

February 20, 2008

Mr. Britt T. McKinney  
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and Chief Nuclear Officer  
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769 Salem Blvd., NUCSB3  
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – THIRD  
10-YEAR INSERVICE INSPECTION (ISI) INTERVAL PROGRAM PLAN RE:  
REQUEST FOR RELIEF NO. 3RR-14 (TAC NOS. MD5176 AND MD5177)

Dear Mr. McKinney:

By letter dated March 30, 2007, PPL Susquehanna, LLC (PPL, the licensee), submitted Relief Request (RR) No. 3RR-14 for Susquehanna Steam Electric Station, Units 1 and 2 (SSES 1 and 2), for relief from certain requirements in the 1988 Edition of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI through the 2000 Addenda. Specifically, the licensee requested relief in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i) for the use of an alternate program for the inspection of the reactor pressure vessel shell-to-flange weld and head-to-flange weld. The licensee proposed to implement the alternative program through the Electric Power Research Institute Performance Demonstration Initiative Program. 3RR-14 is in support of the third 10-year ISI interval for SSES 1 and 2 which began on June 1, 2004, and will end on May 31, 2014.

The Nuclear Regulatory Commission (NRC) staff found PPL's request for relief acceptable in accordance with 10 CFR 50.55a(a)(3)(i) because the proposed alternative provides an acceptable level of quality and safety. The NRC staff authorizes the proposed alternative for the third 10-year ISI interval for SSES 1 and 2.

The NRC staff's safety evaluation is enclosed. If you have any questions, please contact Richard Guzman, at (301) 415-1030.

Sincerely,

*/ra/*

Mark G. Kowal, Chief  
Plant Licensing Branch I-1  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosure:  
Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED  
TO RELIEF REQUEST NO. 3RR-14 FOR THE THIRD 10-YEAR INSERVICE  
INSPECTION INTERVAL PROGRAM OF THE AMERICAN SOCIETY OF MECHANICAL  
ENGINEERS BOILER AND PRESSURE VESSEL CODE, SECTION XI  
PPL SUSQUEHANNA, LLC  
SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2  
DOCKET NOS. 50-387 AND 50-388

## 1.0 INTRODUCTION

By letter dated March 30, 2007, Agencywide Documents Access and Management System Accession No. ML071010140, PPL Susquehanna, LLC (PPL, the licensee), submitted Relief Request (RR) No. 3RR-14 for Susquehanna Steam Electric Station, Units 1 and 2 (SSES 1 and 2), for relief from certain requirements in the 1988 Edition of the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code* (ASME Code), Section XI through the 2000 Addenda. Specifically, the licensee requested relief in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(i) for the use of an alternate program for the inspection of the reactor pressure vessel (RPV) shell-to-flange weld and head-to-flange weld. The licensee proposed to implement the alternative program through the Electric Power Research Institute Performance Demonstration Initiative (PDI) Program. 3RR-14 is in support of the third 10-year inservice inspection (ISI) interval for SSES 1 and 2 which began on June 1, 2004, and will end on May 31, 2014.

## 2.0 REGULATORY REQUIREMENTS

ISI of the ASME Code Class 1, 2, and 3 components is performed in accordance with Section XI of the ASME Code and applicable addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) states that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if: (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.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except the design and access provisions and the pre-service examination requirements, set forth in the 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 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) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ASME Code of record for the SSES 1 and 2 third 10-year ISI interval, is the 1998 Edition through the 2000 Addenda of Section XI of the ASME Code.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Component for Which Relief is Requested

The applicable vessel welds are ASME Code, Section XI, Category B-A, RPV shell-to-flange weld AF (Item B1.30) and head-to-flange weld AG (Item B1.40).

#### 3.2 Applicable ASME Code Requirements

The NRC amended the use of the 1998 Edition through the 2000 Addenda of the ASME Code in 10 CFR 50.55a(b)(2)(xxiv), which states, "The use of Appendix VIII and the supplements to Appendix VIII and Article 1-3000 of Section XI of the ASME BPV Code, 2002 Addenda through the latest edition and addenda incorporated by reference in paragraph (b)(2) of this section, is prohibited." Therefore, when referencing Appendix VIII, licensees are limited to using the 2001 Edition of the ASME Code.

The RPV shell-to-flange weld and the head-to-flange weld are currently required to be examined per Appendix I, I-2100(b) of the 1998 Edition of the ASME Code, Section XI through the 2000 Addenda, which requires that the examination be conducted in accordance with Article 4, except that alternative beam angles may be used. Additionally, there is a requirement to supplement the ASME Code, Section V examinations with Table 1-2000-1. Section T-472.1 of the 1998 Edition of the ASME Code, Section V with the 2000 Addenda defines the ultrasonic scanning criteria for the examination of reactor vessel-to-flange welds and closure head-to-flange welds. These are:

- (T-472.1.1) The beam angle shall be appropriate for the configuration being examined and that the beam angle shall be capable of detecting the calibration reflectors, over the required angle beam paths.
- (T-472.1.2) When scanning for reflectors parallel to the weld seam, the angle beam shall be directed at approximate right angles to the weld axis from both sides of the weld (i.e., from two directions) on the same surface when possible. The search unit shall be manipulated so that the ultrasonic energy passes through the required volume of weld and adjacent base material.
- (T-472.1.3) When scanning for reflectors transverse (perpendicular) to the weld seam, the angle beam shall be directed essentially parallel to the weld axis. The search unit shall be manipulated so that the ultrasonic energy passes through the required volume of weld and adjacent base material. The search unit shall be rotated 180 degrees and the examination repeated.

- (T-472.2) Welds that cannot be fully examined from two directions using the angle beam techniques shall also be examined if possible with a straight beam technique.
- (T-472.3) Welds that cannot be examined from at least one side (edge) using the angle beam technique shall be noted in the examination report. For flange welds, the weld may be examined with a straight beam or low angle longitudinal waves from the flange surface provided the examination volume can be covered.

ASME Code Case N-664, "Performance Demonstration Requirements for Examination of Unclad Reactor Pressure Vessel Welds, Excluding Flange Welds," permits using Appendix VIII, Supplement 4 in lieu of the requirements of Appendix VIII, Supplement 6 for the inner 15 percent performance demonstration. ASME Code Case N-664 is endorsed in Regulatory Guide, 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1."

### 3.3 Licensee's Proposed Alternative

In lieu of the ASME Code Article 4 of Section V angle beam examination, PPL proposes to use an angle beam examination that will be performed using examination procedures, personnel, and equipment qualified in accordance with ASME Code, Appendix VIII, Supplements 4 and 6, as amended by the conditions set forth in 10 CFR 50.55a. Examination of each weld is described below:

#### AF - Vessel-to-Flange (as stated)

The [ASME Code] Section XI required examination volume will be scanned for flaws from the outside of the vessel using a 60-degree refracted longitudinal wave; however, the curvature of the flange surface above the weld will limit transducer travel such that examinations can only be performed from the shell side. Additionally, the refueling bellows prevent examinations from being performed from the vertical portion of the flange surface located directly above the curvature.

Since the examination will be from a single side, the requirements of 10 CFR 50.55a (b)(2)(xvi)(A) apply. Therefore, examinations will be conducted with equipment, procedures, and personnel that have demonstrated proficiency with single-side examinations. To demonstrate equivalency to two-sided examinations, the demonstration must be performed to the requirements of [ASME Code] Appendix VIII as modified by this paragraph and 10 CFR 50.55a(b)(2)(xv)(B) through (G), on specimens containing flaws with non-optimum sound energy reflecting characteristics or flaws similar to those in the vessel being examined. Examination of the [ASME Code] Section XI required volume will be performed as follows:

Per 10 CFR 50.55a(b)(2)(xv)(G)(1), the clad-to-base metal interface, including a minimum of 15 percent T [thickness] (measured from the clad-to-base metal interface), shall be examined from four orthogonal directions using procedures and personnel qualified in accordance with [ASME Code] Supplement 4 to Appendix VIII.

Per 10 CFR 50.55a(b)(2)(xv)(G)(2), if the clad-to-base-metal-interface procedure demonstrates detectability of flaws with a tilt angle relative to the weld centerline

of at least 45 degrees, the remainder of the examination volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction. This must be accomplished using a procedure and personnel qualified for single-side examination in accordance with [ASME Code] Supplement 6. Subsequent examinations of this volume may be performed using examination techniques qualified for a tilt angle of at least 10 degrees.

Per 10 CFR 50.55a(b)(2)(xv)(G)(3), the examination volume not addressed by 10 CFR 50.50a(b)(2)(xv)(G)(1) is considered fully examined if coverage is obtained in one parallel and one perpendicular direction, using a procedure and personnel qualified for single-sided examination when the provisions of 10 CFR 50.55a(b)(2)(xv)(G)(2) are met.

#### AG - Closure Head-to-Flange Weld (as stated)

The [ASME Code] Section XI required examination volume will be scanned for flaws using a 60-degree refracted longitudinal wave. Examinations will be performed from both the head and flange side of the weld; however, the short distance from the weld to the flange limits the examination on the flange side weld. The RPV head is not clad; therefore, when applying [ASME Code] Appendix VIII, only Supplement 6 would normally be required. However, instead of using Supplement 6 to perform the examination of the entire examination volume, guidance will be taken from [ASME Code] Case N-664 (which applies to unclad vessel welds, excluding flanges), to perform the examination of the inner 15% of the examination volume per [ASME Code] Supplement 4 of Appendix VIII. The outer 85% of the examination volume will be examined using [ASME Code] Supplement 6. The application of [ASME Code] Case N-664 (and thus the use of ASME Code, Supplement 4 for the inner 15% on this flange configuration) is considered to be an acceptable practice because the PDI qualification using [ASME Code] Supplement 4 clad specimens is considered to be more difficult than the qualification using [ASME Code], Supplement 6 specimens. By using this approach, weld AG will be examined using the same requirements as specified above for weld AF.

#### 3.4 Licensee's Basis for Relief (as stated)

[ASME Code] Appendix VIII requirements were developed to ensure the effectiveness of UT [ultrasonic testing] examinations within the nuclear industry by means of a rigorous, item-specific performance demonstration. The performance demonstration through PDI was conducted on RPV mockups containing flaws of various size and allocations. The demonstration established the capability of equipment, procedures, and personnel to find flaws that could be detrimental to the integrity of the RPV. The performance demonstration showed that for the detection of flaws in RPV welds, the UT techniques were equal to or surpassed the requirements of the Section V, Article 4 of the ASME Code. Additionally, the PDI qualified sizing techniques are considered to be more accurate than the techniques used in Article 4 of Section V [of the ASME Code].

Although [ASME Code] Appendix VIII is not required for the RPV shell-to-flange weld and RPV head-to-flange weld, the use of [ASME Code] Appendix VIII criteria for detection and sizing of flaws in these welds will be equal to or will exceed the requirements established by Article 4 of Section V [of the ASME Code]. Therefore, the use of this proposed alternative will continue to provide an acceptable level of quality and safety, and approval is requested pursuant to 10 CFR 50.55a(a)(3)(i).

### 3.5 NRC Staff Evaluation

The 1998 Edition, 2000 Addenda of ASME Code, Section XI, IWA-2232 states, "Ultrasonic examination shall be conducted in accordance with Appendix I." Subarticle 1-2120 states that vessels greater than 2 inches in thickness shall be examined in accordance with Section V, Article 4, as supplemented by Table 1-2000-1. ASME Code, Section V, Article 4 provides a prescriptive-based process for qualifying UT of procedures and the scanning requirements for examinations. The prescriptive-based UT uses detailed criteria for setting up and calibrating equipment, calculating coverage, and detecting indications. The capability of a prescriptive-based UT examination is demonstrated with calibration blocks made from representative material containing holes and notches. Performance-based UT requires that detailed criteria be used for performance demonstration tests. The results for the tests are compared against statistically developed screening criteria. The tests are performed on representative mockups containing flaws similar to those found in operating plants. The performance-based tests demonstrate the effectiveness of UT personnel and procedures.

The licensee proposes in lieu of the ASME Code, Article 4 of Section V angle beam examination to use an angle beam examination that will be performed using examination procedures, personnel, and equipment qualified in accordance with ASME Code, Appendix VIII, Supplements 4 and 6, as modified by 10 CFR 50.55a. 10 CFR 50.55a limits the use of Appendix VIII to the 2001 Edition of the ASME Code with no Addenda. ASME Code, Appendix VIII is a performance-based UT method. Examinations are performed with the scanning requirements for Supplements 4 and 6 that are provided in 10 CFR 50.55a(b)(2)(xv)(G), and the scanning volume identified in the ASME Code, Section XI, Figure IWB-2500-4 for the shell-to-flange weld and Figure IWB-2500-5 for the head-to-flange weld.

The scanning requirements are: (1) for the examination of the inner 15 percent through-wall volume, scanning will be performed in four orthogonal directions to the maximum extent possible with procedures and personnel qualified to Appendix VIII, Supplement 4 or; (2) if the inner 15 percent through-wall volume examination is not possible as required above, the inner 15 percent through-wall volume is considered fully examined if coverage is obtained in at least one parallel and one perpendicular direction using personnel and procedures qualified for single side examination in accordance with Supplement 6; and (3) the remaining 85 percent through-wall volume is considered fully examined if coverage is obtained in one parallel and one perpendicular direction using procedures and personnel qualified for single side examination. Single side qualification criteria are provided in 10 CFR 50.55a(b)(2)(xv)(G)(2) and 10 CFR 50.55a(b)(2)(xvi).

Since, the head-to-flange weld has no cladding, the licensee will use ASME Code Case N-664, that permits using Appendix VIII, Supplement 4 in lieu of the requirements of Appendix VIII, Supplement 6 for the inner 15 percent performance demonstration. The scanning of the



uncladded head-to-flange weld would be applied according to the requirements of 10 CFR 50.55a(b)(2)(xv)(G). The procedures, equipment, and personnel qualified to Appendix VIII through the PDI program have shown a high probability of flaw detection, and have increased the reliability of examinations of weld configurations within the scope of the PDI program. Therefore, the proposed alternative will provide an acceptable level of quality and safety.

#### 4.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternative, contained in RR 3RR-14 to use the 1998 Edition through the 2000 Addenda of the ASME Code, Section XI, Appendix VIII, Supplements 4 and 6 as modified by 10 CFR 50.55a(b)(2)(xv) and 10 CFR 50.55a(b)(2)(xvi) for the RPV shell-to-flange weld and head-to-flange weld will provide an acceptable level of quality and safety.

In addition to above, for the head-to-flange weld the licensee will use ASME Code Case N-664, that permits using Appendix VIII, Supplement 4 in lieu of the requirements of Appendix VIII, Supplement 6 for the inner 15 percent performance demonstration and the scanning of the uncladded head-to-flange weld would be applied according to the requirements of 10 CFR 50.55a(b)(2)(xv)(G) provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for SSES, Units 1 and 2 for the third 10-year ISI interval. All other requirements of the ASME Code for which relief has not been specifically requested remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Thomas K. McLellan

Date: February 20, 2008