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Dominion

February 10, 2005

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Serial No.	04-675
MPS Lic/WDB	R1
Docket No.	50-336
License No.	DPR-65

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2
THIRD 10 TEN YEAR INSERVICE INSPECTION (ISI) INTERVAL
RELIEF REQUEST RR-89-54, USE OF ALTERNATIVE ACCEPTANCE STANDARDS REQUIREMENTS WITHOUT FLAW REMOVAL IN ALLOY 600 SMALL BORE NOZZLES

Pursuant to 10 CFR 50.55a(a)(3)(i), Dominion Nuclear Connecticut, Inc. (DNC), requests approval to use alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Code, Section XI, 1989 Edition, for the acceptance standards and successive examinations that are associated with the activities related to performance of half nozzle repair/replacements at Millstone Power Station Unit 2 (MPS2). During the MPS2 Cycle 16 refueling outage, examinations will be performed on the MPS2 pressurizer and reactor coolant system (RCS) hot leg penetrations. Depending on the results of these examinations, MPS2 may elect or be required to implement repair/replacements of pressurizer and/or RCS hot leg small bore penetration nozzles.

Currently, when a half nozzle repair/replacement is performed, ASME Code requirements contain no provisions to allow a flaw to remain in place without prior approval of the U. S. Nuclear Regulatory Commission (NRC). Specifically, DNC proposes the use of alternative acceptance standards and successive examination requirements associated with the activities related to performance of half nozzle repair/replacements. Details are provided in accordance with request RR-89-54 in Attachment 1. This alternative will be used to perform half nozzle repair/replacements to the instrumentation nozzles of the MPS2 pressurizer and RCS hot leg piping, should inspections identify leakage. DNC has determined pursuant to 10 CFR 50.55a(a)(3)(i) that the alternative specified in Attachment 1 provides an acceptable level of quality and safety.

MPS2 is currently in the third 10-year inservice inspection (ISI) interval, which started on April 1, 1999. The 1989 Edition of Section XI, No Addenda applies to the ISI program and the 1998 Edition of Section XI, No Addenda is used as the primary ASME Code Edition for Section XI repair/replacement program activities.

Relief Request RR-89-54 is seeking relief from the 1989 Edition, No Addenda of ASME Section XI, IWA-3300, Flaw Characterization and IWB-2420, Successive Inspections. In lieu of fully characterizing any remaining cracks and performing successive examinations to validate flaw stability, DNC proposes to utilize worst-case assumptions to conservatively estimate the crack extent and orientation. This approach is based on acceptance standards of the 1992 Edition, No Addenda of ASME Section XI and is subject to NRC approval under 10 CFR 50.55a(g)(4)(iv).

Although no immediate application has been identified, this request is being submitted for NRC review and approval to provide contingencies in support of potential half nozzle repair/replacements that may need to be performed in the upcoming spring 2005 outage and future refueling outages for the remainder of the third 10-year ISI interval.

The planned repair is similar to repairs performed previously at Crystal River Unit 3.

During the spring 2005 refueling outage, bare metal visual examinations for boric acid will be performed on the pressurizer and RCS hot leg Alloy 182/600 instrumentation nozzles that are potentially subject to primary water stress corrosion cracking (PWSCC). In order to address the potential need to apply a half nozzle repair/replacement to the pressurizer for any identified leakage at these small bore nozzles, DNC plans to apply a temper bead weld pad deposit using the alternatives in request (RR-89-50), which was submitted for NRC review and approval on June 14, 2004. With DNC's understanding of the 1998 Edition of Section XI, 2000 Addenda, paragraph IWA-4340, DNC did not anticipate the need for additional NRC review in support of half nozzle repair/replacement activities should they be required in the future for the pressurizer or RCS hot leg penetrations. However, based upon the clarifications provided in Regulatory Issue Summary (RIS) 2004-01, "Use of Later Editions and Addenda to ASME Code Section XI For Repair/Replacement Activities," issued October 19, 2004, it is now understood that it is necessary to submit this subsequent request. As a result of the timing of the recent clarification, this request is being submitted with a compressed schedule request. To support the scheduled MPS2 refueling outage in the spring of 2005, DNC is requesting expedited review and approval of this relief request by March 31, 2005.

If you should have any questions regarding this submittal, please contact Mr. Paul R. Willoughby at (804) 273-3572.

Very truly yours,

Leslie N. Hartz
Vice President – Nuclear Engineering

Attachments

(1) Relief Request RR-89-54, Use Of Alternative Acceptance Standards Requirements Without Flaw Removal In Alloy 600 Small Bore Nozzles

Commitments made in this letter: None.

cc: U.S. Nuclear Regulatory Commission
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ATTACHMENT 1

RELIEF REQUEST RR-89-54, USE OF ALTERNATIVE ACCEPTANCE STANDARDS REQUIREMENTS WITHOUT FLAW REMOVAL IN ALLOY 600 SMALL BORE NOZZLES

MILLSTONE POWER STATION UNIT 2
DOMINION NUCLEAR CONNECTICUT, INC.

RELIEF REQUEST RR-89-54, USE OF ALTERNATIVE ACCEPTANCE STANDARDS REQUIREMENTS WITHOUT FLAW REMOVAL IN ALLOY 600 SMALL BORE NOZZLES

CONTENTS

Request RR-89-54, Use of Alternative Acceptance Standards Requirements Without Flaw Removal in Alloy 600 Small Bore Nozzles

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

- Alternative Provides Acceptable Level of Quality and Safety -

1.0 ASME CODE COMPONENTS AFFECTED

a) Name of components:

Pressurizer level, pressure, and temperature instrument nozzle penetrations and reactor coolant system (RCS) hot leg piping instrumentation nozzle penetrations:

Pressurizer Instrumentation Nozzles (8):

Level Nozzles (4): Four 1-inch, schedule 160 level nozzles, two in the upper head and two in the lower head, all fabricated from SB-166 Ni-Cr-Fe alloy with SA-182 (F-316) stainless steel socket weld safe ends.

Pressure Nozzles (2): Two 1-inch, schedule 160 pressure nozzles in the upper head, all fabricated from SB-166 Ni-Cr-Fe alloy with SA-182 (F-316) stainless steel socket weld safe ends.

Temperature Nozzles (2): Two 1-inch, schedule 160 temperature nozzles, one in the top head (steam space) and one in the lower shell (heater area), both fabricated from SB-166 Ni-Cr-Fe alloy with SA-182 (F-316) stainless steel socket weld safe ends.

Reactor Coolant System (RCS) Hot Leg Piping Instrumentation Nozzles (19):

Loop 1 Hot Leg Instrument Nozzles (10): Five 1-inch nominal diameter temperature measurement (RTD) nozzles, B-166 Ni-Cr-Fe alloy and five 3/4-inch schedule 160 pressure measurement or sampling nozzles, all fabricated from B-166 Ni-Cr-Fe alloy with a A-182, type 316 stainless steel safe end.

Loop 2 Hot Leg Instrument Nozzles (9): Five 1-inch nominal diameter temperature measurement (RTD) nozzles, B-166 Ni-Cr-Fe alloy and four 3/4-inch schedule 160 pressure measurement or sampling nozzles, all fabricated from B-166 Ni-Cr-Fe alloy with a A-182, type 316 stainless steel safe end.

b) Function:

The nozzles and penetration welds serve as the pressure boundary for the pressurizer shell and the RCS piping.

c) ASME Code Class:

The pressurizer and RCS piping instrument and sampling nozzle penetrations are ASME Class 1.

d) System:

Reactor Coolant System (RCS)

e) Code Category:

Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels;

Code Item Nos.:

Item No. B4.13 for the modified penetrations and those original penetrations not modified.

Category B-P, All Pressure Retaining Components for the original unmodified locations and modified locations at the new weld.

Code Item Nos.:

Pressurizer:

B15.20, Pressure Retaining Boundary [System Leakage Test & Visual, VT-2 Examination Each Refueling Outage]

B15.21, Pressure Retaining Boundary [System Hydrostatic Test (System Leakage Test Per Code Case N-498-4) & Visual, VT-2 Examination One Test Per Interval]

RCS Piping

B15.50, Pressure Retaining Boundary [System Leakage Test & Visual, VT-2 Examination Each Refueling Outage]

B15.51, Pressure Retaining Boundary [System Hydrostatic Test (System Leakage Test Per Code Case N-498-4) & Visual, VT-2 Examination One Test Per Interval]

2.0 APPLICABLE CODE EDITION AND ADDENDA

The 1989 Edition of ASME Section XI, No Addenda (reference 1), is the current ASME code used for the inservice inspection (ISI) program and the 1998 Edition of ASME Section XI, No Addenda (reference 2), is the primary code edition and addenda used for repair/replacement program activities at Millstone Power Station Unit 2 (MPS2). The ASME Code ISI requirements for the instrumentation nozzles of the pressurizer and the RCS piping are described above and are performed in accordance with Table IWB-2500-1, "Examination Categories B-E and B-P." A visual, VT-2 examination is performed during the system leakage test that is conducted each refueling outage and the system hydrostatic test performed during each 10-year interval. Currently, a system leakage test in accordance with Code Case N-498-4 is performed in lieu of the system hydrostatic test at or near the end of each 10-year interval. Acceptance standards of IWB-3000 from the 1989 Edition of ASME Section XI, No Addenda, and repair/replacement activities of IWA-4000 from the 1998 Edition of ASME Section XI, No Addenda, apply with the exemptions under IWA-4120. Subarticle IWA-4540 requires a system hydrostatic test in accordance with IWA-5000 for welded repairs/replacements to the pressure-retaining boundary, but exempts "component connections, piping, and associated valves that are NPS 1 and smaller" under IWA-4540(b). This exemption also applies when using Code Case N-416-2. In conjunction with these requirements and exemptions, DNC will perform a bare metal, VT-2 type visual examination during the system leakage test per IWA-5211(a) of ASME Section XI, 1992 Edition (reference 3). This bare metal visual examination will be performed at nominal operating pressure and nominal operating temperature during plant start-up for any half nozzle repair/replacement that is installed.

The Construction Code of Record for the pressurizer is the 1968 Edition of ASME Section III with addenda through the summer of 1969 (reference 4). RCS piping is ANSI B31.7 -1968 Edition, Class 1, and the design also satisfies the requirements of ASME Code Section III 1968 Edition with the summer 1969 Addenda (reference 5).

3.0 APPLICABLE CODE REQUIREMENTS

MPS2 intends to use Code Case N-416-2 to perform a system leakage test in lieu of a hydrostatic pressure test. Since the NRC has previously approved this code case, no code relief is required. However, Code Case N-416-2 stipulates the use of the 1992 editions of ASME Sections III and XI for fabrication and installation joint NDE methods and acceptance criteria and the system leakage test. Consequently, DNC has adopted the 1992 Editions of Sections III and XI for all aspects of the NDE and inspection associated with this replacement for MPS2 in lieu of the 1989 Code Edition referenced in the MPS2 ASME Section XI ISI program.

Currently, if leakage is identified at any of the nozzles subject to this relief request the following requirements apply. The acceptance standards of the 1989 Edition of ASME Section XI, No Addenda, IWB-3522 shall be used. The flaw has to be characterized in accordance with IWA-3300 under this same Section XI edition and then it has to meet any of the provisions of IWB-3142 to be acceptable for continued service. Even if a repair/replacement activity is performed using a half nozzle repair/replacement as the chosen option for the repair, the repair/replacement program at MPS2 shall be performed under the requirements of the 1998 Edition of ASME Section XI, No Addenda. Any flaw in an existing J-groove weld of any of the RCS hot leg or pressurizer instrument nozzles would be required to be removed in part under IWA-4422 or analyzed to be acceptable. If any flaw is left in place under these requirements and determined by analysis to be acceptable in accordance with the 1992 Edition of ASME Section XI, No Addenda, IWB-3600, it would then require examinations for at least three successive inspection periods in accordance with the 1989 Edition of ASME Section XI, No Addenda, IWB-2420 to determine if there is any future flaw growth.

4.0 REASON FOR REQUEST

Inspections of the pressurizer and RCS hot leg instrument and sampling nozzle penetrations in response to potential RCS leakage may identify small amounts of RCS leakage emanating from the nozzle interface with the outside surface of the pressurizer shell or RCS hot leg piping.

If leakage is identified, MPS2 plans to perform a pressurizer and/or RCS hot leg piping half nozzle repair/replacement typically depicted in Figure 1 of this Attachment and installed as follows:

1. Mechanical removal of a portion of the existing nozzle.
2. Application of a weld pad or weld buildup (F-No. 43) to the pressurizer shell (P-No 1) base material, (not required for RCS hot leg piping)
2. Machining of the weld pad to accept the new replacement nozzle (P-No. 43) material, (not required for RCS hot leg piping)
3. Installing the new replacement nozzle by using conventional manual gas tungsten arc welding (GTAW) and a "J"-groove partial penetration weld on the outside of the pressurizer or RCS piping.

The existing nozzle(s) and weld(s) will no longer function as a pressurizer vessel or RCS hot leg piping pressure boundary. However, the possible existence of cracks in these welds mandates that the potential for flaw growth be evaluated even if it cannot be characterized under the requirements of IWA-3300. The requirements of the 1989 Edition of ASME Section XI, No Addenda, IWB-3142 essentially allows two options for determining the disposition of discovered cracks. The subject cracks are either removed as part of the repair/replacement process, or left as-is and evaluated per the rules of IWB-3600. Installation of a half nozzle repair/replacement transfers the pressure boundary to the outside surface of the pressurizer shell or RCS hot leg piping, but results in the inaccessibility of the inside surface. The design dictates that the inside weld and nozzle portion be left intact and thus makes it impossible to perform required future examinations in accordance with IWB-2420.

5.0 PROPOSED ALTERNATIVE AND BASIS FOR USE

In lieu of the requirements of the 1989 Edition of ASME Section XI, No Addenda, IWA-3300 and IWB-2420, per 10 CFR 50.55a(a)(3)(i), the following alternative is proposed:

The planned repair for the subject pressurizer and RCS hot leg piping nozzles does not include removal of any flaws assumed to be present in the remaining J-groove partial penetration welds. Therefore, per the requirements of the 1989 Edition of ASME Section XI, No Addenda, IWB-3522 and IWB-3142, the flaws must be evaluated using the appropriate flaw evaluation rules of Section XI. In addition, no initial or successive inspections are planned to characterize the flaws. Thus, the actual dimensions of the flaw will not be fully determined. In lieu of fully characterizing the existing flaws, DNC will utilize worst-case assumptions to conservatively estimate the flaw extent and orientation for MPS2. The postulated flaw extent and orientation will then be evaluated using the rules of the 1992 Edition of ASME Section XI, No Addenda, IWB-3600.

Basis for Use

The assumptions of IWB-3500 are that the flaws are fully characterized to be able to compare the calculated flaw parameters to the acceptable parameters provided in IWB-3500. In the alternative being proposed, the acceptance of the postulated flaw is calculated in accordance with IWB-3600 and based on the two inputs of expected flaw orientation and the geometry of the weld.

Typically, an expected flaw orientation is evaluated based on prevalent stresses at the location of interest. Using worst case (maximum) assumptions with the geometry of the as-left weld, the postulated flaw is assumed to begin at the intersection of the pressurizer shell or RCS hot leg piping inner diameter surface and the pressurizer or RCS hot leg piping nozzle penetration bore and propagate into the pressurizer shell or RCS hot leg piping carbon steel. The depth and orientation are worst-case assumptions for flaws that may occur in the remaining J-groove partial penetration weld configuration. It is assumed that the "as-left" condition of the remaining J-groove weld includes degraded or cracked weld material.

A fracture mechanics evaluation has been performed for the pressurizer instrument nozzle J-groove welds located on the top head, the cylindrical shell, and the bottom head (Document Identifiers 32-5038274-00, 32-5045825-00, and 32-5036571-00) and the RCS hot leg instrument nozzle J-groove welds (Document Identifier 32-5035104-00). All of these analyses determined that degraded J-groove weld material could remain in the pressurizer or RCS hot leg piping with no examination to size any flaws that might remain following the repair. Since the hoop stresses in the J-groove weld are higher than the axial stresses, the preferential direction for cracking is axial, or radial relative to the nozzle. It is postulated that a radial crack in the Alloy 182 weld metal would propagate by PWSCC through the weld to the interface with the carbon steel shell or hot leg piping. It is fully expected that such a crack would then blunt and arrest at the weld-to-shell or hot leg piping 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 shell or hot leg piping material are low, it is assumed that a small flaw could initiate in the carbon steel material and grow by fatigue. It is postulated that the small flaw in the shell or hot leg piping would combine with a large stress corrosion crack in the weld to form a radial corner flaw that would propagate into the carbon steel shell or hot leg piping by fatigue crack growth under cyclic loading.

Residual stresses have been determined and are included in the analyses for the pressurizer top head, the cylindrical shell, and the bottom head with the following document identifiers (Document Identifiers 32-5036643-01, 32-5037641-01, and 32-5037139-01) and for the RCS hot leg piping (Document Identifier 32-5035095-00).

All the weld flaw evaluations identified above have been performed for a postulated radial corner crack. Hoop stresses have been used since they are perpendicular to the plane of the crack. The life of the repair was determined based on fatigue crack growth and crack growth per year of operation. It has been calculated that the repair for the pressurizer and RCS hot leg piping both will provide 40 years of additional service. The final flaw size meets the fracture toughness requirements of the ASME Code using an upper shelf value of 200 ksi/in [sic] for ferritic materials. The results of this analysis indicate that it is acceptable to leave the postulated cracks in the attachment weld (J-groove) for the remaining life of the component, including life extension.

The potential for debris damage resulting from a cracked J-groove partial penetration weld was considered. However, as noted above, radial cracks are postulated to occur in the weld due to the dominance of the hoop stress at these locations. The occurrence of transverse cracks that could intersect the radial cracks is considered remote. There are no identified forces that would drive a transverse crack. Only thermal and welding residual stresses could cause a transverse crack to grow and thus the presence of radial cracks limits the growth potential of the transverse cracks. The radial cracks would relieve the potential transverse crack driving forces. Hence, it is unlikely that a series of transverse cracks could intersect a series of radial cracks resulting in any fragments becoming dislodged. Therefore, it can be concluded that there is an insignificant probability of damage to any RCS or pressurizer component resulting from debris generated because of a cracked weld.

When any half nozzle repair/replacement is installed, a potential for corrosion mechanisms exists because this repair configuration leaves portions of the carbon steel material inside the Pressurizer or RCS hot leg penetrations exposed to the primary reactor coolant. The exposure of the carbon steel material is caused by the existence of a small gap at the junction between the original (Alloy 600) and the new (Alloy 690) nozzles. The analysis contained in Document Identifier 51-5035741-01 has evaluated the long-term impact of the newly exposed carbon steel material to the reactor coolant. The analysis is based on industry experience with known carbon steel exposed to reactor coolant and has concluded that the corrosion that could occur with a half nozzle repair/replacement is negligible even though the rates may vary with different modes of operation, and in its worst case has shown the corrosion to be very low, on the order of 0.001 to 0.002 of an inch per year.

The cited evaluations provide an acceptable level of safety and quality in insuring that the pressurizer shell or RCS hot leg piping remains capable of performing its design function with flaws existing in the original J-groove weld. See Appendix A for a summary of the supporting analyses.

Justification for Granting Relief

Removal of the cracks in the existing J-groove partial penetration welds would incur excessive radiation dose for repair personnel. With the installation of the new pressure boundary welds previously described, the original function of the J-groove partial penetration welds is no longer required. It is well understood that the cause of the cracks in the subject J-groove welds is PWSCC. As shown by industry experience, the carbon steel shell of the pressurizer or RCS hot leg piping impedes crack growth by PWSCC. The alternative described will provide an acceptable level of quality and safety when compared to the code requirements in IWB-3500 to characterize the cracks left in service. Using flaw tolerance techniques, it has been demonstrated that the assumed worst case crack size will not grow to an unacceptable depth into the pressurizer shell or RCS hot leg piping carbon steel base material over the life of the repair. Thus, the pressurizer shell and RCS piping can be accepted per the analytical evaluation performed in accordance with IWB-3600 which satisfies the requirements of IWA-4422 for acceptance without defect removal.

Conclusion

DNC is requesting relief for MPS2 from the requirements of the 1989 Edition of ASME Section XI, No Addenda, IWA-3300, Flaw Characterization and IWB-2420, Successive Inspections. It is assumed that leaking flaws found in the instrumentation nozzles of the pressurizer and the RCS hot leg piping will not be removed and will continue to exist in the original J-groove welds of the pressurizer or RCS hot leg piping instrumentation nozzles that receive a half nozzle repair/replacement. Thus, these welds will be inaccessible for characterization and successive inspections. Therefore, in lieu of fully characterizing these existing cracks, DNC proposes to utilize worst-case assumptions to conservatively estimate the crack extent and orientation to accept these flaws based on the provisions of IWB-3600 and the analysis used to support this relief request. DNC has determined that based on the information contained in this request the proposed alternative will provide an acceptable level of quality and safety.

6.0 DURATION OF PROPOSED ALTERNATIVE

The alternative in this request will be applied for the remainder of the current third 10-year ISI interval that started on April 1, 1999. Once a half nozzle repair/replacement is installed on the RCS hot leg piping, the remnant nozzle will remain in place for the life of the plant, including the license renewal period and the half nozzle repair will be considered a permanent replacement. For the pressurizer any half nozzle repair/replacement will remain in place only until the planned replacement of the pressurizer during refueling outage 2R17 now scheduled for the fall 2006.

7.0 PRECEDENTS

A similar request for the use of a half nozzle repair of Alloy 600 small bore nozzles without flaw removal was submitted by letter dated October 3, 2003, as supplemented by letter dated October 11, 2003, by the Florida Power Corporation (FPC, also doing business as Progress Energy Florida, Inc.) for the Crystal River Nuclear Plant, Unit 3 and was approved by the NRC on January 6, 2004. The safety evaluation was listed under TAC No. MC0963 and Docket No. 50-302.

8.0 REFERENCES

1. 1989 Edition, American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, No Addenda.

2 1998 Edition, ASME Code, Section XI.

3. 1992 Edition, ASME Code, Section XI.

4. Pressurizer - 1968 Edition, ASME Code, Section III, Class A Vessels, with Addenda through Summer 1969.

5. RCS Piping - ANSI B 31.7 -1968 Edition, Class 1, and design also satisfies the requirements of ASME, Code Section III 1968 Edition with the Summer 1969 Addenda.

6. 1992 Edition, ASME Code, Section III, and the 1992 Edition with the 1992 Addenda of Section II for materials.

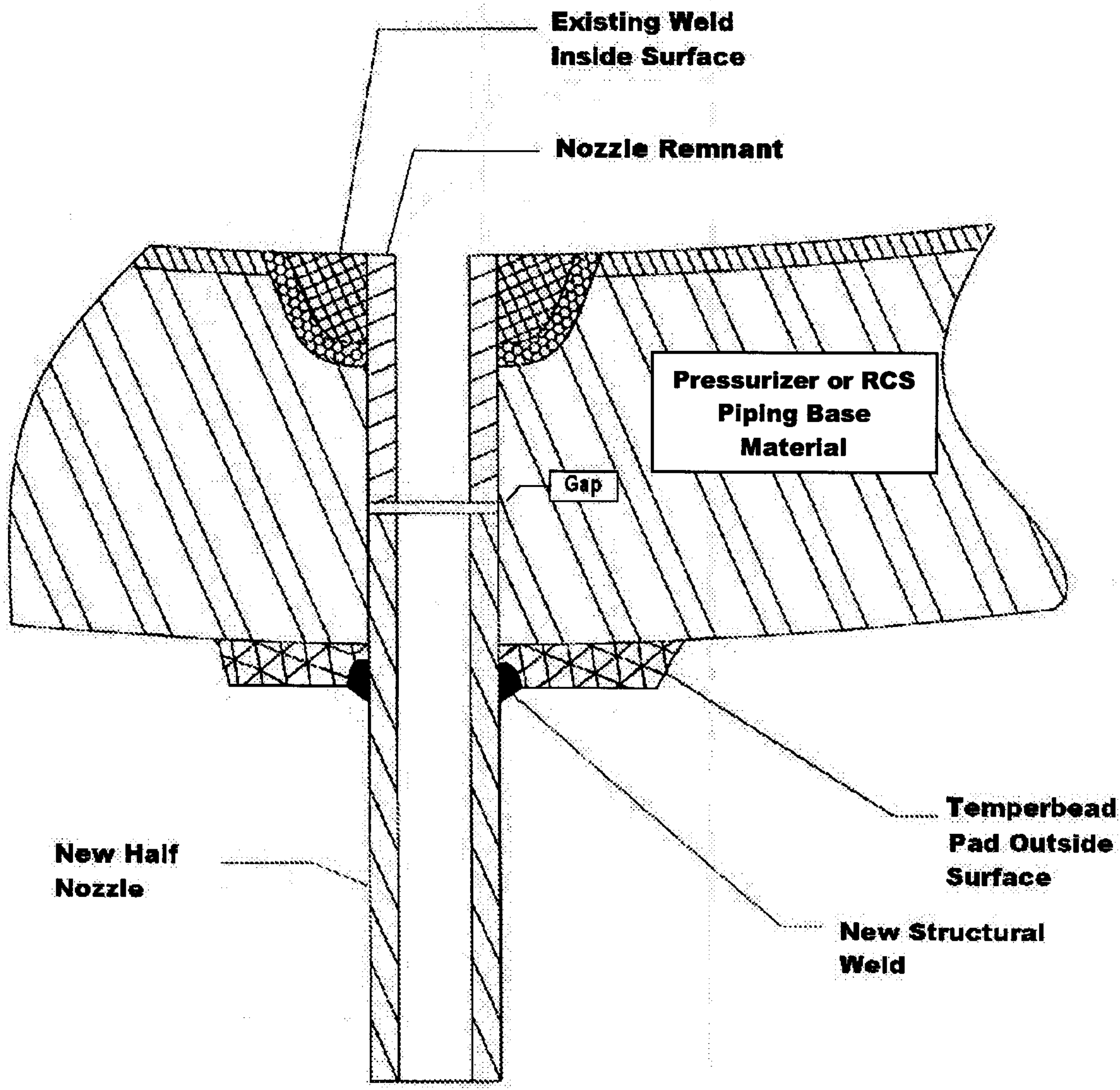

FIGURE 1:
TYPICAL HALF NOZZLE REPAIR/REPLACEMENT WITH
A WELD PAD DEPOSIT

NOTE: The weld pad deposit is not required for RCS hot leg half nozzle repair/replacements.

APPENDIX A

SUMMARY OF ANALYSES PERFORMED

Analysis Number	Title	Purpose / Summary
AREVA / Framatome Document 51-5035741-01	Millstone Power Station Unit 2 (MPS2) Half Nozzle Repair Corrosion Evaluation	This document evaluates the potential corrosion mechanisms affecting the small bore nozzle repairs at MPS2. This evaluation considers the existing and repair materials, including the low alloy/carbon steel exposed by the repair configuration, Alloy 600, Alloy 690, Alloy 182, and Alloy 52 weld metal.
AREVA / Framatome Document 32-5035104-01	MPS2 Hot Leg Nozzle J-Groove Weld Flaw Evaluation	The purpose of this analysis is to assess the suitability of leaving degraded J-groove weld material in the MPS2 hot leg pipe following a half nozzle repair of a pressure measurement or sampling or RTD nozzle. The half nozzle repair involves severing the original nozzle outboard of the partial penetration attachment weld and welding a new nozzle to the outside surface of the pipe. It is postulated that a small fatigue initiated flaw in the carbon steel shell would combine with a large stress corrosion crack in the original J-groove weld and butter to form a radial corner flaw that would propagate into the pipe by fatigue crack growth under cyclic loading conditions. Based on an evaluation of fatigue crack growth into carbon steel pipe and considering the Section XI requirements of the ASME Code for fracture toughness, it has been determined that a postulated radial flaw through the entire Alloy 182 J-groove weld and butter would be acceptable for an additional 40 years of operation.

Analysis Number	Title	Purpose / Summary
AREVA / Framatome Document 32-5035095-00	MPS2 Hot Leg Half Nozzle Repair Analysis	This document contains the analysis and qualification of the possible repairs in ten (10) temperature sensing (RTD) nozzles and in nine (9) pressure measuring or sampling nozzles of the RCS hot legs in MPS2. The repair design is qualified to meet the criteria of the 1992 ASME Code, Section III, NB-3000. This calculation demonstrates that the MPS2 hot leg pressure or sampling nozzle repair design meets the stress and fatigue requirements for the Design Code (ASME Code, Section III, 1992 Edition w/o addendum). Based on the loads and cycles specified in Framatome Document 32-5033829-00, the conservative fatigue analysis indicates that the repair has a cumulative usage factor of 0.87 for 40 years of operation. The stresses within the original weld are also provided as input for the fracture mechanics analysis included in the Appendix.
AREVA / Framatome Document 32-5033829-00	MPS2 Nozzle Repair Analysis – Supporting Data	The purpose of this document is to summarize the loads, including operational transients, for use in analyses of repair configurations for the MPS2 Pressurizer Nozzles and Hot Leg Nozzles. These loads include operational transients, design conditions, and attached piping mechanical loads. Additionally, the pertinent thermal/mechanical material properties are included for those materials included in the repair configurations. The loads are summarized in tabular form in this document. The summary includes assessment of the severity of the transients and recommends consolidation of transient design cycles when applicable. The material properties are tabulated for the pertinent materials.

Analysis Number	Title	Purpose / Summary
AREVA / Framatome Document 32-5038274-00	MPS2 Pzr Top Head Pressure & Level Noz. J-Groove Weld Flaw Eval.	The purpose of this analysis is to assess the suitability of leaving degraded J-groove weld material in the MPS2 pressurizer following a half-nozzle repair of a pressure & level nozzle located in the top head. The half-nozzle repair involves severing the original nozzle outboard of the partial penetration attachment weld and welding a new nozzle to the outside surface of the pressurizer head. It is postulated that a small fatigue initiated flaw in the carbon steel head would combine with a large stress corrosion crack in the original J-groove weld and butter to form a radial corner flaw that would propagate into the pressurizer head by fatigue crack growth under cyclic loading conditions. Based on an evaluation of fatigue crack growth into the carbon steel pressurizer head and considering the Section XI requirements of the ASME Code for fracture toughness, it has been determined that a radial flaw through the entire Alloy 182 J-groove weld and butter would be acceptable for an additional 40 years of operation.
AREVA / Framatome Document 32-5045825-00	MPS2 Pzr Cylindrical Shell Temp. Noz. J-Groove Weld Flaw Eval.	The purpose of this analysis is to assess the suitability of leaving degraded J-groove weld material in the MPS2 pressurizer following a half-nozzle repair of a temperature nozzle located in the cylindrical shell. The half-nozzle repair involves severing the original nozzle outboard of the partial penetration attachment weld and welding a new nozzle to the outside surface of the pressurizer shell. It is postulated that a small fatigue initiated flaw in the carbon steel shell would combine with a large stress corrosion crack in the original J-groove weld and butter to form a radial corner flaw that would propagate into the pressurizer shell by fatigue crack growth under cyclic loading conditions.

Analysis Number	Title	Purpose / Summary
AREVA / Framatome Document 32-5045825-00 **(continued)**	MPS2 Pzr Cylindrical Shell Temp. Noz. J-Groove Weld Flaw Eval.	For temperature conditions (metal temperature 205.3 F and below) when LEFM analysis is considered applicable, the required safety margin of √10 per ASME Section XI, IWB-3612 acceptance criteria is met. When the material is at upper shelf temperatures (metal temperature above 205.3 F) and EPFM is considered appropriate, the ASME Section XI, Appendix K criteria are met. Furthermore, it has been shown that a safety factor of 1.95 on the controlling plant loading transient condition pressure with consideration of plant loading thermal transient stresses also satisfy Reg. Guide 1.161 and Appendix K criteria. Based on the evaluation of the fatigue crack growth for LEFM analysis and an additional crack extension of 0.1 – inch for EPFM analysis, it has been demonstrated that a postulated radial crack in the Alloy 182 J-groove weld and butter would be acceptable for an additional 5-years of operation.
AREVA / Framatome Document 32-5036571-00	MPS2 Pzr Bottom Head Level Noz. J-groove Weld Flaw Eval.	The purpose of this analysis is to assess the suitability of leaving degraded J-groove weld material in the MPS2 pressurizer following a half-nozzle repair of a pressure & level nozzle located in the bottom head. The half-nozzle repair involves severing the original nozzle outboard of the partial penetration attachment weld and welding a new nozzle to the outside surface of the pressurizer head. It is postulated that a small fatigue initiated flaw in the carbon steel head would combine with a large stress corrosion crack in the original J-groove weld and butter to form a radial corner flaw that would propagate into the pressurizer head by fatigue crack growth under cyclic loading conditions. For temperature conditions (metal temperature 205.3 F and below) when LEFM analysis is considered applicable, the required safety margin of √10 per ASME Section XI, IWB-3612 acceptance criteria is met. When the material is at upper shelf temperatures (metal temperature above 205.3 F) and EPFM is considered appropriate, the ASME Section XI, Appendix K criteria are met. Furthermore, it has been shown that a safety factor of 3.1 on the controlling RT transient condition pressure with consideration of RT thermal transient stresses also satisfy Reg. Guide 1.161 and Appendix K criteria. Based on the evaluation of the fatigue crack growth for LEFM analysis and an additional crack extension of 0.1 – inch for EPFM analysis, it has been demonstrated that a postulated radial crack in the Alloy 182 J-groove weld and butter would be acceptable for an additional 5-years of operation.

Analysis Number	**Title**	**Purpose / Summary**
AREVA / Framatome Document 32-5036643-01	MPS2 Pressurizer Upper Level Nozzle (Type 1&2) Repair Analysis	This document contains the analysis and qualification of the possible repairs of the two (2) level sensing, two (2) pressure sensing nozzles (Nozzle Type 2) and one (1) Temperature nozzle (Type 1) in the upper head of the pressurizer in MPS2. The repair design is qualified to meet the criteria of 1992 ASME Code, Section III, NB-3000. The calculations contained in this document demonstrate that the MPS2 pressurizer upper level nozzle repair design meets the stress and fatigue requirements of the design Code (ASME Code, section III, 1992 edition w/o addendum). The conservative fatigue analysis indicates that the repair has a cumulative usage factor of 0.88 for 40 years of operation, compared to the Code maximum allowed value of 1.0. The stresses within the original weld, as input for the future mechanics analysis, are included in the Appendix.
AREVA / Framatome Document 32-5037641-01	MPS2 Pressurizer Nozzle (Type 3) Repair Analysis	This document contains the analysis and qualification of the possible repair of lower Temperature nozzle (Type 3) in the cylindrical shell of the pressurizer in MPS2. The repair design is qualified to meet the criteria of 1992 ASME Code, section III, NB-3000 . Note that only the replacement nozzle, repair weld and adjacent pressurizer shell areas have been qualified for fatigue analysis. The calculations contained in this document demonstrate that the MPS2 pressurizer lower Temperature nozzle repair design meets the stress and fatigue requirements of the Design Code (ASME Code, section III, 1992 edition w/o addendum). The conservative fatigue analysis of the replacement nozzle, repair weld and adjacent pressurizer shell areas indicates that the repair has a cumulative usage factor of 0.93 for 20 years of operation compared to the maximum ASME Code allowable of 1.0. The stresses within the original weld, as input for the fracture mechanics analysis, are included in the Appendix.

Analysis Number	**Title**	**Purpose / Summary**
AREVA / Framatome Document 32-5037139-01	MPS2 Pressurizer Lower Level Nozzle Repair Analysis	The repair design is qualified to meet the criteria of 1992 ASME Code, section III, NB-3000. The stresses within the original weld are also provided as the input for the fracture mechanics analysis. The calculations contained in this document demonstrate that the MPS2 pressurizer lower level nozzle repair design meets the stress and fatigue requirements of the Design Code (ASME Code, section III, 1992 edition w/o addendum). The conservative fatigue analysis indicates that the repair has a cumulative usage factor of 0.46 for 40 years of operation, compared to the Code maximum allowed value of 1.0.