July 21, 2004

Mr. Christopher M. Crane
President and Chief Executive Officer
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 (TMI-1) REQUEST FOR RELIEF FROM FLAW REMOVAL, HEAT TREATMENT, AND NONDESTRUCTIVE EXAMINATION REQUIREMENTS FOR THE THIRD 10-YEAR INSERVICE INSPECTION (ISI) INTERVAL (TAC NO. MC1201)

Dear Mr. Crane:

By letter dated November 3, 2003, as supplemented by letters dated November 7, 18, and 20, 2003, and January 9, 2004, AmerGen Energy Company, LLC (the licensee) submitted to the Nuclear Regulatory Commission (NRC), a request for relief from certain American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code)-required repair and inspection criteria at TMI-1. Specifically, the licensee requested relief from flaw removal, heat treatment, and nondestructive examination requirements for the third 10-year ISI interval. Based on the enclosed safety evaluation, the NRC staff has determined that the request for relief is acceptable.

The NRC staff concludes that the licensee's request for relief may be granted pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.55a(a)(3)(ii). The NRC staff has determined that the proposed request for relief will provide reasonable assurance of maintaining the structural integrity of the pipe. Therefore, the NRC staff authorizes the proposed alternative for the weld overlay of the nozzle-to-safe end weld (SR0010BM) for the third 10-year ISI interval at the TMI-1. This request for relief was granted verbally to the licensee on November 14, 2003.

All other requirements of Section XI of the ASME Code for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

The NRC staff's safety evaluation is enclosed. If you have any questions regarding this approval, please contact the TMI-1 Project Manager, Mr. Timothy G. Colburn, at (301) 415-1402.

Sincerely,

/RA/

Richard J. Laufer, Chief, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure: Safety Evaluation

cc w/encl: See next page

The NRC staff's safety evaluation is enclosed. If you have any questions regarding this approval, please contact the TMI-1 Project Manager, Mr. Timothy G. Colburn, at (301) 415-1402.

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ACCESSION NO.: ML041670510 *SE provided. No substantive changes made.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THREE MILE ISLAND NUCLEAR STATION, UNIT 1 (TMI-1)

REQUEST FOR RELIEF FROM FLAW REMOVAL, HEAT TREATMENT

AND NONDESTRUCTIVE EXAMINATION (NDE) REQUIREMENTS

FOR THE THIRD 10-YEAR INSERVICE INSPECTION (ISI) INTERVAL

AMERGEN ENERGY COMPANY, LLC

DOCKET NO. 50-289

1.0 INTRODUCTION

By letter dated November 3, 2003, as supplemented by letters dated November 7, 18, and 20, 2003, and January 9, 2004, AmerGen Energy Company, LLC (the licensee), requested relief from certain requirements pertaining to flaw removal, heat treatment, and NDE for the third 10-year ISI interval at TMI-1. Specifically, the licensee requested relief to use Alloy 52/152 weld material to overlay a nozzle-to-safe end dissimilar metal weld that contained a crack that is attributed to primary water stress corrosion cracking (PWSCC). The licensee proposed using the methodology of the American Society of Mechanical Engineers (ASME), *Boiler and Pressure Vessel Code* (Code), Cases (CCs) N-504-2, “Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping,” and N-638, “Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique.” The “code acceptable” repair methods specified by ASME Code, Section XI, Paragraphs IWA-4410, IWA-4520(a), IWA-4530(a), and IWA-4540(a) would involve the removal of PWSCC flaws.

2.0 REGULATORY EVALUATION

The ISI of ASME Code, Class 1, 2, and 3 components is to be performed in accordance with Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” of the ASME Code and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(g), except where specific written relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). Section 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that (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.

ENCLOSURE

Pursuant to 10 CFR 50.55a(g)(4), ASME Code, Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in ASME Code, Section XI, to the extent practical 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. The ISI Code of record for TMI-1 is the 1995 edition with 1996 addenda of Section XI of the ASME Code. The third 10-year interval for TMI-1 began April 20, 2001, and is scheduled to end April 19, 2011. The Construction Code is the United States of America Standard (USAS) B31.7, draft 1968 edition including June 1968 errata. The specific paragraphs in Section XI and the Construction Code are listed in the attached Table.

3.0 TECHNICAL EVALUATION

3.1 Components for Which Relief Is Requested

This request is applicable for weld No. SR0010BM connecting the pressurizer surge line to the once-through steam generator “A” hot leg.

3.2 Licensee’s Proposed Alternative to ASME Code and Bases for Requesting Relief

A full structural weld overlay repair is proposed for the nozzle-to-safe end weldments. The nozzle material specification is the American Society for Testing and Materials (ASTM) A-105, Grade 2, carbon steel. The safe end is austenitic stainless steel, ASTM A-336, Type F8M (similar to Type 316). The weld filler material is (Inconel) Alloy 82/182.

The weld overlay will be designed consistent with the requirements of ASME CC N-504-2. The weld overlay will extend around the full circumference of the nozzle-to-safe end weldment location as required by CC N-504-2. The overlay will be 0.51 inches thick and the length will be according to the guidance provided in CC N-504-2. The overlay will completely cover the indication with highly corrosion resistant Alloy 52 material that is highly resistant to primary water stress corrosion cracking (PWSCC).

In order to accomplish this objective, it will be necessary to weld on the carbon steel nozzle material. The temper bead welding approach will be used for this purpose following the guidance of CC N-638. This CC provides for machine gas tungsten-arc welding (GTAW) temper bead weld repairs to P-No. 1 nozzle material at ambient temperature. The temper bead approach was selected because temper bead welding supplants the requirement for post weld heat treatment (PWHT) of the heat affected zones in welded carbon steel material. Also, temper bead welding techniques produce excellent toughness and ductility in heat affected zones of welded carbon steel materials, and, in this case, result in compressive residual stresses on the inside surface, which help to inhibit PWSCC.

The same temper bead rules apply to P-No. 3, Group 3, and P-No. 1, Group 2, base materials. However the P-No. 3, Group 3, base materials are significantly more susceptible to hardening as compared to the P-No. 1, Group 2, base materials.

The hot leg surge nozzle material, ASTM A-105, Grade II, P-No. 1, Group 2, material, upon which temper bead welding is to be performed has a carbon content of 0.315% ladle, 0.315% check. If the carbon content were 0.30% or less, USAS B-31.7 would not require temper bead welding preheat or PWHT for weld thicknesses of 3/4 inch or less on the surge nozzle and ASME III would not require pre-heat or post weld heat treatment for a component 1¼-inch thick or less with a maximum carbon content of 0.30%. For weld thicknesses of less than 1½-inch, 200 degrees F minimum preheat temperature only, without PWHT is required.

A 48-hour post weld hold prior to acceptance inspection is required by CC N-638 and will be implemented to assure that no delayed cracking occurs.

All welders and welding procedures will be qualified in accordance with ASME Code, Section IX, and any special requirements from Section XI or applicable CCs. A manual shielded metal arc weld (SMAW) procedure will be qualified to facilitate localized repairs if required, and to provide a seal weld as necessary during the repair activities.

CC N-504-2 was approved for generic use in Regulatory Guide (RG) 1.147, Revision 13, and was developed for austenitic stainless steel material. An alternate application for nickel-based and carbon materials is proposed due to the specific configuration of the subject weldments. Therefore, the licensee intends to follow the methodology of CC N-504-2, except for the following:

1. Paragraph (b) of CC N-504-2 requires that the reinforcement weld metal shall be low carbon (0.035%) maximum austenitic stainless steel. In lieu of the stainless steel filler material, a consumable welding wire highly resistant to PWSCC has been selected for the overlay weld material. This material is a nickel-based alloy weld filler material, commonly referred to as Alloy 52, and will be applied using the GTAW process. Alloy 52 contains about 30% chromium that imparts excellent corrosion resistance to this material. This filler material is suitable for welding over the carbon steel nozzle, the Alloy 82/182 weld and the stainless steel safe end.

2. Paragraph (e) of CC N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 FN (ferrite number) for the weld reinforcement. Delta ferrite measurements will not be performed for this overlay because Alloy 52 is 100% austenitic and contains no delta ferrite due to the high nickel composition (approximately 60% nickel).

3. Paragraph (h) of CC N-504-2 requires a system hydrostatic test of the completed repair if the flaw(s) penetrated the original pressure boundary or if there is any observed indication of the flaw penetrating the pressure boundary during repair. The ASME Code, Section XI, requirement or alternatives approved by the NRC for pressure testing will be used in lieu of paragraph (h).

CC N-638 was approved for generic use in RG 1.147, Revision 13, and was developed for similar and dissimilar metal welds using ambient temperature machine GTAW temper bead technique. The licensee stated it intends to follow the methodology of CC N-638, except for the following:

1. Paragraph 1(a) of CC N-638 requires the maximum finished area of an individual weld to be limited to 100 square inches and the depth of the weld to be not greater than

one-half of the ferritic base metal thickness. This condition may not be met because the design of the overlay weld may result in exceeding the CC limitations.

2. Paragraph 1(b) of CC N-638 limits repair/replacement activity on a dissimilar metal weld to those along the fusion line of a non-ferritic weld to ferritic base material on which one-eighth of an inch or less of a non-ferritic weld deposit exists above the original fusion line. This requirement is not applicable because the original circumferential groove weld will remain.

3. Section 4(b) of CC N-638 requires that the final weld surface and the band around the area of at least one and one-half times the component thickness or 5 inches, whichever is less, be examined using surface testing (PT) and ultrasonic testing (UT) methods. PT and UT of the weld overlay repair will be performed in accordance with the proposed pre-service inspection (as stated in the licensee's submittals).

3.3 NRC Evaluation

Paragraph 1-727.7 of the Construction Code requires that all defects in the weld requiring repair shall be removed. The licensee is requesting to leave a flaw in the surge nozzle-to-safe end weld. The flaw is oriented in the axial direction on the inside surface of the weldment and is contained within the weld to a depth of 0.48 inches. The weld thickness is approximately 1.062 inches. The flaw is located approximately 25 degrees clockwise from the top of the weld looking into the nozzle. The nozzle is carbon steel with a stainless steel-cladded inside surface (bore), and the safe end is stainless steel. The weld and weld butter are made with Alloy 82/182. The licensee proposed using a full structural weld overlay made with Alloy 52/152 over the cracked Alloy 82/182 butt weld and weld butter.

Based on the UT response, the crack location in the weld, and the cracking history of Alloy 82/182, the licensee determined that the flaw was due to PWSCC. Surge line welds have experienced cracking due to PWSCC and thermal fatigue. Thermal fatigue cracks may have UT acoustic signatures similar to those of PWSCC flaws. Thermal fatigue cracks in the nozzle and/or safe end are caused by fluid flow thermal cycling. Operational experience has shown that thermal fatigue cracks often initiate at symmetric locations in a pipe/nozzle due to similar thermal conditions at those locations. Therefore, it would be expected that if a crack located at 25 degrees was detected, a crack on the opposite side (335 degrees clockwise) of the weld would also be detected. No cracks were observed in the vicinity of the 335-degree location of the weld. Thermal fatigue cracks are also capable of extending through the weld and into the base metal. The UT showed that the crack was confined in the Alloy 82/182 weld metal, which is consistent with PWSCC as the mechanism for flaw initiation and growth. Therefore, the NRC staff agrees that the evidence supports the licensee's determination that the likely degradation mechanism is PWSCC.

Operational experience has also shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, carbon steel base metal, or Alloy 52/152 weld metal. The licensee is applying a 360-degree, full structural weld overlay to control growth in the axial crack and maintain weld integrity. The weld overlay will put compressive stress around the weldment, thus impeding growth of the existing crack and therefore, will fulfill all structural requirements, independent of the existing weld.

Paragraph 1-731.2.1(a) of the Construction Code requires that P-No. 1 materials shall be preheated to a temperature of 175° F for material with a maximum carbon content in excess of 0.30-weight percent and a thickness in excess of 1 inch, and paragraph 1.731.3.1(a) of the Construction Code states that the subject welds shall be given a post-weld heat treatment at 1100° F with a minimum hold time of 1 hour per inch of weld thickness. To eliminate the need for preheat and post-weld heat treatment, the industry developed a temper bead welding technique which was published as CC N-638. The NRC endorsed CC N-638 in RG 1.147, Revision 13. The temper bead technique carefully controls heat input and bead placement which allows subsequent welding passes to stress-relieve and temper the heat affected zones of the base material and preceding weld passes. The welding is performed with low hydrogen electrodes under a blanket of inert gas. The inert gas shields the molten metal from moisture and hydrogen. Therefore, the need for the heat treatment specified by ASME Code is not necessary to produce a sound weld using the temper bead process in CC N-638.

AmerGen intends to follow the methodology of CC N-638, except paragraph 1.0(a) which requires the maximum area of an individual weld, based on the finished surface, be limited to 100 square inches, and the depth of the weld to be not greater than one-half of the ferritic base metal thickness. This condition is not being met because the design for the weld overlay covers an area of approximately 163 square inches which exceeds the limitations of CC N-638. Amergen performed an evaluation to determine the effect of exceeding the 100 square-inch area limitation for temper bead welding onto a low alloy steel nozzle. The nozzle diameters are similar (approximately 12-inch diameter for the evaluation and 10-inch diameter for the actual component to be repaired). The area on which the weld overlay was applied on the nozzle material for the evaluation was 126 square inches as compared to 163 square inches for the actual component to be repaired.

No clear basis has been documented by the ASME Code Working Group on Welding and Special Repair Processes (the group responsible for CC N-638) for the 100 square-inch area limitation. The licensee performed a comparison between two different weld overlay areas. The first evaluation was for a 100 square-inch area and the second was for a 126 square-inch area. The analysis was performed using elastic-plastic finite element analysis with non-linear material properties and simulation of the as-welded condition and weld overlayed condition. Results of these evaluations demonstrate that the stress distributions are similar between the two cases. Both cases show that compressive stress remains on the inside surface near the weld, which supports mitigation of some degradation mechanisms, such as PWSCC. In fact, in some cases, the extended overlay results in higher compressive stress than the 100 square-inch case. Thus, the residual stresses remain in compression on the inside surface of the weld as the nozzle overlay area increases. This supports mitigation of the degradation mechanism. Thus, increasing the overlay area is acceptable for this specific application, i.e. for this degradation mechanism and in this geometry (piping).

Although the focus of the study was on the effects of residual stresses, the licensee noted that the resulting displacements following the 100 square-inch and extended weld overlay cases were very similar. The licensee concluded that there is no significant impact on displacements as a result of extending the weld overlay to a larger area when using the temper bead welding process. The NRC staff agrees that there will be no significant impact on displacements as a result of extending the weld overlay since weld shrinkage (displacements) caused by the weld overlay will be measured and the impact on the system will be determined consistent with CC N-504-2.

Several similar weld overlays have been applied to operating boiling water reactor (BWR) facilities (such as Nine Mile Point 2, Perry, and Duane Arnold) with similar geometry and overlay dimensions. Studies have been performed by Electric Power Research Institute (EPRI) in qualifying weld overlays for application in BWRs, and in these applications, the studies have not identified any issues with shrinkage stresses or weld contraction stresses. The TMI-1 weld overlay design is generally similar to the design applied in BWR feedwater, core spray, and recirculation nozzles.

Paragraph 1-727.4.2(e).1 of the Construction Code requires 100% radiography testing (RT) examinations of all girth butt welds. The proposed alternative is to apply the UT and surface examinations specified in CC N-504-2 and CC N-638. The application for the different nondestructive examination (NDE) methods are shown in the November 3, 2003, tables as supplemented by later submittals.

RT and UT examination methods are complimentary. They are not directly comparable or equivalent. Depending on the flaw type and orientation, RT may be superior to UT or vice versa. RT is most effective in detecting changes in material density, such as volumetric (welding) type flaws (i.e., slag and porosity), and planar type flaws with detectable density differences, such as lack-of-fusion and open cracks that are oriented in a plane parallel to the X-ray beam. RT is limited in detecting small changes in density such as tight, irregular planar flaws and non-optimally oriented planar flaws with respect to the X-ray beam. RT is also limited in determining depth characteristics. The flaws that are easiest for RT to detect are three-dimensional and are associated with the welding process (construction).

In contrast, UT examinations are capable of detecting the features in a component that reflects sound waves. The degree of reflection depends largely on the physical state of matter on the opposite side of the reflective surface and to a lesser extent on specific physical properties of that matter. For instance, sound waves are almost completely reflected at metal-gas interfaces, and partially reflected at metal-to-solid interfaces. Discontinuities that act as metal-gas interfaces, like cracks, laminations, shrinkage cavities, bursts, flakes, pores, and bonding faults are easily detected. These are the types of flaws that generally originate during plant operations and from the welding process. UT is less effective in detecting flaws in a plane parallel to the sound beam because of target size and in detecting volumetric type flaws such as slag, porosity, and other inhomogenieties because of sound dispersion from irregular surfaces. UT may also have difficulty in detecting discontinuities (flaws) that are present in the shallow layer immediately beneath the surface and in separating discontinuities from background noises that are caused by certain metal characteristics like large grains in stainless steels. However, modern UT techniques involving partial reflection of sound waves have successfully detected flaws parallel to the sound beam and volumetric type flaws. Tip diffraction and corner trap UT techniques have successfully characterized these flaws.

In the proposed alternative, the examination coverage consists of scanning with angle beam transducers in two opposite directions perpendicular to the weld axis and two opposite directions parallel to the weld axis, and with a straight beam transducer scanning through the weld overlay and 25% through-wall of the base metal. For the preservice examination, the scan volume is the weld overlay and 25% through-wall of the base metal except for the volume next to the overlay edges. The scans provide assurance that planar flaws, regardless of orientation, will be detected and non-planar, welding flaws will be easier to discern from inhomogenieties. The UT examinations will use procedures and personnel qualified to Section XI, Appendix VIII,

Supplement 11 of the ASME Code as administered by the EPRI Performance Demonstration Initiative (PDI) Program. The qualification process assures that the UT procedure contains sufficient detail and the personnel have the necessary skills for detecting various types of flaws. Flaws that are detected will be evaluated in accordance with the Construction Code's acceptance criteria.

B31.7, Appendix B-1, B-2-160 of the Construction Code provides the acceptance criteria for UT examinations which states, "[l]inear type discontinuities are unacceptable if the amplitude exceeds the referenced level and discontinuities have lengths which exceed .... Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of discontinuity length or signal amplitude." The Construction Code UT technique is prescriptive-based which may be as good as the performance-based UT being proposed by the licensee and required by 10 CFR 50.55a(g)(6)(ii)(C) for Section XI examinations of weld overlays. The NRC staff supports the use of Section XI performance-based UT for this application in lieu of the prescriptive-based UT required by the Construction Code.

The licensee proposed using the acceptance criteria referenced in CC N-504-2 and CC N-638 for planar and laminar flaws. For flaws that appear planar, CC N-504-2 would apply the acceptance criteria from Table IWB-3514-2. Included in the term "planar" are cracks and welding flaws, such as, slag, porosity, and lack-of-fusion. For flaws that appear laminar, N-504-2 would apply the acceptance criteria of IWA-4000 which references the original Construction Code. However, the licensee references the acceptance criteria for both CC N-504-2 and CC N-638. The two CCs agree on the disposition of planar flaws but differ on laminar flaws. Thus for laminar flaws, CC N-638 would use the acceptance criteria of Table IWB-3514-3 which is normally used to disposition flaws discovered in the base material. Applying Table IWB-3514-3 to a weld overlay exposes several inherent oversights. For instance, the acceptance of a laminar flaw size is independent of the weld overlay size, and the acceptance criteria is silent on the inaccessible volume beneath the lamination which may hide other flaws beneath the lamination. The NRC staff used Table IWB-3514-2 acceptance criteria for planar flaws and selected the conservative acceptance criteria of the Construction Code for laminar flaws.

In the licensee's submittal of January 9, 2004, the NRC staff was informed that the post-UT examination of the weld overlay identified a 1.19 square-inch laminar flaw. The flaw size was much less than the 163 square inches of weld overlay surface area. The flaw is located between the second and third weld layers above the pipe surface and approximately 180 degrees away from the original axial flaw which was embedded. Because the volume below the laminar flaw is inaccessible, the defect may extend below the detected surface. The Construction Code acceptance criteria requires the removal of the laminar flaw (lack-of-fusion). The NRC staff evaluated the laminar flaw using the acceptance criteria and calculations of Table IWB-3514-2 .

The uninspectable volume beneath the laminar flaw is shaped like an inverted cone. The licensee was able to use 45-degree and 60-degree angle transducers to angle under the laminar flaw, thus reducing the uninspectable volume to the shape of an inverted cone with the base of the cone being the laminar flaw. The 60-degree angle transducer sets the maximum uninspectable depth at 0.50 inches. The uninspectable depth can be handled as a planar flaw and is similar (within UT tolerance) in depth as the original flaw which was evaluated using

Table IWB-3514-2. The angle transducers would detect any flaw emanating from the inside diameter and growing toward the uninspectable volume.

The licensee did not include the first and second weld layers in designing the structural portions of the weld overlay. According to the licensee, the weld layers above the lamination are sufficient for structural integrity and the weld overlay was designed for the maximum laminar flaw size described in Table IWB-3514-3. The laminar flaw is far removed from the original flaw. Because of the location, the laminar flaw can be considered a welding anomaly that does not jeopardize the structural integrity of the pipe. Therefore, removal of the laminar flaw would create a hardship by expending resources and subjecting personnel to unnecessary radiation doses without a compensating increase in safety and quality.

Paragraph 1-737.1.1 of the Construction Code requires piping repairs to be hydrostatically tested prior to initial operation. The Construction Code is to be used for complete replacement of a pressure boundary or for a pressure boundary that was penetrated. The repair being performed with a weld overlay is on the surface of the pipe-to-nozzle weld which was not penetrated by the flaw. The weld overlay and 25% of the base metal thickness was volumetrically examined to ensure that the flaw did not penetrate the original pressure boundary. To verify the functionality of the pressure boundary, the licensee is following CC N-504-2 for pressure testing which stipulates that system pressure boundaries that have not been penetrated, a system leakage, inservice, or functional test shall be performed in accordance with IWA-5000. The NRC staff endorsed CC N-504-2 in RG 1.147, Revision 13.

2.4 Conclusion

Based on the above review, the NRC staff has determined that the proposed request for relief in the licensee's letter dated November 3, 2003, as supplemented by letters dated November 7, 18, and 20, 2003, and January 9, 2004, will provide reasonable assurance of maintaining the structural integrity of the pipe. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the proposed alternative for the weld overlay of the nozzle-to-safe end weld (SR0010BM) for the third 10-year ISI interval at TMI-1.

All other requirements of Section XI of the ASME Code for which relief has not been specifically requested remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Attachment: Table, Comparison of Code Requirements

Principal Contributors: D. Naujock
E. Andruszkiewicz

Date: July 21, 2004

Three Mile Island Nuclear Station, Unit 1

cc:

Site Vice President - Three Mile Island Nuclear Station, Unit 1
AmerGen Energy Company, LLC
P. O. Box 480
Middletown, PA 17057

Senior Vice President - Nuclear Services
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Vice President - Operations, Mid-Atlantic
AmerGen Energy Company, LLC
200 Exelon Way, KSA 3-N
Kennett Square, PA 19348

Vice President - Licensing and Regulatory Affairs
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Chairman
Board of County Commissioners
of Dauphin County
Dauphin County Courthouse
Harrisburg, PA 17120

Chairman
Board of Supervisors
of Londonderry Township
R.D. #1, Geyers Church Road
Middletown, PA 17057

Senior Resident Inspector (TMI-1)
U.S. Nuclear Regulatory Commission
P.O. Box 219
Middletown, PA 17057

Director - Licensing and Regulatory Affairs
AmerGen Energy Company, LLC
200 Exelon Way, KSA 3-E
Kennett Square, PA 19348

Rich Janati, Chief
Division of Nuclear Safety
Bureau of Radiation Protection
Department of Environmental Protection
Rachel Carson State Office Building
P.O. Box 8469
Harrisburg, PA 17105-8469

Plant Manager - Three Mile Island Nuclear Station, Unit 1
AmerGen Energy Company, LLC
P. O. Box 480
Middletown, PA 17057

Regulatory Assurance Manager - Three Mile Island Nuclear Station, Unit 1
AmerGen Energy Company, LLC
P.O. Box 480
Middletown, PA 17057

Peter Eselgroth, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Michael A. Schoppman
Framatome ANP
Suite 705
1911 North Ft. Myer Drive
Rosslyn, VA 22209

Vice President, General Counsel and Secretary
AmerGen Energy Company, LLC
2301 Market Street, S23-1
Philadelphia, PA 19101

Three Mile Island Nuclear Station, Unit 1

cc:

Dr. Judith Johnsrud
National Energy Committee
Sierra Club
433 Orlando Avenue
State College, PA 16803

Eric Epstein
TMI Alert
4100 Hillsdale Road
Harrisburg, PA 17112

Correspondence Control Desk
AmerGen Energy Company, LLC
P.O. Box 160
Kennett Square, PA 19348

Manager Licensing - Three Mile Island Nuclear Station, Unit 1
Exelon Generation Company, LLC
200 Exelon Way, KSA 3-E
Kennett Square, PA 19348

Associate General Counsel
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

TABLE
COMPARISON OF CODE REQUIREMENTS

Section XI Requirements	**Related Construction Code, B31.7 Requirements**	**Proposed Alternatives & Basis**
IWA-4410(a) states in part "Repair/replacement activities shall be performed in accordance with the Owner's Requirements and the Original Construction Code of the components or system, …"	1-727.7 states in part "All defects in welds requiring repair shall be removed by grinding, chipping, arc, or flame gouging, or machining. …"	Alternative to Code: A full structural weld overlay repair, which extends around the full circumference of the nozzle-to-safe end weldment, is proposed in lieu of repair by defect removal. The weld overlay will be structurally designed using the methodology of Code Case N-504-2 and will account for PWSCC and fatigue crack growth. Basis: The weld overlay will be designed consistent with the methodology of ASME Code Case N-504-2. The as-left PWSCC defect will be completely covered with Alloy 52 that is highly resistant to PWSCC.
	1-731.2.1(a) states in part "P-number 1 materials shall be preheated to a temperature of 175° F for material that has both a specified maximum carbon content in excess of 0.30% and a thickness in excess of 1 in. … "1-731.3.1(a) states in part "…. Except as otherwise specifically provided in the notes of Table 1-731.3.1, all welds shall be given a post-weld heat treatment at a temperature not less than that specified in Table 1-731.3.1. Table 1-731.3.1 and associated Footnote 4 require a post-weld heat treatment at 1100° F at minimum hold time of 1 hr/in of weld thickness.	Alternative to Code: Temper bead welding approach will be used following the methodology of Code Case N-638, which provides for machine gas tungsten-arc welding (GTAW) temper bead welding to P-No.1 nozzle material at ambient temperature. Temper bead welding supplants the requirement for the preheat and post-weld heat treatment of the heat-affected zones in welded carbon steel material. Welding will be performed with water backing. The maximum welded area on the P-No.1 material will be approximately 163 square inches. A nickel-based alloy weld filler material, commonly referred to as Alloy 52, will be used. Basis: Temper bead welding technique produces excellent toughness and ductility in heat-affected zones of welded carbon steel materials, and, in this case, also result in compressive residual stresses on the inside surface, which helps inhibit PWSCC The size of the weld overlay is based on engineering analysis.

Section XI Requirements	Related Construction Code, B31.7 Requirements	Proposed Alternatives & Basis
		Alloy 52 contains about 30% chromium that imparts excellent corrosion resistance to PWSCC. This filler material is more suitable for welding over the carbon steel nozzle, Alloy 82/182 weld, and stainless steel safe-end.
IWA-4520(a) states "Welding or brazing areas and welded joints made for installation of items shall be examined in accordance with the Construction Code identified in the Repair/Replacement Plan."	1-727.4.2(e).1 states "All girth butt welds shall be examined 100% by radiography in accordance with the method set forth in Appendix B-1 and shall meet the acceptance criteria of Appendix B-1."	Alternative to Code: The complete weld overlay will be examined by surface examination and ultrasonic testing methods after a 48-hours post-weld hold period. PDI qualified procedure and personnel will be used to perform the UT examination. The required examination surface area and volume are identified in Table 2 and Figure 1 of the referenced submittal. Post-weld/pre-service surface examination of the base materials will be limited to a 2" band around the entire circumference of the P-No. 1 nozzle material. The 2" band is measured outward from the toe of the weld overlay on the nozzle side. Basis: The alternative examination methods are acceptable examination methods of Code Case N-504-2 and N-638. The upper 25% of the base material needs to be examined because the full structural weld thickness (original nozzle, buttering, weld, and safe-end) overlay is designed such that the full thickness of original base materials is no longer required to carry the applicable loads. A post-weld 2-inch band surface examination needs to be performed on the P-No.1 nozzle because of the potential hydrogen induced cracking. Stainless steel material is not known to be susceptible to hydrogen induced cracking, which is supported by field experience at BWRs.

Section XI Requirements	Related Construction Code, B31.7 Requirements	Proposed Alternatives & Basis
IWA-4530(a) states in part "When portions of items requiring pre-service or inservice inspection are affected by repair/replacement activities, or for items being installed, including welded joints made for installation of items, pre-service inspections shall be performed in accordance with IWB-2200, …" IWB-2200(a) states in part – "Examination required by this Article (with the exception of Examination Category B-P, and the visual VT-3 examination of the internal surfaces of Categories B-L-2 and B-M-2, of Table IWB-2500-1) shall be completed prior to initial plant startup. In addition, these pre-service examinations shall be extended to include essentially 100% of the	N/A	Alternative to the Code: The methodology and requirements for the pre-service inspections are provided in Table 2 of the referenced letter. The inservice inspection requirements are provided in Table 3 of the referenced letter. Basis: These pre-service requirements follow the guidance of ASME Code Cases N-504-2 and N-638. The inservice inspection requirements in Table 3 refer to ASME Code, Section XI, and the methodology of Code Cases N-504-2 and N-638. Re-inspection frequencies have been established based on historical BWR experience.

Section XI Requirements	Related Construction Code, B31.7 Requirements	Proposed Alternatives & Basis
pressure retaining welds in all Class 1 components, except in those components exempted from examination by IWB-1220(a), (b), or (c). …" Examination Category B-J, Item No. B9.11 requires surface and volumetric examination to be performed on the surface area and volume identified in Figure IWB-2500-8.		
N/A	1.737.1.1 states in part "All piping installed shall be tested by a hydrostatic test prior to initial operation to demonstrate leak tightness. …."	Alternative to Code: System leakage test following the weld overlay will be performed. Basis: ASME Code, Section XI through the 2000 addenda permits system leakage tests.