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SOUTHERN COMPANY
Energy to Serve Your World℠

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Docket Nos.: 50-348 50-424
50-364 50-425

NL-06-1713

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

Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Proposed Alternative for Application of
Pressurizer Nozzle Full-Structural Weld Overlays

Ladies and Gentlemen:

Pursuant to 10 CFR 50.55a(a)(3)(i), Southern Nuclear Operating Company (SNC) hereby requests NRC approval of proposed alternative ISI-GEN-ALT-06-03 to allow the application of full-structural weld overlays over the pressurizer nozzle dissimilar metal welds. This alternative is for the Farley Nuclear Plant (FNP) 3rd ISI Interval extending from December 1, 1997 through November 30, 2007 and for the Vogtle Electric Generating Plant (VEGP) 2nd ISI Interval extending from May 31, 1997 through May 30, 2007. The details of the 10 CFR 50.55a request for alternative are enclosed.

Approval is requested by September 15, 2006 to support Unit 1 outage at VEGP beginning September 2006, the Unit 2 outage at VEGP beginning March 2007, the Unit 2 outage at FNP beginning April 2007, and the Unit 1 outage at FNP beginning September 2007.

This letter contains no NRC commitments. If you have any questions, please advise.

Sincerely,

D. E. Grissette

DEG/DRG/daj

Enclosure: Request for Alternative - ISI-GEN-ALT-06-03 – Application of Pressurizer Nozzle Full-Structural Weld Overlays

cc: Southern Nuclear Operating Company
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RType: CFA04.054; CVC7000; LC# 14471

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Enclosure

Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Request for Alternative - ISI-GEN-ALT-06-03
Application of Pressurizer Nozzle Full-Structural Weld Overlays

Enclosure

SOUTHERN NUCLEAR OPERATING COMPANY
ISI-GEN-ALT-06-03
PROPOSED ALTERNATIVE IN ACCORDANCE WITH 10 CFR 50.55a(a)(3)(i)
APPLICATION OF PRESSURIZER NOZZLE FULL-STRUCTURAL WELD OVERLAYS

Plant Site-Unit: Vogtle Electric Generating Plant (VEGP) Units 1 and 2 and Joseph M. Farley Nuclear Plant (FNP) - Units 1 and 2.

Interval Dates: VEGP-1 & -2 Second ISI Interval from May 31, 1997, through May 30, 2007.

FNP-1 Third ISI Interval from December 1, 1997, through November 30, 2007.

FNP-2 Updated Third ISI Interval from July 30, 2001, through July 29, 2011.

NOTE

As approved by the NRC in SER dated March 20, 1997, FNP-2 updates to the latest Edition of Section XI concurrently with FNP-1 as of December 1, 2007. Therefore, this alternative applies to both FNP units only through November 30, 2007.

Requested Date for Approval :

Contingency Overlay Repairs

Approval is requested by September 15, 2006, to support contingency pressurizer weld repairs for VEGP-1 during the Fall 2006 refueling outage that is currently scheduled to begin on September 17, 2006. In addition, approval is also requested to support contingency pressurizer weld repairs for FNP-2 during the Spring 2007 outage that is currently scheduled to begin on April 7, 2007.

NOTE

This repair contingency would only be used if evidence of PWSCC is observed during volumetric or visual examinations of one of the pressurizer dissimilar metal (DSM) welds and would consist of repairing the weld by applying a full-structural weld overlay (FSWOL).

Preemptive Overlays

A preemptive FSWOL will be applied to each of the VEGP-2 and FNP-1 pressurizer DSM welds. This work is currently scheduled for the Spring and Fall 2007 outages at VEGP-2 and FNP-1, respectively. The Spring 2007 outage for VEGP-2 is currently scheduled to begin on March 4, 2007, while FNP-1 is currently scheduled to begin on September 29, 2007. Except as noted above, VEGP-1 and FNP-2 DSM welds will be overlayed during future outages and are not within the scope of this request.

NOTE

If Primary Water Stress Corrosion Cracking (PWSCC) is discovered at the VEGP and FNP units prior to applying the preemptive overlay, a FSWOL may be used to perform repairs, as necessary.

Enclosure

SOUTHERN NUCLEAR OPERATING COMPANY
ISI-GEN-ALT-06-03
PROPOSED ALTERNATIVE IN ACCORDANCE WITH 10 CFR 50.55a(a)(3)(i)
APPLICATION OF PRESSURIZER NOZZLE FULL-STRUCTURAL WELD OVERLAYS

ASME Code Components Affected:

Category R-A Dissimilar metal welds on the pressurizer at VEGP and FNP (Vogtle and Farley have both implemented risk-informed ISI):

VEGP-1	VEGP-2
11201-V6-002-W17 (Relief)	21201-V6-002-W17 (Relief)
11201-V6-002-W18 (Safety)	21201-V6-002-W18 (Safety)
11201-V6-002-W19 (Safety)	21201-V6-002-W19 (Safety)
11201-V6-002-W20 (Safety)	21201-V6-002-W20 (Safety)
11201-V6-002-W21 (Spray)	21201-V6-002-W21 (Spray)
11201-V6-002-W22 (Surge)	21201-V6-002-W22 (Surge)

FNP-1	FNP-2
ALA1-4205-35DM (Spray)	APR1-4205-49DM (Spray)
ALA1-4500-6DM (Surge)	APR1-4500-7DM (Surge)
ALA1-4501-1DM (Safety)	APR1-4501-1DM (Safety)
ALA1-4502-1DM (Safety)	APR1-4502-1DM (Safety)
ALA1-4503-1DM (Safety)	APR1-4503-1DM (Safety)
ALA1-4504-1DM (Relief)	APR1-4504-1DM (Relief)

Category R-A Similar metal welds on the pressurizer at VEGP and FNP:

VEGP-1	VEGP-2
11201-030-45 (Spray)	21201-030-49 (Spray)
11201-053-6 (Surge)	21201-053-6 (Surge)
11201-056-1 (Safety)	21201-056-1 (Safety)
11201-057-1 (Safety)	21201-057-1 (Safety)
11201-058-1 (Safety)	21201-058-1 (Safety)
11201-059-1 (Relief)	21201-059-1 (Relief)

FNP-1	FNP-2
ALA1-4205-34 (Spray)	APR1-4205-48 (Spray)
ALA1-4500-5 (Surge)	APR1-4500-6 (Surge)
ALA1-4501-2 (Safety)	APR1-4501-2 (Safety)
ALA1-4502-2 (Safety)	APR1-4502-2 (Safety)
ALA1-4503-2 (Safety)	APR1-4503-2 (Safety)
ALA1-4504-2&3 (Relief)	APR1-4504-2&3 (Relief)

SOUTHERN NUCLEAR OPERATING COMPANY
ISI-GEN-ALT-06-03
PROPOSED ALTERNATIVE IN ACCORDANCE WITH 10 CFR 50.55a(a)(3)(i)
APPLICATION OF PRESSURIZER NOZZLE FULL-STRUCTURAL WELD OVERLAYS

Applicable Code Edition and Addenda:

The Vogtle and Farley units are in their second and third inspection intervals, respectively. The applicable Code edition and addenda is ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1989 Edition with no addenda. In addition, as required by 10 CFR 50.55a, ASME Section XI, 1995 Edition through 1996 Addenda, is used for Appendix VIII, "Performance Demonstration for Ultrasonic Examinations."

NOTE

Unless identified otherwise, all Code references provided herein are to ASME Section XI.

Applicable Code Requirements:

IWA-4110 of ASME Section XI requires that repairs of welds shall be performed in accordance with Article IWA-4000. IWA-4300 requires that defects be removed or reduced to an acceptable size.

Currently, pressurizer weld examinations are performed at VEGP and FNP using a Risk-Informed Program (Category R-A) that has been approved by the NRC. The examinations performed are the same as those volumetric examinations specified in Section XI, Table IWB-2500-1, Category B-J and B-F.

Reason for Request:

Primary Water Stress Corrosion Cracking has been identified as a degradation mechanism for Alloy 82/182 welds and weld buttering. While no PWSCC flaws have been detected in VEGP or FNP piping, there are geometric limitations such that the required examination volume cannot be met with qualified ultrasonic (UT) techniques. Southern Nuclear Operating Company (SNC) has concluded that the application of a FSWOL over the pressurizer Alloy 82/182 welds is the most appropriate course of action to ensure the integrity of the reactor coolant pressure boundary. In addition, the overlays will be designed to improve the configurations for future examinations.

The 1989 Code does not provide rules for the design of weld overlays or for repairs without removal of flaws. In addition, Code Case N-504-2, which has been approved by the NRC for use, does not provide the methodology for overlaying nickel alloy welds joining austenitic and ferritic base materials; therefore, SNC proposes the following alternative.

Proposed Alternative and Basis for Use:

Proposed Alternative

A full-structural Alloy 52/152 overlay will be applied to each of the pressurizer Alloy 82/182 safe-end welds. Due to the proximity of the adjacent similar metal piping welds, overlay of the safe-end welds may preclude the examination of the adjacent piping weld(s); therefore, the overlay will be extended over the adjacent piping welds, as necessary. In lieu of using the existing IWA-4000 Repair Procedures in the 1989 Section XI Code, SNC proposes to use the following alternative for the design, fabrication, pressure testing, and examination of the weld overlays. This will provide

an acceptable methodology for reducing a defect in austenitic nickel alloy welds to an acceptable size by increasing the wall thickness through deposition of a weld overlay. ASME Section III and Section XI Code references in this alternative are to the 2001 Edition of ASME Section III and ASME Section XI with Addenda through 2003 as modified by 10 CFR 50.55a. The methodology is:

1. General Requirements:

   (a) A full-structural weld overlay will be applied by deposition of Alloy 52/152 weld reinforcement (weld overlay) on the outside surface of the low alloy steel pressurizer nozzles (P-No. 3) to the stainless steel safe end (P-No. 8), inclusive of the Alloy 82/182 weld that joins the two items. In addition, the overlay may be extended to include the adjacent wrought stainless steel to stainless steel welds (P-No. 8 to P-No. 8) to improve their inspectability.

   (b) The Alloy 52/152 weld overlay filler metal is an austenitic nickel alloy having a chromium (Cr) content of at least 28%. The weld overlay is applied 360 degrees around the circumference of the item, e.g., safe end to nozzle weld, and will be deposited using a Welding Procedure Specification (WPS) for groove welding, qualified in accordance with the Construction Code and Owner's requirements and identified in the Repair/Replacement Plan. As an alternative to the post-weld heat treatment requirements of the Construction Code and Owner's requirements, the provisions for Ambient Temperature Temper Bead Welding will be used on the ferritic nozzles. (See "Ambient Temperature Temper Bead Welding," which is located in Appendix 1 to this proposed alternative). The maximum area of an individual weld overlay on the finished surface of the ferritic material shall be no greater than 300 square inches.

   (c) Prior to deposition of the weld overlay, the surface will be examined by the liquid penetrant method. Indications larger than 1/16-inch shall be removed, reduced in size, or corrected in accordance with the following requirements.

      1. One or more layers of weld metal shall be applied to seal unacceptable indications in the area to be repaired with or without excavation. The thickness of these layers shall not be used in meeting weld reinforcement design thickness requirements. Peening the unacceptable indication prior to welding is permitted.

      2. If correction of indications identified in 1(c) is required, the area where the weld overlay is to be deposited, including any local repairs or initial weld overlay layer, shall be examined by the liquid penetrant method. The area shall contain no indications greater than 1/16-inch prior to the application of the structural layers of the weld overlay.

   (d) Weld overlay deposits shall meet the following requirements:

      The austenitic nickel alloy weld overlay shall consist of at least two weld layers

deposited using a filler material such as that identified in 1(b) above. The first layer of weld metal deposited may not be credited toward the required thickness. Alternatively, a diluted layer may be credited toward the required thickness, provided the portion of the layer over the austenitic base material, austenitic filler material weld and the associated dilution zone from an adjacent ferritic base material contains at least 24% Cr. The Cr content of the deposited weld metal as determined by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the WPS for the production weld shall contain at least 24% Cr.

(e) Welding will only be performed for applications predicted not to have exceeded a thermal neutron fluence of 1×10^{17} (E< 0.5 eV) neutrons per cm^2 prior to welding.

2. Crack Growth Considerations and Design

(a) Crack Growth Considerations

Flaw characterization and evaluation requirements shall be based on the as-found flaw, except in the case of a preemptive overlay. For a preemptive overlay, a flaw with a depth of 75% and a circumference of 360 degrees will be assumed. The size of all flaws will be projected to the end of the design life of the overlay. Crack growth, including both stress corrosion and fatigue crack growth, shall be evaluated in the materials in accordance with IWB-3640. If the flaw is at or near the boundary of two different materials, evaluation of flaw growth in both materials is required.

(b) Design

The design of the weld overlay shall satisfy the following, using the assumptions and flaw characterization restrictions in 2(a) above. The following design analysis shall be completed in accordance with IWA-4311.

1. The axial length and end slope of the weld overlay shall cover the weld and the heat affected zones on each side of the weld, and shall provide for load redistribution from the item into the weld overlay and back into the item without violating applicable stress limits of ASME Section III, NB-3200. Any laminar flaws in the weld overlay shall be evaluated in the analysis to ensure that load redistribution complies with the above. These requirements will usually be satisfied if the weld overlay full thickness length extends axially beyond the projected flaw by at least $0.75\sqrt{Rt}$, where R is the outer radius of the item and t is the nominal wall thickness of the item.

2. Unless specifically analyzed in accordance with 2(b)1 above, the end transition slope of the overlay shall not exceed 45 degrees. A slope of not more than 1:3 is recommended.

3. For determining the combined length of circumferentially-oriented flaws

identified by inspection, multiple flaws shall be treated as one flaw of length equal to the sum of the lengths of the individual flaws characterized in accordance with IWA-3300.

4. For circumferentially-oriented flaws identified by inspection, if the combined length is greater than 10% of the circumference of the item, the flaws shall be assumed to be 100% through the original wall thickness of the item for the entire circumference of the item. For circumferentially-oriented flaws, if the combined length does not exceed 10% of the circumference of the item, the flaws shall be assumed to be 100% through the original wall thickness of the item for a circumferential length equal to the combined length of the flaws.

5. For axial flaws identified by inspection, 1.5 inches or longer, or for five or more axial flaws of any length, the flaws shall be assumed to be 100% through the original wall thickness of the item for the entire axial length of the flaw or combined flaws, as applicable.

6. For pre-emptive overlays without a known flaw, the flaw shall be assumed to be 100% through the original wall thickness for the entire circumference.

7. The overlay design thickness of items meeting 2(b)4, 2(b)5 or 2(b)6 above shall be based on the measured diameter, using only the weld overlay thickness conforming to the deposit analysis requirements of 1(d). The combined 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.

8. The effects of any changes in applied loads, as a result of weld shrinkage from the entire overlay, on other items in the piping system (e.g., support loads and clearances, nozzle loads, changes in system flexibility and weight due to the weld overlay) shall be evaluated. Existing flaws previously accepted by analytical evaluation shall be evaluated in accordance with IWB-3640.

3. Examination and Inspection

In lieu of all other examination requirements, the examination requirements proposed herein shall be met. Nondestructive examination methods shall be in accordance with IWA-2200, except as specified herein. Nondestructive examination personnel shall be qualified in accordance with IWA-2300. Ultrasonic examination procedures and personnel shall be qualified in accordance with Appendix VIII, Section XI.

(a) Acceptance Examination

1. The weld overlay shall have a surface finish of 250 micro-inches RMS or better and a flatness sufficient to allow for adequate examination in accordance with procedures qualified per Appendix VIII. The weld overlay shall be examined to verify acceptable configuration.

2. The weld overlay and the adjacent base material for at least ½ inch from each side of the weld shall be examined using the liquid penetrant method. The weld overlay shall satisfy the surface examination acceptance criteria for welds of the Construction Code or ASME Section III, NB-5300. The adjacent base metal shall satisfy the surface examination acceptance criteria for base material of the Construction Code or ASME Section III, NB-2500. If ambient temperature temper bead welding is used, the liquid penetrant examination shall be conducted at least 48 hours after the completed overlay has returned to ambient temperature.

3. The examination volume A-B-C-D in Figure 1, which is provided in Appendix 2 to this proposed alternative, shall be ultrasonically examined to assure adequate fusion (i.e., adequate bond) with the base metal and to detect welding flaws, such as interbead lack of fusion, inclusions, or cracks. The interface C-D shown between the overlay and the weld includes the bond and the heat affected zone from the overlay. If ambient temperature temper bead welding is used, the ultrasonic examination shall be conducted at least 48 hours after the completed overlay has returned to ambient temperature. Planar flaws shall meet the preservice examination standards of Table IWB-3514-2. In applying the acceptance standards, wall thickness "t_w" shall be the thickness of the weld overlay. Laminar flaws shall meet the following:

   i. Laminar flaws shall meet the acceptance standards of Table IWB-3514-3 with the additional limitation that the total laminar flaw shall not exceed 10% of the weld surface area and that no linear dimension of the laminar flaw area exceeds 3.0 inches.

   ii. The reduction in coverage of the examination volume in the aforementioned Figure 1 due to laminar flaws shall be less than 10%. The dimensions of the uninspectable volume are dependent on the coverage achieved with the angle beam examination of the overlay.

   iii. Any uninspectable volume in the weld overlay shall be assumed to contain the largest radial planar flaw that could exist within that volume. This assumed flaw shall meet the inservice examination standards of Table IWB-3514-2. Alternately, the assumed flaw shall be evaluated and shall meet the requirements of IWB-3640. Both axial and circumferential planar flaws shall be assumed.

4. After completion of all welding activities, affected restraints, supports, and

snubbers shall be VT-3 visually examined to verify that design tolerances are met.

(b) Preservice Inspection

1. The examination volume A-B-C-D in Figure 2, which is provided in Appendix 3 to this proposed alternative, shall be ultrasonically examined. The angle beam shall be directed perpendicular and parallel to the piping axis, with scanning performed in four directions, to locate and size any cracks that might have propagated into the upper 25% of the base material or into the weld overlay.

2. The preservice examination acceptance standards of Table IWB-3514-2 shall be met for the weld overlay. In applying the acceptance standards, wall thickness, t_w, shall be the thickness of the weld overlay. Cracks in the outer 25% of the base metal shall meet the design analysis requirements as addressed in Section 2, "Crack Growth Considerations and Design," of this proposed alternative.

(c) Inservice Inspection

1. The weld overlay examination volume A-B-C-D in the aforementioned Figure 2 shall be added to the applicable inspection plans and shall be ultrasonically examined during the first or second refueling outage following application.

2. The weld overlay examination volume in the aforementioned Figure 2 shall be ultrasonically examined to determine if any new or existing cracks have propagated into the upper 25% of the base material or into the overlay. The angle beam shall be directed perpendicular and parallel to the piping axis, with scanning performed in four directions.

3. The inservice examination acceptance standards of Table IWB-3514-2 shall be met for the weld overlay. Alternatively, for Class 1, 2, or 3 piping systems, the acceptance criteria of IWB-3600, IWC-3600, or IWD-3600, as applicable, shall be met for the weld overlay. Cracks in the outer 25% of the base metal shall meet the design analysis requirements as addressed in Section 2, "Crack Growth Considerations and Design," of this proposed alternative.

4. Weld overlay examination volumes that show no indication of crack growth or new cracking shall be placed into a population to be examined on a sample basis. Twenty-five percent of this population shall be examined once every ten years.

5. If inservice examinations reveal crack growth, or new cracking, meeting the acceptance standards, the weld overlay examination volume shall be

reexamined during the first or second refueling outage following discovery of the growth or new cracking.

6. For weld overlay examination volumes with unacceptable indications as described above in Paragraphs 3(c)2 and 3(c)3, the weld overlay shall be removed, including the original defective weld, and the item shall be corrected by a repair/replacement activity in accordance with IWA-4000.

(d) If inservice examinations reveal an unacceptable indication, crack growth into the weld overlay design thickness, or axial crack growth beyond the specified examination volume, additional weld overlay examination volumes, equal to the number scheduled for the current inspection period, shall be examined prior to return to service. If additional unacceptable indications are found in the second sample, a total of 50% of the total population of weld overlay examination volumes shall be examined prior to operation. If additional unacceptable indications are found, the entire remaining population of weld overlay examination volumes shall be examined prior to return to service.

4. Pressure Testing

A system leakage test shall be performed in accordance with IWA-5000.

5. Documentation

Use of this proposed alternative shall be documented on ASME Form NIS-2, "Owner's Report for Repairs or Replacements."

Basis for Use:

The use of weld overlay materials resistant to PWSCC (e.g., Alloy 52/152) that create low tensile or compressive residual stress profiles in the original weld provide increased assurance of structural integrity. The weld overlay is of sufficient thickness and length to meet the applicable stress limits from ASME Section III, NB-3200. Crack growth evaluations for PWSCC and fatigue of any as-found flaws or any conservatively postulated flaws will ensure that structural integrity will be maintained.

As a part of the design of the weld overlay, the weld length, surface finish, and flatness are specified in order to allow qualified ASME Section XI, Appendix VIII UT examinations, as implemented through the EPRI Performance Demonstration Initiative (PDI) Program, of the weld overlay and the required volume of the base material and original weld. The examinations specified in this proposed alternative, versus those limited examinations performed on the original dissimilar welds, will provide improved assurance of structural integrity. Further, if no flaws are found in the upper 25% of the original material by the preservice UT examinations, the postulated 75% through-wall flaw for the preemptive overlays is conservative for crack growth evaluations. If a flaw is detected in the upper 25% of the original material during the preservice examination, the actual flaw size would be used for the crack growth evaluations.

The implementation of the alternative reduces the likelihood for PWSCC in the identified welds and improves piping geometries to permit Appendix VIII UT examinations as implemented through the PDI program. Weld overlay repairs of dissimilar metal welds have been installed and performed successfully for many years in both PWR and BWR applications. The alternative provides improved structural integrity and reduced likelihood of leakage for the primary system. Accordingly, the use of the alternative provides an acceptable level of quality and safety in accordance with 10 CFR 50.55a(a)(3)(i).

Duration of Proposed Alternative: The proposed alternative is applicable for the remainder of the Inservice Inspection Interval for VEGP-1 and -2 that ends on May 30, 2007, plus the remainder of the Inservice Inspection Interval for FNP-1 and -2 that ends on November 30, 2007.

Precedents: This alternative is similar to and generally follows the content and statements made by several utilities, which have pressurized water reactor (PWR) facilities, concerning the addition of FSWOL(s) on DSM piping welds. However, this alternative is not identical to those submitted by other utilities that have used ASME Code Cases, e.g., Code Case N-504-2, already approved by the NRC with a caveat related to the use of Appendix Q in the 2005 Addenda of the 2004 Section XI Edition. These other alternatives included several exceptions to those approved Code Cases because the Code Cases were not specifically developed for the application of FSWOLs on DSM welds. Plants using N-504-2 include, but may not be limited to, Beaver Valley-2 and Calvert Cliffs. A comparison table of the ASME Code Cases N-504-2, N-638-1, both of which have been approved by the NRC for use as documented in NRC Regulatory Guide 1.147, and this proposed alternative has been developed. Code Case N-504-2 versus the proposed alternative is found in Appendix 4, while Code Case N-638-1 versus Appendix 1 of the proposed alternative is found in Appendix 5.

References: None

Status: Awaiting NRC approval.

APPENDIX 1
AMBIENT TEMPERATURE TEMPER BEAD WELDING

1.0 GENERAL REQUIREMENTS

(a) This appendix applies to dissimilar austenitic filler metal welds between P-Nos. 1, 3, 12A, 12B, and 12C[1] materials and their associated welds and welds joining P-No. 8 or 43 materials to P-No. 1, 3, 12A, 12B, and 12C[1] materials with the following limitation: This Appendix shall not be used to repair SA-302 Grade B material unless the material has been modified to include from 0.4% to 1.0% nickel, quenching and tempering, and application of a fine grain practice.

(b) The maximum area of an individual weld overlay based on the finished surface over the ferritic base material shall be 300 square inches.

(c) Repair/replacement activities on a dissimilar-metal weld in accordance with this Appendix are limited to those along the fusion line of a nonferritic weld to ferritic base material on which 1/8-inch, or less of nonferritic weld deposit exists above the original fusion line.

(d) If a defect penetrates into the ferritic base material, repair of the base material, using a nonferritic weld filler material, may be performed in accordance with this Appendix, provided the depth of repair in the base material does not exceed 3/8-inch.

(e) Prior to welding the area to be welded and a band around the area of at least 1-1/2 times the component thickness or 5 inches, whichever is less, shall be at least 50 degrees Fahrenheit.

(f) Welding materials shall meet the Owner's Requirements and the Construction Code and Cases specified in the Repair/Replacement Plan. Welding materials shall be controlled so that they are identified as acceptable until consumed.

(g) Peening may be used, except on the initial and final layers.

2.0 WELDING QUALIFICATIONS

The welding procedures and the welding operators shall be qualified in accordance with ASME Section IX and the requirements of 2.1 and 2.2 provided below.

2.1 Procedure Qualification

(a) The base materials for the welding procedure qualification shall be of the same P-Number and Group Number, as the materials to be welded. The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials being welded.

[1] P-No. 12C designation refers to specific material classifications originally identified in ASME Section III and subsequently reclassified in a later Edition of ASME Section IX.

APPENDIX 1
AMBIENT TEMPERATURE TEMPER BEAD WELDING (Continued)

(b) The root width and included angle of the cavity in the test assembly shall be no greater than the minimum specified for the repair.

(c) The maximum interpass temperature for the first three layers of the test assembly shall be 150 degrees Fahrenheit.

(d) The test assembly cavity depth shall be at least 1 inch. The test assembly thickness shall be at least twice the test assembly cavity depth. The test assembly shall be large enough to permit removal of the required test specimens. The test assembly dimensions surrounding the cavity shall be at least the test assembly thickness and at least 6 inches. The qualification test plate shall be prepared in accordance with Figure 1-1.

(e) Ferritic base material for the procedure qualification test shall meet the impact test requirements of the Construction Code and Owner's Requirements. If such requirements are not in the Construction Code and Owner's Requirements, the impact properties shall be determined by Charpy V-notch impact tests of the procedure qualification base material at or below the lowest service temperature of the item to be repaired. The location and orientation of the test specimens shall be similar to those required in (f) below, but shall be in the base metal.

(f) Charpy V-notch tests of the ferritic heat-affected zone (HAZ) shall be performed at the same temperature as the base metal test of (e) above. Number, location, and orientation of test specimens shall be as follows:

(i) The specimens shall be removed from a location as near as practical to a depth of one-half the thickness of the deposited weld metal. The coupons for HAZ impact specimens shall be taken transverse to the axis of the weld and etched to define the HAZ. The notch of the Charpy V-notch specimen shall be cut approximately normal to the material surface in such a manner as to include as much HAZ as possible in the resulting fracture. When the material thickness permits, the axis of a specimen shall be inclined to allow the root of the notch to be aligned parallel to the fusion line.

(ii) If the test material is in the form of a plate or a forging, the axis of the weld shall be oriented parallel to the principal direction of rolling or forging.

(iii) The Charpy V-notch test shall be performed in accordance with ASME Section II, Part A, SA-370. Specimens shall be in accordance with SA-370, Figure 11, Type A. The test shall consist of a set of three full-size 10 mm X 10 mm specimens. The lateral expansion, percent shear, absorbed energy, test temperature, orientation and location of all test specimens shall be reported in the Procedure Qualification Record.

(g) The average lateral expansion value of the three HAZ Charpy V-notch specimens shall be equal to or greater than the average lateral expansion value of the three unaffected base metal specimens. However, if the average lateral expansion value of the HAZ

Charpy V-notch specimens is less than the average value for the unaffected base metal specimens and the procedure qualification meets all other requirements of this appendix, either of the following shall be performed:

(1) The welding procedure shall be requalified.

(2) An Adjustment Temperature for the procedure qualification shall be determined in accordance with the applicable provisions of NB-4335.2 of Section III, 2001 Edition with 2002 Addenda. The RT_{NDT} or lowest service temperature of the materials for which the welding procedure will be used shall be increased by a temperature equivalent to that of the Adjustment Temperature.

2.2 Performance Qualification

Welding operators shall be qualified in accordance with ASME Section IX.

3.0 WELDING PROCEDURE REQUIREMENTS

The welding procedure shall include the following requirements.

(a) The weld metal shall be deposited by the automatic or machine GTAW process.

(b) Dissimilar metal welds shall be made using A-No. 8 weld metal (ASME Section IX, QW-442) for P-No. 8 to P-No. 1, 3, or 12 (A, B, or C) weld joints or F-No. 43 weld metal (ASME Section IX QW-432) for P-No. 8 or 43 to P-No. 1, 3, or 12 (A, B, or C) weld joints.

(c) The area to be welded shall be buttered with a deposit of at least three layers to achieve at least 1/8-inch overlay thickness with the heat input for each layer controlled to within ±10% of that used in the procedure qualification test. The heat input of the first three layers shall not exceed 45,000 J/in. under any conditions. Particular care shall be taken in the placement of the weld layers of the austenitic overlay filler material at the toe of the overlay to ensure that the HAZ and ferritic base metal are tempered. Subsequent layers shall be deposited with a heat input not exceeding that used for layers beyond the third layer in the procedure qualification.

(d) The maximum interpass temperature for field applications shall be 350 degrees Fahrenheit for all weld layers regardless of the interpass temperature used during qualification. The interpass temperature limitation of QW-406.3 need not be applied.

(e) The interpass temperature shall be determined by one of the following methods:

(1) temperature measurement (e.g., pyrometers, temperature indicating crayons, thermocouples) during welding.

(2) heat flow calculations using the variables listed below as a minimum:
(i) welding heat input

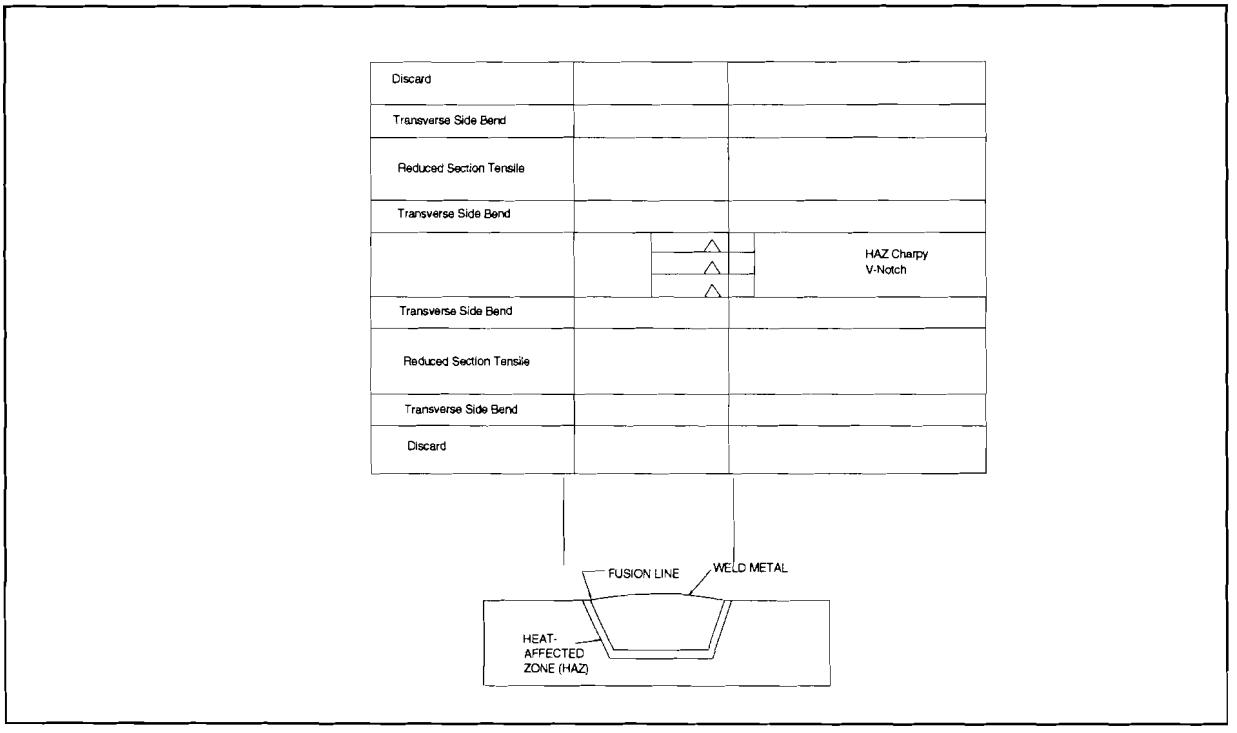
APPENDIX 1
AMBIENT TEMPERATURE TEMPER BEAD WELDING (Continued)

(ii) initial base material temperature
(iii) configuration, thickness, and mass of the item being welded
(iv) thermal conductivity and diffusivity of the materials being welded
(v) arc time per weld pass and delay time between each pass
(vi) arc time to complete the weld

(3) measurement of the maximum interpass temperature on a test coupon that is equal to or less than the thickness of the item to be welded. The maximum heat input of the welding procedure shall be used in the welding of the test coupon.

(f) Particular care shall be given to ensure that the weld region is free of all potential sources of hydrogen. The surfaces to be welded, filler metal, and shielding gas shall be suitably controlled.

APPENDIX 1
AMBIENT TEMPERATURE TEMPER BEAD WELDING (Continued)



GENERAL NOTE:
Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

Figure 1-1
QUALIFICATION TEST PLATE

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APPENDIX 2
UT ACCEPTANCE EXAMINATION VOLUME

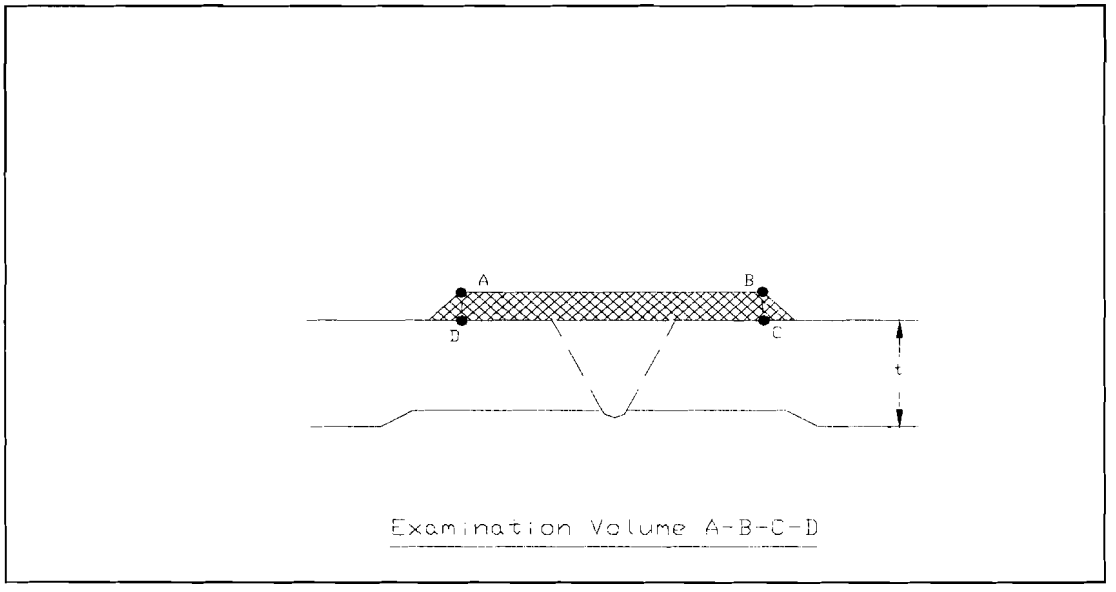

FIGURE 1: ACCEPTANCE EXAMINATION VOLUME

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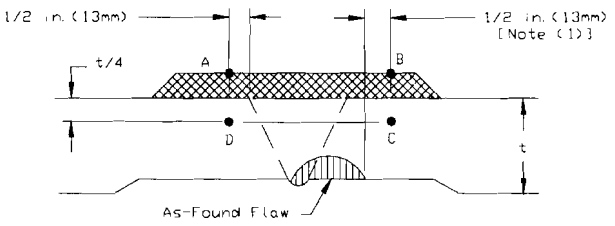
APPENDIX 3
PRESERVICE AND INSERVICE EXAMINATION VOLUME



Examination Volume A-B-C-D

NOTE:
(1) For axial or circumferential flaws, the axial extent of the examination volume shall extend at least 1/2-inch beyond the as-found flaw and at least 1/2-inch beyond the toes of the original weld, including weld end butter, where applied.

FIGURE 2: PRESERVICE AND INSERVICE EXAMINATION VOLUME

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APPENDIX 4
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-504-2

Comparison of Proposed Alternative with N-504-2	
CODE CASE N-504-2	**PROPOSED ALTERNATIVE**
N-504-2 for weld overlay repair of SS piping	Proposed alternative is for dissimilar metal weld overlay repairs.
Reply-reduce a flaw to acceptable size by weld overlay on austenitic SS piping	*Reply*- reduce a flaw to acceptable size by weld overlay on austenitic stainless steel or austenitic nickel alloy piping, components and associated welds
Material covered is P-8	Per Section 1.0(a) materials covered are P-8 or P-43 and P-1, 12A, 2B or 12c or between P-1, 3, 12A, 12B or 12C. Also includes P-8 to P-43, P-8 to P-8 or P-43 to P-43 joined with austenitic filler materials
(b) Filler Material – low C (0.035% max) SS	(b) Filler Materials – Low C (0.035% max) SS or austenitic nickel alloy (28% Cr min.)
(c) (d) Repair of indications prior to overlay	(c) Repair of indications prior to overlay (Same as N-504-2)
(e) Weld Reinforcement Min. 2 layers with-7.5 FN. In first austenitic SS layer 5 FN acceptable by evaluation.	(d) Weld Reinforcement (1) Min. 2 layers with-7.5 FN. In first layer 5FN acceptable if deposited weld metal less than 0.02% C. (2) Provides requirements for austenitic nickel alloy weld overlay.
(f) (g) Design – Requires flaw evaluation of the existing flaw based on IWB-3640 for design life. Requires postulated 100 % through wall for design of the weld overlay (full structural) except for four or fewer axial flaws. Meet ASME Section III for primary local and bending stresses and secondary peak stresses. Requires end transition slope less than 45 degrees. Axial length requirement usually met if overlay 0.75 $(Rt)^{1/2}$ beyond flaws. Shrinkage and other applied loads evaluated on other items and other flawed welds in system.	2.0 Design Requires flaw evaluation of the existing flaw based on IWB-3640. Flaw evaluation of both materials required if flaw is at or near the boundary. Requires postulated 100 % through wall for design (full structural) of the weld overlay. Axial length and end slope shall cover the weld and heat affected zones and shall provide for load redistribution into the item and back into the overlay either out violating stress limits. There is no exception for four or fewer axial flaws. Design analysis per IWA-4311. Meet ASME Section III, NB-3200 applicable stress limits. Any laminar flaws in the weld overlay evaluated to ensure load distribution meets NB-3200. Same as N-504-2 for shrinkage and evaluation of other existing flaws.

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APPENDIX 4
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-504-2
(Continued)

Comparison of Proposed Alternative with N-504-2 (Continued)	
N-504-2	**PROPOSED ALTERNATIVE**
(i) No specific reference given for acceptance examination of the weld overlay. Acceptance criteria of the Construction Code and Section III would be applicable. (Causes problems with volumetric acceptance criteria since construction criteria based on RT examination rather than UT examination. Also presents difficulty in determining applicable criteria for laminar flaws in the overlay) Preservice Exams to the methods of IWB-2200. Exam procedures shall be specified in the Repair Program. Acceptance standard-IWB-3514-2 (planar flaws). UT exams to verify integrity of new applied weld reinforcement. Include upper 25% of pipe wall in the examination.	3.0 Examination and Inspection Examinations in the proposed alternative shall be met in lieu of all other exams. NDE methods to IWA-2200 except as specified in the case. NDE personnel qualified to IWA-2300. UT procedures and personnel qualified to Section XI, Appendix VIII. (a) Acceptance Examinations-Surface finish 250 micro-inch and flatness sufficient to allow adequate examination in accordance with Appendix VIII procedures. PT overlay and ½-inch on either side of the overlay. Acceptance standards for PT-weld overlay, Meet weld Construction Code criteria or NB-5300, base material-Meet base material criteria or NB-2500. 48 hr hold time after item reaches room temperature imposed if ambient temperature temper bead welding imposed. UT examination for acceptance-Figure 1 shows the examination volume. 48 hour hold time after item reaches room temperature imposed if ambient temperature temper bead welding imposed. IWB-3514-2 for planar flaw acceptance. IWB-3514-3 for laminar flaw acceptance with additional limitation not to exceed 10% of the surface area and no linear dimension in excess of 3 inches. Reduction in coverage limited to 10%. Criteria for radial planar flaw size in the uninspected volume for IWB-3640 evaluation. VT-3 of affected restraints, snubbers and supports to verify design tolerances are met. (b) Preservice Examinations Figure 2 defines the examination volume. Angle beam exam parallel and perpendicular to piping axis. Scan in four directions to locate and size flaws. Acceptance criteria IWB-3514-2 for the overlay. Wall thickness t_w is the thickness of

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APPENDIX 4
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-504-2
(Continued)

Comparison of Proposed Alternative with N-504-2 (Continued)	
N-504-2	**PROPOSED ALTERNATIVE**
	the overlay. Flaws in outer 25% of base material meet design requirements of 2.0. (c) Inservice Examinations Examination required 1st or 2nd refueling outage following application. Examination volume the same as Preservice. Acceptance standards the same as Preservice except IWB-3600 evaluation permitted as an alternative to IWB-3514-2 for the weld overlay. Future examination requirements define depending on examination results. (d) Additional Examinations Similar to Code examination expansion rules.
(h) System Hydrostatic Test if pressure boundary penetrated (leak). System Leakage Test if pressure boundary not penetrated (no leak).	4.0 Pressure Testing System Leakage Test per IWA-5000
(k) VT-3 of snubbers, supports and restraints after welding	Covered under 3.0 (a) Acceptance Examinations
(l) Reference to other applicable requirements of IWA-4000	IWA-4000 requirements would be met unless an alternative provided
(m) Use of case to be documented on an NIS-2 form	5.0 Documentation Use of case to be documented on an NIS-2 form

APPENDIX 5
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-638-1

Comparison of Proposed Alternative with N-638-1	
N-638-1	**APPENDIX 1 OF THE PROPOSED ALTERNATIVE**
Code Case N-638-1 provides rules for automatic or machine GTAW temper bead welding without pre-heat or post weld heat treatment. The case covers similar and dissimilar welding for cavity and overlay repairs. The code case permits the use of NDE examinations in accordance with the case in lieu of those in the Construction Code. This case has a broader scope of use then Appendix 1.	Appendix 1 invoked in 1.0 (b) for use of ambient temperature temper bead welding as an alternative to the post weld heat treatment requirements of the Construction Code and Owner's requirements. The appendix provides the ambient temperature temper bead requirements applicable to dissimilar metal weld overlay repairs. NDE requirements are in lieu of the Construction Code and were covered in Section 3.0 of the alternative.
1.0 General Requirements	1.0 General Requirements
Scope of welds in the Reply	(a) Scope of welds. Same as N-638-1
(a) Max area of finished surface of the weld limited to 100 square inches and half of the ferritic base metal thickness. (Note: the depth requirement is for the ferritic material. There is no need to limit either surface area or depth for welding on austenitic SS or nickel alloys since no post weld heat treatment is required.)	(b) Surface area limitation 300 square inches over the ferritic material. (Note: Code Case N-638-3 which has been approved by ASME but has not been issued in Supplement 9. Residual stress analyses results show that stresses for 100 square inches through 500 square inches surface area overlays very similar.)
(b) (c) (d) (e) (f)	(c) (d) (e) (f) (g) same as requirements listed for N-638-1
1.0 Welding Qualifications The welding procedures and welding operators shall be qualified in accordance with Section IX and the requirements of 2.1 and 2.2	2.0 Welding Qualifications The welding procedures and welding operators shall be qualified in accordance with Section IX and the requirements of 2.1 and 2.2
2.1 Procedure Qualification Paragraphs (a) (d) (e) (f) (g) Paragraph (h) Paragraph (i) Paragraph (j)	2.1 Procedure Qualification Paragraphs (a) (b) (c) (d) (e) same as in N-638-1 for equivalent paragraphs. Equivalent paragraph not in Appendix 1. Paragraph (f) same as (i) from N-638-1. Paragraph (g) changed the first sentence adding "lateral expansion" in front of "value" both at the beginning and end of the sentence. Additional provisions as follow were added:

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PROPOSED ALTERNATIVE IN ACCORDANCE WITH 10 CFR 50.55a(a)(3)(i)

APPENDIX 5
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-638-1

Comparison of Proposed Alternative with N-638-1	
N-638-1	**APPENDIX 1 OF THE PROPOSED ALTERNATIVE**
	However if the average lateral expansion value of the HAZ Charpy V-notch specimens is less than the average value of the unaffected base metal specimen and the procedure qualification meets all other requirements of this appendix, either of the following shall be performed: (1) The welding procedure shall be requalified. (2) An Adjustment Temperature for the procedure qualification shall be determined in accordance with the applicable provisions of NB-4335.3 of Section III, 2001 Edition with 2002 Addenda. RT_{ndt} or lowest service temperature of the materials for which the welding procedure will be used shall be increased by a temperature equivalent to that of the Adjustment Temperature. This is identical wording to N-638-2, which has been approved by ASME.
Paragraph (b) Provisions for welding in a pressurized environment	Not included for overlays in Appendix 1.
Paragraph (c) Provisions to address radiation effects	Not included in Appendix 1. Thermal neutron limitation imposed in the proposed alternative.
1.1 Performance Qualification Welding operators shall be qualified in accordance with Section IX.	2.2 Performance Qualification Welding operators shall be qualified in accordance with Section IX.
3.0 Welding Procedure Requirements	3.0 Welding Procedure Requirements
(a) (b) (c) (d)	(a) (b) (c) same as N-638-1 except last two sentences deleted in (c) from N-638-1 since not applicable to this proposed alternative. (d) same as N-638-1 but the following added: The interpass temperature of QW-406.3 need not be applied. This is identical wording to N-638-2, which has been approved by ASME.

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APPENDIX 5
COMPARISON OF SNC-PROPOSED ALTERNATIVE VERSUS CODE CASE N-638-1

Comparison of Proposed Alternative with N-638-1	
N-638-1	**APPENDIX 1 OF THE PROPOSED ALTERNATIVE**
	(e) Paragraph added to clarify temperature measurement requirements. This is identical wording to N-638-2, which has been approved by ASME.
(e)	(f) same as (e) from N-638-1
4.0 Examination	3.0 Examination and Inspection in the proposed alternative for requirements.
5.0 Documentation	5.0 Documentation in the proposed alternative.
	4.0 Pressure Testing in the proposed alternative.