UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 15, 2011

Mr. Michael J. Pacilio
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 - PROPOSED ALTERNATIVE RR-10-02 REGARDING WELD OVERLAY OF THE PRESSURIZER SPRAY NOZZLE TO SAFE-END AND SAFE-END TO ELBOW DISSIMILAR METAL WELDS (TAC NO. ME4795)

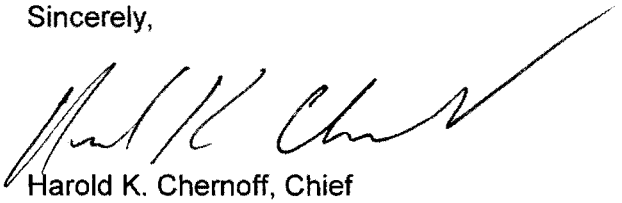
Dear Mr. Pacilio:

By letter dated September 30, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102740532), supplemented by letters dated March 9, 2011 (ADAMS (ADAMS Accession No. ML110680332), April 6, 2011 (ADAMS Accession No. ML110980257), and April 25, 2011 (ADAMS Accession No. ML111160137), Exelon Generation Company, LLC (the licensee) submitted proposed alternative request RR-10-02 for the use of an alternative to certain requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, 2004 Edition, no Addenda, at Three Mile Island, Unit 1 (TMI-1). Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 55a(a)(3)(i), RR-10-02 proposes to install a full structural weld overlay as an alternate repair technique for Alloy 82/182 dissimilar metal welds in the pressurizer spray nozzle to safe-end and safe-end to elbow joints.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the proposed alternative as discussed in the enclosed safety evaluation. The NRC staff review concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, RR-10-02 is authorized pursuant to 10 CFR 50.55a(a)(3)(i). The design and installation aspects of the weld overlay are authorized for the remaining life of the components, including plant life extension. Inspection requirements of the overlay were previously authorized by NRC letter dated July 20, 2011 (ADAMS Accession No. ML111730475), in proposed alternative I4R-05, for the fourth 10-year inservice inspection interval at TMI-1. The fourth 10-year interval at TMI-1 began on April 20, 2011.

If you have any questions, please contact the TMI-1 Project Manager, Mr. Peter J. Bamford, at 301-415-2833.

Sincerely,



Harold K. Chernoff, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE REGARDING WELD OVERLAY OF THE PRESSURIZER SPRAY NOZZLE TO SAFE-END AND SAFE-END TO ELBOW DISSIMILAR METAL WELDS

REQUEST NO. RR-10-02

EXELON GENERATION COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

1.0 INTRODUCTION

By letter dated September 30, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML102740532), supplemented by letters dated March 9, 2011 (ADAMS (ADAMS Accession No. ML110680332), April 6, 2011 (ADAMS Accession No. ML110980257), and April 25, 2011 (ADAMS Accession No. ML111160137), Exelon Generation Company, LLC (the licensee) submitted proposed alternative request RR-10-02 for the use of an alternative to certain requirements of the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, 2004 Edition, no Addenda, at Three Mile Island, Unit 1 (TMI-1). Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 55a(a)(3)(i), RR-10-02 proposes to install a full structural weld overlay (FSWOL) as an alternate repair technique for Alloy 82/182 dissimilar metal (DM) welds in the pressurizer spray nozzle to safe-end and safe-end to elbow joints.

2.0 REGULATORY EVALUATION

Paragraph 50.55a(g)(4) of 10 CFR specifies that ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection (ISI) of Nuclear Power Plant Components," to the extent practical and within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10 year interval, and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code, incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the 120 month interval, subject to the limitations and modifications listed therein. Article IWA-4000, "Repair/Replacement Activities," of the ASME Code, Section XI, provides requirements for repair/replacement activities associated with pressure retaining components and their supports.

Paragraph 50.55a(a)(3) of 10 CFR states that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Paragraph 50.55a(b)(2)(xv) of 10 CFR, "Appendix VIII specimen set and qualification requirements," states, in part, that licensees who use later editions and addenda than the 2001 Edition of the ASME Code shall use the 2001 Edition of Appendix VIII. Licensees choosing to apply these provisions shall apply all of the provisions under this paragraph except for those in paragraph 10 CFR 50.55a(b)(2)(xv)(F), which are optional.

Paragraph 50.55a(b)(2)(xxiv) of 10 CFR requires that the ultrasonic examination (UT) of overlays must be performed using personnel, procedures, and equipment qualified in accordance with the 2001 Edition, no Addenda of the ASME Code, Section XI, Appendix VIII, Supplement 11, "Qualification Requirements For Full Structural Overlaid Wrought Austenitic Piping Welds."

The NRC final rule (76 FR 36232) published in *Federal Register* on June 21, 2011, amended 10 CFR 50.55a to incorporate by reference (with conditions on its use), ASME Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material with or without Application of Listed Mitigation Activities."

The Code of Record for the fourth 10-year ISI interval at TMI-1 is the 2004 Edition with no Addenda of the ASME Code, Section XI. The fourth 10-year interval began on April 20, 2011.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

ASME Code Class:	Class 1
Examination Category:	R-A
Component:	Alloy 600/82/182 Dissimilar Metal Welds
System:	Pressurizer (Reactor Coolant System, or RCS)

The TMI-1 components and ASME material classification relating to the proposed alternative are listed in Tables 1A and 1B.

Table 1A - Component List

Nozzle	**Nozzle to Safe-End Weld No.**	**Item No.**	**Size in.**	**Safe-End to Elbow Adjacent Weld No.**	**Item No.**
Spray	PR-009BM	R1.15 B15.150	4	SP-021BM	R1.11 R1.15 B15.150

Table 1B - Component Materials

Weld No.	Component	Component	Component
PR-009BM	Nozzle – P1	Weld – F43	Safe-End – P43
SP-021BM	Safe-End – P43	Weld – F43	Elbow – P8

3.2 Licensee's Proposed Alternative

The licensee stated that DM welds on Pressurized Water Reactor (PWR) RCSs often consist of Alloy 82/182 weld material to connect stainless steel pipe and safe-ends to vessel and piping nozzles, which are generally constructed using carbon or low alloy ferritic steel. These welds have shown a propensity for primary water stress corrosion cracking (PWSCC) degradation, especially in components subjected to higher operating temperatures such as the pressurizer or RCS hot leg.

The licensee plans to apply a FSWOL to the pressurizer spray nozzle to safe-end and safe-end to elbow DM welds during the upcoming refueling outage in the fall of 2011. The licensee stated that industry operating experience has shown that the 360 degree FSWOL will control the growth of a potential PWSCC crack and maintain RCS structural integrity. The applied FSWOL will also induce a compressive stress in the existing DM welds, thus potentially impeding growth of cracks. Furthermore, the FSWOL will be sized to meet structural requirements without crediting integrity of the existing welds.

The licensee stated that the FSWOL has been used for several years on both Boiling Water Reactors (BWRs) and PWRs to arrest existing flaws from propagating while establishing a new structural pressure boundary. In some cases, FSWOL has been used to reestablish structural integrity of a DM weld containing through-wall flaws. The FSWOL can provide inspectable geometry that allows UT examination in accordance with requirements of the Performance Demonstration Initiative (PDI), Electric Power Research Institute (EPRI) Materials Reliability Program (MRP), and the ASME Code, Section XI.

The licensee stated that there are no comprehensive criteria currently available for applying a FSWOL to DM welds constructed of Alloy 82/182 weld material. For repair/replacement activities, the current Code of Record at TMI-1 (i.e., the 2004 Edition and no Addenda of the ASME Code, Section XI) does not include requirements for the application of a FSWOL.

As an alternative to the provisions of the ASME Code, Section XI, Article IWA-4000, "Repair/Replacement Activities," the licensee proposed to apply a FSWOL to the subject DM welds. The licensee stated that it will design and apply the FSWOL in accordance with ASME Code Case N-504-3, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," with modifications proposed in Attachment 2, Table 2, of RR-10-02. The NRC has approved ASME Code Case N-504-3 in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 15, for use, with the condition that the provisions of Nonmandatory Appendix Q of the ASME Code, Section XI, must also be met.

For welding, the licensee stated that it will utilize a mechanized Gas Tungsten Arc Welding (GTAW) process and the ambient temperature temperbead method with Alloy 52M

(i.e., ERNiCrFe-7A) weld metal. When temperbead welding is not required, manual GTAW with Alloy 52M may be used if local repairs of weld defects are necessary or if additional weld metal is required locally to form the final FSWOL contour. Shielded Metal Arc Welding (SMAW) using Alloy 152 (ENiCrFe-7) would only be used to repair indications in the existing DM welds prior to overlay application.

For temperbead welding, the licensee stated that it will apply ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique," requirements with modifications proposed in Attachment 2, Table 3, of RR-10-02. The NRC has approved for use, ASME Code Case N-638-1 in RG 1.147, Revision 15, with the conditions that: (1) the UT volumetric examinations shall be performed with personnel and procedures qualified for the repaired volume and qualified by demonstration using representative samples which contain construction type flaws; and (2) the acceptance criteria of NB-5330 in the 1998 Edition through 2000 Addenda of the ASME Code, Section III apply to all flaws identified within the repaired volume.

Prior to installation of the FSWOL, the licensee stated that it will complete the bare metal visual examinations of the nozzle to safe-end and safe-end to elbow DM welds immediately after the insulation is removed in the area around the nozzle and DM weld areas. This will ensure that no through-wall cracks exist prior to applying the overlay. The visual examinations will be completed in accordance with 10 CFR 50.55a(g)(6)(ii)(E). The licensee intends to complete a PDI-qualified UT examination of the DM welds prior to application of overlay.

For the UT examinations of the finished FSWOL, the licensee stated that it will use the PDI demonstrated UT examination procedures and personnel developed and administered through the EPRI PDI qualification program, in lieu of the ASME Code, Section XI, Appendix VIII, Supplement 11, requirements.

The licensee stated that the subsequent ISI examinations of FSWOL will be scheduled and performed in accordance with the requirements of the ASME Code, Section XI, Nonmandatory Appendix Q, or any alternate schedules required by the NRC's proposed rule published in the *Federal Register* (75 FR 24324). The licensee stated further that the NRC's proposed rule would incorporate by reference ASME Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated with UNS N06082 or UNS W86182 Weld Filler Material with or without Application of Listed Mitigation Activities."

The licensee stated that its proposed alternative (i.e., FSWOL DM welds) will address Alloy 600 PWSCC degradation and prevent potential failures due to PWSCC based on the use of filler metals (e.g., Alloy 52M) that are resistant to PWSCC. The FSWOL will completely cover the DM welds, Inconel 600 safe-end, ferritic steel nozzle, and adjacent stainless steel material with Alloy 52M material to the extent that PWSCC susceptible material is mitigated and examination capability is maintained for any adjacent welds.

The licensee stated that the FSWOL would create compressive stress profiles in the original weld thus potentially impeding the growth of cracks. The overlay design will comply with ASME Code Case N-504-3 including the ASME Code, Section XI, Appendix Q, except as noted in the application dated September 30, 2010. This includes flaw evaluations and shrinkage stress effects.

3.2.1 FSWOL Design

At the time of the application dated September 30, 2010, the licensee stated that the overlay design, flaw evaluations, and shrinkage stress effects analyses were currently in development and would be addressed per ASME Code Case N-504-3 requirements. These evaluations were subsequently completed and submitted to the NRC for review by letters dated April 6, 2011, and April 25, 2011.

The licensee stated that the FSWOL will be sized to meet structural requirements without crediting integrity of the existing welds. The design basis flaw for the purpose of structural sizing the FSWOL is assumed to be circumferential flaw that is 100% through-wall extending around the entire circumference of the weld. The design life flaw growth analysis will assume that a 75% through-wall flaw exists at the time of weld overlay deposit, based on flaw detection capability in the outer 25% through-wall of the original weld. If a flaw is detected in the outer 25% through-wall of the repaired welds, the design life flaw growth analysis will be revised to address the actual flaw condition detected as required by ASME Code Section XI, Appendix Q. In all cases the overlay design will comply with ASME Code Case N-504-3, including ASME Code Section XI, Appendix Q, requirements, with certain exceptions noted in Table 2 of the licensee's application dated September 30, 2010.

3.2.2 Ambient Temperature Temperbead Technique

The licensee stated that an ambient temperature temperbead welding technique (ASME Code Case N-638-1) will be used when welding on the ferritic base materials of the nozzles in lieu of the post-weld heat treatment requirements of the ASME Code, Section III. Table 3 in Attachment 2 of RR-10-02 addresses the licensee's proposed modification to ASME Code Case N-638-1.

The licensee stated that monitoring of preheat and interpass temperature is necessary to assure the field welding heat input remains within qualified parameters. Weld preheat and heat input are monitored through the use of calibrated contact pyrometers or thermocouples. The interpass temperature is measured multiple times within each layer.

3.3 NRC Staff Evaluation

The staff recognizes that the DM welds in components that are subjected to higher operating temperatures, such as the pressurizer or RCS hot leg, have shown a propensity for PWSCC degradation. The FSWOL of nickel-based alloy (i.e., Alloy 82 or Alloy 182 weld metal and buttering, and Alloy 600 base metal) to DM welds is an acceptable methodology for preventing potential failures due to PWSCC based on the use of filler metals (e.g., Alloy 52M) that are less susceptible to PWSCC. The FSWOL is a deposition of weld reinforcement on the outer diameter (OD) surface of the DM weld or piping component. The FSWOL could be used as a preemptive approach in addressing PWSCC degradation of nickel-based alloy DM welds, or as a repair weld overlay in reestablishing structural integrity of a DM weld containing through-wall leaking flaws. The licensee stated that its proposed FSWOL will completely cover the subject DM welds, Inconel 600 safe-end, ferritic steel nozzle, and adjacent stainless steel material with Alloy 52M material. With this approach, the PWSCC susceptible materials containing potential through-wall leaking flaws will be mitigated, the structural integrity of the DM welds will be maintained or reestablished, and the examination capability will be maintained for any adjacent welds, and established for the overlay itself.

The NRC staff used the requirements of ASME Code Cases N-504-4 and N-638-4, and Appendix Q to the ASME Code, Section XI, to evaluate RR-10-02. The staff recognizes that for the weld overlay design, the licensee followed ASME Code Cases N-504-3 and N-638-1. The staff finds that there are no significant differences between these two versions of each of the code cases, as it relates to this application.

ASME Code Case N-504-4, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," establishes requirements for repair of ASME Code Class 1, 2 and 3 austenitic stainless steel piping by depositing weld reinforcement (weld overlay) on the OD surface of the pipe as an alternative to the provisions of either the Construction Code or the ASME Code, Section XI. The NRC has approved for use, ASME Code Case N-504-4 in RG 1.147, Revision 16, with conditions.

ASME Code Case N-638-4, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temperbead Technique," establishes requirements for performing ambient temperature temperbead welding as an alternative to preheat and post-weld heat treatment requirements of the Construction Code. The NRC has approved for use, ASME Code Case N-638-4 in RG 1.147, Revision 16, with conditions.

3.3.1 General Requirements

General requirements for the FSWOL design are documented in Table 2 of Attachment 2 of RR-10-02. Table 2 includes material specification and the applicable base metal (i.e., carbon steel, stainless steel, and Alloy 82/182) and weld overlay filler metal (i.e., Alloy 52M), and the chromium content of the weld overlay deposits. The licensee stated that it will not perform delta ferrite measurements for weld overlay repairs using Alloy 52M weld metal because the deposited weld overlay (Alloy 52M) is 100% austenitic and contains no delta ferrite due to the high nickel composition (approximately 60% nickel). The staff finds that the proposed general requirements are consistent with the general requirements of ASME Code Case N-504-4 and Appendix Q of the ASME Code, Section XI, and therefore are acceptable.

3.3.2 Design and Analysis Requirements

Section 5.0 and Table 2 of Attachment 2 of RR-10-02 documents requirements for design of the FSWOL repair for the subject DM welds. For design basis flaw for the purpose of structural sizing the weld overlay, the licensee assumed a 360 degree circumferential flaw that is 100% through the original wall thickness of the DM weld. The licensee stated that the design life flaw growth analysis assumes that an ID connected flaw of 75% through-wall of the original weld exists at the time of weld overlay deposit. If a flaw is detected in the outer 25% through-wall of the repaired welds, the design life flaw growth analysis will be revised to address the actual flaw condition detected. The NRC staff recognizes that the licensee has applied the requirements for overlay design specified in Appendix Q of the ASME Code, Section XI, and ASME Code Case N-504-3. Furthermore, the staff notes that the licensee will size the FSWOL to meet structural requirements without crediting integrity of the existing welds.

In the application dated September 30, 2010, the licensee stated that the overlay was in development. The staff issued an RAI requesting that the licensee submit its weld overlay design information including analyses to demonstrate that the weld overlay design will mitigate the potential for PWSCC in the Alloy 82/182 DM welds. By letters dated April 16, 2011, and April 25, 2011, in response to the staff's RAI, the licensee provided its WOL design, stress analysis, and crack growth evaluation to the NRC for review. The staff reviewed the documents

and determined that the licensee used the appropriate design criteria (i.e., the 2004 Edition of the ASME Code, Section III, Article NB-3000) for design of the FSWOL repair for the subject DM welds. The staff also determined that:

- The licensee performed stress analysis to ensure that the subject components impacted by FSWOL repair meet the ASME Code stress limits requirements. The licensee's stress analysis reported that all calculated stress intensities were below their corresponding allowable values, except for two paths. For these two paths, the licensee performed a simplified elastic-plastic analysis which showed that the resulting stress intensities are less than their allowable values.

- The licensee performed flaw growth analysis, due to both fatigue and PWSCC, demonstrating the life of the overlay. The overlay is qualified for 60 service years, which exceeds the remaining life of the plant, including the license renewal period. The licensee's flaw growth analysis showed that the requirements of ASME Code Case N-504-3 were satisfied.

The staff finds the licensee's overlay design, stress analysis, and crack growth evaluation for the subject FSWOL repair acceptable because it complies with the requirements specified in ASME Code Case N-504-4 (as well as N-504-3, per the submittal) and the ASME Code, Section XI, Article NB-3000.

3.3.3 Examination Requirements

Section 5.0 and Table 2 of Attachment 2 of RR-10-02 provides requirements for flaw acceptance, the post-overlay preservice inspection (PSI), and the subsequent ISI examinations of the subject DM welds (i.e., nozzle to safe-end and safe-end to elbow DM welds) prior to and after FSWOL installation. The staff has reviewed the licensee's nondestructive examination (NDE) proposal. These specific requirements are discussed below.

Prior to WOL application examination:

- The licensee proposed to perform a bare metal visual examination of the nozzle to safe-end and safe-end to elbow DM welds immediately after the insulation is removed in the area around the nozzle and DM weld to ensure no through-wall cracks exist prior to applying the FSWOL. The licensee will conduct its visual examinations in accordance with 10 CFR 50.55a(g)(6)(ii)(E).

- In accordance with paragraph (d) of ASME Code Case N-504-3, a dye-penetrant (PT) examination will be performed on the overlay area.

- The licensee will perform a PDI qualified UT examination of the subject DM welds prior to application of FSWOL.

Post-overlay PSI examination:

- The licensee proposed to perform UT examination of finished FSWOL in accordance with the requirements of Article Q-4100 of Nonmandatory Appendix Q of the ASME Code, Section XI. In accordance with proposed alternative request I4R-05, dated

August 10, 2010 (ADAMS Accession No. ML102290162), the licensee will use the PDI demonstrated and qualified UT examination procedures and personnel qualification program, in lieu of the ASME Code, Section XI, Appendix VIII, Supplement 11, requirements. See Section 3.3.5 of this safety evaluation for further discussion of proposed alternative request I4R-05.

- The licensee proposed to conduct an ASME Code, Section XI, IWA-5000, system leakage test in accordance with the TMI-1 ISI program.

- The licensee plans to perform a surface examination of the FSWOL in accordance with the requirements of Article Q-4100 of Nonmandatory Appendix Q of the ASME Code, Section XI, and ASME Code Case N-504-3.

Subsequent ISI examination:

- The licensee will perform subsequent ISI examinations of the subject FSWOL in accordance with requirements specified in Appendix Q of the ASME Code, Section XI, or alternate schedule accepted by the NRC, such as the adoption of ASME Code Case N-770, as proposed in the *Federal Register* at 75 FR 24324. The NRC staff notes that subsequent to the receipt of the licensee's application, this proposed action became a final rule on June 21, 2011 (76 FR 36232). This amended 10 CFR 50.55a to incorporate by reference (with conditions on its use) ASME Code Case N-770-1.

- By letter dated March 9, 2011, in response to the staff's RAI, the licensee stated that the design and installation of the FSWOL are applicable to the remaining service life of the plant. However, the licensee acknowledged and confirmed that the subsequent ISI interval examinations will be performed in accordance with any updated NRC requirements applicable to that interval.

The staff finds the licensee's proposed examinations requirements (PSI and ISI) discussed above, are consistent with (or exceed) the Appendix Q to the ASME Code, Section XI, requirements, and therefore are acceptable.

3.3.4 Ambient Temperature Temperbead Welding

The use of an ambient temperature temperbead operation utilizing the machine GTAW process is documented in EPRI Technical Report GC-111050, "Ambient Temperature Preheat for Machine GTAW Temperbead Applications," dated November 1998, and EPRI Technical Report 1013558, "Repair and Replacement Applications Center (RRAC): Temperbead Welding Applications 48-Hour Hold Requirements for Ambient Temperature Temperbead Welding," dated December 2006. According to the above reports, repair welding performed with an ambient temperature temperbead procedure utilizing the machine GTAW welding process exhibits mechanical properties equivalent to, or better than, those of the surrounding base material. The effectiveness of this process has been demonstrated by laboratory testing, analysis, successful procedure qualifications, and successful repairs.

The staff reviewed Section 5.0 and Table 3 of RR-10-02, which address the effects of the ambient temperature temperbead welding process on mechanical properties of welds, hydrogen-induced cracking, cold restraint cracking, and extent of overlay coverage of ferritic base metal. The licensee provided its proposed requirements for the ambient temperature temperbead welding.

The proposed requirements follow ASME Code Case N-638-1 with a few modifications. The staff's review of the licensee's proposed requirements and modifications is presented below.

The licensee stated that ASME Code Case N-638-1, paragraph 1.0(a), limits the maximum area of an individual weld to 100 square inches. The licensee's proposed alternative expands the maximum area of an individual weld based on the finished surface over the ferritic material to no greater than 300 square inches. The FSWOL will extend to the transition taper of the carbon steel nozzle to provide a weld geometry that allows qualified UT examination of the required examination volume. The licensee stated that a number of temperbead FSWOL repairs successfully applied to safe-end to nozzle welds in the nuclear industry, and a FSWOL repair of these welds having a 300 square inches area was previously approved for TMI-1, by NRC letter dated October 17, 2007 (ADAMS Accession No. ML072770051). Further, the staff notes that ASME Code Case N-638-4, paragraph 1.0(b), limits the maximum area of an individual weld to 500 square inches. EPRI Technical Report 1011898, "RRAC Code Justification for the Removal of the 100 Square Inch Temper Bead Weld Repair Limitation," dated November 2005, cites evaluations of a 12-inch diameter nozzle weld overlay to demonstrate adequate tempering of the weld heat affected zone, residual stress evaluations demonstrating acceptable residual stresses in weld overlays ranging from 100 to 500 square inches. It also concluded that there is no direct correlation of residual stresses with surface area of the repair for overlay repairs done using temperbead welding. Based on the NRC's previous approval for TMI-1, and the similarity of this request to the previously-approved request, the staff approves the weld overlay on the ferritic material up to 300 square inches.

To address hot cracking, the licensee stated that it may install one or more weld barrier layer(s) to prevent hot cracking similar to those weld overlays that were installed during the 2007 refueling outage. The staff issued an RAI requesting that the licensee discuss any additional measures taken to minimize potential hot cracking in stainless steel materials besides installing the weld barrier. By letter dated March 9, 2011, in response to the staff's RAI, the licensee stated that appropriate criteria and parameters have been established for control of the welding process. As an example, the welding heat input "power ratio" range has been determined to minimize weld metal contamination from the existing plant materials. The overlay design includes no welding on cast stainless steel material, as only wrought stainless steel materials are involved. Additionally, the wrought base material chemistries and weld geometry will be reviewed to determine the level of risk for hot cracking. The staff finds the licensee has taken sufficient precaution to minimize potential hot cracking in stainless steel materials.

Direct monitoring of preheat and interpass temperature is necessary to assure the field welding heat input remains within qualified parameters. In the application dated September 30, 2010, the licensee stated that weld preheat and heat input will be monitored through the use of temperature measuring devices such as calibrated contact pyrometers or thermocouples. The staff issued an RAI requesting the licensee clarify which temperature measuring device will be used. By letter dated March 9, 2011, in response to the staff's RAI, the licensee confirmed that weld preheat and heat input will be monitored through the use of a calibrated contact pyrometer. The licensee stated that thermocouples will not be used during the installation of the weld overlay. The staff finds this response acceptable because the requirements of ASME Code Case N-638-4 will be followed.

3.3.5 Performance Demonstration Initiative Program

The staff notes that the licensee submitted a separate proposed alternative request, I4R-05, "Request for Relief from Qualification Requirements of ASME Section XI, Appendix VIII,

Supplement 11, for Examination of Structural Weld Overlays (SWOLs) in Accordance with 10 CFR 50.55a(a)(3)(i)." Request I4R-05 proposes alternatives to the ASME Code, Section XI, Appendix VIII, Supplement 11, inspection requirements applicable to the DM welds in RR-10-02 for the TMI-1 fourth 10-year ISI interval. By letter dated July 20, 2011, (ADAMS Accession No. ML111730475), the NRC authorized I4R-05 for use of the PDI program in lieu of the ASME Code, Section XI, Appendix VIII, Supplement 11, inspection requirements at TMI-1. The scope of I4R-05 includes NRC-approved FSWOL's applied during the fourth ISI interval at TMI-1, and therefore applies to the RR-10-02 overlay.

4.0 CONCLUSION

The NRC staff finds that the requirements of RR-10-02 are either consistent with or exceed the intent of the provisions of ASME Code Cases N-504-4 and N-638-4 and Appendix Q of the ASME Code, Section XI. On the basis of the review and evaluation of the licensee's submittals described above, the NRC staff concludes that the proposed alternative would provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the use of RR-10-02 for the repair of the subject Alloy 82/182 DM welds in the pressurizer spray nozzle to safe-end and safe-end to elbow joints. The design and installation portion of RR-10-02 is authorized for the remaining life of the components, including future plant life extension. The inspection requirements of RR-10-02 are authorized for the TMI-1 fourth 10-year ISI interval.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributors: A. Rezai
P. Bamford

Date: August 15, 2011

If you have any questions, please contact the TMI-1 Project Manager, Mr. Peter J. Bamford, at 301-415-2833.

Sincerely,

/ra/

Harold K. Chernoff, Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
As stated

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