FENOC

FirstEnergy Nuclear Operating Company

Davis-Besse Nuclear Power Station
5501 North State Route 2
Oak Harbor, Ohio 43449-9760

Howard W. Bergendahl
Vice President - Nuclear

419-321-8588
Fax: 419-321-8337

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United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Subject: 10 CFR 50.55a Requests for Alternative Pursuant to American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Inservice Inspection Requirements at the Davis-Besse Nuclear Power Station – Third Ten-Year Interval (RR-A25)

Ladies and Gentlemen:

The purpose of this letter is to request NRC approval of alternatives to the requirements of 10 CFR 50.55a and the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) for the Davis-Besse Nuclear Power Station, Unit 1 (DBNPS) Third Ten-Year Inservice Inspection Interval. These requests propose alternatives to ASME Code Section XI repair requirements for the Reactor Vessel Closure Head Control Rod Drive Mechanism nozzle #3 and nozzle #11 areas.

Review and approval of the attached requests for alternative is requested by May 16, 2002. If you have any questions or require additional information, please contact Mr. David H. Lockwood, Manager-Regulatory Affairs, at (419) 321-8450.

Very truly yours,

Attachments

cc: J.E. Dyer, Regional Administrator, NRC Region III
S.P. Sands, DB-1 NRC/NRR Project Manager
C.S. Thomas, DB-1 Senior Resident Inspector
Utility Radiological Safety Board

A047

DBNPS ISI Program – Third Ten-Year Interval
Relief Request RR-25

(31 Pages Follow)

FIRST ENERGY NUCLEAR OPERATING COMPANY
DAVIS-BESSE UNIT 1
THIRD 10-YEAR INTERVAL
RELIEF REQUEST RR-A25

System/Component(s) for Which Relief is Requested:

Reactor Vessel Closure Head (RVCH). The ASME Code Class is Class 1.

Code Requirement:

IWA-4400 of the 1995 Edition through the 1996 Addenda of ASME Section XI provides welding, brazing, metal removal, and installation requirements related to repair/replacement activities.

IWA-4410(a) states: "Repair/replacement activities shall be performed in accordance with the Owner's Requirements and the original Construction Code of the component or system except as provided in IWA-4410(b), (c), and (d).

IWA-4410(c) states: "Alternatively, the applicable requirements of IWA-4600 may be used for welding..."

IWA-4600(b) states: "When post weld heat treatment is not to be performed, the following provisions may be used.

(1) The welding methods of IWA-4620, IWA-4630, or IWA-4640 may be used in lieu of the welding and nondestructive examination requirements of the Construction Code or Section III, provided the requirements of IWA-4610 are met.

IWA-4630 provides requirements for welding on dissimilar metal welds made without the specified post weld heat treatment.

Code Requirement from Which Relief is Requested:

Because of the risk of unacceptable distortion of the RVCH configuration, it is not feasible to apply the post weld heat treatment requirements of the original Construction Code for this modification. The alternative temper bead methods for dissimilar metal welds (IWA-4610 and IWA-4630) of the 1995 Edition through the 1996 Addenda of ASME Section XI require elevated temperature preheat and post weld soaks that would result in increased radiation dose to repair personnel due to the need to install heat treatment equipment.

As an alternative to the requirements of IWA-4600, the FirstEnergy Nuclear Operating Company (FENOC) proposes to perform the repair of the RVCH with a remotely operated weld tool, utilizing the machine Gas Tungsten-Arc Welding (GTAW) process and the ambient temperature temper bead technique with 50°F minimum preheat and no post weld heat treatment for the welded buttering on the low alloy steel RVCH base material. The final forged insert plug will be attached with a similar metal weld to the Alloy 52 buttered RVCH in accordance with ASME III NB requirements for P-No. 43 to P-No. 43 materials. The activities will be conducted in accordance with the 1995 Edition through the 1996 Addenda of ASME Section XI and the alternative requirements discussed below. Relief is requested to use an alternative in accordance with 10 CFR 50.55a (a)(3)(i) to use the ambient temperature temper bead welding method in lieu of the preheat and post weld soak temperatures in ASME Section XI for the buttering of the RVCH base material.

Table 1 provides a comparison of the Section XI Code Requirements to the requirements for the ambient temperature temper bead method as proposed in this relief request. As noted in Table 1, relief is requested from the following Code requirements.

- IWA-4610(a) – Thermocouples
- IWA-4611.1 – Lack of bond at the RVCH/clad interface, flaws within the original J-groove weld including characterization of flaws within the J-groove weld (IWA-3300/IWB-3420), and successive inspections (IWB-3142.4)
- IWA-4633.2(c) – Ambient Temperature Temper Bead Welding in accordance with the methodology of Code Case N-638
- IWA-4610(b) – Interpass Temperature
- IWA-4631(b) – Surface area of the RVCH weld buttering
- IWA-4610(a) – Preheat Temperature/ Postweld Hydrogen Bake

Alternative Welding Method (Methodology of N-638 and Alternatives):

The FENOC plans to butter the RVCH (P-No. 3 Group No. 3 base material) with F-No. 43 filler material. The proposed alternative to the applicable portions of ASME Section XI is the application of the methodology for ambient temperature temper bead welding outlined in Code Case N-638. The FENOC is not requesting approval to use Code Case N-638 for this application, but to apply its methodology. Therefore, the following text has been prepared using Code Case N-638 methodology as a template, with specific criteria applicable to the RVCH repairs identified. Clarifications to the Code Case template are made in Italics font.

1.0 GENERAL REQUIREMENTS:

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

The temper bead welded buttering surface will exceed 100 square inches. The buttering will consist of 3/16-inch minimum NiCrFe weld buildup on the inner surface (sidewall) of the opening. (See Figure 6 and Basis for Relief for IWA-4631(b)).

(b) Repair/replacement activities on a dissimilar-metal weld 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.

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

(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 inches, whichever is less) will be at least 50°F.

Preheat temperature will be monitored using either Thermocouples (TCs) or contact pyrometer(s) placed at a readily accessible location(s) on the RVCH exterior surface.

(e) Welding materials will meet the Owner's Requirements and the Construction Code and Cases specified in the repair/replacement plan. Welding materials will be controlled so that they are identified as acceptable until consumed.

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

Peening will not be used.

2.0 WELDING QUALIFICATIONS:

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

2.1 Procedure Qualification

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

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

Welding will not be performed in a pressurized environment. Therefore, this requirement is not applicable.

(c) Consideration will 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 will 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.

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

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

(f) The test assembly cavity depth will be at least one-half the depth of the weld to be installed during the repair/replacement activity, and at least 1 inch. The test assembly thickness will be at least twice the test assembly cavity depth. The test assembly will be large enough to permit removal of the required test specimens. The test assembly dimensions surrounding the cavity will be at least the test assembly thickness, and at least 6 inches. The qualification test plate will be prepared in accordance with Figure 1.

(g) Ferritic base material for the procedure qualification test will 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.

No ferritic weld material will be used. Therefore, this requirement is not applicable.

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

1. The specimens will 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 will be taken transverse to the axis of the weld and etched to define the HAZ. The notch of the Charpy V-notch specimens will 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 will be oriented parallel to the principal direction of rolling or forging.

3. The Charpy V-notch test will be performed in accordance with SA-370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products. Specimens will be in accordance with SA-370, Figure 11, Type A. The test will 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 will 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 will 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 will 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 will be buttered with a deposit of at least three layers to achieve at least 1/8 inch overlay thickness as shown in the attached Figure 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 will 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 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 (Attached Figure 3).

The final two sentences, including Fig. 3 of the paragraph above are not applicable since no similar-metal ambient temperature temper bead welding will be performed.

(d) The maximum interpass temperature for field applications will 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 < 100°F.

(e) Particular care will 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 will be performed on the area to be welded.

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

The buttered portion of the RVCH will be examined using the liquid penetrant and the ultrasonic examination methods after the completed weld has been at ambient temperature for at least 48 hours. The final weld, which also includes *the buttered portion of the RVCH will be examined using the liquid penetrant and radiographic examination methods in accordance with ASME Section III, 1992 Edition, No Addenda.*

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

Thermocouples or contact pyrometer(s) will be used to monitor preheat temperature. Interpass temperature measurement will not be performed. Preheat temperature monitoring will take place outside the 1½ T band on readily accessible closure head exterior surface(s). If thermocouples are welded to the surface, the area from which the thermocouple is removed will be ground and examined using a surface examination method.

(d) Nondestructive Examination (NDE) personnel will be qualified in accordance with IWA-2300.

Nondestructive Examination (NDE) personnel will be qualified in accordance with IWA-2300 or NB-5500.

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

The acceptance criteria of the 1992 Edition of ASME Section III is used in accordance with Code Case N-416-1. Code Case N-416-1 is approved in NRC Regulatory Guide 1.147, Revision 12.

The surface examination acceptance criteria will be in accordance with NB-5350 of the 1992 Edition of ASME Section III, No Addenda.

The ultrasonic examination acceptance criteria will be in accordance with NB-5330 of the 1992 Edition of ASME Section III, No Addenda.

The radiographic examination acceptance criteria will be in accordance with NB-5320 of the 1992 Edition of ASME Section III, no Addenda.

5.0 Documentation

Repairs will be documented on Form NIS-2.

The records required by IWA-6000 will be generated.

Basis for Relief:

The CRDM nozzle #3 bore will be removed from the RVCH as part of the investigation portion of the root cause plan. An automated abrasive water jet tool operating above the RVCH will remove the degraded area of the RVCH including the bores for CRDM nozzles #3 and #11 to create an approximate 17-1/2 inch through wall penetration in the RVCH.

The following activities will be performed to install the Alloy 690 forged disk into the CRDM nozzle #3 bore.

a) The CRDM nozzle #3 bore will be machined to its final 17-1/2 inch dimension and PT examined. (Figure 4)

b) Stainless steel (Type 304) gas shield cover and runoff rings will be seal welded with Alloy 52 filler metal on the RVCH inner surface at the CRDM nozzle #3 bore and a stainless steel runoff ring will be similarly welded on outer surface of the RVCH at the bore to facilitate buttering of the bore. (Figure 5)

c) The face of the CRDM nozzle #3 bore will be buttered with a remotely operated machine Gas Tungsten Arc Welding (GTAW) process weld head, using the ambient temperature temper bead process with ERNiCrFe-7 (Alloy 52) filler metal and 50°F minimum preheat temperature. (Figure 6)

d) The final buttering will be machined and/or ground to obtain a minimum of 3/8 inch deposit. (Figure 7)

e) Following a Code-required 48 hour hold period, the final buttering will be PT and UT examined.

f) The Alloy 690 forged insert will be welded to the buttering with a remotely operated machine GTAW weld head, using ERNiCrFe-7 (Alloy 52) filler metal. (Figure 8)

g) The closure weld will be ground for NDE and PT and RT of the weld. Grinding of the surrounding opening will be performed to blend into the localized OD surface degradation.

h) The closure weld will be PT and RT examined.

The major steps for the installation of the CRDM nozzle penetration plug is illustrated in Figures 3 through 8.

IWA-4610(a) – Thermocouples

IWA-4610(a) requires that thermocouples and recording instruments be used to monitor the metal temperature during welding.

The RVCH preheat temperature will be essentially the same as the reactor building ambient temperature. Therefore, RVCH preheat temperature monitoring in the weld region and using thermocouples is unnecessary and would result in additional personnel dose associated with thermocouple placement and removal. Consequently, preheat temperature verification by contact pyrometer on accessible areas of the RVCH is sufficient.

In lieu of using thermocouples for interpass temperature measurements, calculations show that the maximum interpass temperature will never be exceeded based on a maximum allowable low welding heat input, weld bead placement, travel speed, and conservative preheat temperature assumptions. The calculation supports the conclusion that using the maximum heat input through the third layer of the weld, the interpass temperature returns to near ambient temperature. Heat input beyond the third layer will not have a metallurgical affect on the low alloy steel HAZ.

The calculation is based on a typical inter-bead time interval of at least five minutes. The inter-bead interval is based on:

1) the time required to explore the previous weld deposit with the remote cameras housed in the weld head,
2) time to shift the starting location of the next weld bead circumferentially away from the end of the previous weld-bead, and
3) time to shift the starting location of the next bead axially to insure a 50% weld bead overlap required to properly execute the temper bead technique.

A welding mockup on the full size Midland RVCH, which is similar to the Davis-Besse RVCH, was used to demonstrate the welding technique for CRDM Nozzle repairs. During the mockup, thermocouples were placed to monitor the temperature of the head during welding. Thermocouples were placed on the outside surface of the closure head within a 5-inch band surrounding the CRDM nozzle. Three other thermocouples were placed on the closure head inside surface. One of the three thermocouples was placed 1½ inches from the CRDM nozzle penetration on the lower hillside. The other inside surface thermocouples were placed at the edge of the 5 inch band surrounding the CRDM nozzle, one on the lower hillside, the second on the upper hillside. During the mockup, all thermocouples fluctuated less than 15°F throughout the welding cycle. Based on past experience, it is believed that the temperature fluctuation was due more to the resistance heating temperature variations than the low heat input from the welding process. For the Midland RVCH mockup application 300°F minimum preheat temperature was used. The time to complete a buttering pass in this repair will be greater than the time required to complete a CRDM nozzle pass as the weld length is longer. Therefore, for ambient temperature conditions used for this repair, maintenance of the 350°F maximum interpass temperature will not be a concern.

RVCH preheat temperature monitoring in the weld region and using thermocouples is unnecessary and would result in additional personnel dose associated with thermocouple placement and removal.

IWA-4611.1 – Lack of bond at the RVCH/clad interface and flaws within the original J-groove weld including characterization of flaws within the J-groove weld (IWA-3300/IWB-3420), and successive inspections (IWB-3142.4)

The approximate 17½ inch diameter through wall penetration in the RVCH will remove the degraded area of the RVCH including the bores for CRDM nozzles #3 and #11. After the penetration is machined to its 17-1/2 inch diameter final dimension, the bore will be liquid penetrant (PT) examined. The requirements of IWA-4611.1 allow two options for determining the disposition of discovered defects. The defects are either removed as part of the repair process or left as-is and evaluated per the rules of IWB-3600.

Existing UT data from under the cavity area, though inconclusive, suggests that a lack of bond may exist at the clad to base metal interface. Due to the laminar type orientation of the potential flaw(s) there is no driving mechanism expected that would cause the flaw to propagate in such a manner to adversely affect the pressure boundary or structural integrity of the final forged disk to RVCH weld. Therefore any PT indications indicating a lack of bond at the RVCH base material to clad fusion line (interface) will be considered acceptable. This area will be weld over laid during the subsequent buttering process with Alloy 52 filler metal. Grinding associated with the removal of the buttering runoff tab or the weld joint backing strip will be controlled to leave sufficient clad thickness to preclude entry of the reactor coolant into any void between the clad and RVCH base material.

The approximate 17½ inch diameter through wall penetration in the RVCH will not result in the complete removal of the original CRDM nozzle #11 to RVCH J-groove weld or associated buttering. In the event that unacceptable flaw(s) are detected in the RVCH J-groove weld, they will be ground to reduce the maximum possible flaw size. Using worst case (maximum) assumptions with the geometry of the as-left weld, the postulated crack will be assumed to begin at the intersection of the RVCH inner diameter surface and the CRDM nozzle bore and propagate slightly into the RVCH low alloy steel. It is fully expected that such a crack would then blunt and arrest at the butter-to-head interface. The depth and orientation are worst-case assumptions for cracks that may occur in the remaining J-groove partial penetration weld configuration. The maximum possible flaw size will be based on the premise that flaws have not significantly propagated into the low alloy steel RVCH base material, and will be justified using ASME XI criteria. A fracture mechanics evaluation will be performed to determine if degraded J-groove weld material could be left in the RVCH, with no examination to size any flaws that might remain following the repair. It will be postulated that a radial crack in the Alloy 182 weld metal would propagate by Primary Water Stress

Corrosion Cracking (PWSCC) through the weld and butter, to interface with the low alloy steel RVCH.

Remaining portions of the original J-groove weld and buttering in the penetration bore will be overlaid either by the ID buttering of the 17½ inch RVCH opening, or by manual welding methods, using Alloy 52 or 152 on the face of the original J-groove weld and adjacent edge of the buttering. Unacceptable PT indications in the original penetration buttering will be embedded. If no unacceptable PT defects are detected, then grinding to reduce flaw size will not be required, and the entire J-groove weld and buttering will be weld overlaid as described above.

The assumptions of IWB-3600 are that the cracks are fully characterized in order to compare the calculated crack parameters to the acceptable parameters addressed in IWB-3500. The original CRDM nozzle to closure head J-groove weld is extremely difficult to examine ultrasonically (UT) due to the configuration as can be seen in Figure 4. This condition precludes ultrasonic coupling and control of the sound beam needed to perform flaw sizing with reasonable confidence in the measured flaw dimension. Therefore, it is impractical to, and presently no NDE technology has been identified, that can characterize the flaw geometry that may exist therein. Not only is the configuration not conducive to UT, but the dissimilar metal interface between the Alloy 600 weld and the low alloy steel RVCH increases the UT difficulty. Furthermore, due to limited accessibility from the RVCH outer surface and the proximity of adjacent nozzle penetrations, it is impractical to scan from this surface on the RVCH base material to detect flaws in the vicinity of the original weld. The FENOC proposes to accept these flaws by analysis of the worst case that might exist in the J-groove weld.

This analysis will provide a acceptable level of safety and quality in ensuring that the RVCH remains capable of performing it design function for the remaining plant life, with flaws existing in the original J-groove weld. For the reasons described above, areas containing flaws accepted by analytical evaluation will not be reexamined as required by IWB-3142.4.

IWA-4633.2(c) – Ambient Temperature Temper Bead Welding in accordance with the methodology of Code Case N-638

The welding procedure has been qualified in accordance with the requirements of paragraphs 2.0 and 2.1 specified in the Alternative Welding Method.

Quality temper bead welds, without preheat and post weld heat treatment, can be made based on welding procedure qualification test data derived from the machine GTAW ambient temperature temper bead welding process.

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.

A Welding Procedure Qualification has been conducted using P-No. 3 Group No. 3 to P-No. 8 base material welded with F-No. 43 filler metal using ambient temperature temper bead welding. The Procedure Qualification groove in the P-No. 3 Group No. 3 to P-No. 8 base material coupon was 1 inch deep with a ¼ inch wide root and 30° side bevels (60° included angle). The P-No. 3 Group No. 3 base material was approximately 2¼ inches thick and the P-No. 8 base material was 1 inch thick. As shown below, the Framatome-ANP Procedure Qualification Record (PQR) 55-PQ7109 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-PQ7109

PQR 55-PQ7109	Unaffected Base Material	HAZ
0°F absorbed energy (ft-lbs.)	138, 135, 131	135, 141, 181
0°F lateral expansion (mils)	38, 87, 78	80, 81, 81
0°F shear fracture (%)	100, 100, 100	100, 100, 100

The absorbed energy, lateral expansion, and percent shear averages were equal to or greater for the HAZ than 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.

Framatome-ANP has also 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 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-No. 3 Group No. 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.

Based on FRA-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 post weld heat treatment.

IWA-4610(b) – Interpass Temperature

The Ambient Temperature Temper Bead Welding Procedure has a maximum interpass temperature of 350°F as specified in Code Case N-638. The welding procedure was qualified with an interpass temperature of 100°F. Per QW-256 of ASME Section IX an increase greater than 100°F is a supplementary essential variable. The procedure qualification requirements specified in Code Case N-638 imposes a 150°F maximum interpass temperature during the welding of the procedure qualification. This requirement restricts base metal heating during qualification that could produce slower cooling rates that are not achievable during field applications. However, this requirement does not apply to field applications as a 350°F maximum interpass temperature is a requirement in Section 3.0 of the Code Case N-638. The higher interpass temperature is permitted because it would only result in slower cooling rates which could be helpful in producing more ductile transformation products in the heat affected zone. As indicated previously, the actual maximum interpass temperature in situ will be near the preheat temperature.

IWA-4631(b) – Surface area of the RVCH weld buttering

The surface area of the weld butter will be approximately 370 square inches which is greater than the 100 square inches permitted in IWA-4631(a). The 100 square inch limitation is also contained in Code Case N-638 whose methodology was used to establish the proposed Alternative Welding Method. Sound welds with a surface area exceeding 100 square inches have been made in field applications using the Temper Bead GTAW method. For example, during the V.C. Summer repair of the reactor vessel to hot leg weld, the weld buttering was approximately 340 square inches and the weld thickness was approximately 7/8 inch across the face of the terminal end of the nozzle. Furthermore, Framatome ANP has performed several welding procedure qualification tests on thick low alloy steel test coupons with NiCrFe filler materials. Testing of these coupons has not identified any detrimental conditions in any weld heat affected zone. The weld butter on the RVCH will receive a liquid penetrant and ultrasonic examination to verify the integrity of the butter and HAZ. The weld butter and HAZ will also be within the area of interest of the radiographic examination of the final RVCH weld butter to forged disk weld. These nondestructive examinations will confirm that exceeding the 100 square inch limitation has had no effect on the quality of the weld joint

Further the mockup will be evaluated as described in the repair plan (Serial Number 1-1271) for this location to evaluate the structural integrity of the repair by NDE, mechanical testing, and metallography. In addition, an analysis is being performed to ascertain if any differences in residual stresses exist between a 100 square inch butter versus the approximate 370 square inch butter used in the repair. The results of this analysis will be available for NRC review at the DBNPS site.

IWA-4610(a)- Preheat Temperature / IWA-4633.2(d) – Postweld Hydrogen Bake

The IWA-4600 temper bead welding procedure requires a 300°F preheat and a post weld soak at 300°F for 4 hours for P-No. 3 material. Typically these kinds of preheat and post weld 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 RVCH is able to produce martensite from heating and cooling cycles associated with welding. However, the proposed alternative temper bead procedure utilizes a welding process that is inherently free of hydrogen. The GTAW process relies on bare welding electrodes with no flux to trap moisture. An inert gas blanket positively shields the weld and surrounding material from the atmosphere and moisture it may contain. To further reduce the likelihood of any hydrogen evolution or absorption, the alternative welding procedure requires particular care to ensure the weld region is free of all sources of hydrogen. The GTAW process will be shielded with welding grade argon which typically produces porosity free welds. Argon flow rates are 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.

Occupational Exposure:

Recent experience gained from the performance of manual repairs at other plants' on CRDM nozzles on RVCHs indicated that more remote automated repair methods were needed to reduce radiation dose to repair personnel and still provide acceptable levels of quality and safety. Since the FENOC recognizes the importance of ALARA principles, this remote repair method has been developed for the RVCH degradation requiring repair at the DBNPS.

This approach for repair will significantly reduce radiation dose to repair personnel while still maintaining acceptable levels of quality and safety. The total radiation dose for the proposed remote repair method is projected to be approximately 25 Rem . In contrast, using manual repair methods would result in a total radiation dose of approximately 200Rem.

Conclusions:

Relief is requested in accordance with 10 CFR 50.55a(a)(3)(i). The proposed alternative welding method is an acceptable alternative to the temper bead welding process described in the 1995 Edition through the 1996 Addenda of ASME Section XI and will produce sound welds and thereby ensure an acceptable level of quality and safety as required by 10 CFR 50.55a(a)(3)(i).

The final closure weld is a similar metal weld performed in accordance with ASME Section III rules for P-No. 43 to P-No. 43 welds. No relief is requested for the similar metal closure weld.

Code Paragraph	Code Requirement	Comparison
IWA-4100	**GENERAL REQUIREMENTS**	The proposed alternative is in compliance with this Code paragraph.
IWA-4200	**ITEMS FOR REPAIR/REPLACEMENT ACTIVITIES**	The proposed alternative is in compliance with this Code paragraph.
IWA-4300	**DESIGN**	The proposed alternative is in compliance with this Code paragraph. The modification will be justified in accordance with ASME III NB-3200 for the remaining licensed life of the plant.
IWA-4400 **IWA-4410** IWA-4410(a) IWA-4410(c)	**WELDING, BRAZING, METAL REMOVAL, AND INSTALLATION** **General Requirements** Repair/replacement activities shall be performed in accordance with the Owner's Requirements and the original Construction Code of the component or system except as provided in IWA-4410(b), (c), and (d). Alternatively, the applicable requirements of IWA-4600 may be used for welding,....	 The proposed alternative is in compliance with this Code paragraph.
IWA-4430	**Storage and Handling of Welding Material**	The proposed alternative is in compliance with this Code paragraph.
IWA-4440	**Welding and Welder Qualification) Including Welding Operators)**	The proposed alternative is in compliance with this Code paragraph.
IWA-4500 IWA-4520	**EXAMINATION AND TEST** **Examination**	 The proposed alternative is in compliance with this Code paragraph.

Code Paragraph	Code Requirement	Comparison
IWA-4600	**ALTERNATIVE WELDING METHODS**	
IWA-4600(b)	When post weld heat treatment is not to be performed, the following provisions may be used. (1) The welding methods of IWA-4620, IWA-4630, or IWA-4640 may be used in lieu of the welding and nondestructive examination requirements of the Construction Code or Section III, provided the requirements of IWA-4610 are met.	The proposed alternative is in compliance with this Code paragraph. The activity involves the welding of P-No.3 base material cladded with ER 308L (P-No. 8) using F-No. 43 filler material. As F-No. 43 filler material is used, this joint is considered a dissimilar metal weld.
IWA-4610	**General Requirements for All Materials**	
• IWA-4610(a)	The area to be welded plus a band around the area of at least 1-½ times the component thickness or 5 in., whichever is less shall be preheated and maintained at a minimum temperature of 350°F for the SMAW process and 300°F for the GTAW process during welding. The maximum interpass temperature shall be 450°F. Thermocouples and recording instruments shall be used to monitor the process temperatures. Their attachment and removal shall be in accordance with Section III.	1. Relief is requested from preheat requirements 2. Relief is requested from the use of thermocouples and recording instruments to monitor the process temperature.
• IWA-4610(b) • IWA-4610(b)	The welding procedure and the welders or welding operators shall be qualified in accordance with Section IX and the additional requirements of this Subarticle. The welding procedure and the welders or welding operators shall be qualified in accordance with Section IX and the additional requirements of this Subarticl.e	The proposed alternative is in compliance with this Code paragraph The weld metal is SFA-5.14 UNS N06052 and is specified as F-No. 43 in the 2001 Edition of ASME Section IX. An increase in the interpass temperature greater than 100°F is a supplementary essential variable per QW-256 of ASME Section IX. The 350°F interpass temperature is greater than 100°F above that which was used in the ASME Section IX welding procedure qualification process. Relief is requested from the Section IX welding procedure qualification requirements related to interpass temperature.

Code Paragraph	Code Requirement	Comparison
• IWA-4610(b)	The welding procedure and the welders or welding operators shall be qualified in accordance with Section IX and the additional requirements of this Subarticl.e	An increase in the interpass temperature greater than 100°F is a supplementary essential variable per QW-256 of ASME Section IX. The 350°F interpass temperature is greater than 100°F above that which was used in the ASME Section IX welding procedure qualification process. Relief is requested from the Section IX welding procedure qualification requirements related to interpass temperature.
	(1) Procedure Qualification (a) The test assembly material for the welding procedure qualification test shall be of the same P-Number and Group Number, including a postweld heat treatment that is at least equivalent to the time and temperature already applied to the material being welded.	The proposed alternative is in compliance with this Code paragraph.
	(b) The techniques described for the following welding procedures shall be used in the preparation of the welding procedure qualification coupons.	The proposed alternative is in compliance with this Code paragraph.
	(2) Performance Qualification. If the weld is to be performed where physical obstructions impair the welder's ability to perform, the welder shall also demonstrate the ability to deposit sound weld metal in the positions required, using the same parameters and simulated physical obstructions as are involved in the repair/replacement activity.	The proposed alternative is in compliance with this Code paragraph.
IWA-4610(c)	The neutron fluence in the weld area shall be taken into account when establishing the weld metal composition limits.	The proposed alternative is in compliance with this Code paragraph. Neutron fluence is not an issue at the location where the activity will be performed.

Code Paragraph	Code Requirement	Comparison
IWA-4611 **IWA-4611.1** • IWA-4611.1(a)	**Metal Removal** **General Requirements** Defects shall be removed or reduced in size in accordance with this Paragraph. The component shall be acceptable for continued service if the resultant section thickness created by the cavity is at least the minimum design thickness. If the resulting section thickness is less than the minimum design thickness, the component shall be corrected by repair/replacement activities in accordance with this Article. Alternatively, the defect removal area and any remaining portion of the flaw may be evaluated and the component accepted in accordance with the appropriate flaw evaluation provisions of Section XI or the design provisions of the Owner's Requirements and either the Construction Code or Section III.	The alternative to evaluate flaws remaining in the J-groove weld to the provisions of Section XI is applicable to this alternative. However, the J-groove weld flaws cannot be fully characterized as required for evaluation in accordance with the standards of IWB-3500. The evaluation is performed to meet the requirements of IWB-3142.4 1. Relief from characterizing flaws in accordance with IWA-3300 is requested. 2. Relief from performing successive inspections in accordance with IWB-3142.4 is requested
• IWA-4611.1(b)	The original defect shall be removed: (2) when welding is required in accordance with IWA-4630 or IWA-4640, and the defect penetrates base material.	Indications exceeding liquid penetrant acceptance standards may exist in the original J-groove weld and at the RVCH and clad interface. Any such indications, which cannnot be removed, will be embedded by the buttering of the nozzle bore. Relief to permit defects to remain in the original J-groove weld and at the RVCH and clad interface is requested.
IWA-4611.1(c)	The Repair/Replacement Program and Plans, and associated evaluation shall be subject to review in accordance with IWA-4150(d).	The proposed alternative is in compliance with this Code paragraph.
IWA-4611.2	**Thermal Removal Process**	This Code Requirement is not applicable to the proposed alternative

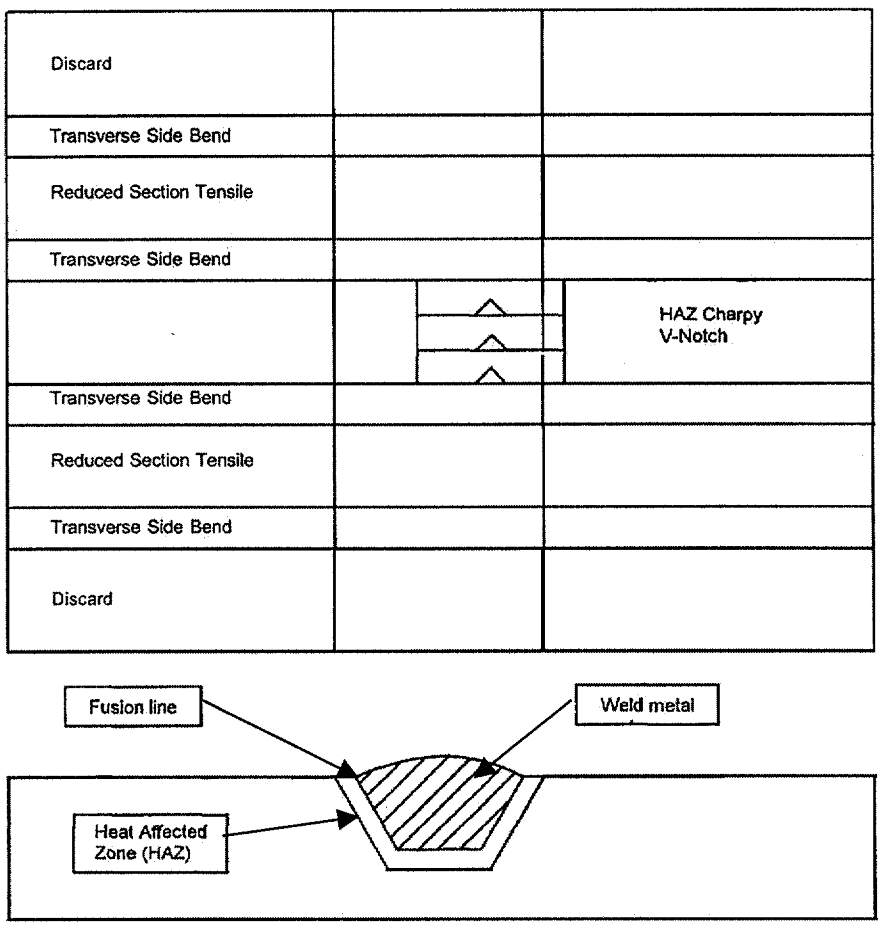
Code Paragraph	Code Requirement	Comparison
IWA-4611.3 IWA-4611.3(a)	**Mechanical Removal Processes** If a mechanical removal process is used in an area where welding is not to be performed, the area shall be faired in to the surrounding area.	The proposed alternative is in compliance with this Code paragraph.
IWA-4611.3(b)	Where welding is to be performed, the cavity shall be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding.	The proposed alternative is in compliance with this Code paragraph.
IWA-4611.4 IWA-4611.4(a)	Examination Following Metal Removal After final grinding, the affected surfaces, including surfaces of cavities prepared for welding, shall be examined by the magnetic particle or liquid penetrant method to ensure that the indication has been reduced to an acceptable limit in accordance with IWA-3000. This examination is not required when defect elimination removes the full thickness of the weld and backside of the weld joint is not accessible for removal of examination materials.	The proposed alternative is in compliance with this Code paragraph.
IWA-4611.4(b)	Indications detected as a result of the excavation that are not associated with the defect being removed shall be evaluated for acceptability in accordance with IWA-3000.	The proposed alternative is in compliance with this Code paragraph.
IWA-4630 **IWA-4631** IWA-4631(a)	**Dissimilar Materials** **General Requirements** Repair/replacement activities on welds that join P-No. 8 or P-No. 43 material to P-No. 1, 3, 12A, 12B, and 12C material may be made without the specified post weld heat treatment, provided the requirements of IWA-4631(b) and IWA-4632 through IWA-4634 are met.	The proposed alternative is in compliance with this Code paragraph.

Code Paragraph	Code Requirement	Comparison
• IWA-4631(b)	Repair/replacement activities in accordance with this paragraph are limited to those along the fusion line of a nonferritic to ferritic base material where 1/8 in. or less on nonferritic weld deposit exists above the original fusion line after defect removal. If the defect penetrates into the ferritic base material, welding of the base material may be performed in accordance with IWA-4633 provided the depth of the weld in the base material does not exceed 3/8 in. The repair/replacement activity performed on a completed joint shall not exceed one-half the joint thickness. The surface of the completed weld shall not exceed 100 sq. in.	Relief from the 100 square inch surface is requested.
IWA-4632 IWA-4632(a)	**Welding Procedure Qualification** The test assembly cavity depth shall be at least one-half the depth of the weld installed during the repair/replacement activity but not less than 1 in. The test assembly thickness shall be a 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, but not less than 6 in. The qualification test place shall be prepared in accordance with Fig. IWA-4622.1.	 The proposed alternative is in compliance with this Code paragraph.
IWA-4632(b)	The ferritic base material and HAZ shall meet the requirements of IWA-4622.	The proposed alternative is in compliance with this Code paragraph.
IWA-4633 **IWA-4633.1**	**Welding Procedure** **Shielded Metal-Arc Welding.** The procedure shall include the requirements of IWA-4633.1(a) through (f): (a) The weld metal shall be deposited using A-No. 8 weld metal (QW-442) for P-No. 8 to P-No. 1 or P-No. 3 weld joints or F-No. 43 weld metal (QW-432) for either P-No. 8 or P-No. 43 to P-No. 1 or P-No. 3 weld joints. The maximum bead width shall be four times the electrode core diameter.	 The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only. SFA-5.11 ENiCrFe-7 filler material is designated as F-No. 43 in the 2001 Edition of ASME Section IX.

Code Paragraph	Code Requirement	Comparison
	(b) All covered electrodes used for qualification test and welding shall be from freshly opened, hermetically sealed packages or heated ovens maintained between 225°F and 350°F. Electrodes withdrawn from hermetically sealed containers or ovens for longer than 8 hr shall be discarded.	The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only.
	(c) The electrodes may be maintained in heated ovens in the work area. The oven temperature shall be maintained between 225°F and 350°F. Electrodes exposed to the atmosphere for more than 8 hr shall be discarded.	The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only.
	(d) All areas of the ferritic base material, exposed or not, on which weld metal is to be deposited, shall be covered with a single layer of weld deposit using 3/32 in. diameter electrodes. The weld bead crown surface shall be removed by grinding or machining before depositing the second layer. The second layer shall be deposited with 1/8 in. diameter electrodes. Subsequent layers shall be deposited with welding electrodes no larger than 5/32 in. in diameter. (See Fig. IWA-4633.1-1).	The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only.
	(e) After at least 3/16 in. of weld metal has been deposited, the weld area shall be maintained in the range of 450°F – 550°F for 4 hr minimum.	The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only.
	(f) Subsequent to the above heat treatment, the balance of the welding may be performed at a maximum interpass temperature of 350°F.	The repair activity is in compliance with this Code paragraph. The SMAW process will be used for repairs to the new weld only.
IWA-4633.2	**Gas Tungsten-Arc Welding.** The procedure shall include the requirements of IWA-4633.2(a) through (e).	
IWA-4633.2(a)	The weld shall be made using A-No. 8 weld metal (QW-422) for P-No. 8 to P-No. 1 or P-No. 3 weld joints or F-No. 43 to P-No. 1 or P-No. 3 weld joints.	The proposed alternative is in compliance with this Code paragraph.

Code Paragraph	Code Requirement	Comparison
IWA-4633.2(b)	The weld metal shall be deposited by the automatic or machine gas tungsten arc weld process using cold wire feed.	The proposed alternative is in compliance with this Code paragraph.
• IWA-4633.2(c)	The cavity shall be buttered with the first six layers of weld metal as shown in Fig. IWA-4633.2-1, Steps 1 through 3, with the weld heat input for each layer controlled to within ±10% of that used in the procedure qualification test. Subsequent layers shall be deposited with a heat input equal to or less than that used for layers beyond the sixth in the procedure qualification (See Fig. IWA-4633.2-1, Step 4). The completed weld shall have at least one layer of weld reinforcement deposited and then this reinforcement shall be removed by mechanical means, making the finished surface of the weld substantially flush with the surface surrounding the weld.	Relief is requested to use the alternative welding method described in this relief request.
• IWA-4633.2(d)	After completion of welding, or when at least 3/16 in. of weld metal has been deposited, the weld area shall be maintained at a minimum temperature of 300°F for a minimum of 2 hr in P-No. 1 materials. For P-No. 3 materials, the holding time shall be a minimum of 4 hr.	Relief is requested to use the alternative welding method described in this relief request in lieu of the post weld soak.
IWA-4633(e)	Subsequent to the above heat treatment, the balance of the welding may be performed at maximum interpass temperature of 350°F.	The proposed alternative is in compliance with this Code paragraph.
IWA-4634	**Examination** The weld as well as the preheated band shall be examined by the liquid penetrant method after the completed weld has been at ambient temperature for at least 48 hr. The weld shall be volumetrically examined.	 The proposed alternative is in compliance with this Code paragraph.
IWA-4530	**PRESERVICE INSPECTION AND TESTING** (a) When portions of items requiring preservice or inservice inspection are affected by repair/replacement activities, or for items being installed, including welded joints made for installation of items,	 The proposed alternative is in compliance with this Code paragraph. Table IWB-2500-1 Examination Category B-A provides requirements for the examination of pressure

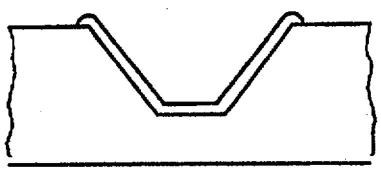
Code Paragraph	Code Requirement	Comparison
	preservice inspections shall be performed in accordance with IWB-2200, IWC-2200, IWD-2200, IWE-2200, IWF-2200, or IWL-2200 prior to return of the system to service. The preservice inspection may be performed either prior to or following the pressure test required by IWA-4540.	boundary welds in Reactor Vessels. The Code Items in this Examination Category do not specifically apply to the new weld. As the weld was designed as a full penetration weld, Code Item B1.30 was selected to provide the most appropriate examination requirements. The radiographic examination conducted to accept the final weld will be used as the preservice examination of this weld.
IWA-4540 IWA-4540(a)	**Pressure Testing of Class 1, 2, and 3 Items** After welding on a pressure retaining boundary or installation of an item by welding or brazing a system hydrostatic test shall be performed in accordance with IWA-5000.	 The proposed alternative is in compliance with this Code paragraph. Code Case N-416-1 shall be applicable for the test.



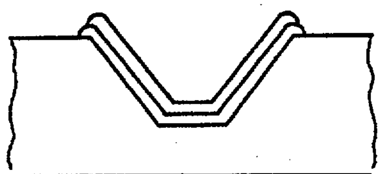
GENERAL NOTE: Base metal Charpy impact specimens are not shown. This figure illustrates a similar-metal weld.

QUALIFICATION TEST PLATE

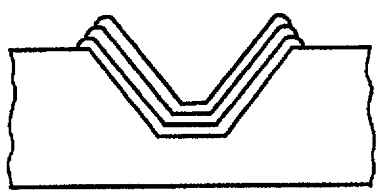
Figure 1



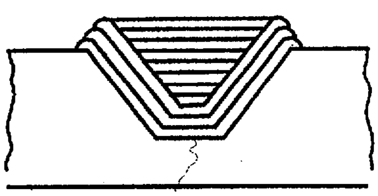
Step 1: Deposit layer one with first layer weld parameters used in qualification.



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.

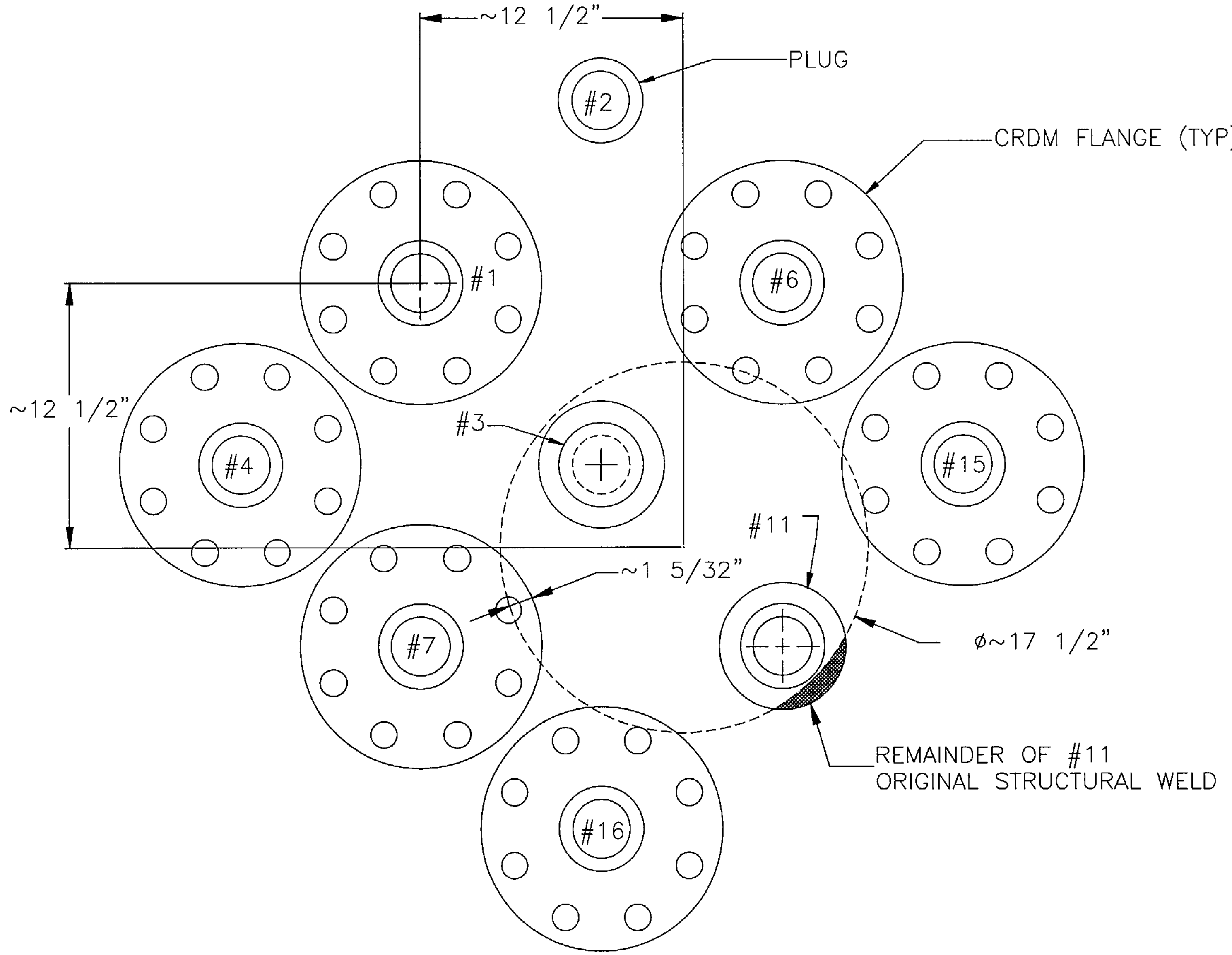


Step 4: Subsequent layers to be deposited as qualified, with heat input less than or equal to that qualified in the test assembly. NOTE: Particular care shall be taken in application of the fill layers to preserve the temper of the weld metal and HAZ

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.

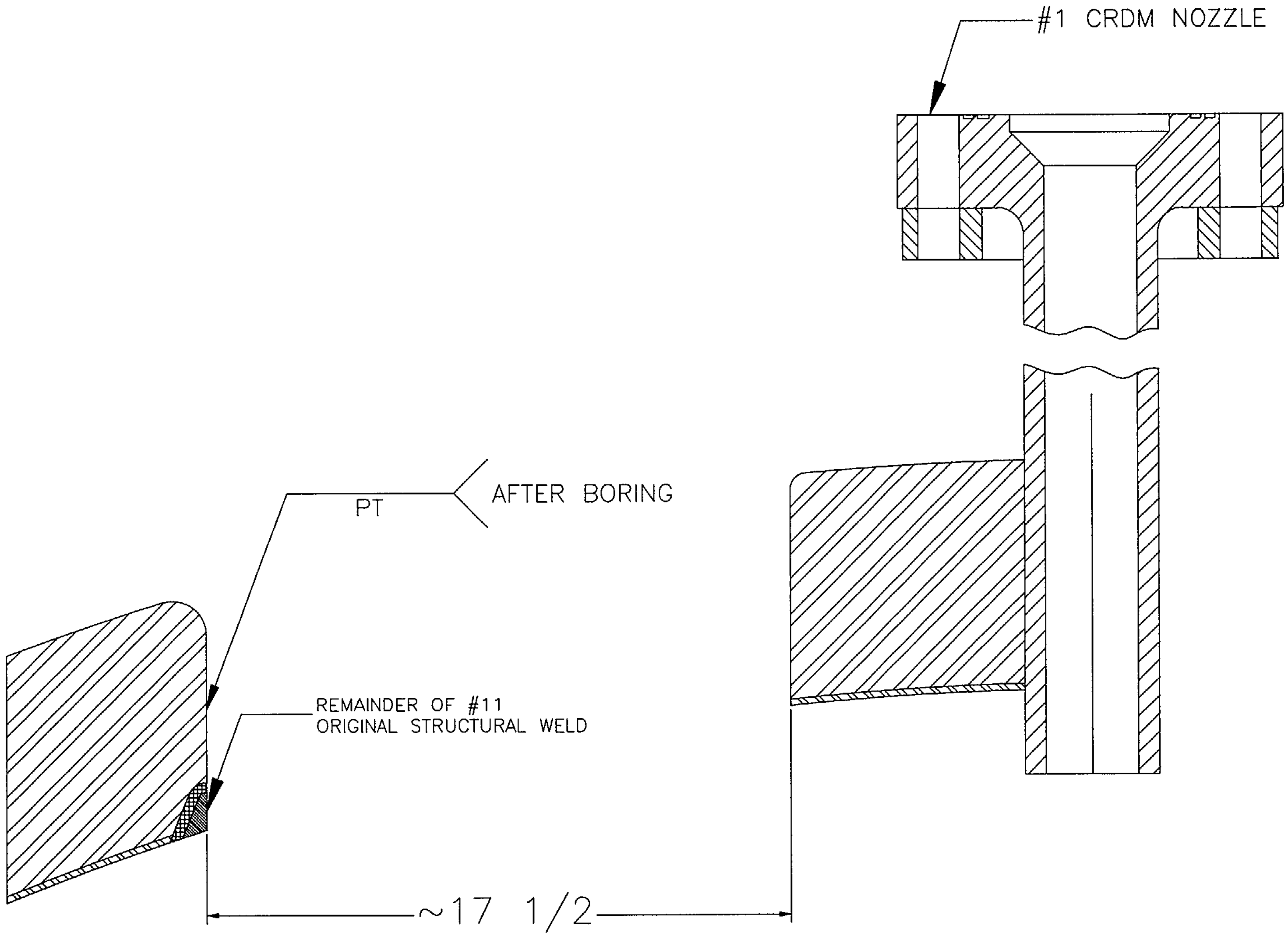
AUTOMATIC OR MACHINE (GTAW) TEMPERBEAD WELDING

Figure 2



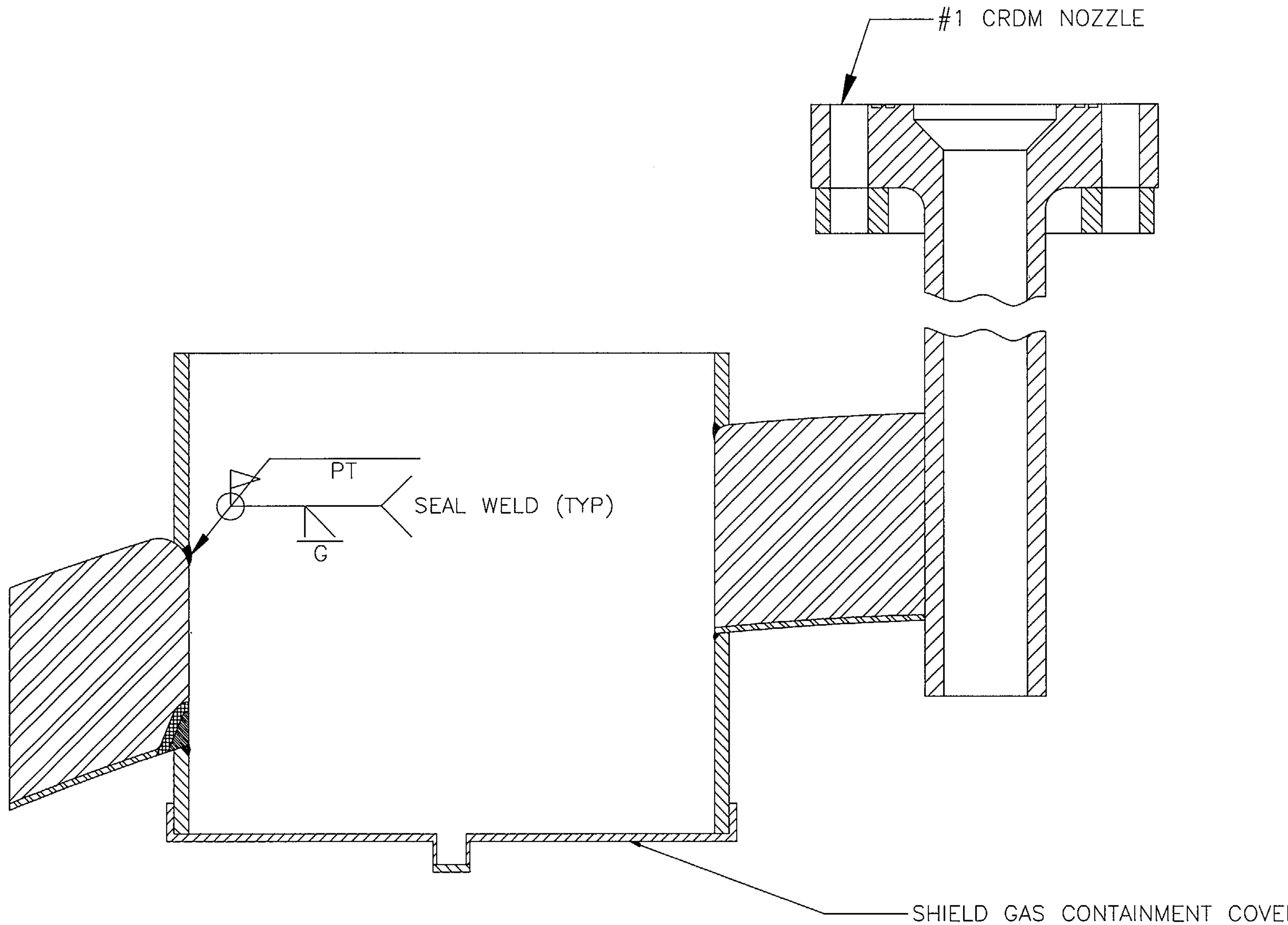
PLAN VIEW OF REPAIR AREA

Figure 3



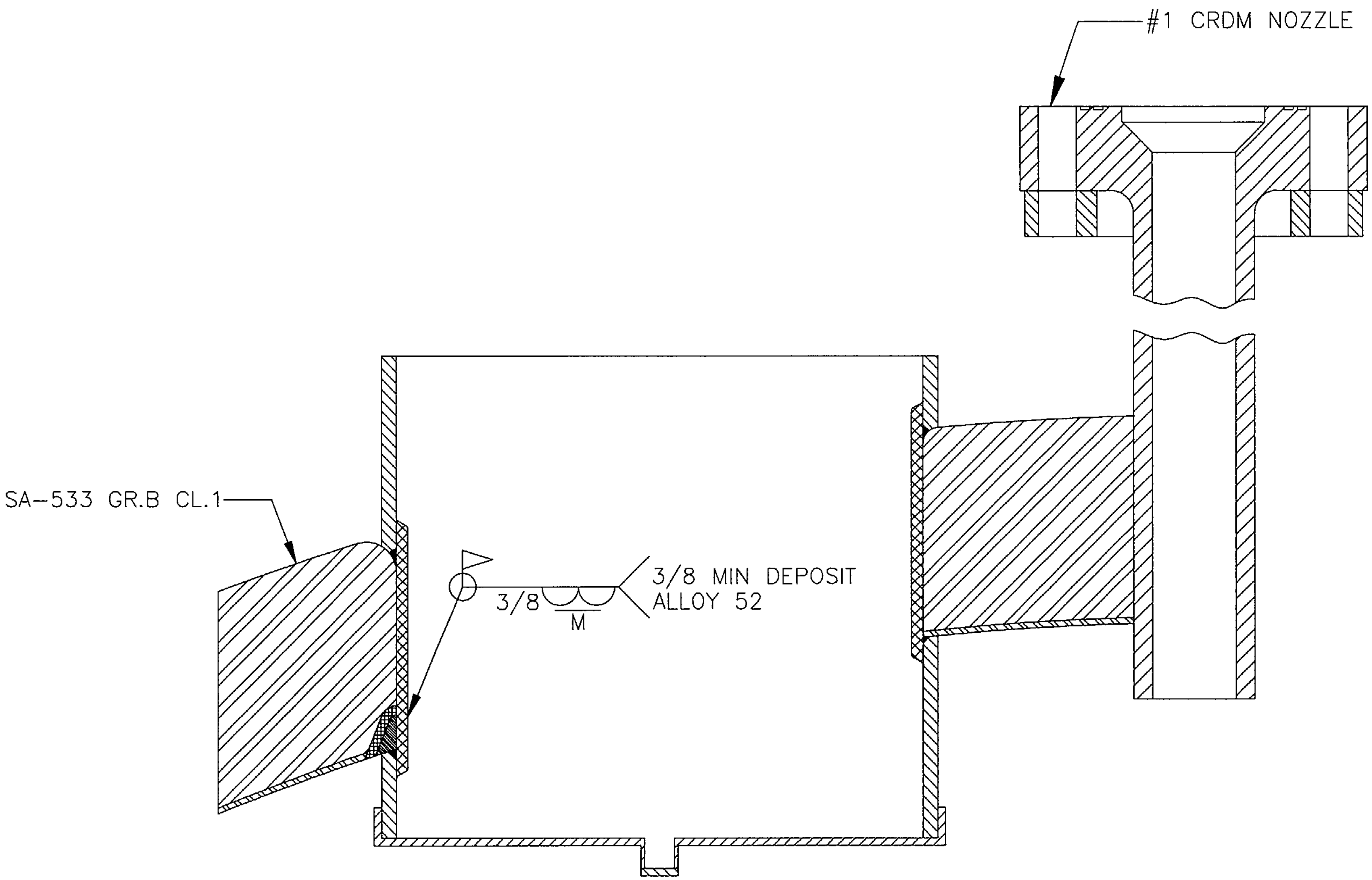
ABRASIVE WATERJET CUT TO
APPROXIMATELY 17 1/4" AND
FINISH BORE REPAIR AREA

Figure 4



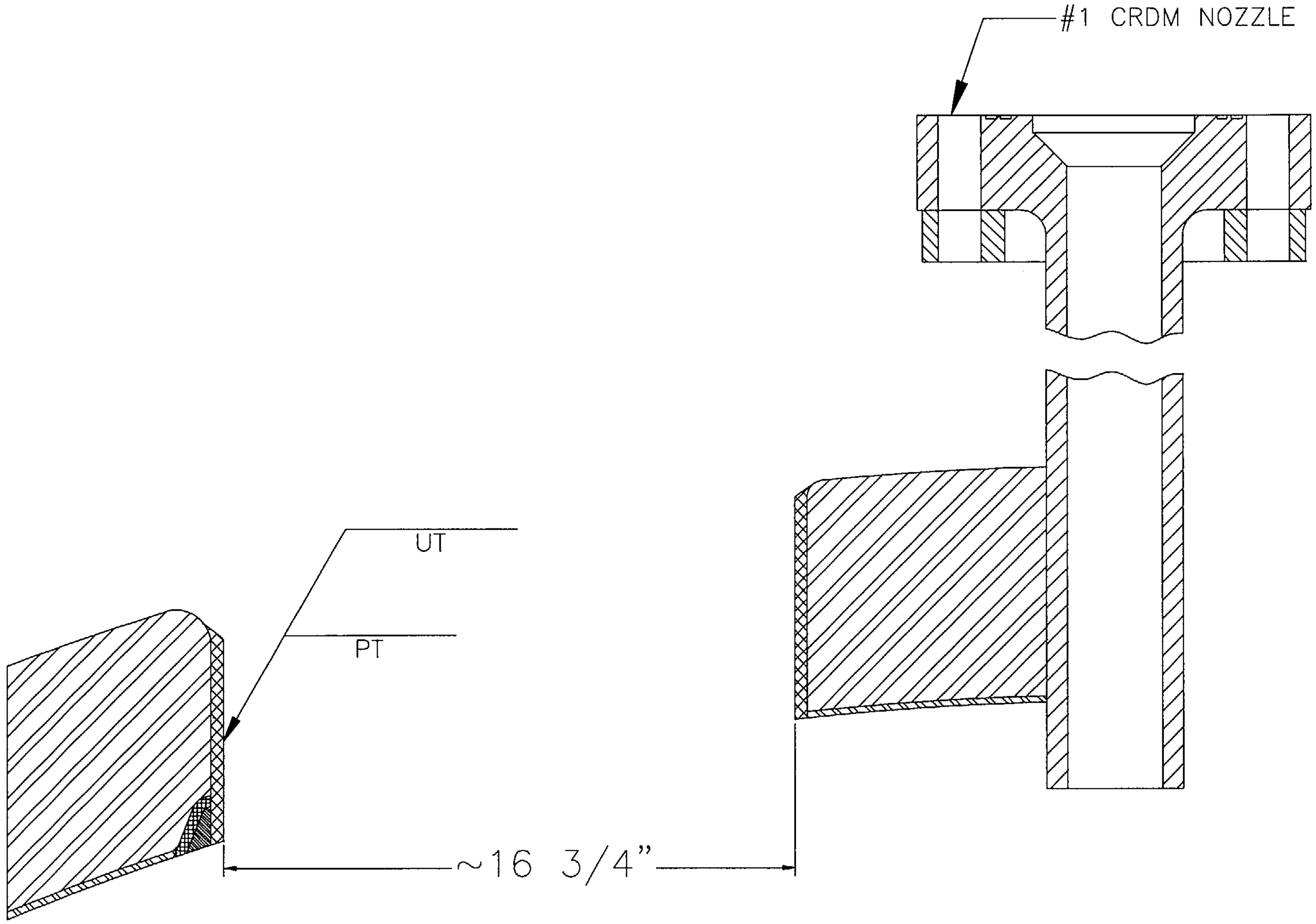
INSTALL OD AND ID RUNOFF RINGS

Figure 5



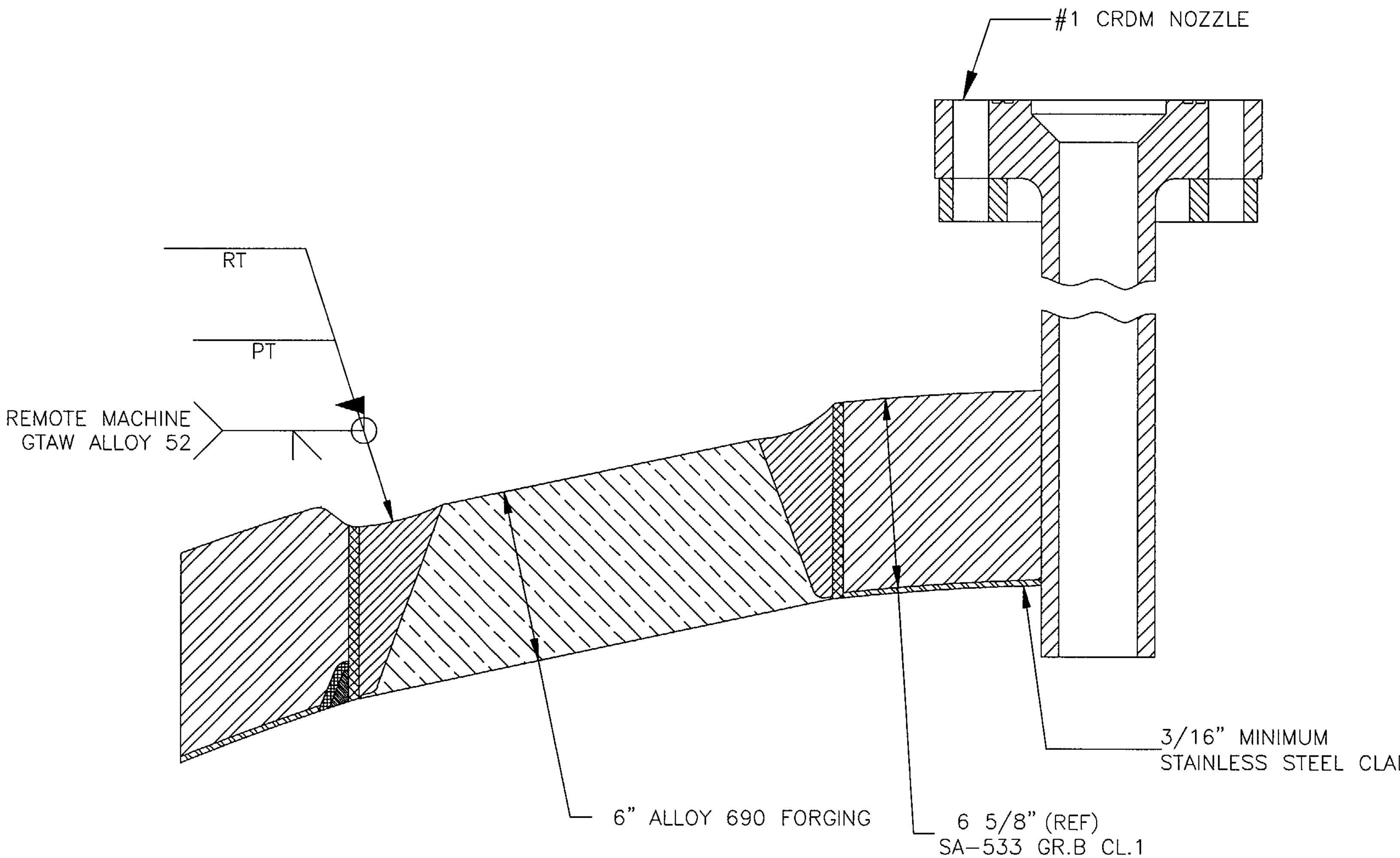
DEPOSIT BUTTER
REMOTE MACHINE GTAW

Figure 6



MACHINE BORE & INSPECT

Figure 7



WELD, BLEND GRIND & INSPECT

Figure 8

COMMITMENT LIST

The following list identifies those actions committed to by the Davis-Besse Nuclear Power Station (DBNPS) in this document. Any other actions discussed in the submittal represent intended or planned actions the DBNPS. They are described only for information and are not regulatory commitments. Please notify the Manager - Regulatory Affairs (419-321-8450) at the DBNPS of any questions regarding this document or associated regulatory commitments.

COMMITMENTS	DUE DATE
None	