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An Exelon/British Energy Company

October 18, 2001
5928-01-20299

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

THREE MILE ISLAND, UNIT 1 (TMI UNIT 1)
OPERATING LICENSE NO. DPR-50
NRC DOCKET NO. 50-289

SUBJECT: ASME SECTION XI RELIEF REQUEST ASSOCIATED WITH REACTOR VESSEL HEAD REPAIR (RR-01-18) – Revision 1

References:
1. AmerGen Letter to NRC dated September 12, 2001, "ASME Section XI Relief Requests Associated with Reactor Vessel Head Repair (Revision 2)."
2. Exelon/AmerGen Letter to NRC dated August 31, 2001, "Exelon/AmerGen Response to NRC Bulletin 2001-01, 'Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles.'"
3. AmerGen Letter to NRC dated October 16, 2001, "ASME Section XI Relief Request Associated With Reactor Vessel Head Repair (RR-01-18)"

Pursuant to 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(a)(3)(ii), AmerGen Energy Company, LLC (AmerGen) submitted, in reference 1, revision 2 of four (4) relief requests (No.s RR-01-14 through RR-01-17), incorporating additional information in response to NRC requests. Relief was requested from portions of the ASME Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1995 Edition through 1996 Addenda. An additional request (RR-01-18), proposing to use the ambient temperature temper bead technique with a 50°F minimum preheat temperature and no post weld heat treatment was submitted in reference 3. This request, which references Code Case N-638 modified as described in Attachment 1 to this letter, provides a time savings enhancement to the process permitted by use of the relief requests and alternatives requested in reference 1. The repairs presented in reference 1 are unchanged and those details are not repeated in this letter. This letter provides additional information requested by the NRC in a telephone conference on October 18, 2001. Changes from the October 16, 2001 submittal in Attachment 1 are indicated with revision bars.

The AmerGen repair plan institutes machine remote processes for CRDM nozzle repair similar to that used at the Oconee Nuclear Station – Unit 2 with the enhancements described in this letter, which have just been just been performed at the Crystal River

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Nuclear Plant. The projected time savings results from being able to perform CDRM nozzle repairs concurrently. Additionally, the ambient technique will reduce the heat stress for personnel required in the vicinity of the reactor head during the repair process.

The results of the visual inspections described in Reference 2 and performed on the RV head indicated that the potential number of CRDM nozzles welding repair may exceed the number of repairs in the original T1R14 Outage scope. The suspect nozzles identified by the visual inspections are subsequently examined by UT to confirm through wall cracking of the nozzle. Depending on the results of the nozzle UT examinations, AmerGen intends to begin the CRDM nozzle repairs concurrent with TC repair work which requires the use of preheat using the methods presented in Reference 1 (use of the Requests for Relief Nos. RR-01-14, RR-01-15, RR-01-16, and RR-01-17). If UT results confirm the need for CRDM nozzle repairs beyond the number that was planned, the additional CRDM nozzle repair work would continue beyond the completion of TC nozzle repairs. At that time we may desire to terminate preheat and perform the balance of CRDM repairs using the ambient temperature temper bead technique (use of the Requests for Relief Nos. RR-01-14, RR-01-15, RR-01-17, and RR-01-18). Based on the efficiencies projected from use of this alternative (RR-01-18), it is estimated that up to 10 days of critical path outage time can be saved assuming that all of the 12 CRDM nozzles undergoing UT examination need repair.

Pursuant to 10 CFR 50,55a(a)3(i), AmerGen has determined that use of the proposed alternative provides an acceptable level of quality and safety. NRC approval is requested by October 19, 2001.

Very truly yours,

George B Rockbel III for

Michael P. Gallagher
Director – Licensing and Regulatory Affairs
Mid-Atlantic Regional Operating Group

Attachment 1 – Relief Request No. RR-01-18

cc: H. J. Miller, USNRC, Regional Administrator, Region I
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ATTACHMENT 1

TMI UNIT 1

THIRD TEN-YEAR INTERVAL

ASME Section XI Relief Requests Associated With Reactor Vessel Head Repair

Relief Request No. RR-01-18

Three Mile Island Unit 1
Request for Relief No. RR-01-18
"Ambient Temperature Temper Bead Repair Technique"

I. COMPONENT IDENTIFICATION

Code Class:	Class 1
Reference:	ASME, Section XI; 1995 Edition through 1996 Addenda
Examination Categories:	B-O (Section XI)
Item Number:	B14.10 (Section XI)
Description:	Use of Ambient Temperature Temper Bead Welding Technique
Component Numbers:	Reactor Pressure Vessel (RPV) Closure Head Control Rod Drive Mechanism (CRDM) Nozzle Penetrations - All as necessary

II. CODE REQUIREMENTS FROM WHICH AN ALTERNATIVE IS REQUESTED

a) ASME B&PV Code, Section XI 1995 Edition through 1996 Addenda, Subparagraph IWA 4410 requires that: "Repairs/replacements activities shall be performed in accordance with the Owner's requirements and the original Construction Code of the component or system..." and "Later Editions and Addenda of the Construction Code or later different Construction Code, either in its 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-4600 may be used for Class 1 components.

b) In accordance with 10CFR50.55a(a)(3)(i), AmerGen is requesting relief from the following portion of ASME Section XI, subparagraph IWA-4410(c) to perform RPV CRDM nozzle penetration repairs: "Alternatively, the applicable requirements of IWA-4600 may be used for welding..." As an alternative to Section XI, AmerGen is proposing to perform the repair with a remotely operated weld tool, utilizing the machine Gas Tungsten-Arc Welding (GTAW) process and the ambient temperature temper bead method with 50°F minimum preheat temperature and no post weld heat treatment. The description of the proposed alternative is provided in the following section.

III. PROPOSED ALTERNATIVE PROVISIONS

AmerGen plans to perform CRDM nozzle penetration repairs by welding the RPV Head (P-No. 3) and CRDM nozzle (P-No. 43) base materials with (F-No. 43) filler material. The proposed alternative to the applicable portion of ASME, Section XI is the application of the methodology for ambient temperature temper bead repair

outlined in Code Case N-638. AmerGen is not requesting approval to use the as-written Code Case for this application, but rather to apply the methodology to a partial penetration weld, which was not specifically addressed by the Code Case. Since the methodology was originally written to address repairs to full penetration welds in Reactor Vessels, and the application for TMI Unit 1 involves making new partial penetration welds in Reactor Vessels, some of the as-written requirements either do not apply or require substitution of equivalent requirements applicable to partial penetration welds. Therefore, the following text has been prepared using the Code Case methodology as a template (in italics font), with the specific criteria applicable to this modification identified and appropriately dispositioned.

1.0 GENERAL REQUIREMENTS

(a) The maximum area of an individual weld based on the finished surface will be 100 sq. in., and the depth of the weld will 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.

Note that Relief Request No. RR-01-14 in reference 1 incorporates the use of Alloy 690 based weld filler material.

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

Note that peening will not be performed for the nozzle repair. Therefore, this requirement is not applicable.

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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.

Note that no relief is being requested in this area.

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.

(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.

Note that the nozzle repair will not be performed in a pressurized environment. Therefore, this requirement is not applicable.

(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.

Note that no repair welding will be performed in the core belt line region of the reactor vessel. Therefore this requirement has been considered, but is not applicable.

(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 will 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), 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 subparagraph (g) above.

Note that no ferritic weld metal will be used. Therefore this requirement is not applicable.

(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 subparagraph (g). 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 coupons for HAZ impact specimens will 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 will 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, Fig. 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 will 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.

Note that the dissimilar metal welds will be made using F-No. 43 weld metal (QW-432) for P-No. 43 to P-No. 3 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 in. 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 the ferritic material to ensure that the HAZ and ferritic weld metal are tempered. Subsequent layers will 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).

Note that the final two sentences, including Figure 3, of the paragraph above are not applicable since no similar-metal welding will be performed. Figure 3 is not included in this letter.

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

Proposed: The maximum interpass temperature for field applications will be 350°F, verified by calculation rather than thermocouple measurement, regardless of the interpass temperature during qualification.

Justification: See Relief Request No. RR-01-17 in Reference 1.

(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 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]

Proposed: The final weld will be examined using surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours (i.e., Relief Request No. RR-01-16 submitted in reference 1 will not be utilized in conjuction with this Request for Relief No. RR-01-18). However, the band around the area defined in paragraph 1.0(d) cannot be examined due to the physical configuration of the partial penetration weld. See Relief Request No. RR-01-15 in Reference 1.

The ultrasonic examination will not be performed in accordance with Appendix I of Section XI.

Justification: The purpose for the examination of the band is to assure all flaws associated with the weld repair area have been removed or addressed. In the case of this repair, the repair welding will be performed remotely from the known defect. The final examination of the new weld repair and immediately surrounding area within the band will be sufficient to verify that defects have not been induced in the low alloy reactor vessel (RV) head material due to the welding process.

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[3] Refer to the 1989 Edition with 1989 Addenda and later Editions and Addenda.

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Appendix I is a Section XI reference for inservice inspection and is not applicable to this Section III designed weld. The ultrasonic examination will be performed in accordance with ASME Section III, 1989 Edition, no addenda. See Relief Request No. RR-01-15 in Reference 1.

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

Proposed: Thermocouples will not be used to monitor interpass temperature. See Request for Relief No. RR-01-17, in Reference 1. Thermocouples will not be used to monitor 50°F minimum preheat. Instead preheat will be monitored using contact pyrometers, on accessible areas of the closure head external surfaces.

Justification: The use of contact pyrometers will reduce the stay time and dose associated with attaching, grinding, and surface examination when removing thermocouples. The use of contact pyrometers is an equivalent method to that of thermocouples when verifying the minimum 50°F preheat. The TMI Unit 1 welding program permits the use of contact pyrometers for checking preheat as stated: "Preheat temperature shall be verified by temperature indicating crayons, contact pyrometers, or thermocouples..."

(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.

Proposed: Surface examination acceptance criteria will be in accordance with NB-5350. Ultrasonic examination acceptance criteria will be in accordance with NB-5330. Additional acceptance criteria may be specified by the Owner to account for differences in weld configurations.

Justification: Since ASME XI, IWB-3000 does not provide acceptance criteria for ultrasonic and surface examinations of partial penetration welds in RV heads, ASME Section III, NB-5000 will be used to evaluate indications. Since the design basis for the partial penetration weld is established by ASME Section III, 1989 Edition with no addenda, the examination acceptance standards of NB-5330 (UT) and NB-5350 (PT) are required to compliment the design.

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5.0 DOCUMENTATION

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

IV. BASIS FOR ALTERNATIVE

A detailed description of the repair process using preheat and its basis is provided in Reference 1. Use of this proposed alternative is being requested in accordance with 10 CFR 50.55a(a)(3)(i). The basis for the proposed relief request using an ambient temperature temper bead welding process in providing an acceptable level of quality and safety to the temper bead welding process in ASME, Section XI is presented in the following discussion:

a) 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 and base metal.

As shown below, the FRA-ANP PQR 7164 using P-No. 3, Group No. 3 base material exhibited improved Charpy V-notch properties in the HAZ from both an absorbed energy and lateral expansion perspective as compared to the unaffected base material.

PQR 7164	**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, 80.

The absorbed energy, lateral expansion, and percent shear were significantly greater for the HAZ than the unaffected base material at both test temperatures. It is clear from these results that the GTAW temper bead process has the capability of producing acceptable repair welds.

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b) AmerGen has concluded that quality temper bead welds can be performed with 50°F minimum preheat and no post heat treatment based on ASME committee approval of Code Case N-638 and FRA-ANP prior welding procedure qualification test data using machine GTAW ambient temperature temper bead welding. FRA-ANP has previously qualified the GTAW temper bead process in support of ASME approval of Code Case N-606-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique for Boiling Water Reactor (BWR) CRD Housing/Stub Tube Repairs." The qualifications were performed at room temperature with cooling water to limit the maximum interpass temperature to a maximum of 100°F. The qualifications were performed on the same P-3 Group-3 base material as proposed for the CRDM repairs, using the same filler material, i.e. Alloy 52 AWS Class ERNiCrFe-7, with similar low heat input controls as will be used in the repairs. Also, the qualifications did not include a post weld heat soak. The qualification of the ambient temperature temper bead welding process demonstrates that the proposed alternative provides an acceptable level of quality and safety.

c) The proposed alternative repair technique has been demonstrated as an acceptable method for performing RPV repairs. The ambient temperature temper bead technique has been approved by the ASME committee per Code Case N-638. The ambient temperature temper bead technique has been approved by the NRC as having an acceptable level of quality and safety and used successfully at several utilities (Duane Arnold, Nine Mile Point and Fitzpatrick).

Therefore, based on the discussion above, AmerGen has determined that the proposed alternative provides an acceptable level of quality and safety.

V. IMPLEMENTATION SCHEDULE

TMI Unit 1 is currently in its Cycle 14 Refueling Outage (T1R14) and making preparations to perform RPV Head CRDM nozzle repairs. NRC approval of this relief request is requested by October 19, 2001 prior to beginning the CRD nozzle repair work.

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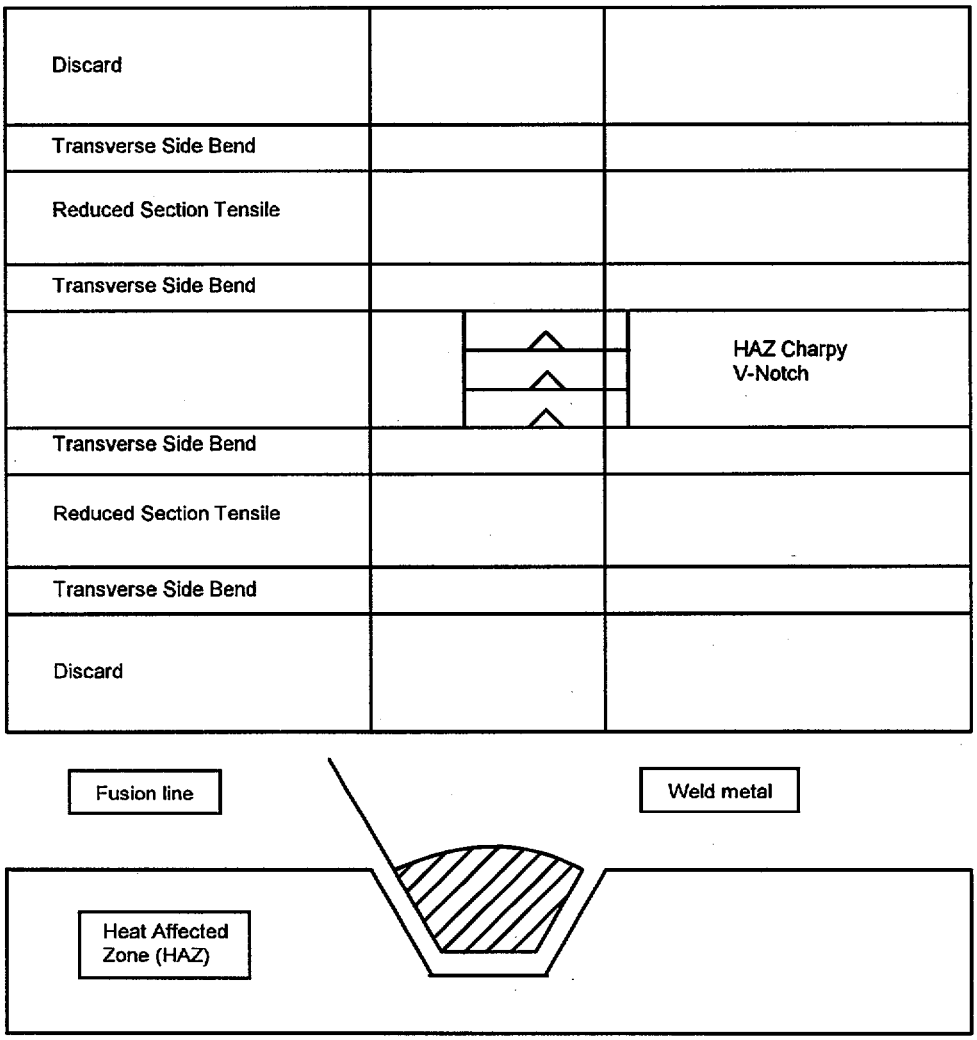

GENERAL NOTE: Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

QUALIFICATION TEST PLATE

Figure 1

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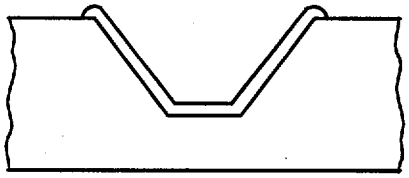
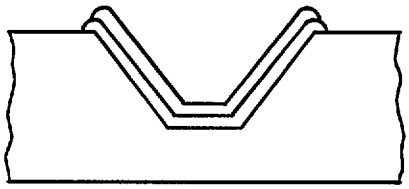
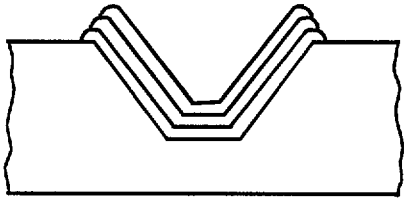


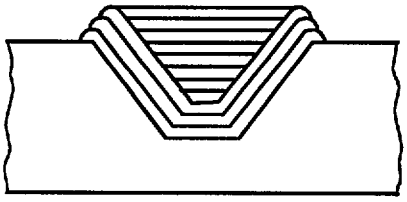
Step 1: Deposit layer one with first layer weld parameters used in qualification.



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