FPL

SEP 1 2 2001
L-2001-207
10 CFR 50.55a

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
ASME Section XI Relief Requests Nos 28–34, Associated With Reactor Vessel Head Repair

During the upcoming Turkey Point Unit 3 Cycle 19 Refueling Outage, scheduled to begin October 1, 2001, visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head Penetration Nozzles will be conducted. Nozzles showing evidence of leakage will be repaired.

In order to conduct the repairs efficiently, and to ensure personnel exposure is kept to a minimum, relief requests from portions of the ASME Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1995 Edition through 1996 Addenda must be approved. Pursuant to 10 CFR 50.55a (a)(3), Florida Power & Light Company (FPL) requests approval of Relief Requests Nos. 28 through 34, attached.

FPL has determined pursuant to 10 CFR 50.55a (a)(3)(ii) that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The repair plan seeks to significantly reduce exposures by instituting machine remote processes for nozzle repair, similar to those used at Oconee Nuclear Station Unit 2 (ONS-2), and planned for use at Three Mile Island Unit 1. Based on the ONS-2 experience of repairing manually versus repairing with machine remote processes, FPL estimates radiological dose savings of greater than 24 Rem for each CRDM nozzle repaired. There are 59 CRDM nozzles on the Unit 3 reactor vessel head. If repairs are necessary, approval of these requests is required in order to realize the above radiological dose savings.

Approval of these requests will allow repairs to nozzles using alternatives to welding processes and examination requirements of several ASME Code sections for the repair of Class A Reactor Vessel head components. The relief requests have been evaluated, and FPL has determined that the alternatives described in each relief request provide an acceptable level of quality and safety.

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A table of contents has been provided which identifies all documents.

We request approval of these reliefs by October 6, 2001, to support the Turkey Point Unit 3 refueling outage. Please contact John Manso at (305) 246-6622, if there are any questions about this submittal.

Very truly yours,

John P. McElwain
Vice President
Turkey Point Plant

CLM

Attachments

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant
Florida Department of Health and Rehabilitative Services

Turkey Point Unit 3

ASME Section XI Relief Requests Associated With Reactor Vessel Head Repair

Table of Contents

Relief Request No. 28
"Implementation of Code Case N-638 in a Dry Lay-up Condition"

I. COMPONENT IDENTIFICATION:

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (a)(3)(i), relief is requested to implement Code Case N-638 as an alternative to the requirements of ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1989 Edition.

Furthermore, the Code Case Reply specifies "...when it is impractical, for operational or radiological reasons, to drain the component, and...." Draindown is not applicable for these repairs.

IV. BASIS FOR RELIEF:

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire

lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

Substantial personnel dose savings would be realized by eliminating the installation and removal of heating pads. Quality temper bead welds can be performed without preheat and post heat, based on Code Case N-638 ASME approval and FRA-ANP prior welding procedure qualification test data using machine GTAW ambient temperature temper bead welding.

FRA-ANP has 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 BWR CRD Housing/Stub Tube Repairs." The supporting welding Procedure Qualification Records for this work, PQ7109-00 and PQ7153-00 (Framatome Proprietary Documents) were performed at room temperature with cooling water to limit the maximum interpass temperature to no more than 100°F. These 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 UNS N06052, SFA 5.14 Class ERNiCrFe-7, with similar low heat input controls as will be used in the repairs. The qualifications did not include a post-weld heat soak.

Industry experience has found that delayed hydrogen cracking requires a hydrogen concentration above about 5ml/100g of deposited weld metal, and a weld and Heat Affected Zone (HAZ) with low ductility/toughness. Delayed hydrogen cracking tends to occur in carbon and alloy steel welds produced by processes which use a flux, e.g,. shielded metal arc welding (SMAW), submerged arc welding (SAW), or flux cored arc welding (FCAW). The flux in these processes can pick up moisture that breaks down during welding to produce atomic hydrogen. The atomic hydrogen is partially absorbed by the weld metal and HAZ. Absorption of hydrogen,

in sufficient quantity in low ductility material, may cause delayed hydrogen cracking. The GTAW process uses argon gas as the shielding medium and does not use a hygroscopic flux.

Moisture-contaminated shielding gas or high humidity environments may introduce hydrogen into GTAW welds. EPRI performed tests where argon shielding gas was bubbled through a cylinder of water and then mixed with welding grade argon having a dew point of –70 degrees F to produce gas mixtures with dew points from –60 degrees F to +60 degrees F. At the worst case dew point of +60 degrees F (an unrealistically high dew point), the measured hydrogen concentration in test welds was 4.6 ml/100g of weld metal (EPRI, Document TR103354, "Temperbead Welding Repair of Low Alloy Pressure Vessel Steels; Guidelines," December 1993, Chapter 2, "Diffusion of Hydrogen in Low Alloy Steel," D. Gandy & S. Findland). This value falls in the extra low hydrogen range specified by the American Welding Society (AWS). The EPRI study also measured the hydrogen content of bare filler material and found it to be less than 1 ml/100g of weld metal.

The GTAW consumables to be used consist of bare wire with non-hygroscopic flux. The combination of weld joint cleanliness preparation and maintenance, use of the low moisture absorbing GTAW process, and maintenance of sufficient shielding gas cover, eliminates the possibility of hydrogen induced cracking.

It should also be noted that the original ASME XI Code Case N-432 "Repair Welding Using Automatic or Machine Gas Tungsten-Arc Welding (GTAW) Temper Bead Technique," was developed using ferritic welding filler material whereas the welding for this repair is an austenitic weld filler. This is significant in that the austenitic weld acts as a sink for hydrogen, which adds additional assurance that the procedures used preclude any concerns for delayed hydrogen induced cracking of the HAZ (N. Bailey, "Weldability of Ferritic Steels," ASM International, Abington Publishing, 1994).

VI. PROPOSED ALTERNATIVE:

Implement Code Case N-638 as an alternative to the requirements of ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1989 Edition while the Reactor Vessel Head is in dry lay-up.

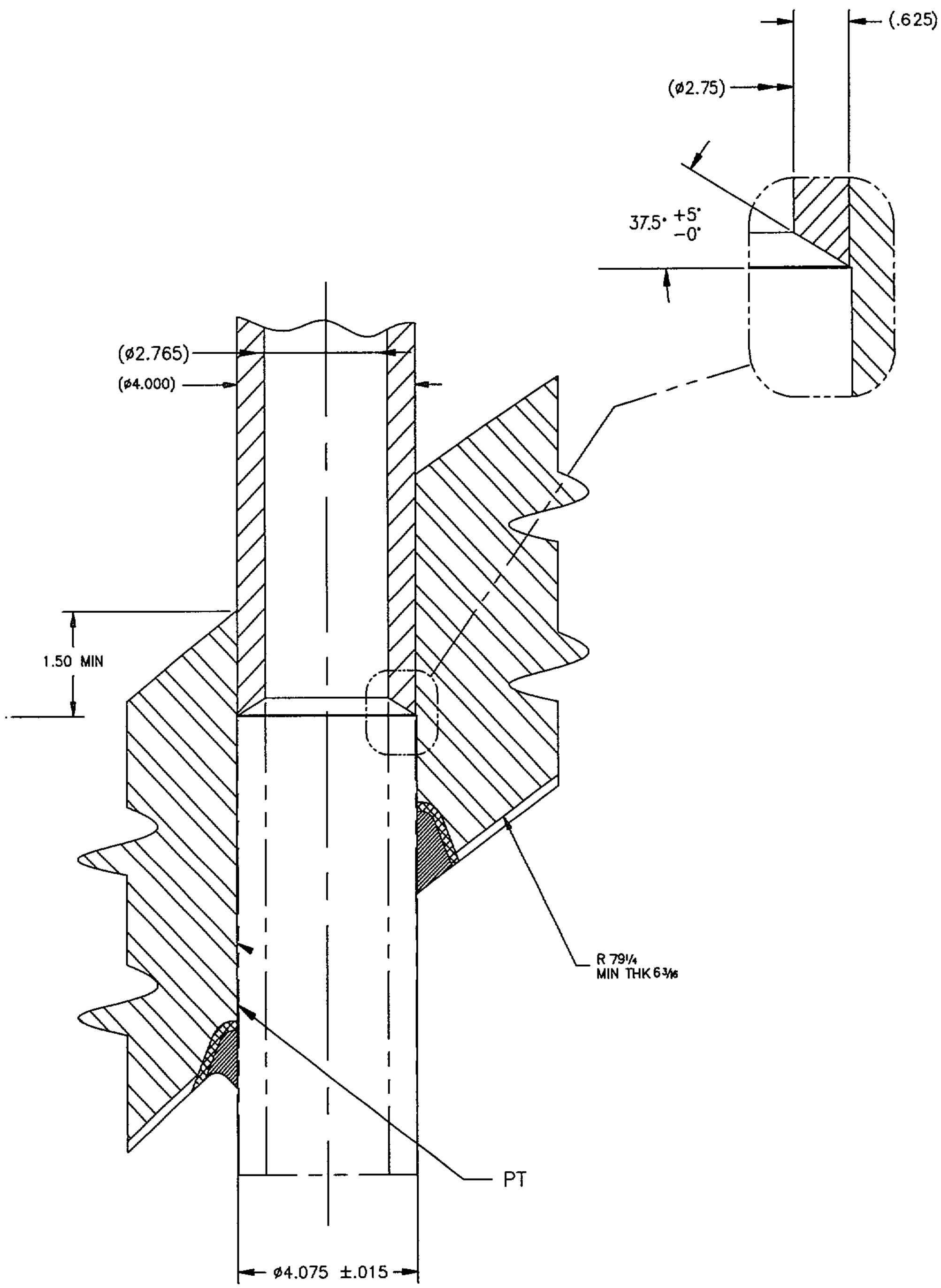

Figure 1:

PTN-3 CRDM Machining

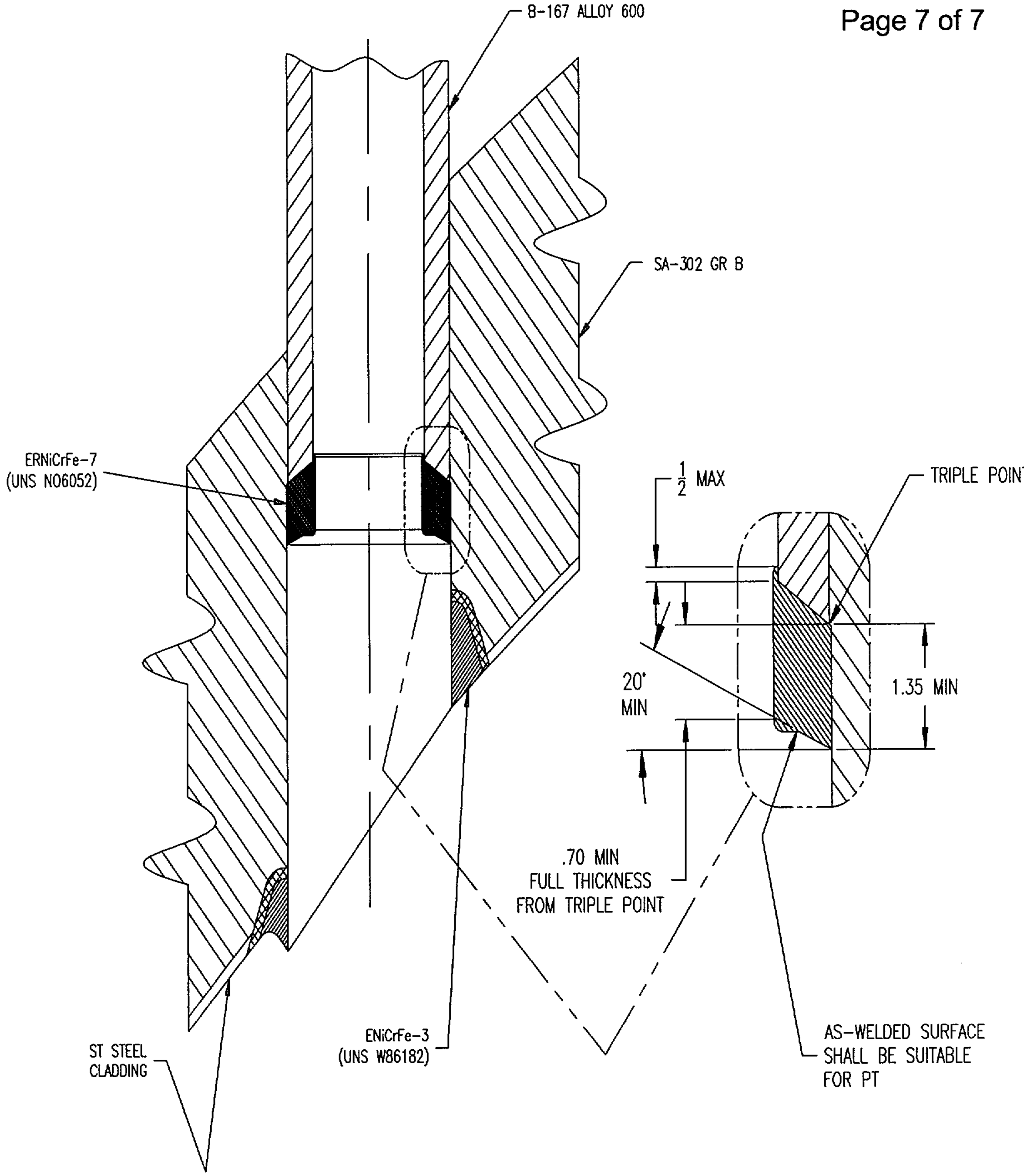

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

Relief Request No. 29
"Reduction of Ultrasonic Examination Band Requirements"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (a)(3)(i), relief is requested to implement an alternative to Code Case N-638 paragraph 4.0(b) which specifies the weld and 5" band shall be ultrasonically examined (UT) after the completed weld has been at ambient temperature for 48 hours.

Due to the unique geometry of the CRDM penetration modification, it is not practical to examine the band area defined by N-638 paragraph 4.0(b). In lieu of examination of the band area, it is proposed that liquid penetrant examination (PT) and UT examination be performed in the weld repair region after the completed weld has been at ambient temperature for 48 hours.

IV. BASIS FOR RELIEF:

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has

estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the

minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

The first purpose for the examination of the band is to assure all flaws in the area of the repair have been removed or addressed, since these flaws may be associated with the original flaw and may have been overlooked. In this case, the repair welding is performed remote from the known defect.

The second purpose of the examination is to detect flaws that may be revealed as a result of the repair. In this case, there are no flaws in the base metal in the region being repaired. The purpose of the repair is to remove any defective portions of the nozzle(s), sever the existing weld from the nozzle, and install a new pressure boundary weld. The proposed examination of the new weld surfaces (welded region) and immediate surrounding areas within the band is sufficient to verify that defects have not been induced in the low alloy steel RVCH material due to the welding process.

The final weld surface and adjacent base metal will be examined by PT after welding. UT will be performed scanning from the ID surface of the weld, excluding the transition taper portion at the bottom of the weld, and adjacent portion of the CRDM nozzle bore. The UT is qualified to detect flaws in the repair weld and base metal interface in the repair region, to the maximum practical extent. The examination extent is consistent with the Construction Code requirements.

Furthermore, based on the repair configuration, the UT is of no practical

value when scanning from the outer surface of the head or from the head clad ID surface.

The UT transducers and delivery tooling are capable of scanning from cylindrical surfaces with inside diameters near 2.75 in. The UT equipment is not capable of scanning from the face of the taper. Approximately 70% of the weld surface will be scanned by UT. Approximately 83% of the RVCH ferritic steel HAZ will be covered by the UT.

The transducers to be used are shown in Table 1. The UT coverage volumes are shown in Figures 3 through 8 for the various scans.

Additionally, the final modification configuration and surrounding ferritic steel area affected by the welding is either inaccessible, or extremely difficult to access to obtain the necessary access and scans.

Also, elimination of the band UT will result in reduction in dose to personnel.

VI. PROPOSED ALTERNATIVE:

In lieu of examination of the band area, it is proposed that PT and UT examination be performed in the weld repair region after the completed weld has been at ambient temperature for 48 hours.

Search Unit Selection						
Angle/Mode	**Freq.**	**Model**	**Mfg.**	**Size**	**Focal Depth**	**Beam Direction**
0° L-wave	2.25 MHz	2077	Sigma	.15" x .30"	0.45"	N/A
45° L-wave	2.25 MHz	2118	Sigma	.30" x .20"	0.45"	Axial
70° L-wave	2.25 MHz	2370	Sigma	.72" x .21"	0.69"	Axial
45° L-wave (effective)	2.25 MHz	2117	Sigma	.30" x .20"	0.45"	Circ.

Table 1:

PTN-3 CRDM Replacement Weld
UT Search Unit Transducer Characteristics

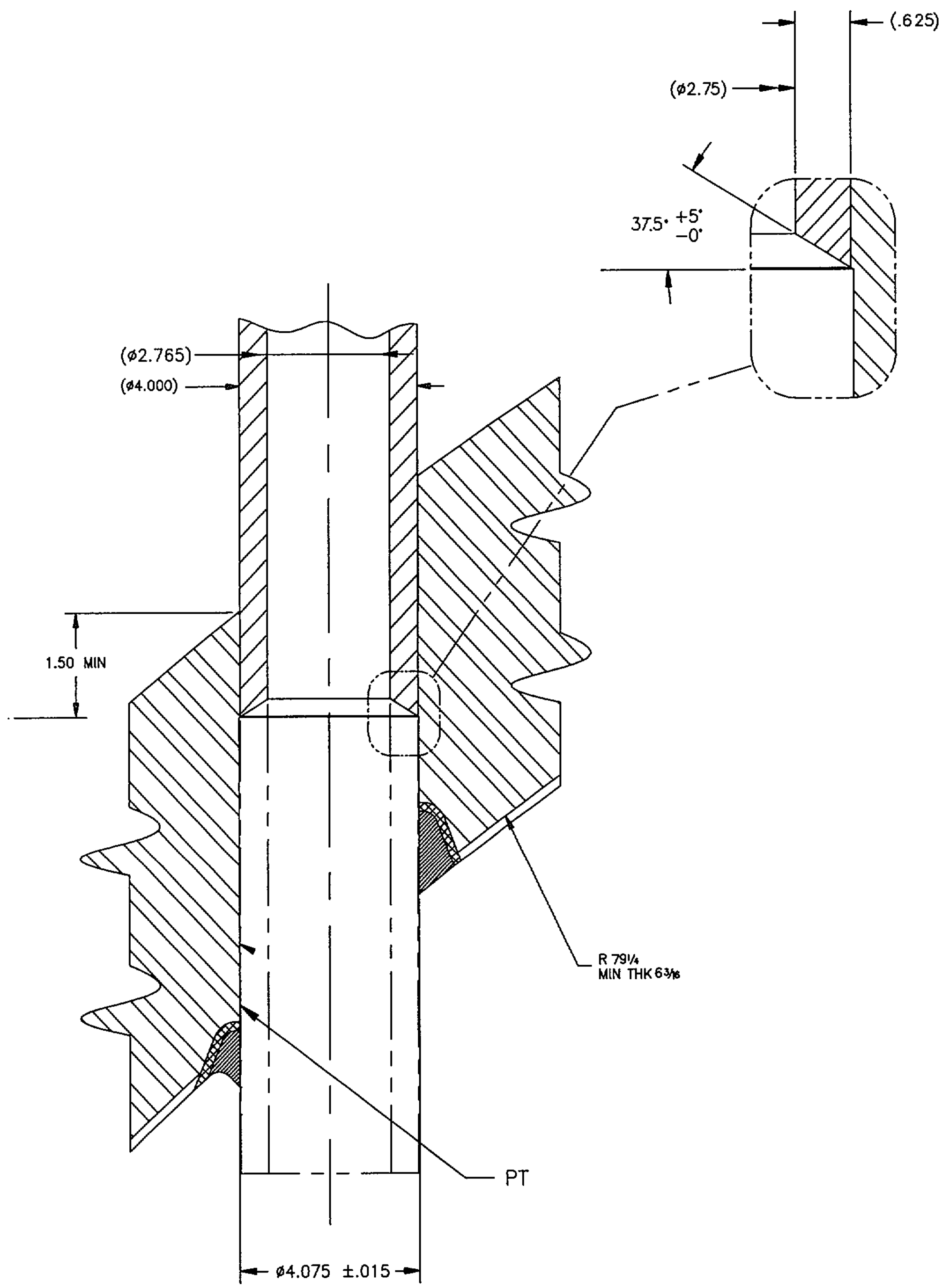

Figure 1:

PTN-3 CRDM Machining

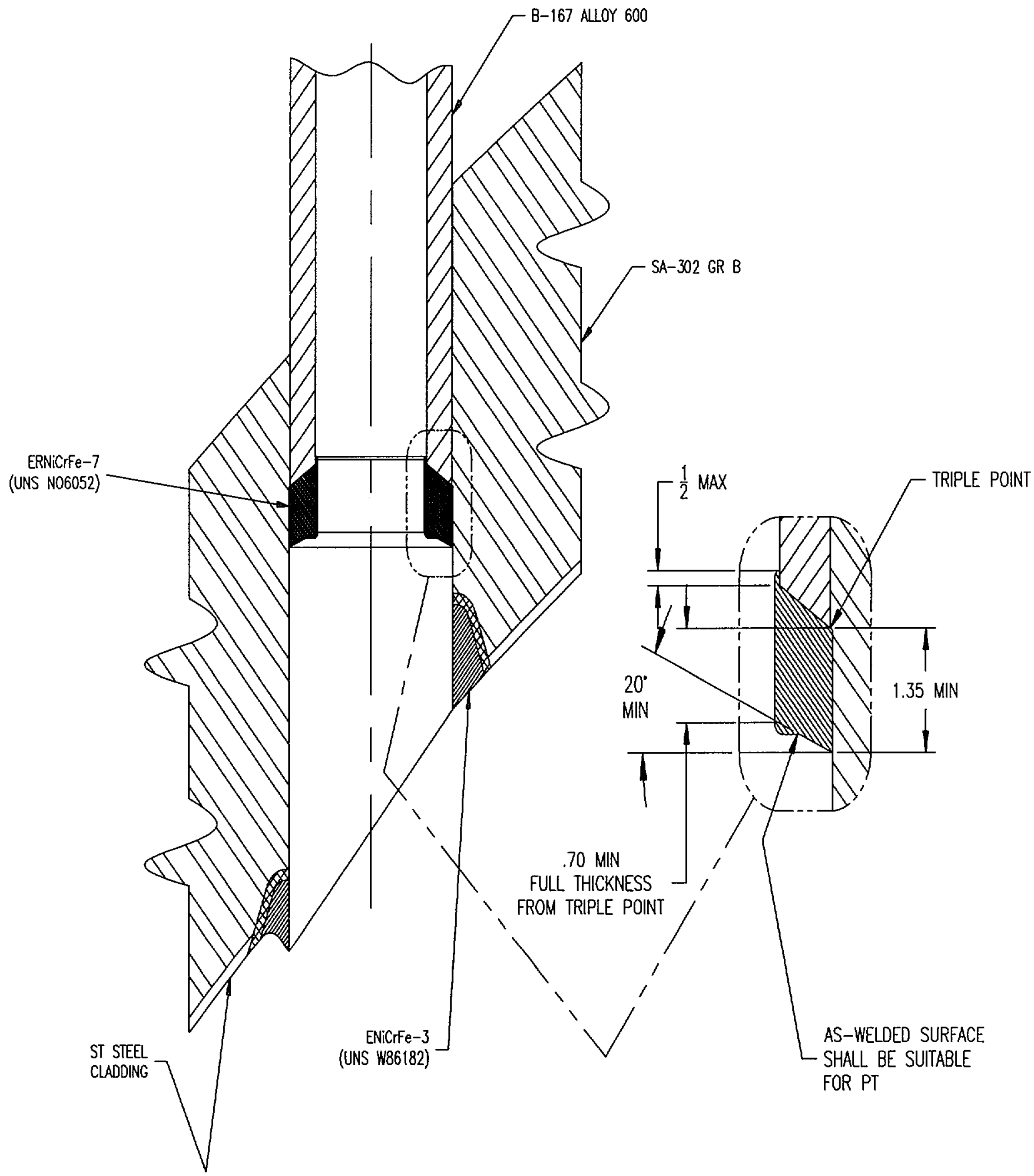

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

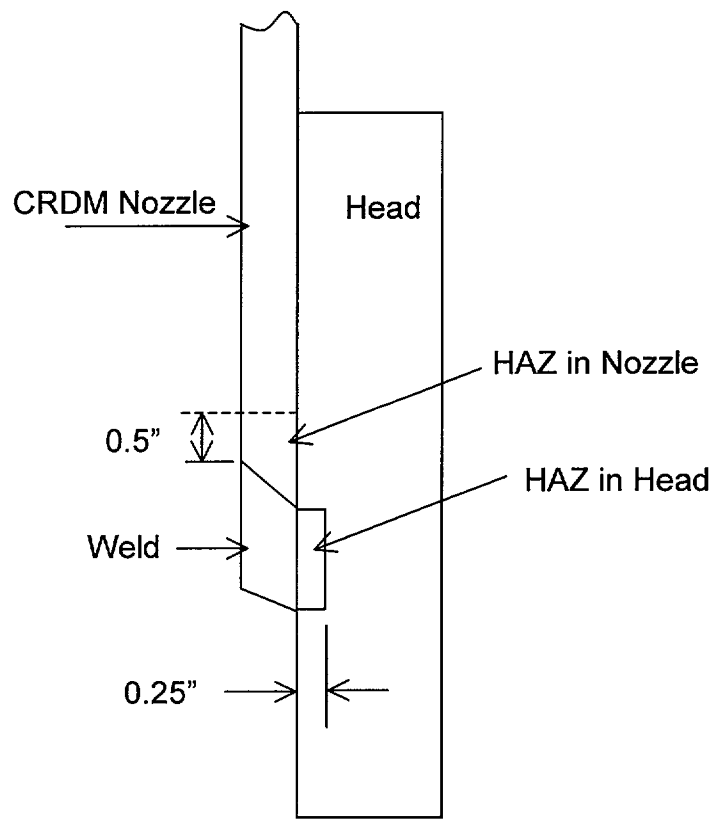

Figure 3:

PTN-3 CRDM Temper-Bead Weld Repair Areas to be Examined

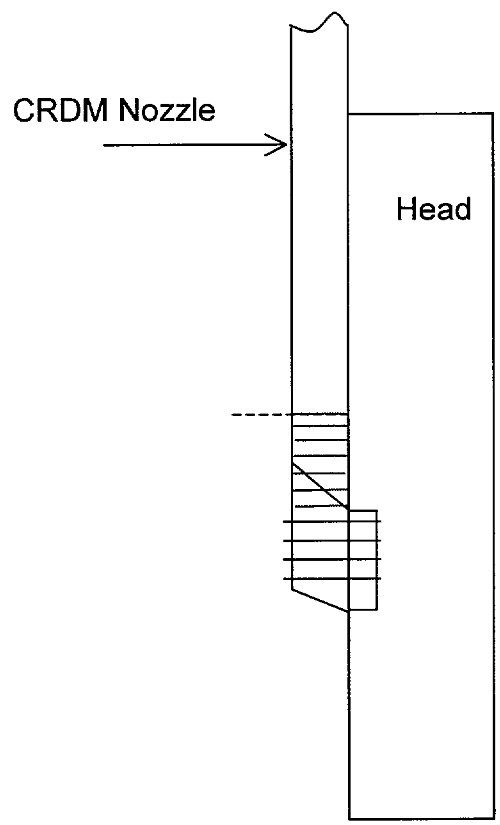

Figure 4:

PTN-3 CRDM Temper-Bead Weld Repair, UT 0 degree and 45L Beam Coverage Looking Clockwise and Counter-clockwise

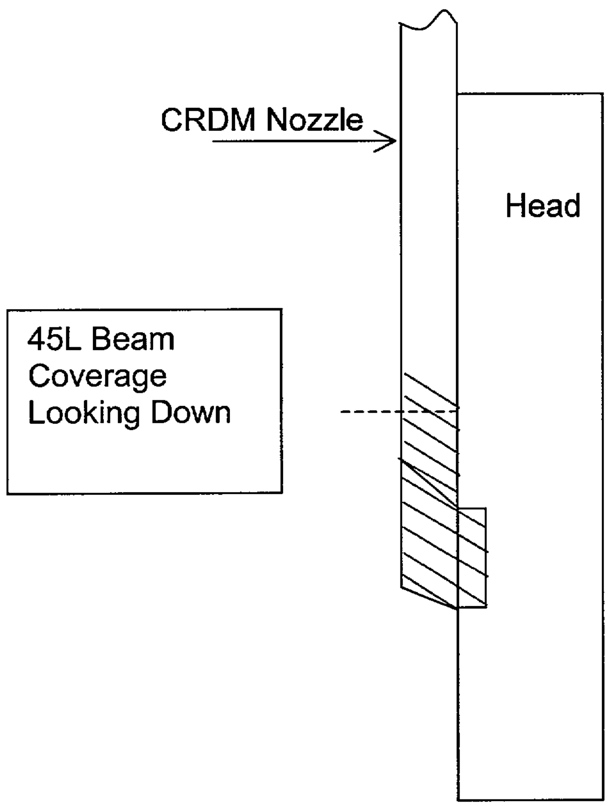

Figure 5:

PTN-3 CRDM Temper-Bead Weld Repair, 45L UT Beam Coverage Looking Down

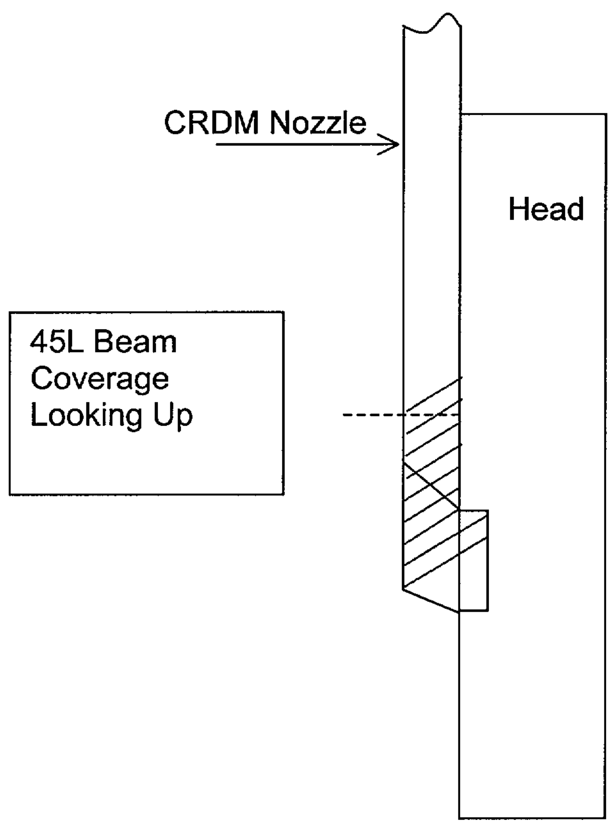

Figure 6:

**PTN-3 CRDM Temper-Bead Weld Repair,
45L UT Beam Coverage Looking Up**

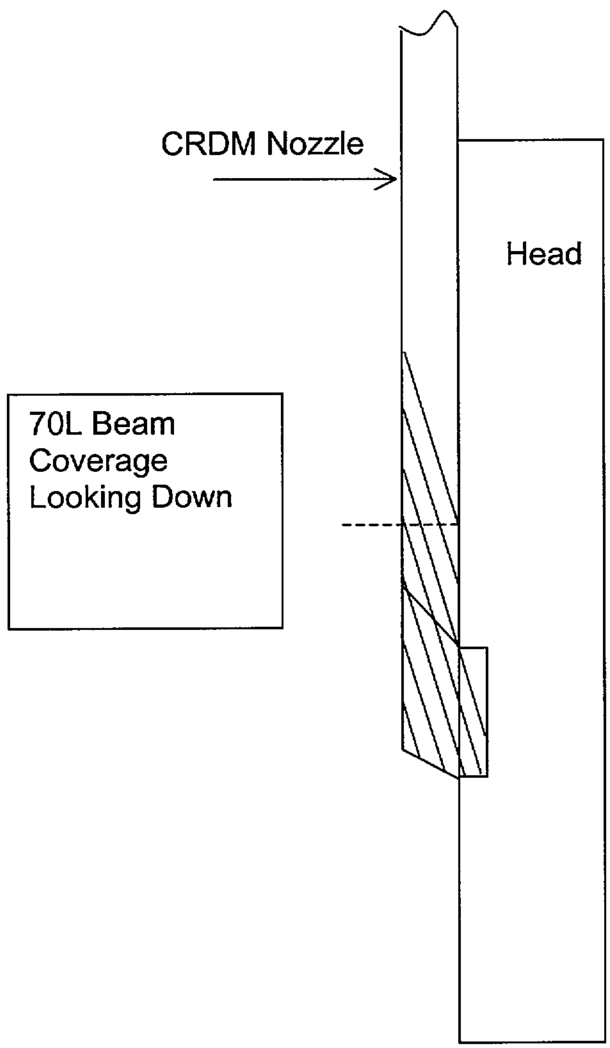

Figure 7:

PTN-3 CRDM Temper-Bead Weld Repair,
70L UT Beam Coverage Looking Down

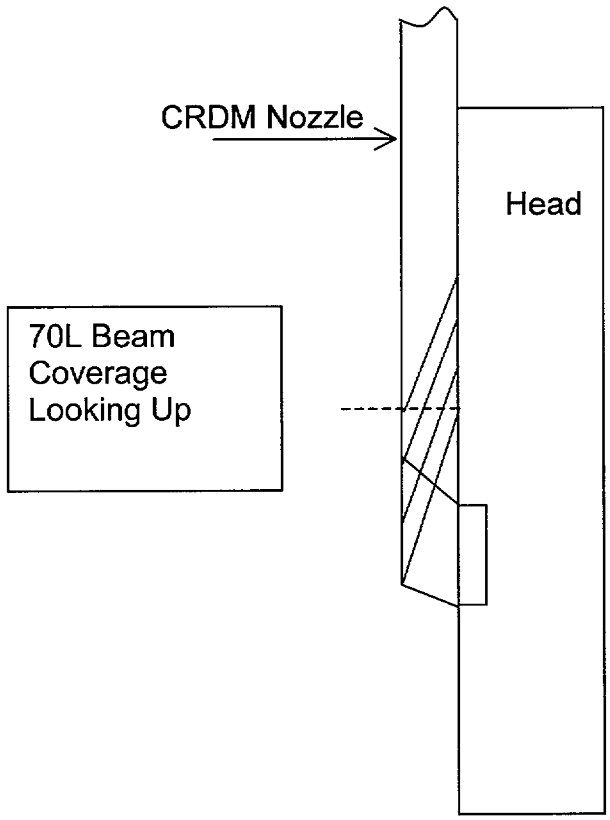

Figure 8:
PTNP-3 CRDM Temper-Bead Weld Repair, 70L UT Beam Coverage Looking Up

Relief Request No. 30
"Alternative Liquid Penetrant Examination of Weld Repair Area"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II. CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (g)(5)(iii), relief is requested from paragraph 4.0(b) of Code Case N-638. Code Case N-638 paragraph 4.0(b) specifies the weld and 5" band shall be examined by PT after the completed weld has been at ambient temperature for 48 hours.

PT will not be performed outside the immediate area of the new weld.

IV. BASIS FOR RELIEF

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to

PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

The first purpose for the examination of the band is to assure all flaws in the area of the repair have been removed or addressed, since these flaws may be associated with the original flaw and may have been overlooked. In this case, the repair welding is performed remote from the known defect.

The second purpose of the examination is to detect flaws that may be revealed as a result of the repair. In this case, there are no flaws in the base metal in the region being repaired. The purpose of the repair is to remove any defective portions of the nozzle(s), sever the existing weld from the nozzle, and install a new pressure boundary weld. The proposed examination of the new weld surfaces (welded region) and immediate surrounding areas within the band is sufficient to verify that defects have not been induced in the low alloy steel RVCH material due to the welding process.

The final weld surface and adjacent base metal will be liquid penetrant examined after welding. UT will be performed scanning from the ID surface of the weld, excluding the transition taper portion at the bottom of the weld, and adjacent portion of the CRDM nozzle bore. The UT is qualified to detect flaws in the repair weld and base metal interface in the repair region, to the maximum practical extent. The examination extent is consistent with the Construction Code requirements.

PT coverage is shown in Figures 9 and 10.

Additionally, the final modification configuration and surrounding ferritic steel area affected by the welding is either inaccessible, or is extremely difficult to access to obtain the necessary access.

Also, elimination of the band PT will result in reduction in dose to personnel.

VI. PROPOSED EXAMINATION:

Liquid Penetrant (PT) examination will be performed only in the immediate area of the new weld.

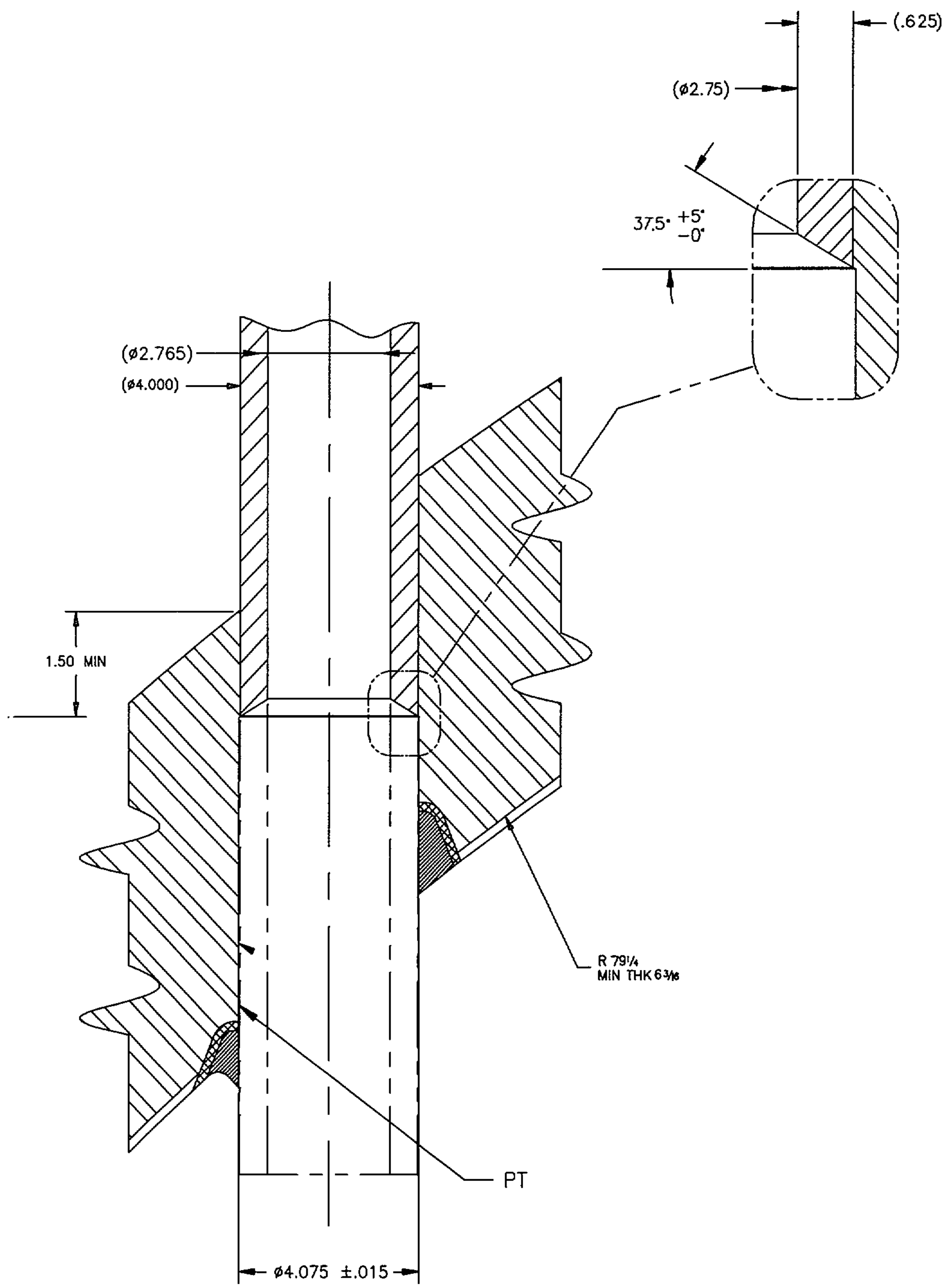

Figure 1:

PTN-3 CRDM Machining

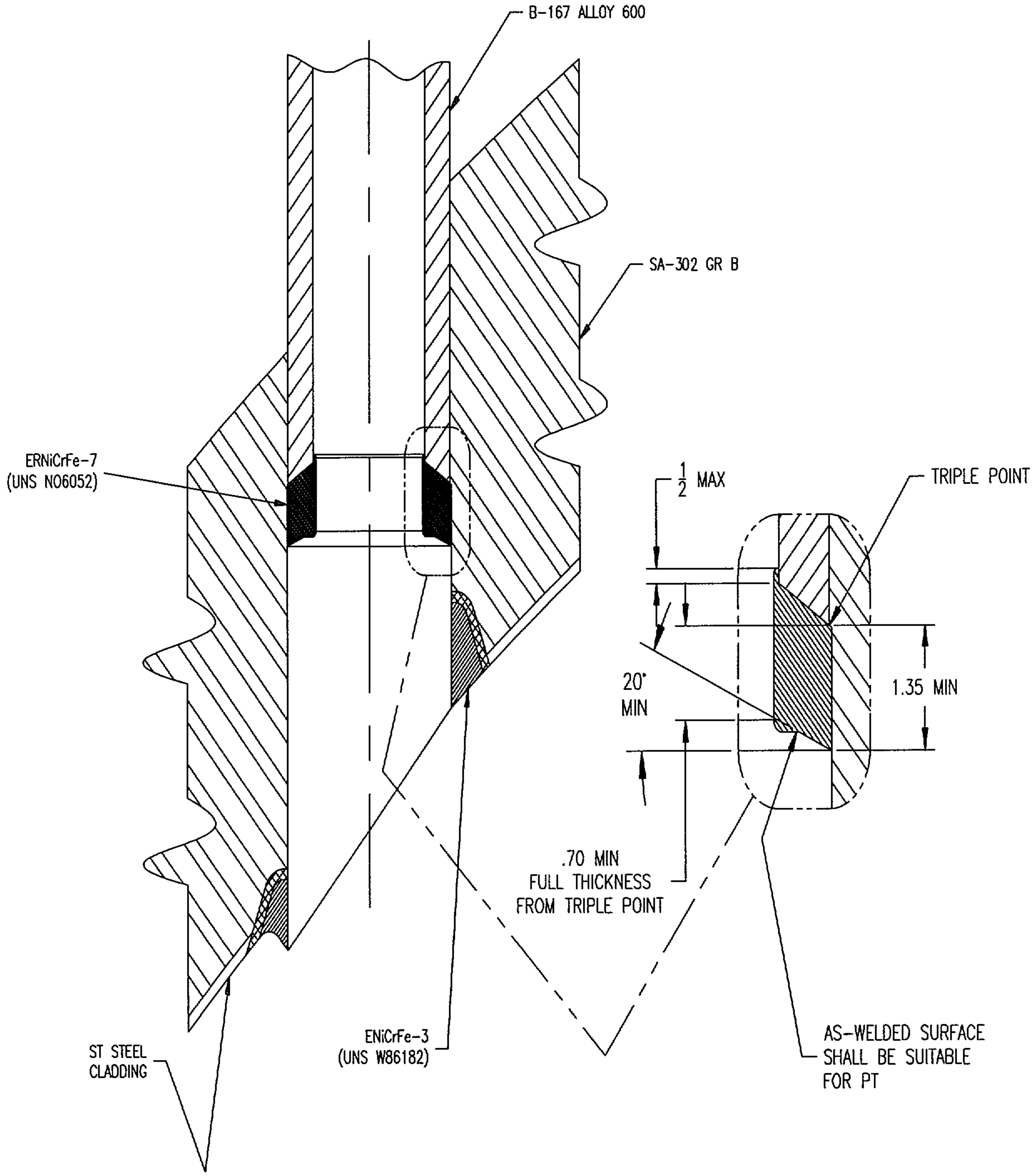

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

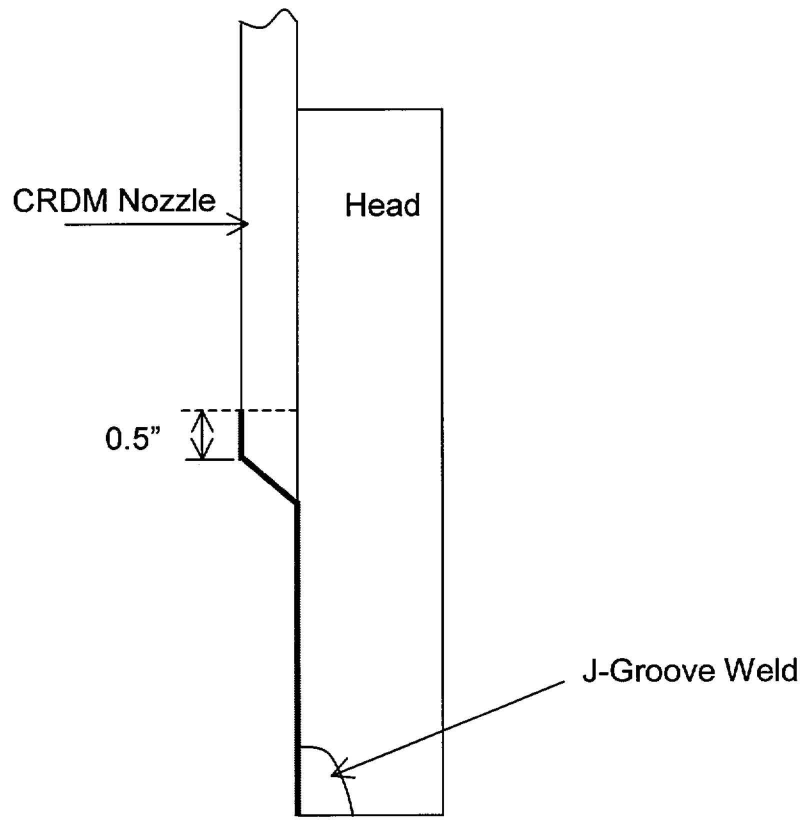

Figure 9:

PTN-3 CRDM Temper-Bead Weld Repair, PT Coverage Prior to Welding

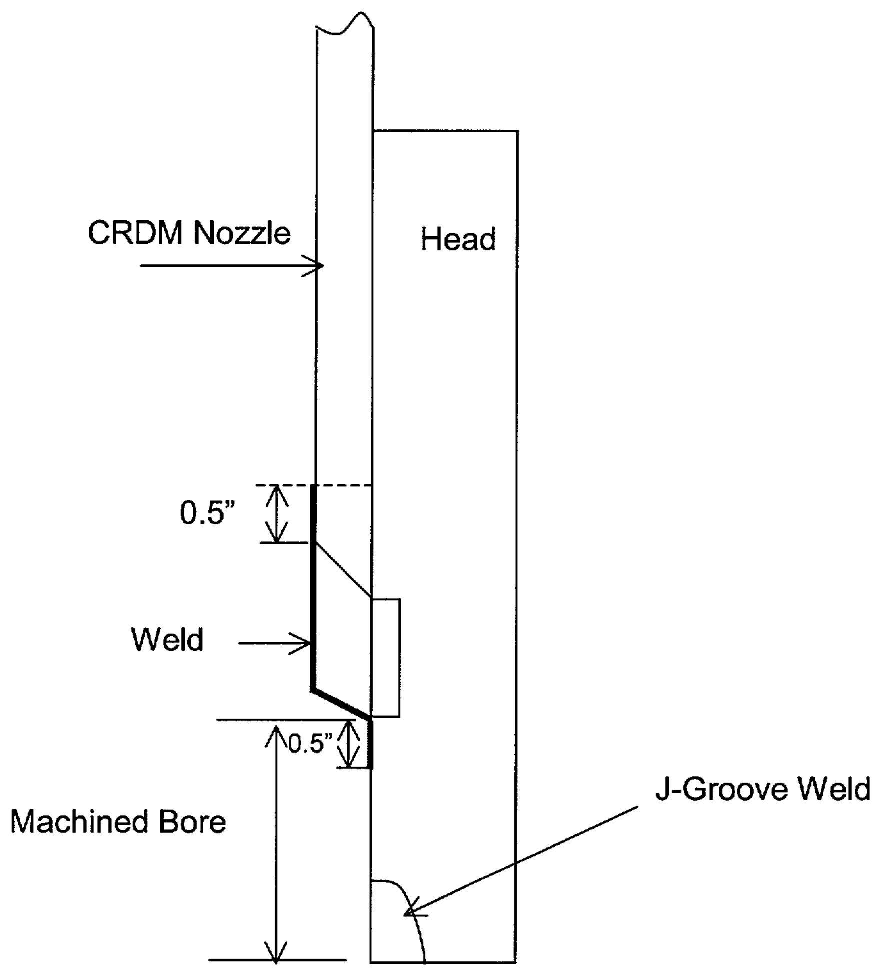

Figure 10:

PTN-3 CRDM Temper-Bead Weld Repair, PT Coverage After Welding

Relief Request No. 31
"Alternative to Monitoring of Interpass Temperatures"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II. CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (a)(3)(i), relief is requested from ASME XI 1989 Edition IWA-4533(b) which requires the use of thermocouples to monitor interpass temperature during welding. The new weld is inaccessible for mounting thermocouples near the weld. In lieu of using thermocouples for interpass temperature measurements, calculations show that the maximum interpass temperature will not be exceeded.

IV. BASIS FOR RELIEF

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to

PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

Due to the difficulty in placing thermocouples adjacent to the new CRDM nozzle to closure head weld inside the penetration, direct monitoring of the interpass temperature is not practical. The remote welding machine will be installed into the CRDM nozzle from below the RVCH. The machine is then clamped into position against the new bore by expanding mandrels. Placing thermocouples within the small space to monitor interpass temperature is impractical. In lieu of monitoring the interpass temperature via adjacent thermocouples, a calculation has been performed justifying the actual interpass temperature at the weld location based on the maximum allowable, but 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, due to the weld thickness (distance from the low alloy ferritic steel base material), will not have a metallurgical affect on the low alloy ferritic steel heat affected zone.

The calculation is based on a typical inter-bead time interval of five minutes. The five minute inter-bead interval is based on the time required to: 1) explore the previous weld deposit with the two remote cameras housed in the weld head, 2) shift the starting location of the next weld bead circumferentially away from the end of the previous weld bead, and 3) shift the starting location of the next bead axially to insure the 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 Turkey Point RVCH, was used to demonstrate the welding technique described herein. 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 1-1/2 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 18-hour 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. Therefore for ambient temperature conditions used for this repair, maintenance of the 350°F maximum interpass temperature will certainly not be a concern.

In summary, controlling the heat input parameters assures that the maximum interpass temperature is not exceeded and thus provides an acceptable level of quality and safety.

VI. PROPOSED ALTERNATIVE:

Calculations that show that the maximum interpass temperature will not be exceeded will be relied upon, in lieu of using thermocouples for interpass temperature measurements,

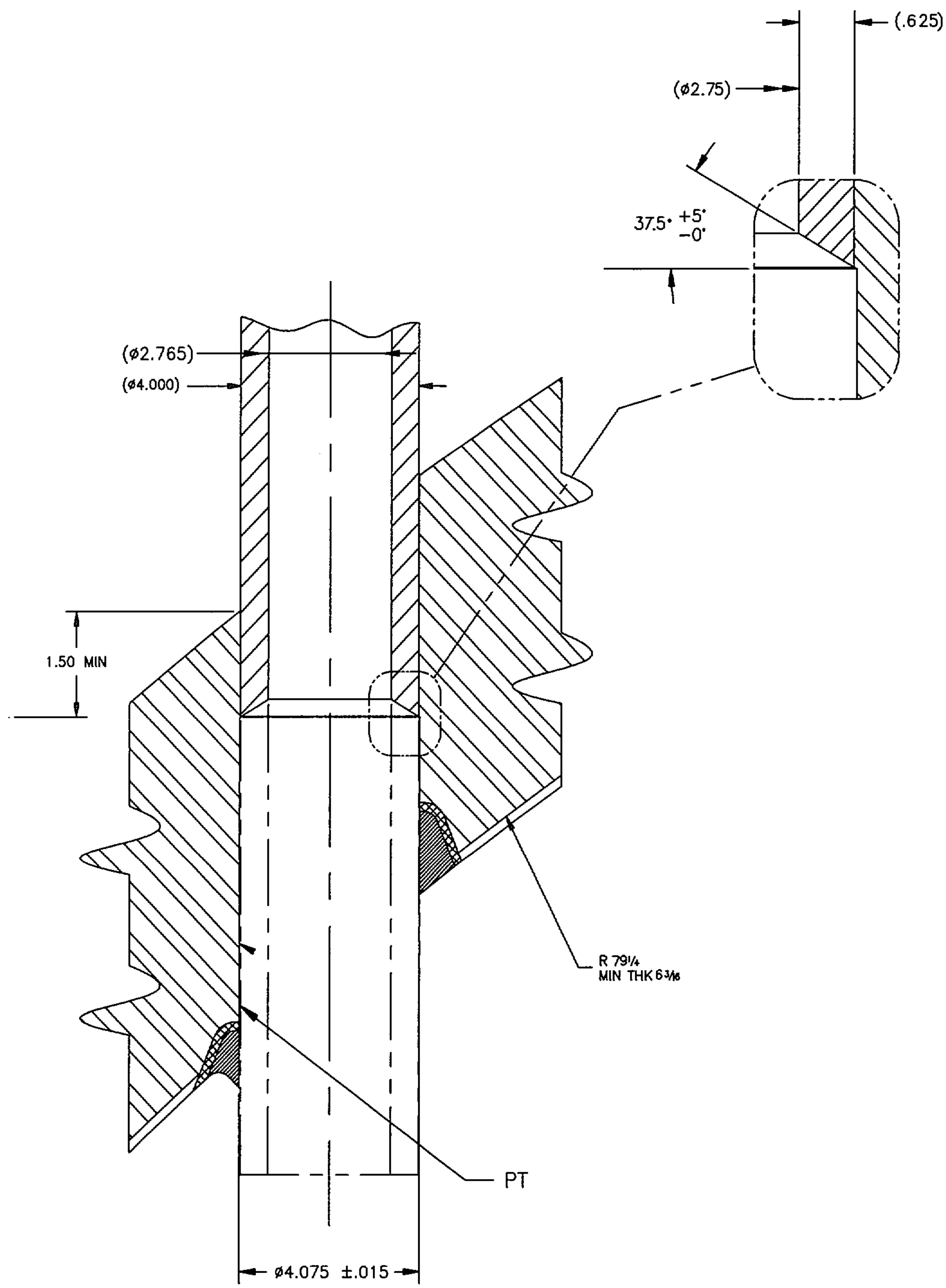

Figure 1:

PTN-3 CRDM Machining

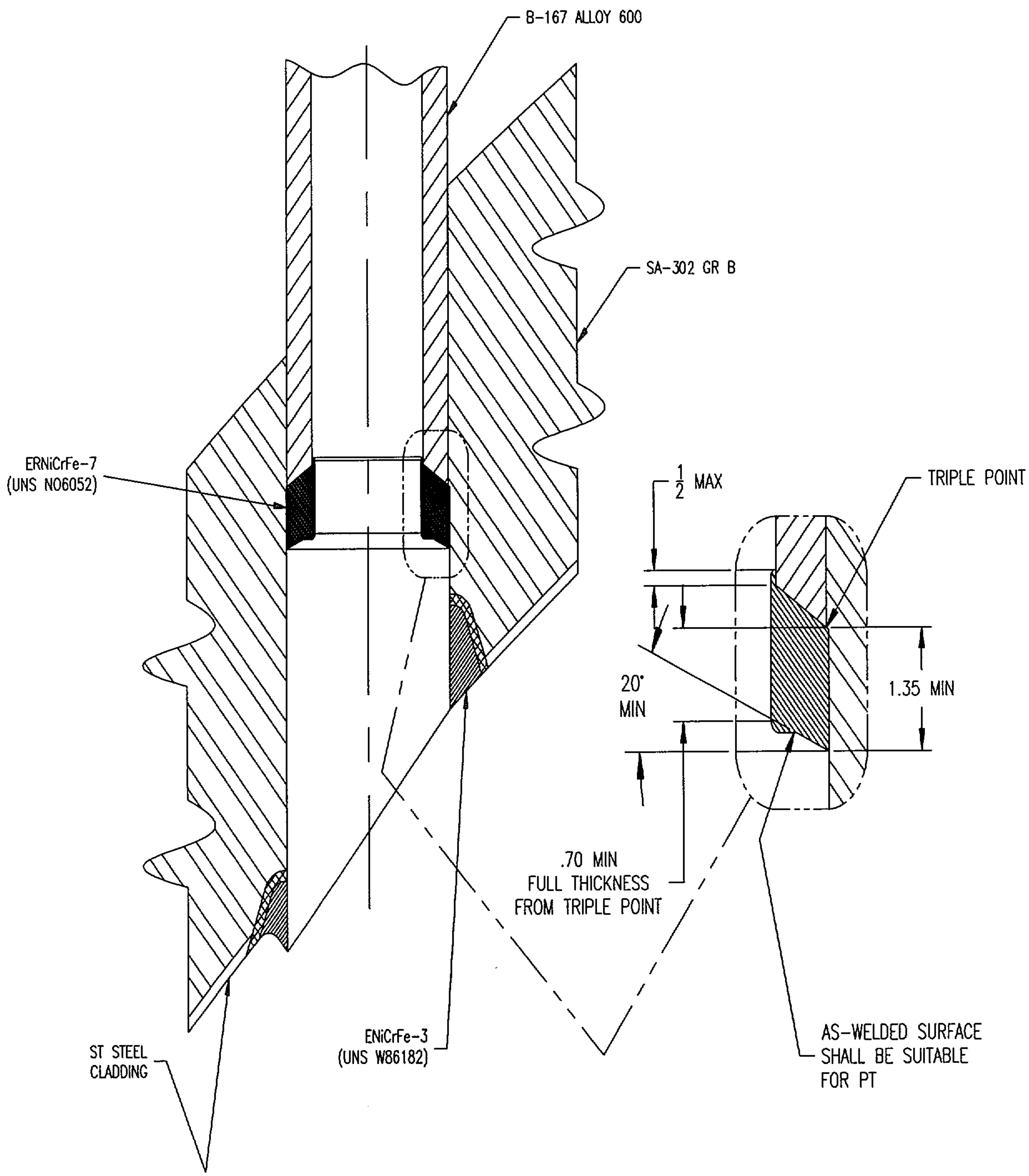

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

Relief Request No. 32
"IWA-3300(b) and IWB-3420"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II. CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (g)(5)(iii), relief is requested from ASME XI IWA-3300 (b) and IWB-3420, that require flaw characterization. Flaws may remain in the original Ni-Cr-Fe housing nozzle penetration J-prep buttering or the Ni-Cr-Fe CRDM housing-to-closure-head attachment weld. It will be impractical to characterize these flaws by NDE and to show the flaws do not extend into the ferritic head base material.

Except for a chamfer at the corner of the original weld, the original J-groove weld will not be removed. Since it has been determined that cracking in the J-groove weld will most likely accompany a leaking CRDM nozzle, it must be assumed that the "as-left" condition of the remaining J-groove weld includes degraded or cracked weld material. The extent of this cracking has varied.

IV. BASIS FOR RELIEF:

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant

compared to the thickness of the RV closure head. FRA-ANP has estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME

Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

It will be shown to be acceptable to leave the postulated cracks in the attachment weld and buttering. ASME Section XI calculations will be performed to show the flaws are acceptable for a number of years. The only driving mechanism is fatigue crack growth and that would only be driven by heat-up cool-down cycles (6 heatup/cooldown cycles assumed per year). The fracture mechanics evaluation will assume a radial (with respect to the penetration center line) crack exists with a length equal to the partial penetration weld prep depth. Based on industry experience and operation stress levels there is no reason for service related cracks to exist in the ferritic material.

A fracture mechanics evaluation will be performed to determine if degraded J-groove weld material could be left in the vessel, with no examination to size any flaws that might remain following the repair. Since the hoop stresses in the J-groove weld are generally about two times the axial stress at the same location, the preferential direction for cracking is axial, or radial relative to the nozzle. It will be postulated that a radial crack in the Alloy 182 weld metal would propagate due to PWSCC, through the weld and butter, to the interface with the low alloy steel RVCH. It is fully expected that such a crack would then blunt and arrest at the butter-to-head interface. Ductile crack growth through the Alloy 182 material would tend to relieve the residual stresses in the weld, as the crack grew to its final size and blunted. Although residual stresses in the

RVCH material are low, it will be assumed that a small flaw could initiate in the low alloy steel material and grow by fatigue. It will be postulated that a small flaw in the RVCH would combine with a large stress corrosion crack in the weld to form a radial corner flaw that would propagate into the low alloy steel RVCH by fatigue crack growth under the cyclic loading conditions associated with heatup and cooldown.

Residual stresses will not be included in the flaw evaluations since it was demonstrated by analysis that these stresses are compressive in the low alloy steel base metal. Any residual stresses that remained in the area of the weld following the boring operation would be relieved by such a deep crack, and therefore need not be considered.

VI. PROPOSED ALTERNATIVE:

Flaw evaluations will be performed for a postulated radial corner crack on the RVCH penetration, where stresses are the highest and the radial distance from the inside corner to the low alloy steel base metal (crack depth) is the greatest. Hoop stresses will be used since they are perpendicular to the plane of the crack. Fatigue crack growth, calculated for the remaining operational life will be minimal, and the final flaw size will be shown to meet the fracture toughness requirements of the ASME Code using an upper shelf value of 200 ksi√in for ferritic materials.

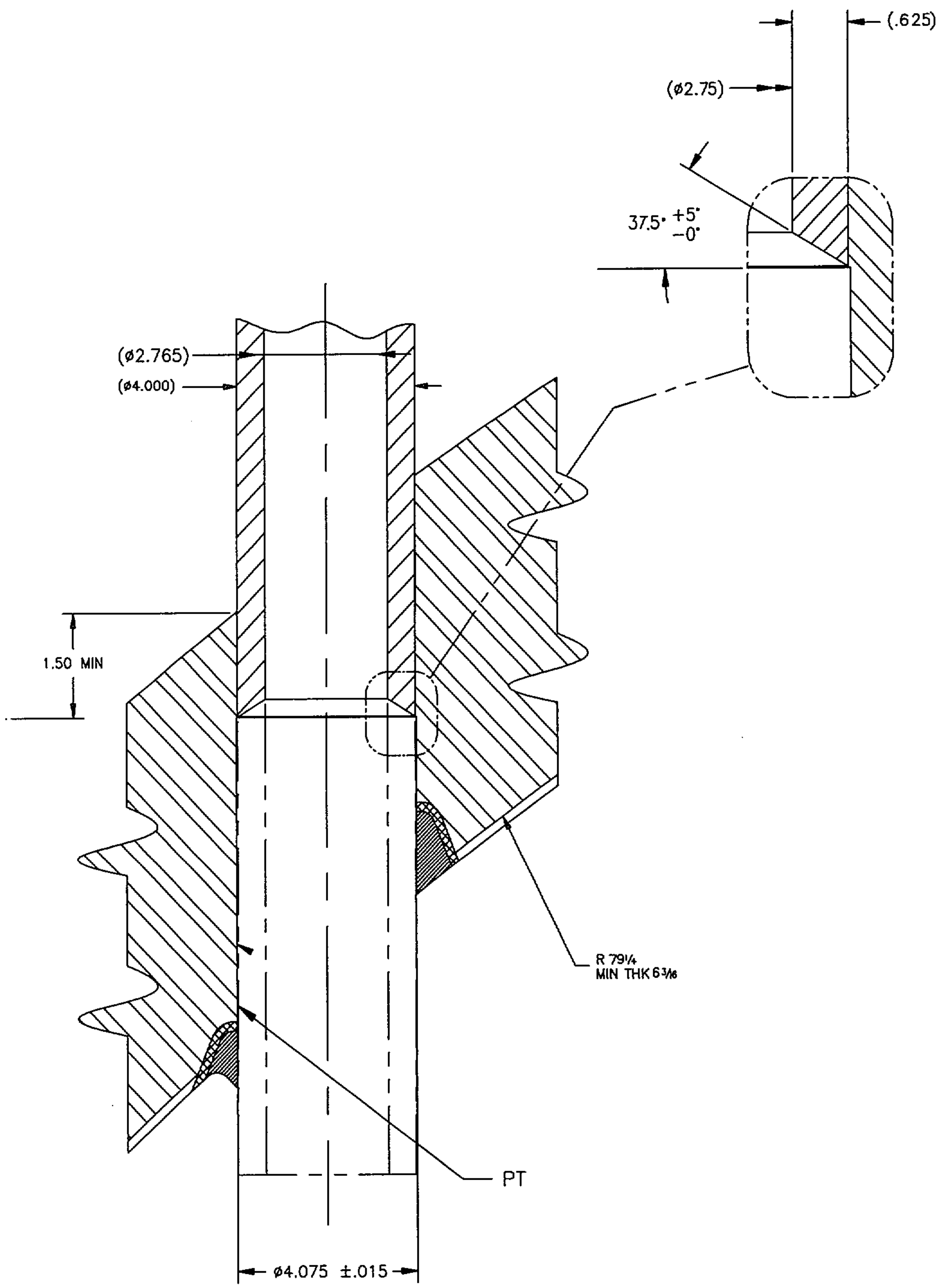

Figure 1:

PTN-3 CRDM Machining

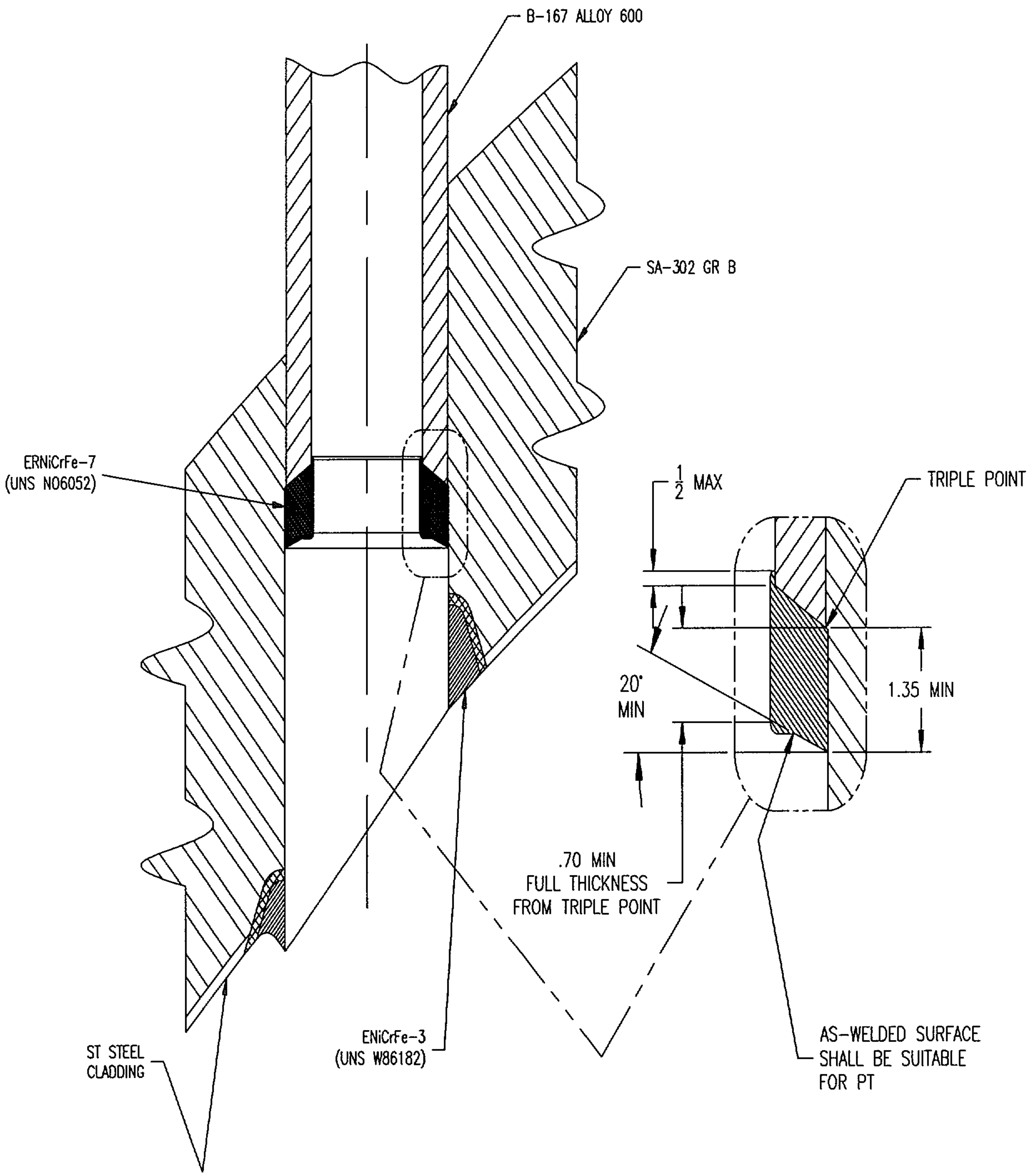

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

Relief Request No. 33
"Alternative Ultrasonic Examination Acceptance Criteria"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II. CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (a)(3)(i), relief is requested to implement an alternative to the requirements of Code Case N-638 paragraph 4.0(b), which requires Ultrasonic examination (UT) in accordance with ASME XI Appendix I and paragraph 4.0(e) which specifies UT in accordance ASME XI IWB-3000.

UT will be performed in accordance with ASME III NB-5000 using NB-5330 acceptance criteria.

IV. BASIS FOR RELIEF:

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire

lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

Design Conditions
Normal, Operating, and Upset Conditions
Emergency Conditions
Faulted Conditions
Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

ASME XI provides for examination of repair/replacements in accordance with the Construction Code.

The ASME XI Working Group on Welding and Special Repair Processes is evaluating changes to the Code Case similar to the following:

Removal of the last sentence of 4.0(b) (specifying ultrasonic examination shall be in accordance with Appendix I) and replacing with "The examination methodology shall be in accordance with the Construction Code or Section XI".... and

4.0(e) change from "IWB-3000" to " NB-5330 or IWB-3000".

Code Case N-416-1 specifies the use of ASME III 1992 Edition, no Addenda, for NDE methods and acceptance criteria.

The UT transducers and delivery tooling are capable of scanning from cylindrical surfaces with inside diameters near 2.75 in. The UT equipment is not capable of scanning from the face of the taper. Approximately 70% of the weld surface will be scanned by UT. Approximately 83% of the closure head ferritic steel HAZ will be covered by the UT.

The transducers to be used are shown in Table 1. The UT coverage volumes are shown in Figures 3 through 8 for the various scans.

VI. PROPOSED ALTERNATIVE:

UT will be performed in accordance with ASME III NB-5000 using NB-5330 acceptance criteria.

Search Unit Selection						
Angle/Mode	**Freq.**	**Model**	**Mfg.**	**Size**	**Focal Depth**	**Beam Direction**
0° L-wave	2.25 MHz	2077	Sigma	.15" x .30"	0.45"	N/A
45° L-wave	2.25 MHz	2118	Sigma	.30" x .20"	0.45"	Axial
70° L-wave	2.25 MHz	2370	Sigma	.72" x .21"	0.69"	Axial
45° L-wave (effective)	2.25 MHz	2117	Sigma	.30" x .20"	0.45"	Circ.

Table 1:

PTN-3 CRDM Replacement Weld
UT Search Unit Transducer Characteristics

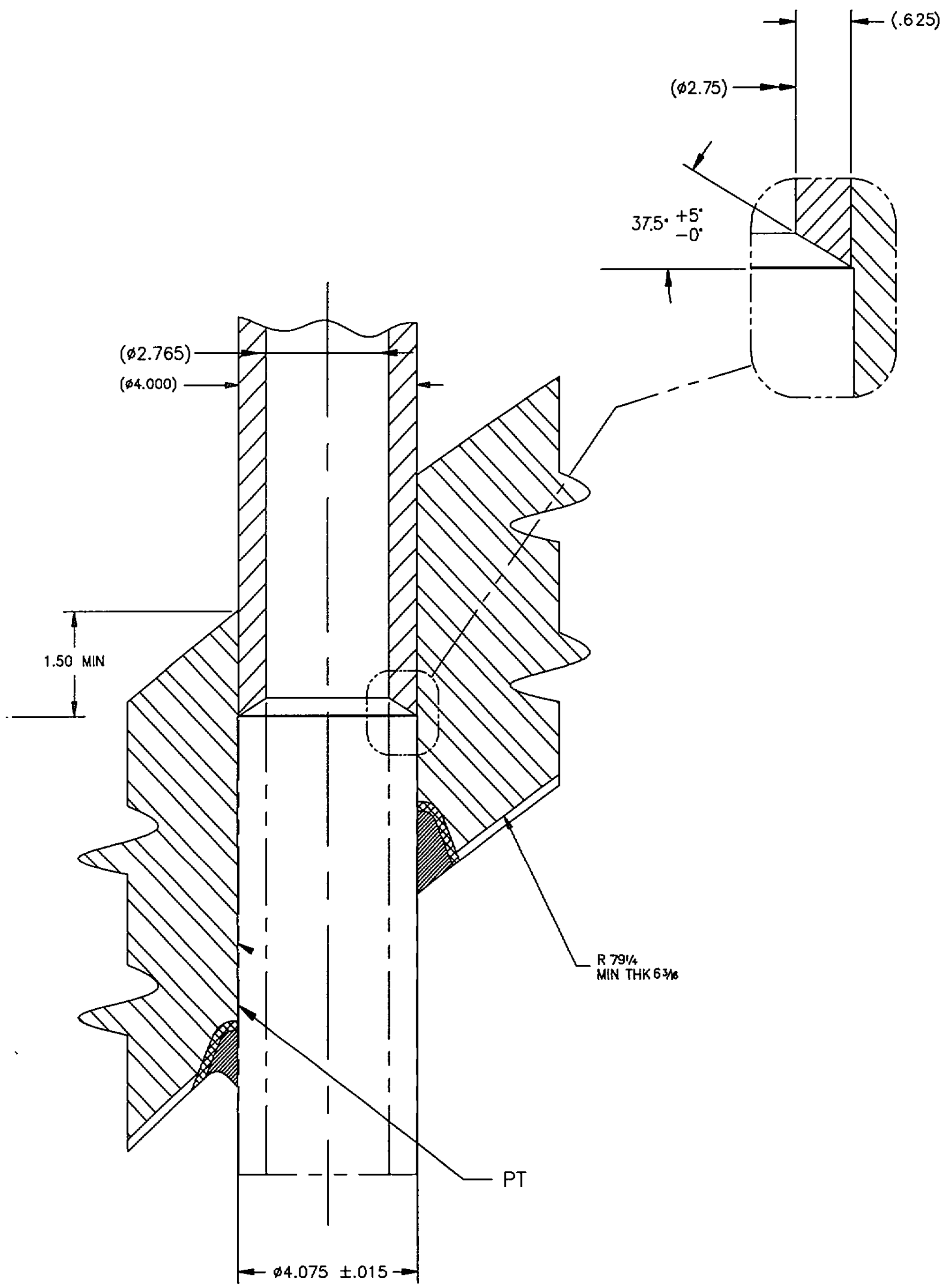

Figure 1:

PTN-3 CRDM Machining

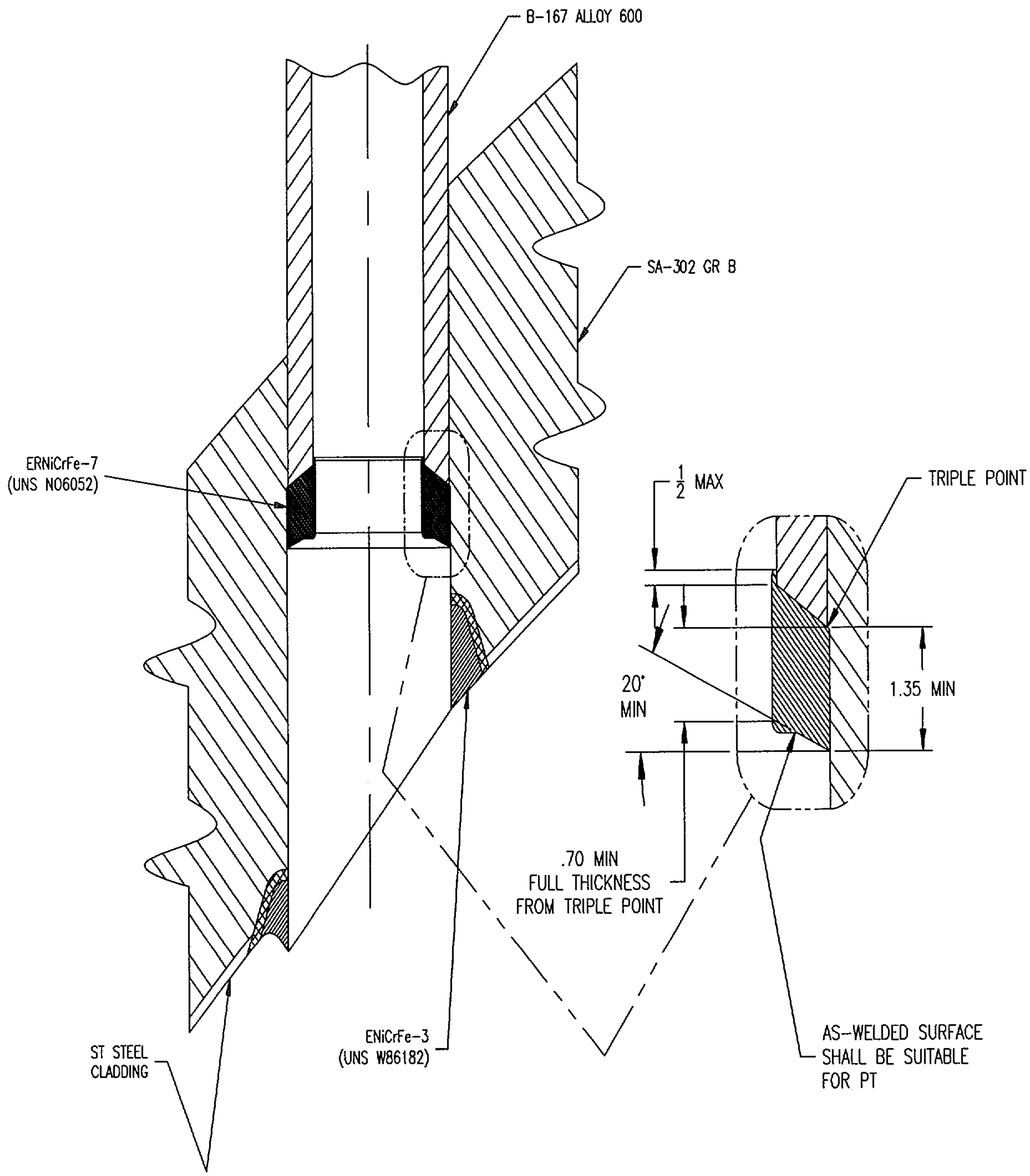

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds

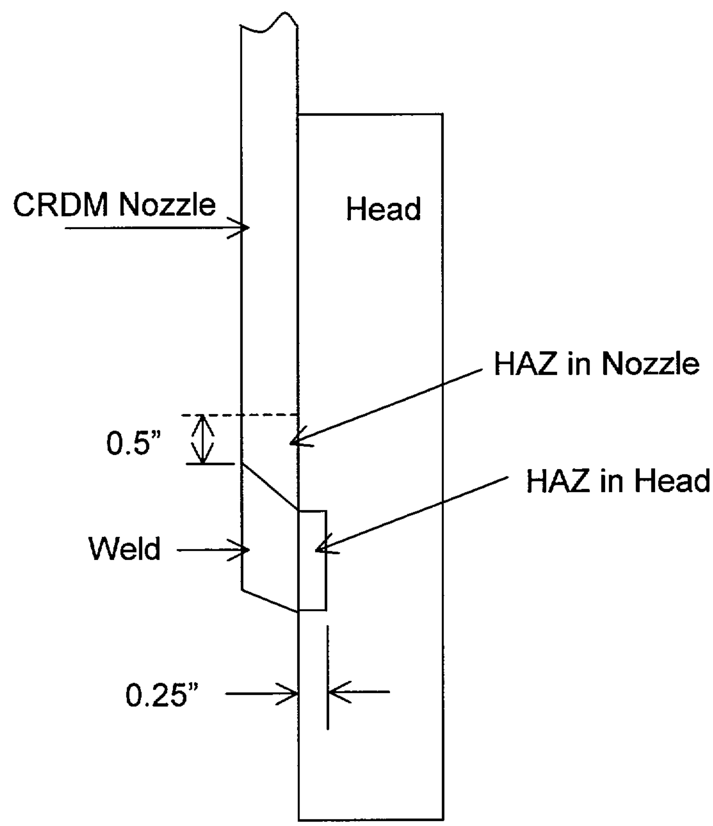

Figure 3:

PTN-3 CRDM Temper-Bead Weld Repair
Areas to be Examined

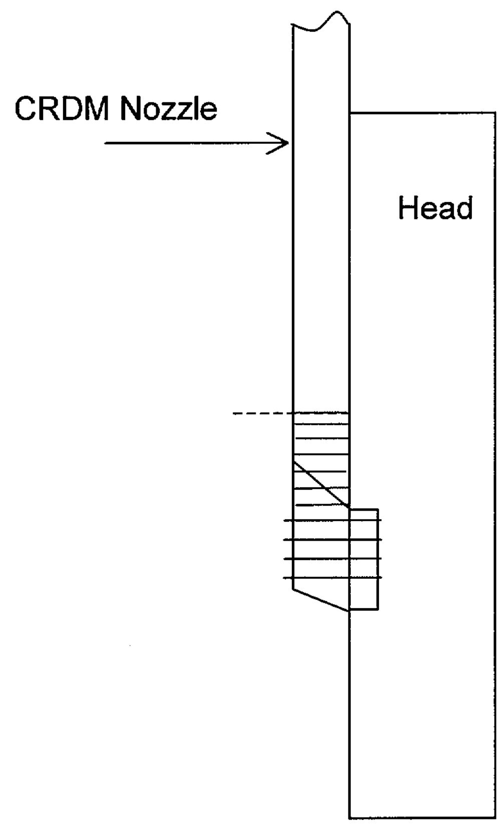

Figure 4:

**PTN-3 CRDM Temper-Bead Weld Repair,
UT 0 degree and 45L Beam Coverage
Looking Clockwise and Counter-clockwise**

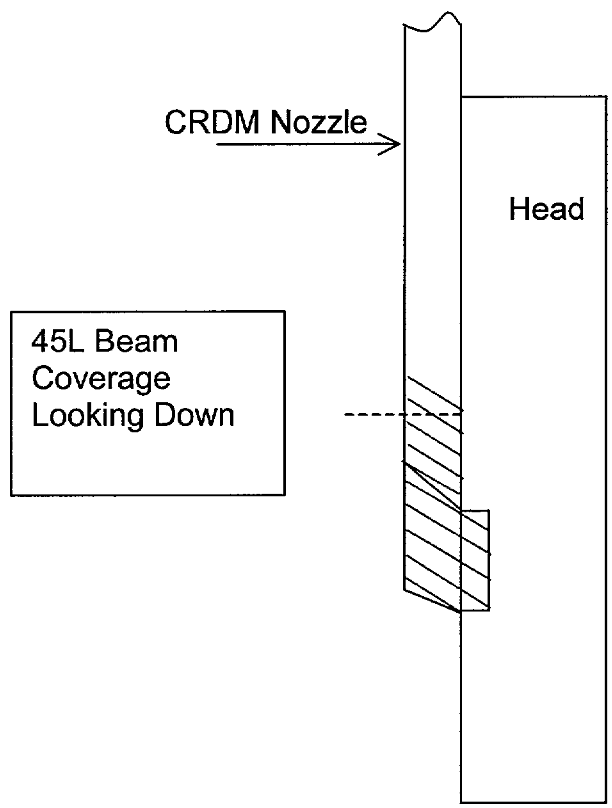

Figure 5:

**PTN-3 CRDM Temper-Bead Weld Repair,
45L UT Beam Coverage Looking Down**

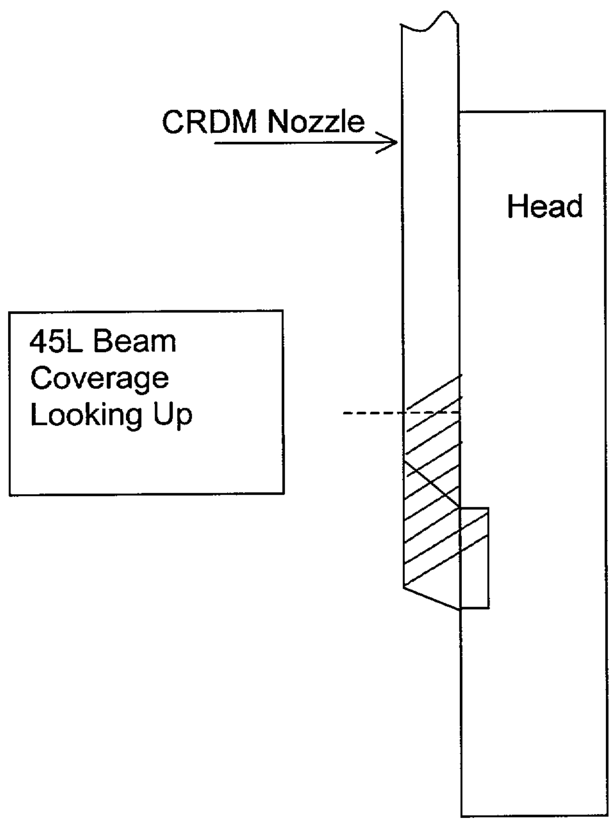

Figure 6:

**PTN-3 CRDM Temper-Bead Weld Repair,
45L UT Beam Coverage Looking Up**

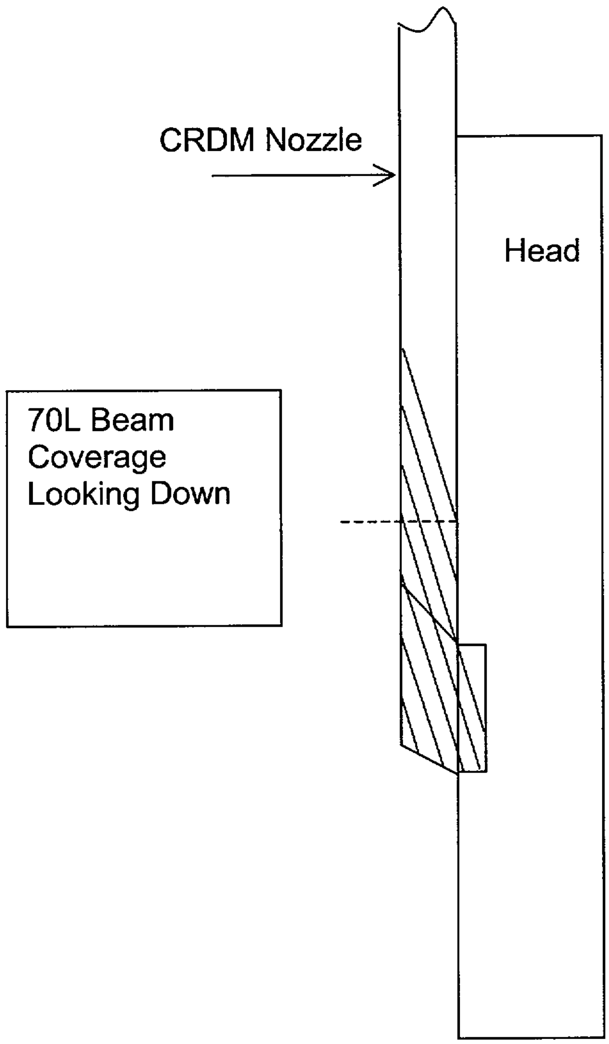

Figure 7:

**PTN-3 CRDM Temper-Bead Weld Repair,
70L UT Beam Coverage Looking Down**

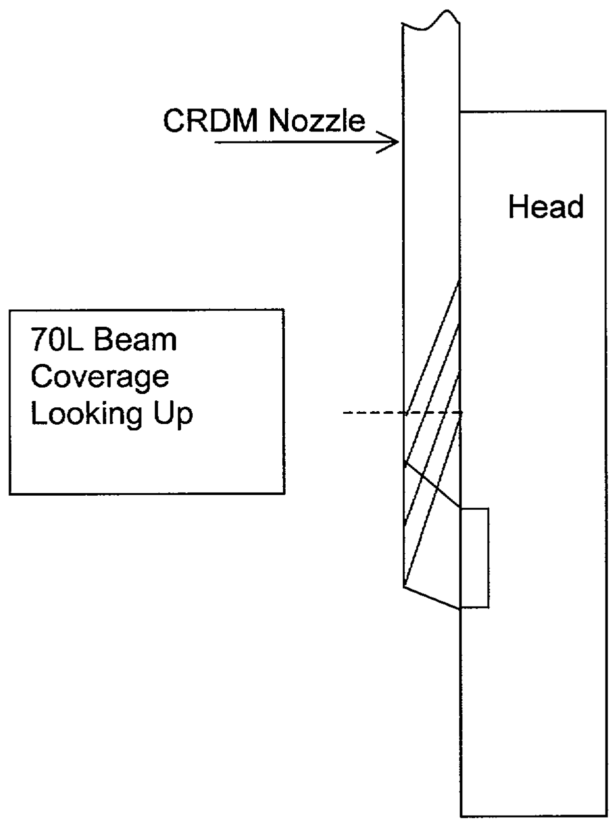

Figure 8:
PTN-3 CRDM Temper-Bead Weld Repair, 70L UT Beam Coverage Looking Up

Relief Request No. 34
"Use of Code Case N-638 for PTN-3 Reactor Pressure Vessel Head Material"

I. COMPONENT IDENTIFICATION

Turkey Point Unit 3
Reactor Vessel Closure Head Penetrations, Class 1
FPL Drawing No. 5610-M-400-57 Rev. 1

II. CODE REQUIREMENT:

Rules for Inservice Inspection of Nuclear Power Plant Components, Section XI, 1989 Edition, Examination Category B-O, "Pressure Retaining Welds in Control Rod Housings," code item B14.10.

III. RELIEF REQUESTED:

Pursuant to 10 CFR 50.55a (a)(3)(i), relief is requested to implement Code Case N-638 for use with SA-302 Gr. B material as an alternative to the requirements of ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1989 Edition. Code Case N-638 specifies applicability for all P-No. 3 Group No. 3 base materials except SA-302 Gr. B.

The Turkey Point Unit 3 Closure Head is constructed of SA-302 Gr. B material, but the Code Case is to be used for the repair.

IV. BASIS FOR RELIEF:

Visual inspections for leakage/boric acid deposits of the Reactor Vessel Closure Head (RVCH) Control Rod Drive Mechanism (CRDM) nozzle penetrations will be conducted on the exterior surfaces of the RVCH. Nondestructive examinations will be performed from beneath the head to characterize the leakage, utilizing liquid penetrant (PT), eddy current, and ultrasonic (UT) methods. Nozzles showing evidence of leakage will be repaired. The repair plan seeks to significantly reduce exposures for CRDM repair by instituting machine remote processes similar to those used at the Oconee Nuclear Station Unit 2, except ambient temperature temper bead welding will be used as specified in ASME Section XI Code Case N-638.

All repair equipment will be staged from underneath the RVCH using remotely operated equipment to the maximum practical extent. The existing CRDM nozzle will be removed to approximately mid-RVCH-wall thickness by machining. The machining process will remove the entire lower portion of the CRDM nozzle and will also perform the CRDM nozzle repair weld preparation. The machined surface will be cleaned prior to PT. The repair weld will be performed with a machine Gas Tungsten-Arc Welding (GTAW) weld head using the temper bead process. The final weld face will be machined. The final weld will be liquid penetrant and ultrasonically examined. The final inside surface of the CRDM nozzle near the new weld, and the new weld, will then be conditioned by abrasive water-jet machining to produce a final surface that is in compression, to produce optimum resistance to primary water stress corrosion cracking.

The CRDM nozzle repair configuration is illustrated in Figures 1 and 2.

Each CRDM nozzle to be repaired will receive a roll expansion into the RVCH base material equal to an approximate 1-3% nozzle wall thickness reduction. The roll expansion will insure that the nozzle will not move during the repair operations. Then the lower portion of the nozzle will be removed, by machining to a depth above the existing J-groove partial penetration weld. This operation will sever the existing J-groove partial penetration weld from the subject CRDM nozzle(s). A bevel will be machined into the lower end of the nozzle(s) in preparation for the repair weld. A weld tool will then be used to install a new Alloy 52 pressure boundary weld between the shortened nozzle and the inside bore of the RVCH, utilizing the machine GTAW process and the ambient temperature temper bead method, in accordance with Code Case N-638.

This approach for repair of the leaking CRDM nozzles will significantly reduce radiation dose to repair personnel. The total radiation dose for the remote semi-automated repair method currently is projected to be 7.5 Rem per nozzle. In contrast, FPL projects that using manual repair methods would result in a total radiation dose of 32 Rem per nozzle.

The repair method described above leaves a band of ferritic low alloy steel exposed to the primary coolant. The effect of corrosion on the exposed area, both reduction in RVCH thickness and primary coolant Iron (Fe) release rates, has been evaluated by Framatome-ANP (FRA-ANP). The results will show that the general corrosion of the low alloy steel base material is conservatively estimated to be 0.0032 inch/year. This estimate is based on extensive industry data and FRA-ANP experience. The corrosion depth after 40 years operation is conservatively estimated to be 0.128 inches (0.0032 inch/year X 40 years). This is insignificant compared to the thickness of the RV closure head. FRA-ANP has

estimated that the Fe release from 69 repaired CRDM nozzles would equal 1017 gram/year, which is less than 15% of the total Fe release from all other sources. Since Turkey Point has 59 CRDM nozzles, the release would be even less.

EPRI's NMAC Document TR-104748, "Boric Acid Corrosion Guidebook," supports the conclusion that a corrosion rate of 0.0032 inch/year is conservative. The Guidebook contains a compilation of data on boric acid corrosion rates and example calculations for operating plants.

An analysis of the new pressure boundary welds will be performed using a 3-dimensional model of a CRDM nozzle located at the most severe hillside orientation. The software program ANSYS (general purpose finite element program that is used industry-wide) will be used for this analysis. Per FRA-ANP internal procedures, the ANSYS computer code is independently verified as executing properly, by the solution of verification problems using ANSYS and then comparison of the results to independently determined values.

The analytical model will include the RVCH, CRDM nozzle, repair weld, and remnant portions of the original Alloy 600 welds. The model is analyzed for thermal transient conditions as contained in the design specifications. The resulting maximum thermal gradients will be applied to the model along with the coincident internal pressure values. The ANSYS program will then calculate the stresses throughout the model (including the repair welds). The stresses will be post-processed by ANSYS routines to categorize stresses into categories that are consistent with the criteria of the ASME Code.

The calculated stress values are compared to the ASME Code, Section III, NB-3000 criteria for:

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Normal, Operating, and Upset Conditions
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Testing Conditions

A very conservative Stress Concentration Factor (SCF) of 4.0 was assumed for the new pressure boundary weld.

A primary stress analysis for design conditions will be performed. A maximum Primary General Membrane Stress Intensity (Pm) will be calculated and shown to be less than the maximum allowed by the ASME Code = 27.0 ksi. This value will be actually for the RVCH but has the minimum margin for primary stress criteria of any portion of the model (including repair weld, CRDM nozzle, or original welds). The criteria for the primary stresses resulting from the remaining service conditions have greater margin than that shown above.

The maximum cumulative fatigue usage factor will be calculated and allowable years of future plant operation will be based on the maximum allowed ASME Code usage factor criterion of 1.0. The limiting location for this value is the point at the intersection of the bottom of the repair weld and the penetration bore. At the bottom of the crevice between the CRDM nozzle outside surface and the RV closure head bore, the calculated fatigue usage factor for 40 years of future operation will not be limiting to the fatigue life of the repair.

The Relief Request specified below describes variations from the governing ASME documents applicable to the CRDM Nozzle ID Ambient Temperature Temper Bead Weld.

V. JUSTIFICATION FOR USE OF THE ALTERNATIVE

A single member on ASME Main Committee objected to the inclusion of SA-302 Gr. B base material applicability due to concerns relevant to Heat Affected Zone (HAZ) toughness levels as a result of welding without use of a full post weld heat treatment (stress relief). The exclusion was therefore incorporated to obtain unanimous approval for Code Case N-638.

The Turkey Point RVCH plate was provided by Lukens Steel as firebox (pressure vessel) quality, electric furnace melted, silicon killed fine grain melting practice and vacuum degassed. The plate was 180" x 180" x 6-9/16"T after rolling at the mill. The plate was subsequently quenched and tempered by Babcock & Wilcox after forming the closure head dome. This material was manufactured similar to SA-533 Gr A, which is not excluded from applicability by Code Case N-638.

The FRA-ANP Process Qualification Record (PQR) 7164 (preliminary and not released) using P-No. 3 Group No. 3 base material exhibited improved Charpy V-notch (CVN) 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 also should be observed from the test data that the unaffected base material impact properties were significantly higher than the minimum required by Code (50 ft-lbs and 35 MLE).

Furthermore the carbon equivalency (CE) as calculated using the ASME XI, 1998 Edition including Addenda through 2000 rules, and adding rather than subtracting the (Mn+Si)/6 term, show that the Turkey Point RVCHs have a CE of about 0.544% whereas the PQR test assembly base material has a CE of about 0.599%.

Metallography showed no evidence of untempered martensite or delayed hydrogen cracking in the HAZ of PQR 7164. Furthermore, the tensile and bend tests showed good ductility in the HAZ.

In addition, FRA-ANP has two (2) PQRs on file that were performed on SA-302 Gr. B material without PWHT.

PQR 2745, performed in accordance with ASME III Code Case 1401, "Welding Repairs to Cladding of Class 1 Section III Component after Final Postweld Heat Treatment," and using quenched and tempered SA-302 Gr B, two (2) transverse and two (2) longitudinal bends showed no defects.

PQR 2305, using 200°F preheat and no post weld heat soak, four (4) transverse side bends showed no defects. HAZ CVN impacts recorded were 59, 59, and 56 ft lbs. Unaffected base metal impacts were not provided. The base material heat treatment is unknown.

UT of the production weld and its HAZ, to the extent practical, will be performed after 48 hours at ambient temperature to verify weld quality and no hydrogen cracking has occurred in the HAZ.

PT of the production weld and the exposed portion of its HAZ will be performed after 48 hours at ambient temperature to verify weld quality and no hydrogen cracking has occurred in the exposed portion of the HAZ.

There are no exclusions of the use of any of the approved temper bead processes using preheat on SA-302 Gr. B material. Based on the above there is no technical basis for exclusion of welding on this material using qualified ambient temperature temper bead machine GTAW processes.

VI. PROPOSED ALTERNATIVE:

FPL will implement Code Case N-638, for the repair of the Turkey Point Unit 3 Reactor Vessel Closure Head for use with SA-302 Gr. B material, as an alternative to the requirements of ASME Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1989 Edition.

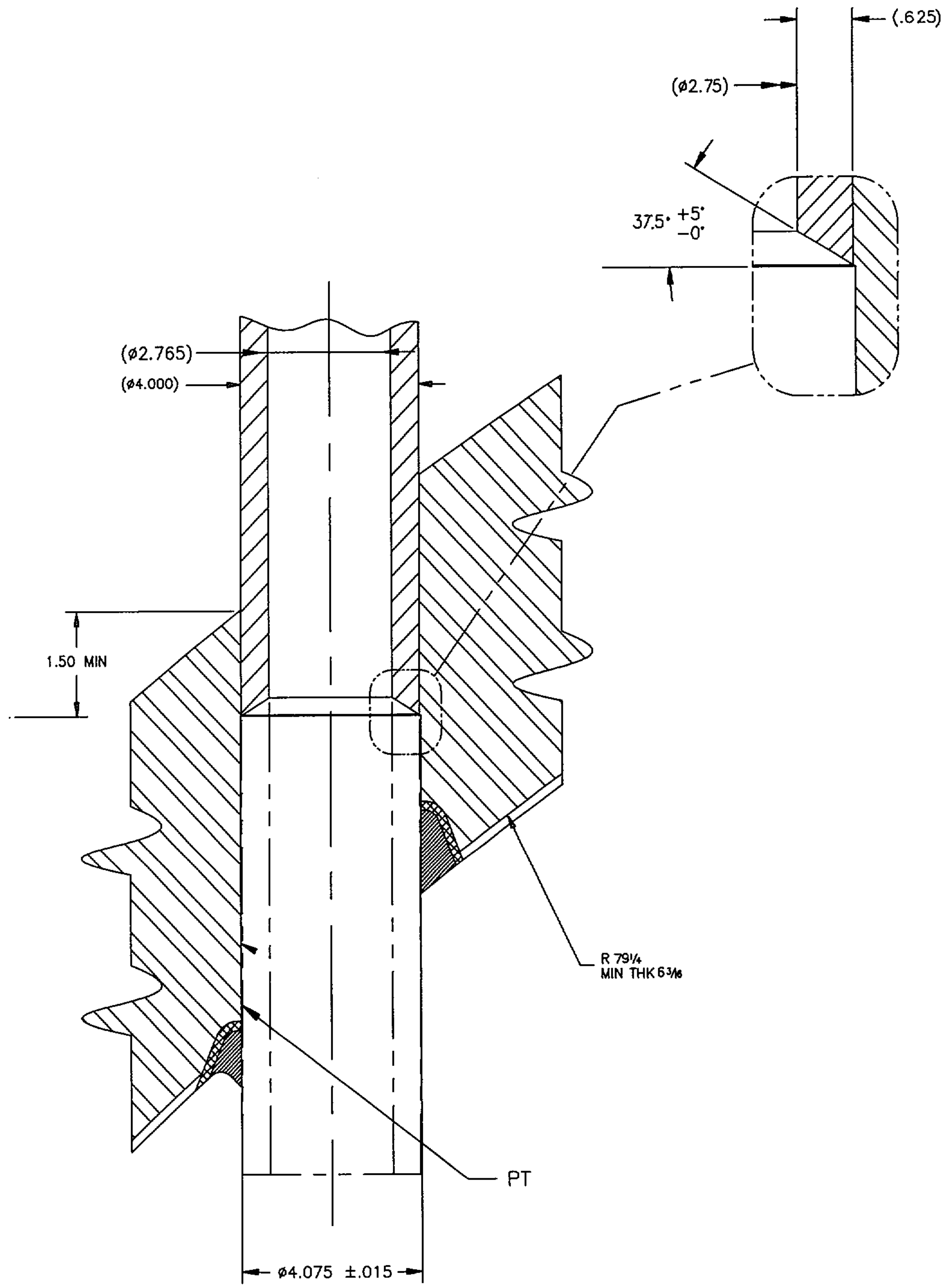

Figure 1:

PTN-3 CRDM Machining

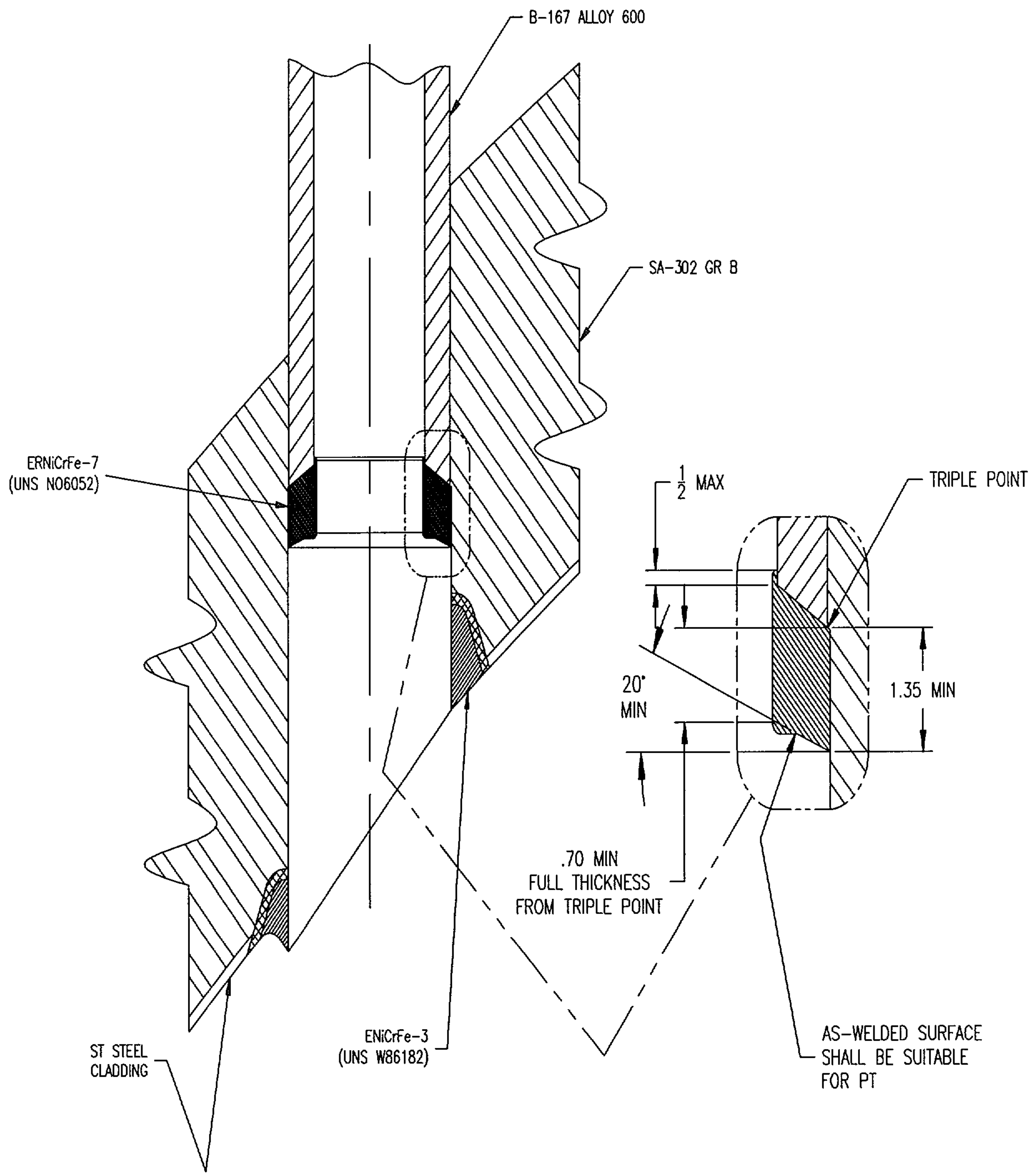

Figure 2:

PTN-3 New CRDM Pressure Boundary Welds