September 12, 2007

Mr. M. R. Blevins
Senior Vice President &
Chief Nuclear Officer
TXU Power
Attn: Regulatory Affairs Department
P.O. Box 1002
Glen Rose, TX 76043

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 1 - RELIEF FROM ASME CODE, SECTION XI FOR IMPLEMENTATION OF THE EPRI-PDI SUPPLEMENT 11 PROGRAM REQUIREMENTS, AND WELD OVERLAYS, RELIEF REQUEST B-6 (TAC NO. MD3315)

Dear Mr. Blevins:

The Nuclear Regulatory Commission (NRC) staff has reviewed and evaluated the information provided by TXU Generation Company LP (the licensee), in its letter dated October 3, 2006, as supplemented by letter dated February 2, 2007. The licensee requested approval of Relief Request (RR) B-6, for Comanche Peak Steam Electric Station (CPSES), Unit 1, in which the licensee requested relief from certain requirements of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI, for the current second 10-year inservice inspection (ISI) interval. Specifically, the licensee's relief request will allow application of full-structural weld overlays in pressurizer nozzle safe end welds that diverge from the requirements contained in Section XI of the ASME Code.

Based on the information provided in the licensee's submittal, as supplemented, the NRC staff determines that the licensee has provided acceptable alternatives to the requirements of the ASME Code in RR B-6. The NRC staff concludes that the alternatives proposed by the licensee provide an acceptable level of quality and safety. Therefore, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), the proposed alternatives are authorized for the CPSES, Unit 1, for the remainder of their second 10-year ISI interval.

On February 28, 2007, the NRC staff verbally authorized the use of RR B-6 for CPSES, Unit 1 during the refueling outage**.** This letter and the enclosed safety evaluation provide the written follow-up of the NRC staff's basis for the verbal authorization.

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

Sincerely,

/RA by Michael T. Markley for/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-445

Enclosure: Safety Evaluation

cc w/encl: See next page

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

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Comanche Peak Steam Electric Station

cc:
Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 2159
Glen Rose, TX 76403-2159

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Mr. Fred W. Madden, Director
Regulatory Affairs
TXU Generation Company LP
P.O. Box 1002
Glen Rose, TX 76043

George L. Edgar, Esq.
Morgan Lewis
1111 Pennsylvania Avenue, NW
Washington, DC 20004

County Judge
P.O. Box 851
Glen Rose, TX 76043

Environmental and Natural
Resources Policy Director
Office of the Governor
P.O. Box 12428
Austin, TX 78711-3189

Mr. Richard A. Ratliff, Chief
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756-3189

Mr. Brian Almon
Public Utility Commission
William B. Travis Building
P.O. Box 13326
1701 North Congress Avenue
Austin, TX 78701-3326

Ms. Susan M. Jablonski
Office of Permitting, Remediation
and Registration
Texas Commission on Environmental
Quality
MC-122
P.O. Box 13087
Austin, TX 78711-3087

Terry Parks, Chief Inspector
Texas Department of Licensing
and Regulation
Boiler Program
P.O. Box 12157
Austin, TX 78711

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

APPLICATION OF WELD OVERLAYS IN PRESSURIZER NOZZLE SAFE END NOZZLES

RELIEF REQUEST B-6

COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 1

TXU GENERATION COMPANY, LP

DOCKET NO. 50-445

1.0 INTRODUCTION

By letter dated October 3, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML062850255), as supplemented by letter dated February 2, 2007 (ADAMS Accession No. ML070400286), TXU Generation Company LP (the licensee) submitted Relief Request (RR) B-6, requesting relief from selected American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI requirements related to the repair and examination of pressure retaining welds in piping at the Comanche Peak Steam Electric Station (CPSES), Unit 1. Specifically, the licensee proposed modifications to ASME Code Cases N-504-02, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1 (N-504-2)," and N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique (N-638-1)," and the application of ASME Code, Section XI, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds," as administered by the Electric Power Research Institute (EPRI) - Performance Demonstration Initiative (PDI) program. The request is for full structural preemptive weld overlays (PWOLs) of nozzle-to-safe end dissimilar metal and safe end-to-piping stainless steel butt welds associated with pressurizer and connected piping. The request is for the second inservice inspection (ISI) interval which started August 13, 2000, and is scheduled to end August 12, 2010.

2.0 REGULATORY EVALUATION

In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(g)(4), ASME Code Class 1, 2, and 3 components must meet the requirements set forth in ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that all inservice examinations 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 ASME Code, Section XI, incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 10-year interval.

For CPSES, Unit 1, the ISI Code of record is the 1998 edition with 2000 addenda of ASME Code, Section XI.

Alternatives to requirements may be authorized or relief granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), or 10 CFR 50.55a(g)(6)(i). In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance with the specified ASME Code requirement is impractical for the facility.

Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to Commission approval. Portions of editions and addenda may be used provided that related requirements of the respective editions or addenda are met.

3.0 TECHNICAL EVALUATION

3.1 Components for which Relief is Requested

The request for relief is applicable to the safe end welds for the ASME Code Class 1 pressurizer spray, relief, safety, and surge nozzles in CPSES, Unit 1, as specified in the licensee's October 3, 2006, application and supplemented by letter dated February 2, 2007..

3.2 ASME Code Requirements for which Relief Is Requested

ASME Code, Section XI, Article 4000, specifies requirements for repair and replacement of pressure-retaining components. Certain requirements of IWA-4000 can be accomplished using the methodology of ASME Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1," and the methodology of ASME Code Case N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten Arc Welding] Temper Bead Technique, Section XI, Division I."

N-504-2 allows the use of a weld overlay to enhance pipe integrity. This Code Case has been endorsed in NRC Regulatory Guide (RG) 1.147, Revision 14, for generic use with the condition that the provisions of ASME Code, Section XI, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," must also be met.

N-638-1 provides for welding dissimilar metals. This Code Case has been endorsed in RG 1.147, Revision 14, for generic use with the condition that ultrasonic testing (UT) examination shall be demonstrated for the repaired volume using representative samples, which contain construction-type flaws. The acceptance criteria of NB-5330 of ASME Code, Section III edition and addenda apply to all flaws identified within the repaired volume.

ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," provides requirements for UT procedures, equipment, and personnel for UT of the completed weld overlay.

3.3 Code Case N-504-2

3.3.1 Licensee's Proposed Modifications to N-504-2

The licensee proposes using N-504-2 for full structural preemptive weld overlays (PWOLs) for the subject components with the following modifications:

- Use of a nickel-based alloy weld material, Alloy 52/52M, rather than the low-carbon (0.035 percent maximum) austenitic stainless steel.
- Relaxation from the requirement to perform delta ferrite measurements to meet the 7.5 Ferrite Number (FN) requirement of N-504-2. The FN requirement cannot be met because the Alloy 52/52M weld material is 100 percent austenitic and contains no delta ferrite.
- Modification to the provisions of Appendix Q-3000(b), published in unendorsed addenda 2006 of the ASME Code, Section XI.
- In lieu of a hydrostatic test, a system leakage test will be performed in accordance with the 2000 addenda of ASME Code, Section XI, IWA-5000.

3.3.2 Licensee's Basis for Relief

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee stated that the weld overlay (WOL) has been designed consistent with the requirements of N-504-2 with the specific thickness and length computed according to the guidance provided in the subject ASME Code Case. The licensee stated that Alloy 52/52M material is highly resistant to primary water stress-corrosion cracking (PWSCC). The chromium content of Alloys 52 and 52M is 28 - 31.5 percent and Alloy 52M has a higher Niobium content (0.5 - 1 percent) than Alloy 52. The chromium content of Alloy 52/52M is roughly twice that of the existing Alloy 82/182. Both Alloy 82/182 and 52/52M WOL materials are austenitic and have ductile properties and toughness similar to austenitic stainless steel piping welds at operating temperature of pressurized water reactors. Furthermore, these filler materials are suitable for welding over the ferritic nozzle, Alloy 82/182 weld, and the austenitic stainless steel pipe, welds, and safe ends.

Paragraph (e) of N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52/52M is 100 percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60 percent nickel). The licensee further stated that the filler material selected for these repairs is fully austenitic, and is, therefore, exempt from delta ferrite content requirements.

The licensee stated that ASME Code Action BC05-1530 approved a revision to Appendix Q which was published in the 2006 Addenda of ASME Code, Section XI. The explanation for this revision notes that the action was to correct the wording in Nonmandatory Appendix Q, which was first published in the 2005 addenda. The licensee stated that the 2005 addenda was approved as part of BC03-1658 as the incorporation of N-504-2. The first correction was to Q-3000(b) which was to delete the requirement for the design of the WOL to satisfy the requirements of the Construction Code and Owner's requirements. There was no similar wording in N-504-2. The licensee stated that the wording in the codified version was

inappropriate because meeting the requirements of the Construction Code required the absence of cracks. The primary purposes of the N-504-2 and Nonmandatory Appendix Q was to repair cracks with the external WOL.

The licensee stated that a system hydrostatic test at 1.02 times Class 1 reactor coolant system operating pressure at normal operating temperature is of no value and provides no more assurance about the structural condition of the WOL than the system leakage test. For the application of WOLs, extensive surface and volumetric examinations of the WOLs are required by N-504-2 and Nonmandatory Appendix Q, which provide equivalent assurance of the quality of the WOL.

3.3.3 NRC Staff's Evaluation of Modifications to N-504-2

Under the rules of IWA-4421, in 1998 edition with the 2000 addenda, repairs shall be performed in accordance with the owner's design specification and the original construction code of the component or system. Later editions and addenda of the construction code, or a later different construction code, either in their entirety or portions thereof, and ASME Code Cases may be used. In addition to the above, defects shall be removed or reduced in size in accordance with IWA-4422. Alternatively, the component may be evaluated and accepted in accordance with the appropriate flaw evaluation provisions of ASME Code, Section XI or the design provisions of the owner's requirements and either the construction code or ASME Code, Section III. N-504-2 is being used by the licensee to perform PWOLs for pressurizer spray and relief nozzle-to-safe-end welds. N-504-2 was conditionally approved by the staff for use under RG 1.147, Revision 14, "Inservice Inspection ASME Code Case Acceptability, ASME Code, Section XI, Division 1." Therefore, the use of N-504-2 as an alternative to the mandatory ASME Code repair provisions is acceptable to the staff, provided the licensee has complied with all conditions and provisions of the ASME Code Case.

N-504-2 was conditionally approved by the staff for use under RG 1.147, Revision 14. The condition required the use of Nonmandatory Appendix Q, which provides the nondestructive examination (NDE) methods, volume and acceptance criteria for the WOL.

The first proposed modification to the N-504-2 provisions involves the use of a nickel-based alloy weld material, rather than the low-carbon austenitic stainless steel. The licensee stated that paragraph (b) of N-504-2 requires that the reinforcement weld material shall be low-carbon (0.035 percent maximum) austenitic stainless steel. In lieu of the stainless steel weld material, Alloy 52/52M, a consumable welding wire highly resistant to PWSCC, was proposed for the WOL material. The NRC staff notes that the use of 52/52M material is consistent with weld filler material used to perform similar WOLs at operating boiling-water reactor (BWR) facilities. The EPRI has performed studies in qualifying WOLs (full structural, design, and barrier overlays) for application in BWRs, and in these applications, the studies have not identified any issues associated with shrinkage stress or weld contraction stresses. The similarities of design between BWR nozzles and the full structural PWOLs in the licensee's relief request provide reasonable assurance that there is a correlation in the performance of weld shrinkage and weld contraction stresses in the subject weld.

The NRC staff notes that the licensee is performing full structural PWOLs on dissimilar metal welds made of Alloy 182 material. For material compatibility in welding, the NRC staff

considers that Alloy 52/52M is a better choice of filler material than austenitic stainless steel material for this weld joint configuration. Alloy 52/52M contains about 30 percent chromium which would provide excellent resistance to PWSCC in the reactor coolant environment. This material is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 Filler Metal, and has been previously approved by the NRC staff for similar applications. Therefore, the licensee's proposed use of Alloy 52/52M for the WOLs as a modification to the requirements of N-504-2, paragraphs (b) and (e) is acceptable as it will provide an acceptable level of quality and safety, and is, therefore, acceptable. The staff concludes that the proposed use of Alloy 52/52M weld material for the full structural PWOLs as a modification to the requirement of N-504-2, paragraph (b) will provide an acceptable level of quality and safety and is, therefore, acceptable.

The second proposed modification to the N-504-2 provisions involved paragraph (e) of N-504-2 which requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52/52M material is 100 percent austenitic. N-504-2 allows the use of WOL repair by deposition of weld reinforcement on the outside surface of the pipe in lieu of mechanically reducing the defect to an acceptable flaw size. However, N-504-2 is designed for WOL repair of austenitic stainless steel piping. Therefore, the material requirements regarding the carbon content limitation (0.035 percent maximum) and the delta ferrite content of at least 7.5 FN, as delineated in N-504-2, paragraphs (b) and (e), apply only to austenitic stainless steel WOL materials to ensure its resistance to intergranular stress-corrosion cracking. These requirements are not applicable to Alloy 52/52M, a nickel-based material which the licensee will use for the WOLs. Based on the discussion above, the staff concludes that the modifications to N-504-2, paragraph (e) will provide an acceptable level of quality and safety, and is, therefore, acceptable.

The third and fourth modifications involve the licensee's use of two corrections to Article Q-3000 of ASME Code, Section XI, Nonmandatory Appendix Q, which was published in the 2006 Addenda for ASME Code, Section XI. The correction involves the deletion of "the requirement for the design of the overlay to satisfy the requirements of the Construction Code and Owner's requirements," in paragraph Q-3000(b) of ASME Code, Section XI, Appendix Q. The staff concurs with the licensee's assessment that the earlier version is correct. Construction Code NB-5300 acceptance criteria does not allow the presence of cracks, reqardless of size. Both PWOLs and full structural WOL repairs may require welding over existing cracks, which is considered a mitigation technique for crack growth. This provision would, nevertheless, not permit cracks in the WOL material itself. The second correction in paragraph Q-3000(b)3 consisted of changing the words "pressure design" to "overlay design thickness". "Pressure design" is incorrect and was not used in N-504-2**.** Overlay design thickness is to confirm that the licensee is complying with the version of Appendix Q identified in the condition to N-504-2 in RG 1.147, Revision 14, and that the modifications are primarily editorial in nature. The staff concludes that the third and fourth modifications to Nonmandatory Appendix Q, will provide reasonable assurance of the integrity of the WOLs and, are therefore, acceptable.

The fifth modification requested by the licensee is to use a system leakage test in accordance with the 2000 addenda of ASME Code, Section XI, IWA-5000. The licensee's proposed modification of performing a system leakage test versus a hydrostatic test is supported by the staff's position with respect to ASME Code Case N-416-3 (N-416-3), "Alternative Pressure Test

Requirement for Welded or Brazed Repairs, Fabrication Welds or Brazed Joints for Replacement Parts and Piping Subassemblies, or Installation of Replacement Items by Welding or brazing, Classes 1, 2, and 3, Section XI, Division 1." N-416-3 was unconditionally approved for use in RG 1.147, Revision 14. N-416-3 states that: "... a system leakage test may be used provided the following requirements are met:"

> (a) NDE shall be performed on welded repairs, fabrication and installation joints in accordance with the methods, and acceptance criteria of the applicable Subsection of the 1992 edition of Section III.

The acceptance criteria in ASME Code, Section III do not allow the presence of cracks, regardless of length, and is geared more towards construction type welds. The licensee will conduct a system pressure test and post-repair NDE examinations which are required by N-504-2, utilizing the appropriate PDI procedures, as discussed later in this safety evaluation. The post-repair examination volume includes the full thickness of the PWOL plus 25% of the underlying base metal thickness. The specimen sets for PDI qualification for PWOL examinations include construction type flaws. Therefore, use of PDI qualified personnel and procedures for the examination of the PWOL will result in the reliable detection of construction type flaws and meets the intent of compliance with the applicable subsection of the 1992 edition of ASME Code, Section III.

Based on the discussion above, the staff concludes that the modifications to N-504-2 will provide an acceptable level of quality and safety, and are therefore, acceptable.

3.4 Code Case N-638-1

3.4.1 Licensee's Proposed Modifications to N-638-1

The licensee proposes using N-638-1 with the following modifications for full structural PWOLs:

- The maximum area of the individual weld based on the finished surface over the ferritic material will be approximately 300 square inches.
- Full UT of the 1.5T band on the ferritic side of the WOLs will not be performed. UT will be performed on the actual WOL, meeting the requirements of N-504-2 and Nonmandatory Appendix Q of ASME Code, Section XI.
- In lieu of weld-attached thermocouples and recording instruments, process temperatures will be monitored with non-attached devices, such as contact pyrometers.
- In lieu of the NDE requirements of N-638-1, the NDE requirements of N-504-2 and Nonmandatory Appendix Q of the 2005 Addenda of ASME Code, Section XI will be used.

3.4.2 Licensee's Basis for Relief

For the first modification, the licensee stated that the ½-base metal thickness limitation, which also includes the 100-square-inch surface area limitation under N-638-1 of 1.0(a), applies only to excavations and repairs, and is not applicable to the WOLs that are the subject of the relief request. The staff agrees that the 100-square-inch surface area limitation is not applicable to this configuration which consists of an overlay rather than an excavation of ferritic material.

There have been a number of temper bead WOL repairs applied to safe end-to-nozzle welds in the nuclear industry and a similar 300-square-inch full structural WOL was recently approved by the staff for Susquehanna Steam Electric Station, Unit 1 and D.C. Cook Nuclear Plant, Unit No. 1.

For the second modification, the licensee stated that in lieu of the requirement to perform a UT examination of the 1.5T (T = through-wall thickness) band next to the WOL, the post-WOL NDE will be performed in accordance with the requirements of N-504-2. The licensee stated that N-638-1 applies to any type of welding where a temper bead technique is to be employed and is not specifically written for a WOL repair. The licensee stated that if the cracking were to occur, it would be beneath the heat-affected zone of the WOL instead of the 1.5T area that is not covered by the WOL. Finally, UT of the 1.5T band is not feasible because of the nozzle configuration, therefore, meaningful UT information cannot be obtained.

For the third modification, the licensee stated that preheat and interpass temperatures will be monitored with a contact pyrometer. Due to the location of the repair and area radiation dose rates, the placement of welded thermocouples for monitoring weld interpass temperature is determined to be not beneficial based on dose savings.

For the fourth modification, the licensee will perform examinations to the criteria in N-504-2 and Nonmandatory Appendix Q to ASME Code, Section XI, 2005 addenda.

3.4.3 NRC Staff's Evaluation of Modifications to N-638-1

The licensee is applying a 360-degree, full structural PWOL to mitigate PWSCC associated with dissimilar metal welds. N-504-2 with modifications is being used for PWOLs to austenitic base material, while N-638-1 with modifications will be used for PWOLs applied to ferritic base material. N-638-1 is endorsed with conditions in RG 1.147, Revision 14. N-638-1 provides a welding process for filling excavations in ferritic base material without the need for preheat and postweld heat treatments that are required by the construction code. The PWOLs are made with Alloy 82/182 material which is not susceptible to PWSCC. Operational experience has shown that PWSCC is blunted at the interface between the Alloy 82/182 PWOLs and stainless steel, carbon steel, or the original butt weld base material.

For the first modification, N-638-1 limits the weld surface area of the repair to 100 square inches. The welding process for filling a cavity excavated in the base material creates localized stresses which can result in distortions and yielding from shrinkage. The licensee's proposed modifications are to expand the application of N-638-1 to 300 square inches for PWOLs. The carefully controlled heat input and weld bead placement prescribed in N-638-1 result in stress reliving and tempering of the base material and each preceding weld pass. The welding is performed using low hydrogen electrodes under a blanket of inert gas. The gas provides a shield over the molten metal puddle which protects the puddle from moisture and hydrogen. In the application of the PWOLs, residual stresses are minimized with the reheat characteristics of the temper bead process and there are no large excavations in the base metal. For PWOLs, most of the residual stresses in the weld area are relieved except for the PWOL perimeter and adjacent base material. The licensee's proposed increase in weld surface area to 300 square inches should have minimal effect on the bulk of the PWOL surface area which is examined using surface and UT methods. The increase in the PWOL perimeter is examined using the

same NDE techniques that would be used for the original 100 square inches which is a surface examination method. Therefore, the staff concludes that the increase in surface repair area up to 300 square inches will provide an acceptable level of quality and safety.

For the second modification, N-638-1 requires a surface examination of a 1.5T (T=through-wall thickness) or a 5.0-inch band, which ever is less, on the ferritic side of the PWOL. The licensee proposed using the requirements of N-504-2 and Nonmandatory Appendix Q which reduces the surface examination area to 0.5 inches of ferritic base material adjacent to the perimeter of the PWOL. The purpose of the surface examination of the ferritic base material is to detect any cracking that may have occurred as a result of the PWOL. Any cracking that might occur is normally located in the heat-affected zone (HAZ) or the unannealed ferritic base material. Because of the controls on heat input during the PWOL process, the HAZ is located close to the initial PWOL pass. The use of low hydrogen electrodes and inert gas cover minimizes any delayed cracking. In the event that cracking would occur, the cracking would be detected using the requirements of N-504-2 and Nonmandatory Appendix Q of ASME Code, Section XI. Therefore, the staff concludes that reducing the ferritic base material adjacent to the PWOL to 0.5 inches will provide an acceptable level of quality and safety.

Also the licensee's application of a PWOL results in a contour that is UT-inspectable except for the edge taper where the overlay transitions to the nozzle surface and on the curvature of the nozzle. The proposed weld-edge configuration has the same UT examination difficulties as are considered under ASME Code, Section XI, Appendix Q. It requires only a surface examination of the tapered area of the WOL. The most appropriate technique to detect surface cracking is the surface examination technique. Therefore, use of a surface examination in the area of the WOL taper and band beyond the toe of the overlay on the ferritic material is acceptable and it provides an acceptable level of quality and safety.

The third modification requested by the licensee is to manually record process temperatures using calibrated instruments such as contact pyrometers. Paragraph 4.0(c) of N-638-1 states that when weld-attached thermocouples and recording instruments are used, the area from which the thermocouples have been removed will be ground and examined using a surface examination. Published literature clearly identifies grinding as a method of cold working which acts as a crack initiation site for PWSCC-sensitive materials. The opportunity to reduce the amount of cold work in these materials is considered an effective tool to prevent cracking. The licensee's modification to monitor process temperatures with contact instrumentation that eliminates welding and grinding is considered a good practice and an effective remedy to minimize cold work. Based on the discussion above, the staff concludes that the modification to monitor process temperatures with calibrated contact temperature monitoring devices will provide an acceptable level of quality and safety.

The fourth modification is to the acceptance criteria stated in the applicable code cases in relation to the respective positions contained in RG 1.147, Rev. 14 that requires the use of construction code flaw acceptance criteria. In lieu of the acceptance criteria of NB-5330 of ASME Code, Section III, the proposed modification is to use ASME Code, Section XI, Code Case N-504-2 and Nonmandatory Appendix Q of ASME Code, Section XI. ASME Code, Section III, flaw acceptance standards are derived from the capability of radiography to detect and size flaws originating from the fabrication process used during new facility construction.

The ASME Code, Section III, acceptance criteria do not allow for the presence of any cracks or crack-like indications, regardless of their size, and are geared more towards volumetric flaws. The capability of radiography is a function of density differences such as 2 percent or greater changes in density. The density changes normally associated with cracks, depending on orientation, are much less than the detection capability of radiography. There is an inherent, unknown tolerance in the ASME Code, Section III acceptance criteria for radiography which encompasses tight cracks and densities below the detection capabilities of radiography. Flaws detected using radiography are not precise enough for applying ASME Code, Section XI, crack-growth analyses, as flaw depth cannot be measured with radiography. ASME Code, Section III radiography is not applicable for evaluating flaws for continued plant operations because of the difficulty associated with depth sizing flaws.

The application of N-638-1 is to apply austenitic weld metal on ferritic base material using a controlled heat input that relieves welding stresses and prevents crack-sensitive microstructures in the ferritic material. The purpose of N-638-1 is to establish an austenitic surface for the application of N-504-2 to complete the structural WOL. The N-638-1 applied weld metal is sandwiched between base metal and N-504-2 weld metal. Locating a flaw in N-638-1 weld metal using ASME Code, Section III, radiography would be extremely difficult.

Many flaws that are not detected or accurately sized with radiography have a high likelihood of being detected and sized with UT, depending on orientation. These flaws are normally detected with UT during the ASME Code, Section XI preservice inspection. Also, the preservice UT is used to characterize flaws detected during the ASME Code, Section III radiography examination. The flaws of concern are the ones that cause failure immediately or grow to failure in the future. The ASME Code, Section XI preservice acceptable flaw standards were developed to consider the materials in which the flaw indications are detected, the orientation and size of the indications, and ultimately their potential structural impact of the flaw on the component. The flaws detected during preservice inspections are subjected to periodic ISI as established in ASME Code, Section XI, Appendix Q, paragraph Q-4300. This includes inspection frequencies for monitoring existing crack growth and identifying new cracks. Thus, the established preservice NDE acceptance criteria in N-504-2/Appendix Q for WOLs made with Alloy 52/52M weld metal should also be applied to the portion of the WOL made during the application of N-638-1, which will provide an acceptable level of quality and safety.

3.5 ASME Section XI, Appendix VIII, Supplement 11

3.5.1 Licensee's Proposed Relief to ASME Code, Section XI, Appendix VIII, Supplement 11

The licensee requested relief from the requirements of ASME Code, Section XI, Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds," 1998 edition through 2000 addenda, as amended by 10 CFR 50.55a(b)(2)(xxiv). The specific Supplement 11 paragraphs are 1.1(b), 1.1(d)(1), 1.1(e)(1), 1.1(e)(2), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(2), 1.1(e)(2)(a)(3), 1.1(e)(2)(b)(1), 1.1(e)(2)(b)(2), 1.1(e)(2)(b)(3), 1.1(f)(1), 1.1(f)(3), 1.1(f)(4), 2.0, 2,1, 2.2(d), 2.3, 3.1, 3.2(a), and 3.2(b).

3.5.2 Licensee's Proposed Alternative and Bases

Pursuant to the provisions in 10 CFR 50.55a(a)(3)(i), the licensee proposed alternatives that will be implemented through use of the EPRI PDI program WOL examination qualification requirements, for the remainder of the third 10-year ISI interval.

3.5.3 NRC Staff's Evaluation

The U.S. nuclear utilities created the PDI program to implement the performance demonstration requirements contained in Appendix VIII of Section XI of the ASME Code. To this end, PDI has developed a program for qualifying equipment, procedures, and personnel for examinations of WOLs in accordance with the UT criteria of ASME Code, Section XI, Appendix VIII, Supplement 11 (Supplement 11). Prior to the Supplement 11 program, EPRI maintained a performance demonstration program for WOL qualification under the Tri-party Agreement (Reference 1). Instead of having two programs with similar objectives, the NRC staff recognized the PDI program for WOL qualifications (Reference 2) as an acceptable alternative to the Tri-party Agreement (Reference 1).

The PDI program is routinely assessed by the staff for consistency with the current ASME Code and proposed changes. The PDI program does not fully comport with the existing requirements of Supplement 11. PDI presented the differences at public meetings in which the NRC participated (References 3 and 4). The differences are in flaw location within test specimens and fabricated flaw tolerances.

The changes in flaw location permitted using test specimens from the Tri-party Agreement (Reference 1), and the changes in fabricated flaw tolerances provide UT acoustic responses similar to the responses associated with intergranular stress corrosion cracking. Based on the discussions at these public meetings, the staff determined that the PDI program provides an acceptable level of quality and safety.

Evaluations of the differences identified in the PDI program with Supplement 11, paragraphs 1.1(b), 1.1(d)(1), 1.1(e)(1), 1.1(e)(2), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(2), 1.1(e)(2)(a)(3), 1.1(e)(2)(b)(1), 1.1(e)(2)(b)(2), 1.1(e)(2)(b)(3), 1.1(f)(1), 1.1(f)(3), 1.1(f)(4), 2.0, 2,1, 2.2(d), 2.3, 3.1, 3.2(a), and 3.2(b) are as follows:

Paragraph 1.1(b) of Supplement 11 states limitations to the maximum thickness for which a procedure may be qualified. The ASME Code states that "The specimen set must include at least one specimen with overlay thickness within minus 0.10-inch to plus 0.25-inch of the maximum nominal overlay thickness for which the procedure is applicable." The ASME Code requirement addresses the specimen thickness tolerance for a single specimen set, but is confusing when multiple specimen sets are used. The PDI proposed alternative states that "the specimen set shall include specimens with overlay not thicker than 0.10-inch more than the minimum thickness, nor thinner than 0.25-inch of the maximum nominal overlay thickness for which the examination procedure is applicable." The proposed alternative provides clarification on the application of the tolerance. The tolerance is unchanged for a single specimen set; however, the proposed alternative clarifies the tolerance for multiple specimen sets by providing tolerances for both the minimum and maximum thicknesses. The proposed wording eliminates confusion while maintaining the intent of the overlay thickness tolerance.

Therefore, the staff finds this PDI program alternative maintains the intent of the Supplement 11 requirements and is acceptable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. For example, flaw implantation requires excavating a volume of base material to allow a pre-cracked coupon to be welded into this area. This process would add weld material to an area of the specimens that typically consists of only base material, and could potentially make ultrasonic examination more difficult and not representative of actual field conditions. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibit crack-like reflective characteristics. Instead of all flaws being cracks, as required by paragraph 1.1(d)(1), the PDI WOL performance demonstrations contain at least 70 percent cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The fabricated flaws are semi-elliptical with tip widths of less than 0.002 inch. The licensee provided further information describing a revision to the PDI program alternative to clarify when real cracks, as opposed to fabricated flaws, will be used: “Flaws shall be limited to the cases where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws.” The NRC has reviewed the flaw fabrication process, compared the reflective characteristics between actual cracks and PDI-fabricated flaws, and found the fabricated flaws for this application provide assurance that the PDI program meets the intent of the Supplement 11 requirements. Therefore, the staff finds the proposed alternative to the Supplement 11 requirements is acceptable.

Paragraph 1.1(e)(1) requires that at least 20 percent but less than 40 percent of the flaws shall be oriented within ±20 degrees of the axial direction (of the piping test specimen). Flaws contained in the original base metal HAZ satisfy this requirement; however, PDI excludes axial fabrication flaws in the WOL material. PDI has concluded that axial flaws in the overlay material are improbable because the overlay filler material is applied in the circumferential direction (parallel to the girth weld); therefore, fabrication anomalies would also be expected to have major dimensions in the circumferential direction. The NRC finds that this approach to implantation of fabrication flaws is reasonable for meeting the intent of the Supplement 11 requirements. Therefore, the staff concludes that the PDI’s exclusion of flaws oriented in the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases this permits flaws to be spaced closer than what is allowed by IWA-3300 for classification as a multiple set of flaws, thus potentially making the performance demonstration more challenging than the existing requirements. Hence, the staff concludes that PDI’s application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2) requires that specimens be divided into base metal and overlay grading units. The PDI program adds clarification with the addition of the word “fabrication” and ensures flaw identification by ensuring all flaws will not be masked by other flaws with the addition of “Flaws shall not interfere with ultrasonic detection or characterization of other flaws.”

PDI's alternative provides clarification and assurance that the flaws are identified. Therefore, the staff finds the PDI alternative to the Supplement 11 requirements is acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld, and the base grading unit includes the outer 25 percent of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to 1 inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The proposed change permits the PDI program to continue using test specimens from the existing WOL program which have flaws on both sides of the welds. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. The WOL qualification is designed to be a near-side (relative to the weld) examination, and it is improbable that a candidate would detect a flaw on the opposite side of the weld due to the sound attenuation and re-direction caused by the weld microstructure. However, the presence of flaws on both sides of the original weld (outside the PDI grading unit) may actually provide a more challenging examination, as candidates must determine the relevancy of these flaws, if detected. The staff has determined that PDI's use of the 1-inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld, as described in the PDI program alternative, is an acceptable alternative to the Supplement 11 requirements. Therefore, the staff finds the proposed alternative acceptable.

Paragraph 1.1(e)(2)(a)(2) requires, when base metal cracking penetrates into the overlay material, that a portion of the base grading unit shall not be used as part of the overlay grading unit. The staff finds that the PDI program adjusts for the changes in Paragraph 1.1(e)(2)(a)(2) and conservatively states that when base metal flaws penetrate into the overlay material, no portion of it shall be used as part of the overlay fabrication grading unit. The staff finds that the PDI program also provided clarification by the addition of the term "flaws" for "cracks" and the addition of "fabrication" to "overlay grading unit." The staff concludes that the PDI program alternative provides clarification and conservatism and, therefore, is acceptable.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exists on all sides of the grading unit and flawed grading units must be free of interfering reflections from adjacent flaws which addresses the same concerns as the ASME Code. Hence, the staff concludes that the PDI's application of the variable flaw-free area adjacent to the grading unit meets the intent of the Supplement 11 requirements and is, therefore, acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches. The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01 (Reference 1). This criterion may be more challenging to meet than that of the ASME Code because of the variability associated with the shape of the grading unit. Therefore, the staff concludes that PDI's application of the grading unit is an acceptable alternative to the Supplement 11 requirements and is acceptable.

Paragraph 1.1(e)(2)(b)(2) requires that unflawed overlay grading units shall be surrounded by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch around its entire perimeter. The PDI program redefines the area by noting unflawed overlay fabrication grading units shall be separated by at least 1 inch of unflawed material at both ends and sufficient area on both sides to preclude interfering reflections from adjacent flaws. The staff determined that the relaxation in the required area on the sides of the specimens, while still ensuring no interfering reflections, may provide a more challenging demonstration than required by the ASME Code because of the possibility for having a parallel flaw on the opposite side of the weld. Therefore, the staff concludes that the PDI's application is an acceptable alternative to the Supplement 11 requirements.

Paragraph 1.1(e)(2)(b)(3) requirements are retained in the PDI program. In addition, the PDI program requires that initial procedure qualification detection test sets contain three times the number of flaws required for a personnel qualification. To qualify new values of essential variables, the equivalent of at least one personnel qualification set is required. The staff concludes that PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides for a more stringent qualification criteria.

Paragraph 1.1(f)(1) requirements are retained in the PDI program, with the clarification change of the term "flaws" for "cracks." In addition, the PDI program includes the requirements that sizing sets shall contain a distribution of flaw dimensions to verify sizing capabilities. The PDI program also requires that initial procedure qualification sizing test sets contain three times the number of flaws required for a personnel qualification. To qualify new values of essential variables, the equivalent of at least one personnel qualification set is required. The staff concludes that PDI's additions enhance the ASME Code requirements and are, therefore, acceptable because it provides a more stringent qualification criteria.

Paragraphs 1.1(f)(3) and 1.1(f)(4) requirements are clarified by the PDI program by replacing the term "cracking" with "flaws" because of the use of alternative flaw mechanisms. The staff concludes that this clarification in the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.0, "Conduct of Performance Demonstration," in Supplement 11 is clarified in the PDI by the addition of the sentence, "[T]he overlay fabrication flaw test and the base metal flaw test may be performed separately." The staff concludes that the PDI program did not change the intent of the ASME Code but provided additional clarification. Therefore, this alternative in PDI is acceptable.

Paragraph 2.1, "Detection Test," in Supplement 11 states, in part, "... the candidate shall be made aware of the types of grading units (base or overlay) that are present for each specimen." In PDI, this is changed to "... the candidate shall be made aware of the types of grading units (base metal or overlay fabrication) that are present for each specimen." The staff concludes that the PDI program did not change the intent of the ASME Code but provided additional clarification. Therefore, this alternative in the PDI is acceptable.

Paragraph 2.2(d) requirements are clarified by the PDI program by the addition of the terms "metal" and "fabrication". The staff determined that the clarifications provide acceptable

classification of the terms they are enhancing. Therefore, the staff concludes that the PDI program meets the intent of the ASME Code requirements and is acceptable.

Paragraph 2.3 requires that, for depth sizing tests, 80 percent of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. This requires detection and sizing tests to be performed separately. The PDI revised the WOL program to allow sizing to be conducted either in conjunction with, or separately from, the flaw detection test. If performed in conjunction with detection and the detected flaws do not meet the Supplement 11 range criteria, additional specimens will be presented to the candidate with the regions containing flaws identified. Each candidate will be required to determine the maximum depth of flaw in each region. For separate sizing tests, the regions of interest will also be identified and the maximum depth and length of each flaw in the region will similarly be determined. In addition, PDI stated that grading units are not applicable to sizing tests, and that each sizing region will be large enough to contain the target flaw, but small enough such that candidates will not attempt to size a different flaw. The staff determined that the above clarification provides a basis for implementing sizing tests in a systematic, consistent manner that meets the intent of Supplement 11. Therefore, the staff concludes that the PDI's method is acceptable.

Paragraph 3.1 requires that examination procedures, equipment and personnel (as a complete ultrasonic system) are qualified for detection or sizing of flaws, as applicable, when certain criteria are met. The PDI program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase this passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The personnel and equipment are still required to meet the Supplement 11 requirement. Therefore, the PDI program criteria exceeds the ASME Code requirements for personnel, procedures, and equipment qualification. The staff concludes that the PDI program criteria is acceptable.

Paragraph 3.2(a), in Supplement 11 states, "... The length of base metal cracking is measured at the 75% through-base-metal position." In PDI, this is changed to "... The length of base metal flaws is measured at the 75% through-base-metal position." The staff concludes that the PDI program did not change the intent of the ASME Code but provided additional clarification. Therefore, this alternative in PDI is acceptable.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.10 inch are reported as being intrusions into the overlay material. The PDI program omits this criterion because of the difficulty in actually fabricating a flaw with a 0.10-inch minimum extension into the overlay, while still knowing the true state of the flaw dimensions. However, the PDI program requires that cracks be depth-sized to the tolerance specified in the ASME Code which is 0.125 inch. Since the ASME Code tolerance is close to the 0.10-inch value of paragraph 3.2(b), any crack extending beyond 0.10 inch into the overlay material would be identified as such from the characterized dimensions. The staff determined that reporting of an extension in the overlay material is redundant for performance demonstration testing

because of the flaw sizing tolerance. Therefore, the staff concludes that PDI's elimination of highlighting a crack extending beyond 0.10 inch into the overlay material is acceptable.

Based on the evaluation of the differences in the PDI program to the requirements in Supplement 11, the NRC staff concludes that the differences provide an acceptable level of quality and safety and, therefore, the differences to Supplement 11 are acceptable.

4.0 REGULATORY COMMITMENT

The licensee has made the following Regulatory Commitment:

The results of the final evaluation of the confirmatory analyses based on actual weld shrinkage measurements after the weld overlay will be provided to NRC within 14 days from completion of the UT examination of the weld overlays and prior to plant startup.

5.0 CONCLUSION

Based on the discussion above, the staff concludes that the ASME Code Case N-504-2 and N-638-1 modifications proposed in Relief Request B-6, for the preemptive full structural overlay of the welds listed in the licensee's October 3, 2006, submittal, as supplemented by letter dated February 2, 2007, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed modifications for the remaining service life of the subject welds.

Secondly, based on the discussion above, the staff concludes that the alternatives to ASME Code, Section XI, Appendix VIII, Supplement 11, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternatives for the remainder of CPSES, Unit 1, second ISI interval.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

6.0 REFERENCES

1. The Tri-party Agreement between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), "Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE (Nondestructive Examination) Personnel," July 3, 1984.

2. Letter from William H. Bateman of NRC to Michael Bratton of Entergy Nuclear Southwest (PDI Chairman), "Weld Overlay Performance Demonstration Administered by PDI as an Alternative for Generic Letter 88-01 Recommendations," January 15, 2002 (ADAMS Accession No. ML020160532).

3. Memorandum from Donald G. Naujock to Terence Chan, "Summary of Public Meeting Held January 31 - February 2, 2002, with PDI Representatives," March 22, 2002 (ADAMS Accession No. ML010940402).

4. Memorandum from Donald G. Naujock to Terence Chan, “Summary of Public Meeting Held June 12 through June 14, 2001, with PDI Representatives,” November 29, 2001 (ADAMS Accession No. ML013330156).

Principal Contributor: Timothy K. Steingass

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