Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

June 19, 2003
NOC-AE-03001549
10CFR50.55a

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
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Rockville, MD 20852

South Texas Project
Unit 1
Docket No. STN 50-498
Request for Alternative to ASME Section XI Requirements Associated with
Half-Nozzle Repair/Replacement for Bottom Mounted Instrument Penetrations
(Relief Request RR-ENG-2-32)

Pursuant to 10 CFR 50.55a(a)(3)(i), STP Nuclear Operating Company (STPNOC) hereby requests NRC approval of alternatives to the requirements of ASME Section XI and Section III Codes, including the approval of Section XI Code Case N-638. These alternatives are being requested for use in the repair/replacement of bottom mounted instrument (BMI) penetrations during the current Unit 1 forced outage. STPNOC proposes to use the provisions of Code Case N-638 to deposit weld metal pads on the outside surface of the reactor vessel bottom head at repaired penetrations without postweld heat treatment. 10CFR50.55a Request RR-ENG-2-32 is attached.

STPNOC requests NRC approval of this request for alternative by July 25, 2003 based on the schedule for repairing BMI penetrations in the Unit 1 reactor pressure vessel during the current forced outage.

If there are any questions regarding this request, please contact Mr. Michael Lashley at 361-972-7523 or me at 361-972-7181.

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Manager,
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jtc

Attachment: 10CFR50.55a Request RR-ENG-2-32

A047

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10CFR50.55a Request RR-ENG-2-32

Proposed Alternative
In Accordance with 10 CFR 50.55a(a)(3)(i)

–Alternative Provides Acceptable Level of Quality and Safety –

1. <u>ASME Code Components Affected</u>

Reactor vessel bottom mounted instrumentation (BMI) nozzle penetrations. There are 58 BMI nozzles welded to the bottom head of the reactor vessel. The ASME Code Class is Class 1.

2. <u>Applicable Code Edition and Addenda</u>

ASME Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 1989 Edition, no Addenda

3. <u>Applicable Code Requirements</u>

Section XI, IWA-4120(a) states:

> Repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used. If repair welding cannot be performed in accordance with these requirements, the applicable alternative requirements of IWA-4500 and the following may be used...

The Construction Code for the STP Unit 1 reactor vessel bottom head (RVBH) and BMI penetration nozzles is the 1971 Edition of ASME Section III with addenda through the Summer 1973 Addenda (1971-S1973).

Section III, Paragraph NB-4622.1 states in part:

> ...all welded components or pieces of components shall be given a final postweld heat treatment at a temperature not less than specified in Table NB-4622.1-1...

Section III, Paragraph NB-5245 states:

> Partial penetration welds, as permitted in NB-3352.4(d), shall be examined progressively using the magnetic particle or liquid penetrant methods.

The increments of examination shall be the lesser of 1/2 of the maximum weld dimension measured parallel to the centerline of the connection or 1/2 inch. The surface of the finished weld shall also be examined.

4. Reason for Request

STP Nuclear Operating Company (STPNOC) cannot meet all the applicable requirements of the 1971-S1973 Section III Code. Therefore, this request for alternative applies to Section XI, IWA-4120(a) and specified portions of the Section III Code as described below.

5. Proposed Alternatives and Bases Providing an Acceptable Level of Quality and Safety

STPNOC has identified two BMI nozzles (Penetrations 1 and 46) that require repair/replacement during the current forced outage. Framatome ANP will perform the repair/replacement on these nozzles utilizing the half-nozzle technique in which the lower portion of the nozzle is replaced with a nozzle fabricated from SB-166 Alloy 690 material and the pressure boundary weld is moved from the inside to the outside of the RVBH. The final configuration is depicted in Figure 1. An Inconel Alloy 52 weld pad is deposited on the outside surface of the RVBH around each of these penetrations and a J-groove weld preparation is machined in the pad for attachment of the Inconel Alloy 690 nozzle. In accordance with IWA-4120(a), STPNOC will use the original Section III Code applicable to the RVBH and BMI nozzles as the basis for the repair/replacement.

The BMI penetrations subject to repair/replacement will be modified as follows. The piping will be removed from the nozzle. The lower end of the nozzle will be removed flush with the RVBH outer surface. A remotely operated weld head will be used to deposit an Alloy 52 (F-No. 43 filler material) weld pad on the outside surface of the low alloy steel RVBH (P-No. 3 Group No. 3) base material, utilizing the machine Gas Tungsten-Arc Welding (GTAW) process, and the ambient temperature temper bead technique with 50°F minimum preheat and no postweld heat treatment. The weld pad will be of a thickness to provide for sufficient cover over the ferritic low alloy steel material so the replacement nozzle-to-pad weld can be performed using conventional welding methods. The lower end of the original Alloy 600 nozzle will be removed by drilling and replaced with an Alloy 690 half-nozzle. The Alloy 690 replacement half-nozzle will be welded to the Alloy 52 pad in accordance with Section III, 1971-S1973, NB requirements. The original Alloy 182 J-groove weld at the interior surface of the RVBH will remain intact.

Since STPNOC cannot meet all the applicable requirements of the 1971-S1973 Section III Code, this request for alternative applies to IWA-4120(a) and specified portions of the Section III Code as described below. This request for alternative identifies the specific requirements of Section III and Code Case N-638 that will not be met and proposes alternatives that provide an acceptable level of quality and safety.

5.1 Alternative to Section XI, IWA-4120(a):

Since all the applicable requirements of the Construction Code cannot be met, the repair/replacement plan is not in literal compliance with IWA-4120(a). As an alternative, STPNOC requests NRC approval of the alternatives to Section III requirements and Code Case N-638 requirements listed in 5.2 through 5.5 below.

Basis of Alternative Providing an Acceptable Level of Quality and Safety

NRC approval of these alternatives to Section III and Code Case N-638 requirements constitutes an alternative method of complying with the requirements of IWA-4120(a). No further justification is required.

5.2 Alternative to Section III, NB-4622.1:

Paragraph NB-4622.1 of the 1971-S1973 Section III Code requires a minimum postweld heat treatment (PWHT) temperature of 1100°F for P-No. 3 material. Performance of this PWHT is not practical for this repair/replacement because the reactor vessel is filled with water and the time spent performing PWHT would result in additional radiation dose to repair personnel.

As an alternative to the PWHT requirements, STPNOC proposes to deposit weld pads on the RVBH in accordance with Code Case N-638. This Code Case allows performance of the repair with a remotely operated machine GTAW process and the ambient temperature temper bead method with 50°F minimum preheat temperature and no PWHT.

Basis of Alternative Providing an Acceptable Level of Quality and Safety

The welding controls of Code Case N-638 assure tempering of the low alloy base material heat-affected zone (HAZ) and previous layers of weld metal such that PWHT is not required for relief of the weld-induced stresses in the HAZ and weld pad.

Code Case N-638 has been preliminarily approved by NRC in Draft Regulatory Guide DG-1091 (Proposed Revision of Regulatory Guide 1.147), December 2001. Table 1 of DG-1091, "Acceptable Section XI Code Cases," lists Code Case N-638 with no exceptions or conditions on its application. Regulatory Guide 1.147, Revision 13 is expected to be published in the near future and adopted by a rulemaking in 10CFR50.55a.

Quality temper bead welds without preheat and postweld heat treatment can be made based on welding procedure qualification test data derived from the machine GTAW ambient temperature temper bead welding process. The results of procedure qualification work undertaken to date indicate that the process produces sound and tough welds. For instance, typical tensile test results have been ductile breaks in the weld metal. In cases where failure was in the weld, the weld tensile strength was greater than the specified minimum tensile strength of the test assembly ferritic steel base material.

Framatome ANP has prepared a welding procedure qualification in accordance with the requirements of Code Case N-638 as described in Appendix A. A detailed review of the requirements of Code Case N-638 and of its application to the BMI repair/replacement weld pad is provided in Appendix B.

The proposed weld repair technique will produce sound welds, providing an acceptable level of quality and safety.

5.3 Alternative to Section III, NB-5245:

There are no nondestructive examination (NDE) requirements in Section III specifically applicable to the proposed weld configuration, which is a reinforced partial penetration nozzle weld. The weld pad on the RVBH is similar to the weld reinforcement described in NB-5244 for attachment of nozzles in vessels with full penetration welds, which requires an ultrasonic examination (UT). The nozzle-to-pad weld is a partial penetration weld. Paragraph NB-5245 provides NDE requirements for partial penetration welds and requires a two-stage liquid penetrant (PT) or magnetic particle (MT) examination. Section III, NB-5244 and NB-5245 are both applicable, but NB-5245 more closely matches the proposed configuration and is selected as the most applicable examination requirement.

The weld pad on the outside surface of the RVBH will be considered a partial penetration weld (refer to NB-3337.3) for Section III NDE purposes. STPNOC proposes to perform both UT (to the extent practical) and PT examinations of the final weld pad in accordance with the requirements of Code Case N-638 in lieu of the two-stage PT or MT required by NB-5245.

Basis of Alternative Providing an Acceptable Level of Quality and Safety

The PT examination required by NB-5245 has limited capability. It can only detect surface connected flaws on the weld surface at half thickness and final thickness. The zero degree UT technique can to detect welding flaws (e.g., lack of fusion, lack of penetration) at the weld-base material interface as well as throughout the weld metal. This UT technique will also examine the base material below the weld pad for laminations and other base material flaws. Additionally, 45- and 60-degree angle refracted longitudinal wave UT beams will be used to examine the weld pad and 1/4 inch of low alloy base material below the weld pad. The creeping wave UT technique will also be applied on the weld pad surface.

After completion of the BMI repair/replacement welding, the modified nozzle welds, including the deposited weld pad, will be visually (VT-2) examined for leakage during a system leakage test in accordance with Code Case N-416-2. This Code Case requires NDE of BMI repair/replacement welds in accordance with the methods and acceptance criteria of Subsection NB of the Section III Code, 1992 Edition. Since the NDE requirements of Code Case N-638 will be used in lieu of Section III NDE requirements to verify the quality of the repair welding, these same Code Case N-638 NDE requirements should take precedence over those in Code Case N-416-2.

Therefore, the UT examinations of the weld pad will meet the methodology requirements of Section XI, Appendix I (i.e., Article 4 or Article 5, as applicable, of Section V, 1989 Edition with 1989 Addenda). The UT acceptance standards will be in accordance with IWB-3000 of Section XI, 1989 Edition. The PT and MT examinations will meet the methodology and acceptance standard requirements of NB-5000 of Section III Code, 1992 Edition.

The zero degree and angle beam UT examinations of the weld pad, the PT examination of the final weld pad surface, and the MT applied pre- and post-welding on the low alloy base material provide an acceptable level of quality and safety.

5.4 Alternative to Code Case N-638, Paragraph 2.1(a):

Paragraph 2.1(a) addresses welding procedure qualification materials and includes the following requirement: "The materials shall be postweld heat treated to at least the time and temperature that was applied to the materials being welded." Since the heat treatment of the material qualified by Framatome ANP for P-No. 3 Group 3 base material does not match the specific PWHT temperature applied to the RVBH material during fabrication, STPNOC requests NRC approval of an alternative method of meeting the intent of this requirement based on the use of the Larsen-Miller parameter.

Basis of Alternative Providing an Acceptable Level of Quality and Safety

Review of the accumulated PWHT time and temperature applicable to the RVBH ferritic low alloy steel material revealed a total time above 1100°F of approximately 17.5 hours with a temperature excursion above 1170°F to 1190°F for 6 hours. The applicable welding procedure qualification record test assembly base material for the temper bead weld pad buildup was subject to PWHT at 1150°F for 60 hours.

The issue is whether the 1150°F PWHT for 60 hours of the Procedure Qualification Record (PQR) test conservatively represents the actual component PWHT (1100°F-1160°F for 11.5 hours and 1190°F for 6 hours) relative to the shift in transition temperature. Logsdon (Ref. 9.1) tested SA-508 Class 2a and SA-533 Grade B Class 2, both P-No 3 Group No. 3 low alloy steel materials used in nuclear component manufacture, for the effect of PWHT temperature and time as measured by change in reference temperature - nil ductility transition (RT_{NDT}). His SA-508 Class 2a data show that RT_{NDT} increases with the Larson-Miller parameter, while his SA-533 Grade B Class 2 data show no change with various PWHT temperatures and times. The Larson-Miller parameter for 1150°F and 48 hours is slightly higher than for 1190°F and 6 hours. Therefore, the PWHT at the lower temperature for the longer time meets the intent of Code Case N-638 since it ensures that the transition temperature of the PQR test is conservative relative to the repaired component. Data by Konkol and Stout (Refs. 9.2 and 9.3) shows the same trend for P-No. 1 Group 1 and 2 carbon steels.

The foregoing evaluation demonstrates that the PWHT of the Framatome welding procedure qualification material exceeds the PWHT of the STP RVBH material. Therefore, the Framatome welding procedure qualification will provide an acceptable level of quality and safety.

5.5 Alternative to Code Case N-638, Paragraph 4.0(b):

Paragraph 4.0(b) includes the requirement that a surface examination and UT examination be performed on the five-inch band of base material surrounding the weld pad after the weld has been at ambient temperature for 48 hours. STPNOC believes there is no need to volumetrically examine this base material because the BMI repair/replacement application is not a typical application of Code Case N-638. STPNOC proposes to perform only an MT examination of the surface of this five-inch band of base material surrounding the weld pad and a PT examination of the base material surface adjacent to the weld pad.

Basis of Alternative Providing an Acceptable Level of Quality and Safety

The UT examination of the base material beyond the weld repair in Code Case N-638 is intended to detect additional base material defects around the defect being excavated and repaired. The provisions of Code Case N-638 are being used to deposit a weld pad on the surface of unflawed low alloy base material. Welding the pad to the RVBH low alloy material is not expected to have any effect on the low alloy material beyond the weld pad, especially within the volume of the low alloy material. The weld pad and the base material below the weld pad will be examined by a zero degree UT technique. The weld pad will also be examined with 45- and 60-degree refracted longitudinal wave beams and a creeping wave technique. Performing UT on the base material beyond the weld pad in this application has no technical basis and is contrary to the STP ALARA program.

An MT examination will be performed on the five-inch radial band of base material around the weld pad after pad deposit. This MT examination will detect surface-connected or near-surface discontinuities (if any) in this band produced by the welding process. Additionally, a PT examination will be performed on the surface of the weld pad, including adjacent portions of the low alloy base material. This assures full PT examination coverage of the edge of the weld pad and HAZ adjacent to the weld pad.

The alternative of an MT examination of the five-inch base material band, with supplemental coverage by PT examination of the material adjacent to the pad, after the weld pad has been deposited will provide an acceptable level of quality and safety.

6. Conclusions

Experience gained by the industry from performance of manual repairs on control rod drive mechanism nozzles on reactor vessel closure heads at other plants indicates that remote automated repair methods are needed to reduce radiation dose to repair personnel and still provide acceptable levels of quality and safety. Consistent with STPNOC ALARA goals, a remote welding technique will be utilized for the repair/replacement of BMI nozzles in the RVBH. This approach for repair/replacement will significantly reduce radiation dose to repair personnel while still maintaining acceptable levels of quality and safety.

The proposed alternative welding methods, welding procedure qualification requirements, and NDE requirements will produce sound, defect-free welds, provide an acceptable level of quality and safety, and will not adversely affect the health and safety of the public.

7. Duration of Proposed Alternative

The approved request for alternative will be implemented during the current Unit 1 forced outage for repairing bottom mounted instrument penetrations.

8. Precedents

Indian Point Units 2 and 3
Docket Nos. 50-247 and 50-286
TAC Nos. MB5712 and MB5713
May 1, 2003

Arkansas Nuclear One Units 1 and 2
Docket Nos. 50-313 and 50-368
TAC Nos. MB4288 and MB4289
April 16, 2003

Crystal River Unit 3
Docket No. 50-302
TAC No. MB2881
December 11, 2001

Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
TAC Nos. MB4311 and MB4312
April 25, 2003

Waterford Unit 3
Docket No. 50-382
TAC No. MB4286
April 16, 2003

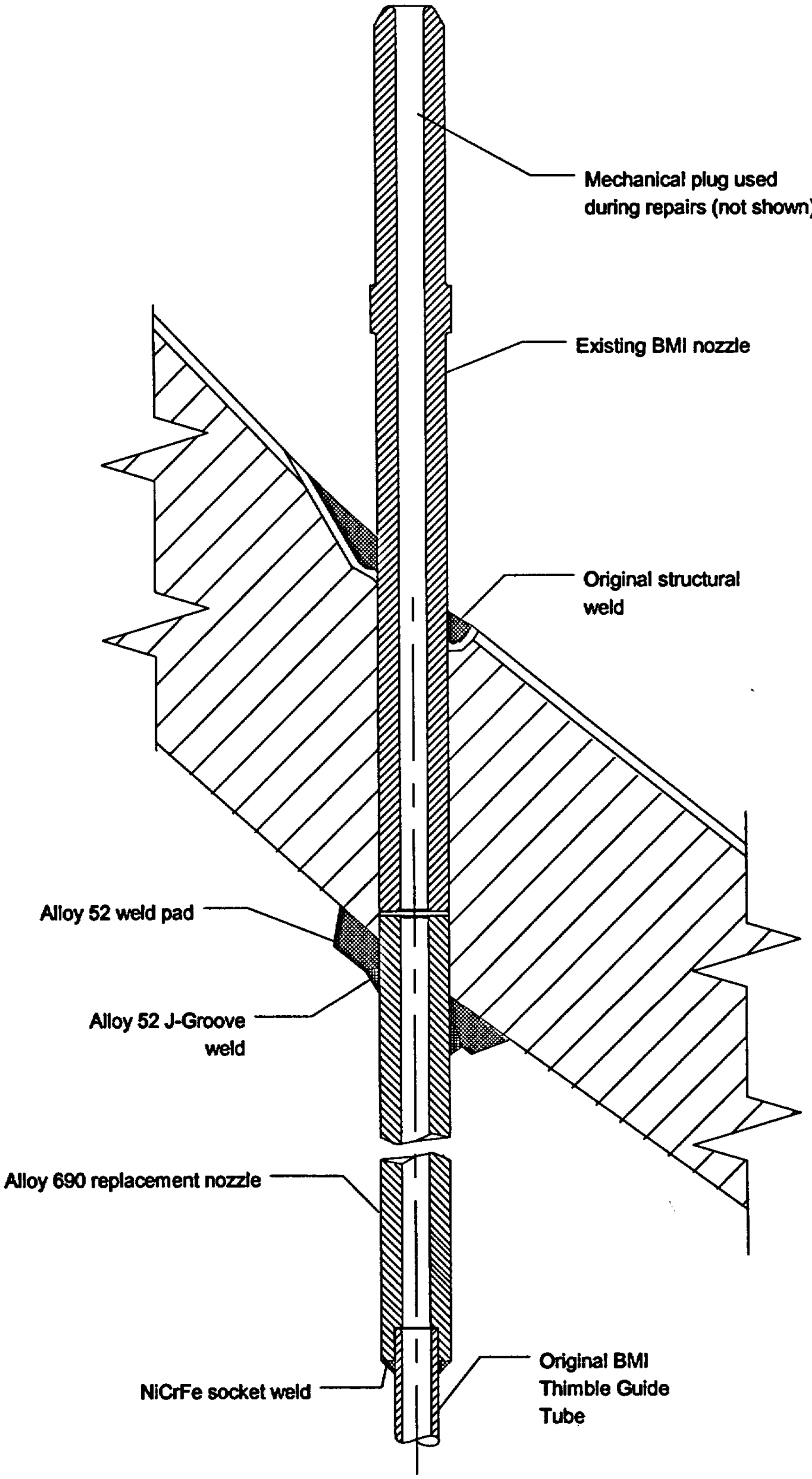
Three Mile Island Unit 1
Docket No. 50-289
TAC No. MB3177
December 4, 2001

9. References

9.1 Logsdon, W. A., "The Influence of Long-Time Stress Relief Treatments on the Dynamic Fracture Toughness Properties of ASME SA508 Cl2a and ASME SA533 Gr B Cl 2 Pressure Vessel Steels," Journal of Materials for Energy Systems, American Society for Metals, Vol. 3, No. 4, March 1982

9.2 Konkol, P. J., "Effects of Long-Time Postweld Heat Treatment on the Properties of Constructional-Steel Weldments," Welding Research Council Bulletin 302, February 1988

9.3 Stout, R. D., "Postweld Heat Treatment of Pressure Vessel Steels," Welding Research Council Bulletin 302, February 1985



Final Configuration
Figure 1

Appendix A

Justification for Ambient Temperature Temper Bead Welding Without Postweld Heat Treatment

A Welding Procedure Qualification has been conducted by Framatome ANP using P-No. 3 Group No. 3 material welded with F-No. 43 filler metal and machine GTAW ambient temperature temper bead welding. The procedure qualification cavity in the P-No. 3 Group No. 3 base material coupon was 2.75 inches deep with a 0.75 inch wide root and 30° side bevels (60° included angle). The P-No. 3 Group No. 3 base material was approximately 11.5 inches thick. As shown in the following table, the Framatome ANP PQR 55-PQ7164 using P-No. 3 Group No. 3 base material exhibited improved Charpy V-notch properties in the HAZ from both absorbed energy and lateral expansion perspectives, compared to the unaffected base material.

Properties of PQR 55-PQ7164	Unaffected Base Material	HAZ
+50°F absorbed energy (ft-lbs.)	69, 55, 77	109, 98, 141
+50°F lateral expansion (mils)	50, 39, 51	59, 50, 56
+50°F shear fracture (%)	30, 25, 30	40, 40, 65
+80°F absorbed energy (ft-lbs.)	78, 83, 89	189, 165, 127
+80°F lateral expansion (mils)	55, 55, 63	75, 69, 60
+80°F shear fracture (%)	35, 35, 55	100, 90, 90

The absorbed energy, lateral expansion, and shear fracture averages were equal to or greater for the HAZ than for the unaffected base material. It is clear from these results that the GTAW ambient temperature temper bead process has the capability of producing acceptable repair welds.

As documented by EPRI (Ref. A.1), research shows that carefully controlled heat input and bead placement allow subsequent welding passes to relieve stress and temper the HAZ of the base material. The use of the machine GTAW temper bead process will allow precise control of heat input, bead placement, and bead size and contour as compared to the shielded-metal arc welding process. The very precise control over these factors afforded by the machine GTAW process provides effective tempering of the HAZ.

The machine GTAW temper bead process uses a welding process that is inherently free of hydrogen. The GTAW process relies on bare welding electrodes and bare wire filler metal with no flux to trap moisture. An inert gas blanket provides shielding for the weld and surrounding metal, which protects the region during welding from the atmosphere and the moisture it may contain, and typically produces porosity-free welds. In accordance with the weld procedure qualification, welding grade argon is used for the inert gas blanket. Typically, the argon is 99.997% pure with no more than 1 ppm hydrogen. A typical argon flow rate would be approximately 15-50 ft^3/hr and would be adjusted to assure adequate shielding of the weld without creating a venturi affect that might draw oxygen or water vapor from the ambient atmosphere into the weld. Specific controls to ensure the welding electrodes, filler metal, and the weld region are free of all sources of hydrogen will be used to further reduce the likelihood of any hydrogen evolution or absorption.

Typically, preheat and post-heat soak are used to mitigate the effects of the solution of atomic hydrogen in ferritic materials prone to hydrogen embrittlement cracking. The susceptibility of ferritic steels is directly related to their ability to transform to martensite with appropriate heat treatment. The P-No. 3 material of the RVBH is able to produce martensite from heating and cooling cycles associated with welding.

Based on Framatome ANP prior welding procedure qualification test data using machine GTAW ambient temperature temper bead welding, quality temper bead welds can be performed with 50°F minimum preheat and no postweld heat treatment. The procedure and controls associated with machine GTAW are acceptable for this application. The preheat and post-heat temperature requirements are unnecessary to ensure an acceptable level of quality and safety. Further, attaining these elevated preheat and post-heat temperatures would result in increased radiation dose to repair personnel due to the need to install and remove heating equipment and insulation.

Reference

A.1 Electric Power Research Institute Report GC-111050, "Ambient Temperature Preheat for Machine GTAW Temperbead Application," November 1998

Appendix B

Application of Code Case N-638 Requirements to BMI Repair/Replacement at South Texas Project

The proposed alternative to the applicable portions of ASME Section XI and Section III involves application of the methodology for ambient temperature temper bead welding specified in Code Case N-638. STPNOC has reproduced the text of N-638 below, except for footnotes, and cited the alternatives requested or specific criteria applicable to the RVBH BMI repair/replacement weld pad after each applicable paragraph. Clarifications of the STP application of Code Case N-638 requirements are made in *italics*.

Case N-638
Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique
Section XI, Division 1

Inquiry: May the automatic or machine GTAW temper bead technique be used without use of preheat or postweld heat treatment on Class 1 components?

Reply: It is the opinion of the Committee that repair to P-No. 1, 3, 12A, 12B, and 12C except SA-302 Grade B, material and their associated welds and P-No. 8 or P-No. 43 material to P-Nos. 1, 3, 12A, 12B, and 12C except SA-302 Grade B, material and may be made by the automatic or machine GTAW temper bead technique without the specified preheat or postweld heat treatment of the Construction Code, when it is impractical, for operational or radiological reasons, to drain the component, and without the nondestructive examination requirements of the Construction Code, provided the requirements of paras. 1.0 through 5.0, and all other requirements of IWA-4000, are met.

1.0 GENERAL REQUIREMENTS

(a) The maximum area of an individual weld based on the finished surface shall be less than 100 sq. in., and the depth of the weld shall not be greater than one-half of the ferritic base metal thickness.

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

(c) 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 Case, provided the depth of repair in the base material does not exceed 3/8 in.

(d) Prior to welding the area to be welded and a band around the area of at least 1½ times the component thickness or 5 in., whichever is less shall be at least 50°F.

(e) 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.

(f) 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 Section IX and the requirements of paras. 2.1 and 2.2.

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.

Section 5.4 of the Request for Alternative (above) provides the basis for STPNOC compliance with this requirement.

(b) Consideration shall be given to the effects of welding in a pressurized environment. If they exist, they shall be duplicated in the test assembly.

(c) Consideration shall be given to the effects of irradiation on the properties of material, including weld material for applications in the core belt line region of the reactor vessel. Special material requirements in the Design Specification shall also apply to the test assembly materials for these applications.

No welding will be performed in the core belt line region of the reactor vessel. Therefore, this requirement has been considered, but is not applicable. Neutron fluence experienced by the new materials and welds associated with this modification is expected to be less than 4E+18 n/cm^2 by the end of 40 calendar years of operation.

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

(e) The maximum interpass temperature for the first three layers of the test assembly shall be 150°F.

(f) The test assembly cavity depth shall be at least one-half the depth of the weld to be installed during the repair/replacement activity and at least 1 in. 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 in. The qualification test plate shall be prepared in accordance with Fig. 1.

(g) 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 subparagraph (i) below, but shall be in the base metal.

(h) Charpy V-notch tests of the ferritic weld metal of the procedure qualification shall meet the requirements as determined in (g) above.

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

(1) 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 test 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 specimens 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.

(2) 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.

(3) The Charpy V-notch test shall be performed in accordance with 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.

(j) The average values of the three HAZ impact tests shall be equal to or greater than the average values of the three unaffected base metal tests.

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 (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 (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 as shown in Fig. 2, Steps 1 through 3, with the heat input for each layer controlled to within ± 10% of that used in the procedure qualification test. Particular care shall be taken in placement of the weld layers at the weld toe area of ferritic material to ensure that the HAZ and ferritic weld 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. For similar-metal welding, the completed weld shall have at least one layer of weld reinforcement deposited. This reinforcement shall be removed by mechanical means, so that the finished surface is essentially flush with the surface surrounding the weld (Fig. 3).

The final two sentences of the paragraph above, including the reference to Figure 3, are not applicable since no similar-metal ambient temperature temper bead welding will be performed. Also "and ferritic weld metal" in the second sentence does not apply.

(d) The maximum interpass temperature for field applications shall be 350°F regardless of the interpass temperature during qualification.

The maximum interpass temperature will be 350°F, verified by calculation rather than thermocouple measurement. The maximum interpass temperature used for the welding procedure qualification was <150°F.

(e) 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.

4.0 EXAMINATION

(a) Prior to welding, a surface examination shall be performed on the area to be welded.

(b) The final weld surface and the band around the area defined in para. 1.0(d) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic examination shall be in accordance with Appendix I.

STPNOC proposes an alternative to the requirement to perform a UT examination on the five-inch radial band of base material beyond the weld pad. Section 5.5 of the Request for Alternative (above) provides the basis for STPNOC's proposed alternative to this requirement.

(c) Areas from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method.

(d) NDE personnel shall be qualified in accordance with IWA-2300.

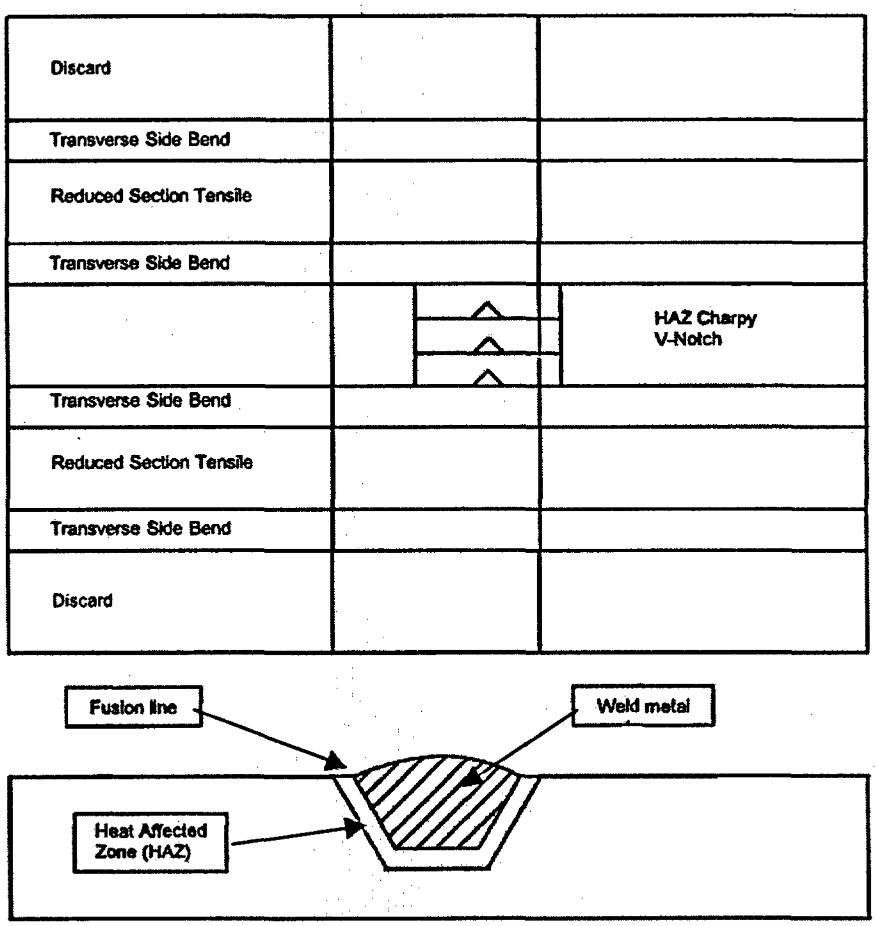
(e) Surface examination acceptance criteria shall be in accordance with NB-5340 or NB-5350, as applicable. Ultrasonic examination acceptance criteria shall be in accordance with IWB-3000. Additional acceptance criteria may be specified by the Owner to account for differences in weld configurations.

See detailed discussion of NDE methodology and acceptance standard requirements in Section 5.3 of the Request for Alternative (above).

5.0 DOCUMENTATION

Use of this Case shall be documented on Form NIS-2.

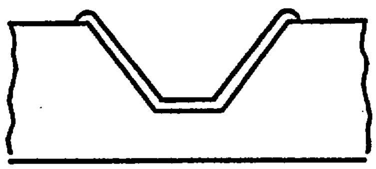
This Request for Alternative (RR-ENG-2-32) will be cited on the Form NIS-2 since all the requirements of this Case are not being met.



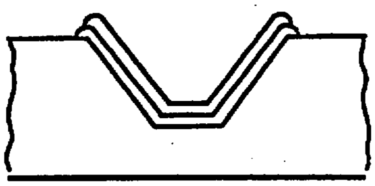
GENERAL NOTE: Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

QUALIFICATION TEST PLATE

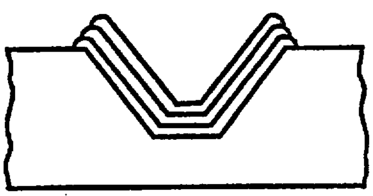
Figure 1



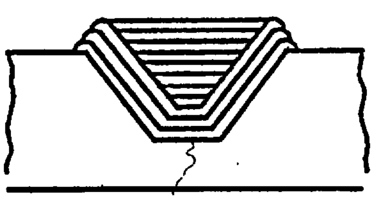
Step 1: Deposit layer one with first layer weld parameters used in qualification.



Step 2: Deposit layer two with second layer weld parameters used in qualification. NOTE: Particular care shall be taken in application of the second layer at the weld toe to ensure that the weld metal and HAZ of the base metal are tempered.



Step 3: Deposit layer three with third layer weld parameters used in qualification. NOTE: Particular care shall be taken in application of the third layer at the weld toe to ensure that the weld metal and HAZ of the base metal are tempered.

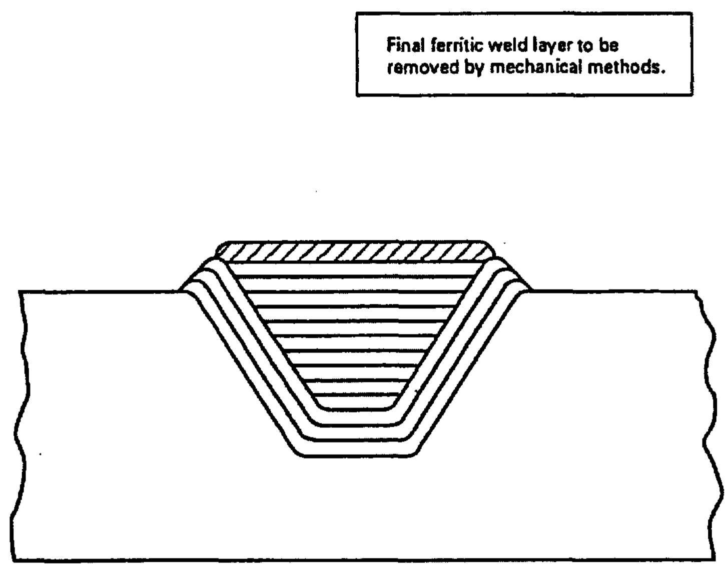


Step 4: Subsequent layers to be deposited as qualified, with heat input less than or equal to that qualified in the test assembly. NOTE: Particular care shall be taken in application of the fill layers to preserve the temper of the weld metal and HAZ

GENERAL NOTE: The illustration above is for similar-metal welding using a ferritic filler material. For dissimilar-metal welding, only the ferritic base metal is required to be welded using steps 1 through 3 of the temperbead welding technique.

AUTOMATIC OR MACHINE (GTAW) TEMPERBEAD WELDING

Figure 2



GENERAL NOTE: For ferritic filler metals the completed weld shall have at least one layer of weld reinforcement deposited. This reinforcement shall be removed by mechanical means, so that the finished surface of the weld is essentially flush with the surface of the component surrounding the repair.

FIG. 3 FINAL FERRITIC WELD LAYER