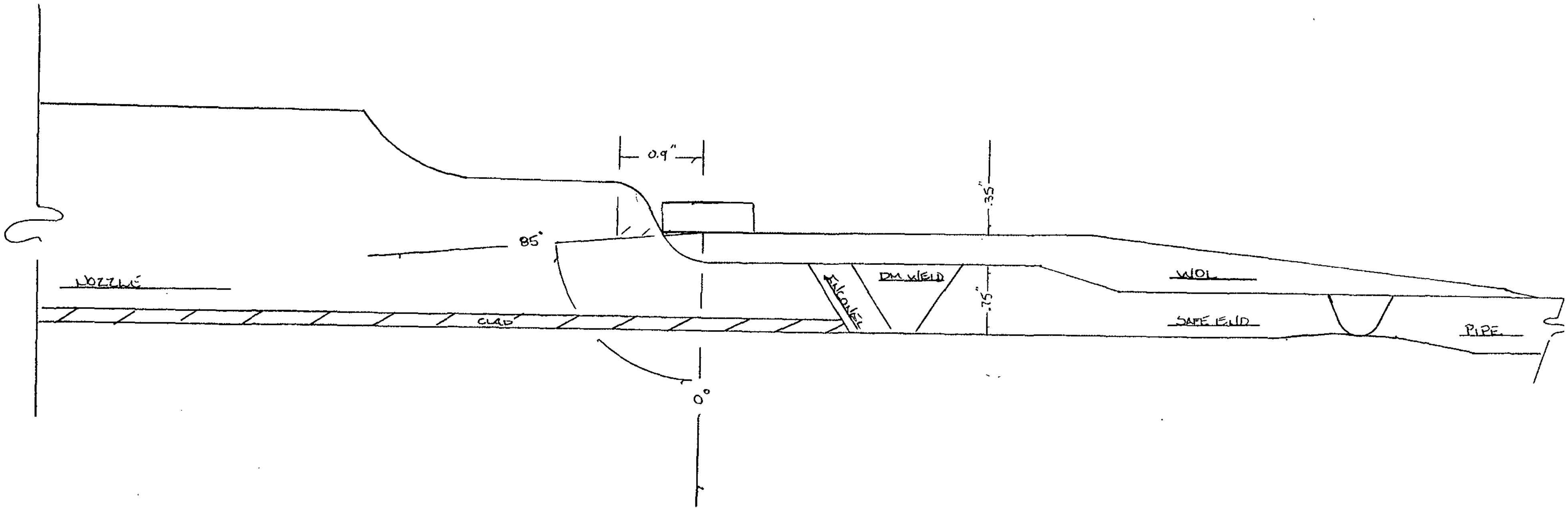


Figure 5.6 Phased array UT coverage for ONS Pressurizer spray nozzle.

6.0 WELD OVERLAY DESIGN AND VERIFICATION

The design of these weld overlays incorporates the requirements of ASME Code Case N-504-2, and Code Case N-638-1, with modifications as described above in Section 5.0 and in the attached tables. Each of the weld overlay locations and designs is exactly similar to those of Oconee Unit 1 described in Oconee relief request ON-06-004 (ref.: Precedent 8 in Section 8.0 below). The analyses performed for Unit 1 are bounding for all three Oconee units and demonstrate the modifications are long-term repairs for mitigation of PWSCC at each of the locations considered in the analysis. The fundamental design basis for full structural weld overlays is to maintain the original safety margins of the welds, with no credit taken for the underlying PWSCC susceptible weldments. The design basis flaw for the purpose of structural sizing of the overlay is assumed to be 360 degrees and 100% through the original wall thickness of the DMW. For the crack growth analysis the initial flaw size is assumed to be 360 degrees and 75% through the original wall thickness. The 75% through-wall assumption is selected based upon the PDI-qualified inspection of the overlay at the conclusion of the weld overlay process, which includes the outer 25% of the original weld. If flaws are detected in the post-overlay inspection, they will be evaluated in accordance with the requirements of Code Case N-504-2 and Appendix Q. Analyses demonstrate that the overlay designs meet the requirements of ASME Code, Section XI, IWB-3640, in addition to the structural requirements of ASME Code Case N-504-2 for full structural weld overlays. No credit is taken for the diluted first layer of the overlays over the PWSCC susceptible weldments. Except for as-built evaluations of items 4 through 6, the following analyses and verifications that were performed, for Oconee Unit 1 are equally applicable to the two units included in this request for relief.

1. Nozzle specific stress analyses established a residual stress profile in the nozzle. Severe ID weld repairs were assumed that effectively bound any actual weld repairs to the nozzle. The weld overlay was subsequently applied to simulate the final residual stress profile. Post weld overlay residual stresses at normal operating conditions were shown to result in beneficial compressive stresses on the inside surface of the components, further assuring that crack growth into the overlay is highly unlikely.

2. Fracture mechanics analyses were performed to predict crack growth with the assumption that cracks exist that are equal to or greater than the thresholds of the NDE techniques to be used on the nozzles. Potential crack growth due to PWSCC as well as due to fatigue crack growth in the original DMW was evaluated. The crack growth analyses considered all design loads and transients, plus the post weld overlay residual stress distributions. These analyses demonstrate that cracks will not grow beyond the original DMW thickness for the time period until the next scheduled inservice inspection.

3. The analyses demonstrate that application of the weld overlays does not impact the conclusions of the existing nozzle Stress Reports. ASME Code, Section III stress and fatigue criteria are met, as detailed in ASME Code Case N-504-2.

4. Shrinkage will be measured during the overlay application. Shrinkage stresses arising from the weld overlays will be demonstrated have no adverse effect at other locations in the piping systems. Clearances of affected support and restraints will be checked after the overlay repair, and will be reset within the design ranges as required.

5. The total added weight on the piping systems due to the overlays will be evaluated for potential impact on piping system stresses and dynamic characteristics.

6. The as-built dimensions of the weld overlays will be measured and evaluated to demonstrate that they equal or exceed the minimum design dimensions of the overlays.

Summaries of the results of the bounding analyses for the items listed in 1 through 3 above were submitted to the NRC at the conclusion of the Oconee Unit 1 EOC 23 (Fall 2006) outage by letter dated November 27, 2006. Items 4 through 6 will be completed prior to entry into mode 4 during the restart of Oconee Unit 2 during the EOC 22 (Spring 2007) outage and during the restart of Oconee Unit 3 during the EOC 23 (Fall 2007) outage. All analyses and data will be available for review by the NRC resident or field inspectors as needed.

7.0 DURATION OF THE PROPOSED ALTERNATIVES

These structural weld overlays will remain in place for the design life of the repair that is defined by the evaluation required in paragraph (g) of Code Case N-504-2 and corresponding requirements in Nonmandatory Appendix Q. The overlays will be performed during the fourth inspection interval for Oconee unit 2 and Oconee Unit 3. The interval start and end dates are:

Oconee Unit 2	Start: 09/09/2004	End: 09/09/2014
Oconee Unit 3	Start: 01/02/2005	End: 12/16/2014

The Code of Record for inservice inspection during these intervals is the ASME Boiler and Pressure Vessel Code, Section XI, 1998 Edition through 2000 Addenda for both units.

8.0 PRECEDENTS

1. Letter from Richard J. Laufer, NRC, to Christopher M. Crane, AmerGen, "Three Mile Island Nuclear Station, Unit 1 (TMI-1) Request for Relief from Flaw Removal, Heat Treatment, and Nondestructive Examination Requirements for the Third 10-year Inservice Inspection (ISI) Interval (TAC.No. MC1201)," Accession Number ML041670510, dated July 21, 2004.

2. 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 Code Cases N-504-2 and N-638 Requirements (TAC Nos. MC2450, MC2451 and MC2594)," Accession Number ML051220568, dated June 22, 2005.

3. Letter from L. Raghavan, NRC, to Mano K. Nazar, I&M, "Donald C. Cook Nuclear Plant, Unit 1 - Alternative to Repair Requirements of Section XI of the American Society of Mechanical Engineers Code (TAC No. MC06751)," Accession Number ML051720006, dated June 27, 2005.

4. 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)," Accession Number ML051930316, dated July 20, 2005.

5. 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)," Accession Number ML053260012, dated January 20, 2006.

6. Southern California Edison's San Onofre Unit 2, verbal authorization given on March 23, 2006.

7. First Energy's Davis Besse Unit 1, verbal authorization given on April 5, 2006.

8. Duke Energy Corporation, Request for Relief 06-ON-004, for Oconee Unit 1, verbal authorization given on October 30, 2006.

9. Duke Energy Corporation, Request for Relief 06-GO-001, for McGuire Unit 2, verbal authorization given on September 28, 2006.

10. Duke Energy Corporation, Request for Relief 06-GO-001, for Catawba Unit 1, verbal authorization given on December 18, 2006.

9.0 REFERENCES

(1) ASME Code, Section XI, 1998 Edition through 2000 Addenda, IWA-4000.

(2) ASME Code, Section XI, 1998 Edition through 2000 Addenda, Mandatory Appendix VIII, Supplement 11.

(3) ASME Code Case N-504-2, Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1, March 12, 1997.

(4) ASME Code Section XI, through 2005 Addenda, Nonmandatory Appendix Q, Weld Overlay Repair of Class 1 , 2, and 3 Austenitic Stainless Steel Piping Weldments.

(5) ASME Code Case N-638-1, Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1 , February 13, 2003.

(6) ASME Code Case N-638-3, Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1 , April 18, 2006 & accompanying white paper.

(7) Calvert Cliffs, Units 1 & 2 – ASME Section XI Relief Request to Use Weld Overlay & Associated Alternative Techniques, Accession Number ML060240110, dated January 18, 2006.

(8) "Justification for the Removal of the 100 Square Inch Limitation for Ambient Temperature Temper Bead Welding on P-3 Material", EPRI-NP- 1011898, February 2005.

(9) "Inconel Weld-Overlay Repair for Low-Alloy Steel Nozzle to Safe-End Joint", EPRI NP-7085-D, January 1991.

(10) Safety Evaluation by the Office of Nuclear Reactor Regulation related to Three Mile Island Nuclear Station, Unit 1 (TMI-1) Request for Relief from Flaw Removal, Heat Treatment and Non-Destructive Examination (NDE) Requirements for the Third 10-Year Inservice Inspection (ISI) Interval, Amergen Energy Company, LLC Docket No. 50-289, July 21, 2004, Accession Number ML041670510.

10.0 CONCLUSION

Duke concludes that the alternative repair approach described above presents an acceptable level of quality and safety to satisfy the requirements of 10 CFR 50.55a(a)(3)(i). The approach described in this relief request includes evaluation of available operating experience related to previously NRC approved applications of overlays to DMW.

ATTACHMENT 1

CONTENTS

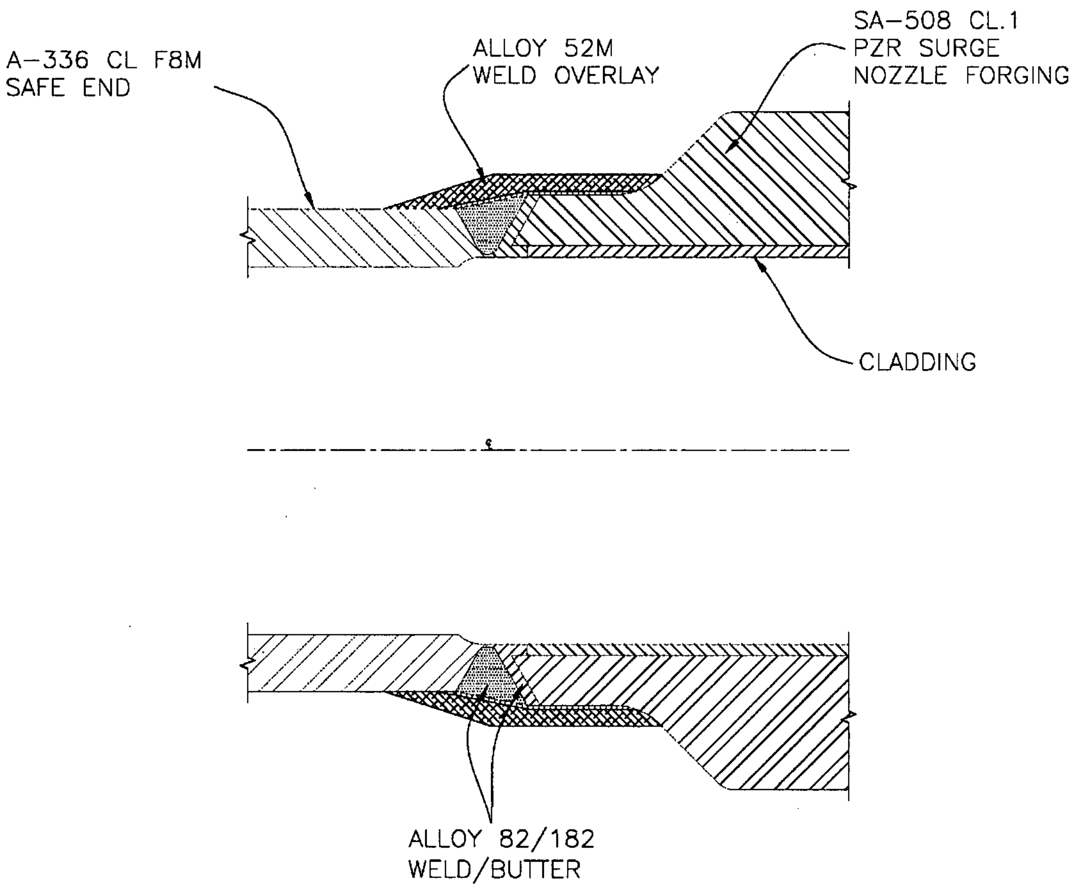


Figure A1: Pressurizer Surge Nozzle Weld Overlay (Typical)

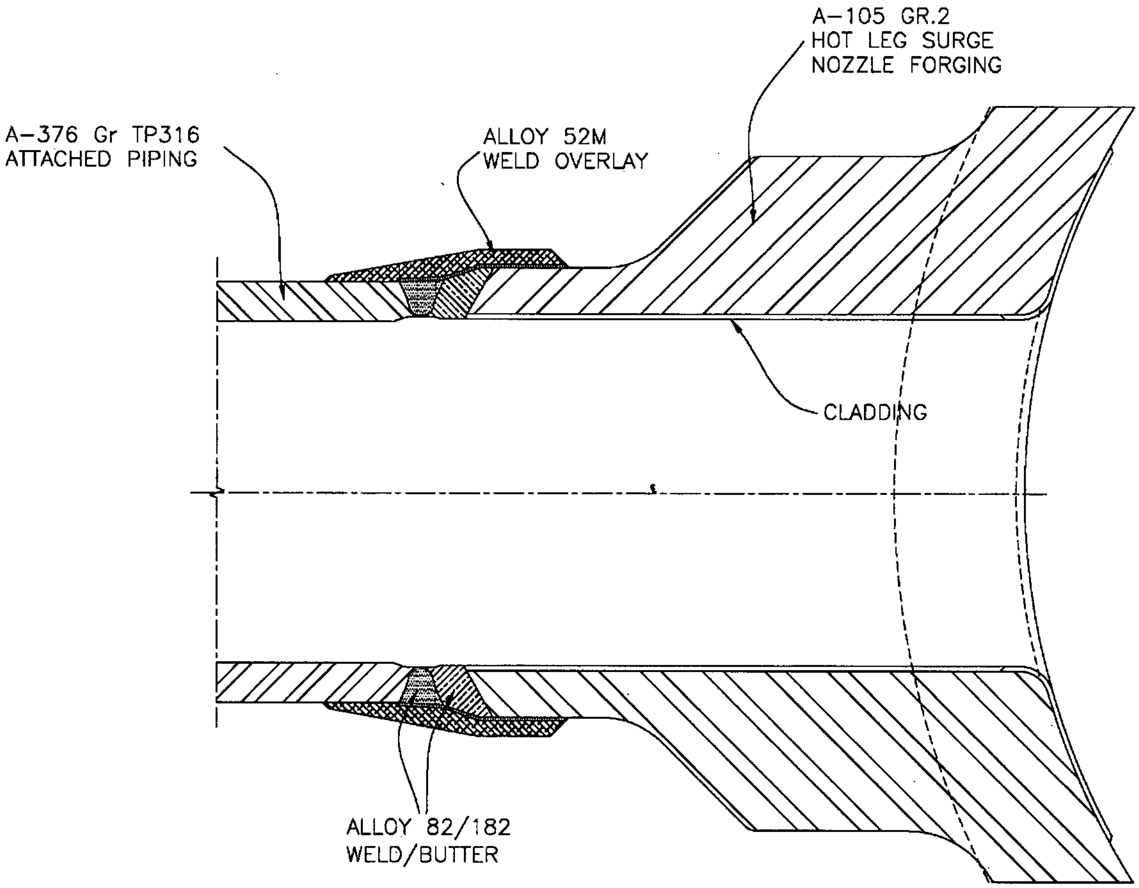


Figure A2: Hot Leg Surge Nozzle Weld Overlay (Typical)

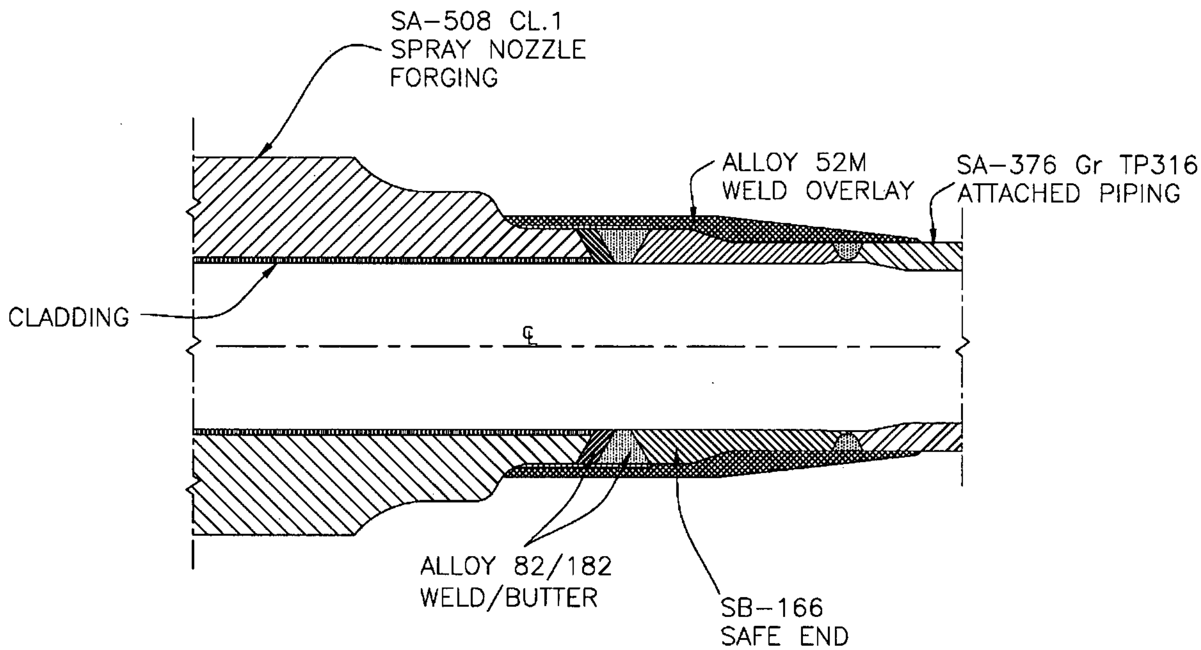


Figure A3: Pressurizer Spray Nozzle Weld Overlay (Typical)

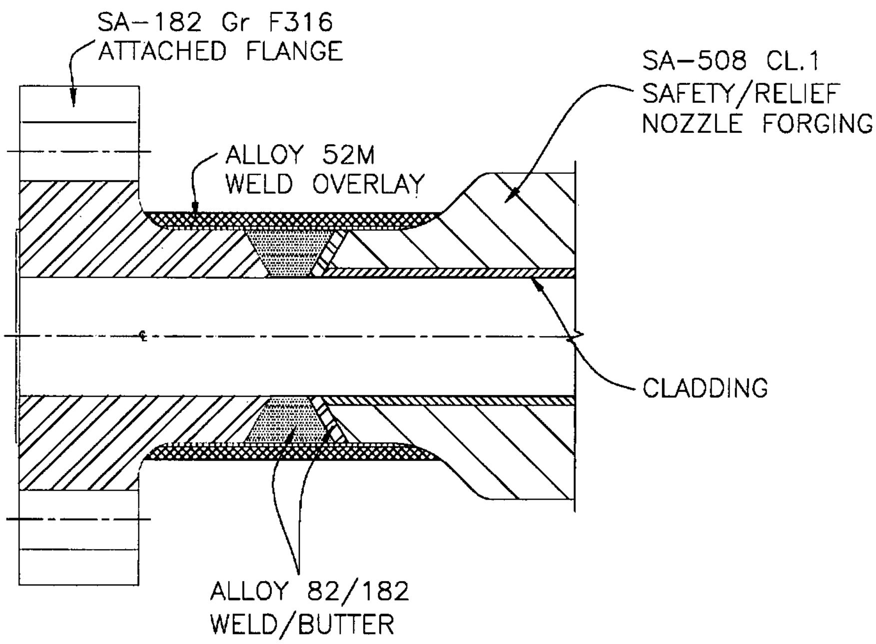


Figure A4: Pressurizer Safety/Relief Nozzle Weld Overlay (Typical)

Table A1 Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

Code Case N-504-2	Modification/Basis
Reply: It is the opinion of the Committee that, in lieu of the requirements of IWA-4120 in Editions and Addenda up to and including the 1989 Edition with the 1990 Addenda, in IWA-4170(b) in the 1989 Edition with the 1991 Addenda up to and including the 1995 Edition, and in IWA-4410 in the 1995 Edition with the 1995 Addenda and later Editions and Addenda, defect in austenitic stainless steel piping may be reduced to a flaw of acceptable size in accordance with IWB-3640 from the 1983 Edition with the Winter 1985 Addenda, or later Editions and Addenda, by deposition of weld reinforcement (weld overlay) on the outside surface of the pipe, provided the following requirements are met. **[Essentially same as Scope of Appendix Q]:**	**Modification.** Code Case N-504-2 will be used for weld overlay repairs to the ferritic and nickel alloy base material as well as the austenitic stainless steel base material. **Basis:** *Code Case N-504-2 is accepted for use along with Nonmandatory Appendix Q in the current NRC Regulatory Guide 1.147 Rev. 14. For the weld overlay of the identified welds at Oconee Units 1, 2 & 3 the base material will be ferritic material with existing nickel alloy weld metal to which an austenitic stainless steel or Alloy 600 safe end is welded. Industry operational experience has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52/52M/52MS weld metal. The 360° structural weld overlay will control growth in any PWSCC crack and maintain weld integrity. The weld overlay will induce compressive stress in the weld, thus impeding growth of any reasonably shallow cracks. Furthermore, the overlay will be sized to meet all structural requirements independent of the existing weld.*
(b) Reinforcement weld metal shall be low carbon (0.035% max.) austenitic stainless steel applied 360° around the circumference of the pipe, and shall be deposited in accordance with a qualified welding procedure specification identified in the Repair Program. **[Same as Q-2000(a)]**	**Modification.** In lieu of austenitic stainless steel filler material, the reinforcement weld metal will be a nickel alloy. **Basis:** *The weld metal used may be ERNiCrFe-7A (Alloy 52M, UNS N06054) or ERNiCrFe-7 (Alloy 52 UNS N06052). This weld metal is assigned F43 by ASME per Code Case 2142-2. The requirements of ASME Section III, NB-2400 will be applied to all filler material. The chromium content of Alloy 52M/MS is 28-31.5%, identical to that of Alloy 52. The main difference in Alloy 52 vs. Alloy 52M/MS is a higher Niobium content (0.5-1 %). The difference in chemical composition between Alloy 52 and Alloy 52M/MS improves the weld-ability of the material and pins the grain boundaries thus preventing separation between the grains and hot tearing during weld puddle solidification. These filler materials were selected for their improved resistance to PWSCC. Alloys 52 and 52M/MS contain about 30% chromium that imparts excellent corrosion resistance. The existing Alloy 82/182 weld and the Alloy 52M/52MS overlay are nickel base and have ductile properties and toughness similar to austenitic stainless steel piping welds at pressurized water reactor operating temperature. These filler materials are suitable for welding over the ferritic nozzle, nickel alloy weld or base material, and the austenitic stainless steel safe end or pipe*

Table A1 Modifications To Code Case N-504-2 and Corresponding Non-Mandatory Appendix Q Requirements

Code Case N-504-2	Modification/Basis
	components.
(e) The weld reinforcement shall consist of a minimum of two weld layers having as-deposited delta ferrite content of at least 7.5 FN. The first layer of weld metal with delta ferrite content of least 7.5 FN shall constitute the first layer of the weld reinforcement design thickness. Alternatively, first layers of at least 5 FN may be acceptable based on evaluation. **[Same as Q-2000(d)]**	**Modification:** Delta ferrite (FN) measurements will not be performed for weld overlay repairs made of Alloy 52/52M/52MS weld metal. **Basis:** *Welds of Alloy52/52M/52MS are* ***<u>100% austenitic</u>*** *and contain no delta ferrite due to the high nickel composition (approximately 60% nickel).*
Pressure Testing (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 a flaw penetrating the pressure boundary is observed during the welding operation, a system hydrostatic test shall be performed in accordance with IWA-5000. If the system pressure boundary has not been penetrated, a system leakage, inservice, or functional test shall be performed in accordance with IWA-5000.	**Modification:** If a flaw or evidence of a flaw is observed, in lieu of hydrostatic testing, a system leakage test and an ultrasonic examination (UT) of the weld overlay will be performed consistent with ASME IWA-4540(a)(2), as modified by Nonmandatory Appendix Q. ***Basis:*** *Application of* IWA-4540(a)(2) *for a system leakage test in lieu of a system hydrostatic test requires performance of NDE in accordance with the methods and acceptance criteria of the applicable Subsection of the 1992 Edition of ASME Section III. ASME Section III Subsection NB Article 5000 for Examination does not address the structural weld overlay type configuration. The NDE requirements of Nonmandatory Appendix Q will be followed for the required NDE in lieu of ASME Section III. Code Case N-504-2 and Nonmandatory Appendix Q provide appropriate examination requirements including examination volume, acceptance criteria, and examination methods per Appendix VIII.*

Table A2 Alternatives to Appendix VIII, Supplement 11

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

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

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
1 0 SPECIMEN REQUIREMENTS	
1.1 General. The specimen set shall conform to the following requirements.	
(b) The specimen set shall consist of at least three specimens having different nominal pipe diameters and overlay thicknesses. They shall include the minimum and maximum nominal pipe diameters for which the examination procedure is applicable. Pipe diameters within a range of 0.9 to 1.5 times a nominal diameter shall be considered equivalent. If the procedure is applicable to pipe diameters of 24 inch or larger, the specimen set must include at least one specimen 24 inch or larger but need not include the maximum diameter. The specimen set must include at least one specimen with overlay thickness within -0.1 inch to +0.25 inch of the maximum nominal overlay thickness for which the procedure is applicable.	**Alternative:** (b) The specimen set shall include specimens with overlays not thicker than 0.1 inch more than the minimum thickness, nor thinner than 0.25 inch of the maximum nominal overlay thickness for which the examination procedure is applicable. **Basis:** *To avoid confusion, the overlay thickness tolerance contained in the last sentence was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence in paragraph 1.1 (d) (1).*
(d) Flaw Conditions	
(1) Base metal flaws. All flaws must be cracks in or near the ~ butt weld heat-affected zone, open to the inside surface, and extending at least 75% through the base metal wall. Flaws may extend 100% through the base metal and into the overlay material; in this case, intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the cracking. Specimens containing IGSCC shall be used when available.	**Alternative:** (1) ... must be in or... intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws. Specimens containing intergranular stress corrosion cracking shall be used when available. At least 70% of the flaws in the detection and sizing tests shall be cracks and the remainder shall be alternative flaws. Alternative flaw mechanisms, if used, shall provide crack-like reflective characteristics and shall be limited by the following: (a) The use of alternative flaws shall be limited to when the implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws. (b) Flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches. **Basis:** *This paragraph requires that all base metal flaws be cracks. Implanting a crack*

Table A2 Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining an effective ultrasonic response, flaws shall be semi elliptical with a tip width of less than or equal to 0.002 inches, and at least 70% of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws. To avoid confusion, the overlay thickness tolerance contained in paragraph 1.1(b) ***last*** *sentence, was reworded and the phrase "and the remainder shall be alternative flaws" was added to the next to last sentence. Paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws.*
(e) Detection Specimens	
(1) At least 20% but less than 40% of the flaws shall be oriented within +/-20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. The rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.	**Alternative:** (1) At least 20% but less than 40% of the base metal flaws shall be oriented within +/-20° of the pipe axial direction. The remainder shall be oriented circumferentially. Flaws shall not be open to any surface to which the candidate has physical or visual access. **Basis:** *The requirement for axially oriented overlay fabrication flaws was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated GTA W techniques with the filler metal applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic. The requirement for using IWA-3300 for proximity flaw evaluation was excluded; instead indications will be sized based on their individual merits.*
(2) Specimens shall be divided into base and overlay grading units. Each specimen shall contain one or both types of grading units.	**Alternative:** (2) Specimens shall be divided into base metal and overlay fabrication grading units. Each specimen shall contain one or both types of grading units. Flaws shall not interfere with ultrasonic detection or characterization of other flaws. **Basis:** *Inclusion of "metal" and "fabrication" provides clarification. Flaw identification is improved by ensuring flaws are not masked by other flaws.*

Table A2 Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
(a)(1) A base grading unit shall include at least 3 inch of the length of the overlaid weld. The base grading unit includes the outer 25% of the overlaid weld and base metal on both sides. The base grading unit shall not include the inner 75% of the overlaid weld and base metal overlay material, or base metal to-overlay interface.	**Alternative:** (a)(1) A base metal grading unit includes the overlay material and the outer 25% of the original overlaid weld. The base metal grading unit shall extend circumferentially for at least 1 inch and shall start at the weld centerline and be wide enough in the axial direction to encompass one half of the original weld crown and a minimum of 0.50" of the adjacent base material. **Basis:** *The phrase "and base metal on both sides," was inadvertently included in the description of a base metal grading unit, The PDI program intentionally excludes this requirement because some of the qualification samples include flaws on both sides of the weld. To avoid confusion several instances of the term "cracks" or "cracking" were changed to the term "flaws" because of the use of alternative Flaw mechanisms. Modified to require that a base metal grading unit include at least1inch of the length of the overlaid weld, rather than 3 inches.*
(a)(2) When base metal cracking penetrates into the overlay material, the base grading unit shall include the overlay metal within 1 inch of the crack location. This portion of the overlay material shall not be used as part of any overlay grading unit.	**Alternative:** (a)(2) When base metal flaws penetrate into the overlay material, the base metal grading unit shall not be used as part of any overlay fabrication grading unit. **Basis:** *Substituted terms provide clarification and are consistent with 1d(1) above. The PDI program adjusts for this conservative change for excluding this type grading unit.*
(a)(3) When a base grading unit is designed to be unflawed, at least 1 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.	**Alternative:** (a)(3) Sufficient unflawed overlaid weld and base metal shall exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws. **Basis:** *Modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement.*
(b)(1) An overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 in^2. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inch	**Alternative:** (b)(1) An overlay fabrication grading unit shall include the overlay material and the base metal-to-overlay interface for a length of at least 1 inch **Basis:** *The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01. This criterion may be more challenging than the ASME Code because of the variability associated with the shape of the grading unit.*
(b)(2) An overlay grading unit designed to be unflawed shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1	**Alternative:** (b)(2) Overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface

Table A2 Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
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.	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 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.*
(b)(3) Detection sets shall be selected from Table VIII-S2-1. The minimum detection sample set is five flawed base grading units, ten unflawed base grading units, five flawed overlay grading units, and ten unflawed overlay grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units.	**Alternative:**...base metal grading units, ten unflawed base metal grading units, five flawed overlay fabrication grading units, and ten unflawed overlay fabrication grading units. For each type of grading unit, the set shall contain at least twice as many unflawed as flawed grading units. For initial procedure qualification, detection sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required. **Basis:** *Clarified the guidance for initial procedure qualifications versus qualifying new values of essential variables.*
(f) Sizing Specimen	
(1) The minimum number of flaws shall be ten. At least 30% of the flaws shall be overlay fabrication flaws. At least 40% of the flaws shall be cracks open to the inside surface.	**Alternative:** (1) The...least 40% of the flaws shall be open to the inside surface. Sizing sets shall contain a distribution of flaw dimensions to assess sizing capabilities. For initial procedure qualification, sizing sets shall include the equivalent of three personnel qualification sets. To qualify new values of essential variables, at least one personnel qualification set is required. **Basis:** *Clarified the guidance for initial procedure qualifications versus qualifying new values of essential variables and is consistent with 1d(1) above..*
(3) Base metal cracking used for length sizing demonstrations shall be oriented circumferentially.	**Alternative:** (3) Base metal flaws used…circumferentially. **Basis:** *Clarified wording to be consistent with 1d(1) above.*
(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 inch in the through-wall direction.	**Alternative:** (4) Depth sizing specimen sets shall include at least two distinct locations where a base metal flaw extends into the overlay material by at least 0.1 inch in the through-wall direction. **Basis:** *Clarified wording to be consistent with 1d(1) above.*
2.0 Conduct of Performance Demonstration	
The specimen inside surface and identification shall be concealed from the candidate.	**Alternative:** The specimen ...prohibited. The overlay fabrication flaw test and the base

Table A2 Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
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.	metal flaw test may be performed separately. **Basis:** *Clarified wording to describe process .*
2.1 Detection Test.	
Flawed and unflawed grading units shall be randomly mixed. Although the boundaries of specific grading units shall not be revealed to the candidate, the candidate shall be made aware of the type or types of grading units (base or overlay) that are present for each specimen.	**Alternative:** Flawed...(base metal or overlay fabrication)...each specimen. **Basis:** *Clarified wording similar to 1(e)2 above..*
2.2 Length Sizing Test	
(d) For flaws in base grading units, the candidate shall estimate the length of that part of the flaw that is in the outer 25% of the base wall thickness.	**Alternative:** (d) For . . . base metal grading . . . base metal wall thickness. **Basis:** *Clarified wording for consistency.*
2.3 Depth Sizing Test.	
For the depth sizing test, 80% of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. For the remaining flaws, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region.	**Alternative:** (a) The depth sizing test may be conducted separately or in conjunction with the detection test. (b) When the depth sizing test is conducted in conjunction with the detection test and the detected flaws do not satisfy the requirements of 1.1(f), additional specimens shall be provided to the candidate. The regions containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. (c) For a separate depth sizing test, the regions of each specimen containing a flaw to be sized shall be identified to the candidate. The candidate shall determine the maximum depth of the flaw in each region. **Basis:** *Clarified wording to better describe process.*
3.0 ACCEPTANCE CRITERIA	
3.1 Detection Acceptance Criteria	
Examination procedures, equipment, and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.	**Alternative:** Examination procedures are qualified for detection when: a. All flaws within the scope of the procedure are detected and the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for false calls. b. At least one successful personnel demonstration has been performed meeting the acceptance criteria defined in (c). c. Examination equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VIII-S2-1 for both detection and false calls.

Table A2 Alternatives to Appendix VIII, Supplement 11

SUPPLEMENT 11 - QUALIFICATION REQUIREMENTS FOR FULL STRUCTURAL OVERLAID WROUGHT AUSTENITIC PIPING WELDS	PDI PROGRAM: The Proposed Alternative to Supplement 11 Requirements
	d. 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:** *Clarified wording to better describe the difference between procedure qualification and equipment and personnel qualifications.*
3.2 Sizing Acceptance Criteria	
(a) The RMS error of the flaw length measurements, as compared to the true flaw lengths, is less than or equal to 0.75 inch. The length of base metal cracking is measured at the 75% through-base-metal position.	**Alternative:** (a) The...base metal flaws is...position. **Basis:** *Clarified wording to be consistent with 1d(1) above.*
(b) All extensions of base metal cracking into the overlay material by at least 0.1 inch are reported as being intrusions into the overlay material.	**Alternative:** This requirement is omitted. ***Basis:*** *The requirement for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the supplement 2 depth sizing criteria*

Table A3 Modifications to Code Case N-638-1

Code Case N-638-1	Modification/Basis
Weld Area 1.0(a) The maximum area of an individual weld based on the finished surface shall be 100 sq. inch, 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*** will not exceed 500 square inches. Depth in N-638-1 refers to depth of the repair cavity and is not applicable to the weld overlays described in this request for relief. ***Basis:*** *The maximum area of the WOL for the surge line nozzle will be approximately 120 sq-in over the ferritic material. An ASME white paper providing technical justification for extending the area limitation to 500 sq. inch was published by the ASME Code Committees. As previously noted in the text, this white paper has been submitted to the NRC for their use.*
Examination (Referenced below in 4.0(b) para. 1.0(d) Prior to welding the area to be welded and a band around the area of at least 11/2 times the component thickness or 5 inch, whichever is less shall be at least 50°F.) 4.0(b) The final weld surface and a band around the area defined in para. 1.0 (d) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with Appendix I.[3] [3]Refer to the 1989 Edition with the 1989 Addenda and later Editions and Addenda	**Modification:** The required liquid penetrant examination of 4.0(b) will be performed. In lieu of ultrasonic examination in accordance with Appendix I, the ultrasonic examination will be in accordance with N-504-2 and Appendix Q. **Basis:** *For the application of the weld overlay repair addressed in this request the appropriate examination methodologies and volumes are provided in Code Case N-504-2 and Nonmandatory Appendix Q Code Case N-638-1 applies to any type of welding where a temper bead technique is to be employed and is not specifically written for a weld overlay repair. Code Case N-638-3 has eliminated the requirement to examine a band around the area to be welded, and specifies required post weld non-destructive examination of the welded region only.*

Table A3 Modifications to Code Case N-638-1

Code Case N-638-1	Modification/Basis
4.0(c) requires temperature monitoring by welded thermocouples per IWA-4610(a)	**Modification:** Preheat and interpass temperatures for the weld overlay will be measured using a temporarily attached or contact pyrometer. Readout of the temperature may be local using a manual method or remotely monitored by the operator. Interpass temperature control required by Code Case N-638-1 will be maintained. ***Basis:*** *The proposed technique is faster and does not compromise collection of required data. The proposed technique provides data equivalent to that obtained from weld attached thermocouples to monitor interpass temperature during welding. As noted earlier in this document, the NRC has previously approved this type of temperature data collection.*