March 21, 2002

Mr. Harold W. Keiser
Chief Nuclear Officer & President
PSEG Nuclear LLC - X04
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 2 - RELIEF FROM ASME CODE REQUIREMENTS RELATED TO THE INSERVICE INSPECTION PROGRAM, SECOND 10-YEAR INTERVAL, RELIEF REQUEST S2-RR-B04 (TAC NO. MB3398)

Dear Mr. Keiser:

By letter dated November 7, 2001, as supplemented on February 11, 2002, PSEG Nuclear LLC (PSEG) submitted a request for relief from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (the Code), Section XI, requirements for certain inservice inspections (ISI) involving the Reactor Pressure Vessel (RPV) vessel-to-flange weld at Salem Nuclear Generating Station, Unit No. 2 (Salem). In the letters, PSEG requested use of alternative requirements by performing ultrasonic (UT) examination of the RPV vessel-to-flange weld from the vessel shell side in accordance with ASME Code, Section XI, Division 1, 1995 Edition, 1996 Addenda, Appendix VIII, Supplements 4 and 6, as amended by the *Federal Register* notice dated September 9, 1999 (64 FR 51370), in lieu of ASME Code, Section V, Article 4, requirements. Relief was requested for Salem for the second 10-year interval vessel examination scheduled for the spring 2002 refueling outage.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the subject relief request. As documented in the enclosed Safety Evaluation (SE), the staff concludes that the proposed alternative will provide reasonable assurance of structural integrity. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternative for Salem for the second 10-year ISI interval, on the basis that the proposed alternative provides an acceptable level of quality and safety.

Sincerely,

/RA/

James W. Clifford, Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-311

Enclosure: Safety Evaluation

cc w/encl: See next page

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PSEG Nuclear LLC

Salem Nuclear Generating Station,
Unit No. 2

cc:

Mr. Elbert C. Simpson
Senior Vice President &
Chief Administrative Officer
PSEG Nuclear - N19
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. Mark B. Bezilla
Vice President - Technical Support
PSEG Nuclear - N10
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. David F. Garchow
Vice President - Operations
PSEG Nuclear - X10
P.O. Box 236
Hancocks Bridge, NJ 08038

Mr. Gabor Salamon
Manager - Nuclear Safety and Licensing
PSEG Nuclear - N21
P.O. Box 236
Hancocks Bridge, NJ 08038

Jeffrie J. Keenan, Esquire
PSEG Nuclear - N21
P.O. Box 236
Hancocks Bridge, NJ 08038

Ms. R. A. Kankus
Joint Owner Affairs
PECO Energy Company
Nuclear Group Headquarters KSA1-E
200 Exelon Way
Kennett Square, PA 19348

Lower Alloways Creek Township
c/o Mary O. Henderson, Clerk
Municipal Building, P.O. Box 157
Hancocks Bridge, NJ 08038

Dr. Jill Lipoti, Asst. Director
Radiation Protection Programs
NJ Department of Environmental
Protection and Energy
CN 415
Trenton, NJ 08625-0415

Richard Hartung
Electric Service Evaluation
Board of Regulatory Commissioners
2 Gateway Center, Tenth Floor
Newark, NJ 07102

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

Senior Resident Inspector
Salem Nuclear Generating Station
U.S. Nuclear Regulatory Commission
Drawer 0509
Hancocks Bridge, NJ 08038

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE ULTRASONIC EXAMINATION OF

REACTOR PRESSURE VESSEL (RPV) VESSEL-TO-FLANGE WELD

IN ACCORDANCE WITH RELIEF REQUEST S2-RR-B04

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 2

DOCKET NO. 50-311

1.0 INTRODUCTION

By letter dated November 7, 2001, as supplemented on February 11, 2002, PSEG Nuclear LLC (PSEG) submitted a request for relief from the ASME Code, Section XI, requirements for certain inservice inspections (ISI) involving the Reactor Pressure Vessel (RPV) vessel-to-flange weld at Salem Nuclear Generating Station, Unit No. 2 (Salem). In the letters, PSEG requested use of alternative requirements by performing ultrasonic testing (UT) examination of the RPV vessel-to-flange weld from the vessel shell side in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code), Section XI, Division 1, 1995 Edition, 1996 Addenda, Appendix VIII, Supplements 4 and 6, as amended by the *Federal Register* Notice dated September 9, 1999 (64 FR 51370), in lieu of ASME Code, Section V, Article 4, requirements.

Relief was requested for Salem, Unit No. 2, for the second 10-year interval ISI scheduled for the spring 2002 refueling outage.

2.0 BACKGROUND

Regulatory Requirements

The ISI of the ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g), except where specific written relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). Pursuant to 10 CFR 50.55a(a)(3), alternatives to the requirements of paragraph (g) may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), Director of the Office of Nuclear Reactor Regulation, 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) 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 (ISI) 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) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to Commission approval.

3.0 RELIEF REQUEST

3.1 Component Description

Salem, Unit No. 2, ASME Section XI, Class 1, Category B-A Pressure Retaining Welds In RPV Item No. B1.30 shell-to-flange weld.

3.2 ASME Code Examination Requirement for which Relief is Requested

ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” 1983 Edition with Summer 1983 Addenda, Subsection IWA-2232, requires UT examination of the RPV-to-flange weld to be in accordance with ASME Code, Section V, Article 4. In addition, Regulatory Guide (RG) 1.150, Revision 1, “Ultrasonic Testing Of Reactor Vessel Welds During Preservice and Inservice Examinations,” serves as regulatory guidance for the UT examination of RPV welds.

Relief was requested for Salem, Unit No. 2, for the second 10-year interval ISI scheduled for the spring 2002 refueling outage.

3.3 PSEG’s Proposed Alternative to ASME Code

PSEG proposes to perform a UT examination of the RPV vessel-to-flange weld from the vessel shell side in accordance with ASME Code, Section XI, Division 1, 1995 Edition, 1996 Addenda, Appendix VIII, Supplements 4 and 6, as amended by the *Federal Register* Notice dated September 9, 1999 (64 FR 51370), in lieu of ASME Code, Section V, Article 4, requirements.

3.4 PSEG’s Basis for the Proposed Alternative

In its letter dated November 7, 2001, PSEG provided its revised basis for requesting relief (as stated):

> PSEG Nuclear Salem Unit 2 is required to perform in-service examination of the RPV flange weld in accordance with the requirements of ASME Section V Article 4 and the subsequent guideline requirements of Regulatory Guide 1.150 Rev 1.

Federal Register Notice 64 FR 51370 through 51400, dated September 22, 1999, revised the 1999 Edition of 10 CFR 50.55(a) Codes and Standards. This revision requires that ASME Section XI, Appendix VIII, Supplements 4, *Qualification Requirements For The Clad/Base Metal Interface of Reactor Vessel*, and Supplement 6, *Qualification Requirements For Reactor Vessel Welds Other Than Clad/Base Metal Interface*, be implemented for most of the RPV welds by Nov 22, 2000. The RPV vessel-to-flange weld is the only RPV circumferential weld not included in Appendix VIII.

This relief is requested to allow the use of a PDI qualified procedure to complete the UT examination of the RPV vessel-to-flange weld from the vessel side of the weld in accordance with ASME Section XI, Div. 1, 1995 Edition, 1996 Addenda, Appendix VIII Supplement 4 and 6 as amended by the Federal Register Notice 64 FR 51370 through 51400, dated September 22, 1999 in lieu of ASME Section V Article 4.

During the upcoming ten (10) year RPV weld examinations, we will be employing personnel, procedures and equipment, demonstrated and qualified by a Performance Demonstration Initiative (PDI) and in accordance with ASME Section XI, Div.1, 1995 Edition, 1996 Addenda, Appendix VIII Supplements 4 and 6 as amended by the Federal Register Notice 64 FR 51370 through 51400, dated September 22, 1999 for the adjacent welds.

The remote examinations will be performed using the WesDyne International Supreem Robot and WesDyne Paragon data acquisition system in accordance with PDI qualified procedure PDI-ISI-254 *"Remote Inservice Examination of Reactor Vessel Shell Welds". The procedure was successfully demonstrated in accordance with ASME Section XI, Appendix VIII, Supplements 4 and 6* in 2001 (PDQS 404). The procedure complies with ASME Section XI, Appendix VIII, 1995 edition, 1996 Addenda as modified in final rule. [ ]

Appendix VIII was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous, item specific performance demonstration. The performance demonstration was conducted on a RPV mockup containing flaws of various sizes and locations. The demonstration established the capability of equipment, procedures and personnel to find flaws that could be detrimental to the integrity of the RPV.

Although Appendix VIII is not a requirement for this weld, the qualification process to Appendix VIII criteria demonstrates that the examination and evaluation techniques are equal or surpass the requirements of paragraph IWA-2232, "Ultrasonic Examination" of Section XI of the ASME Code and the guidance in RG 1.150.

A comparison between the ASME Section V Article 4 based UT methods and the procedures developed to satisfy the PDI/Appendix VIII can be best described as a comparison between a compliance-based procedure (ASME Section V Article 4) and a results-based procedure (PDI/Appendix VIII). ASME Section V

procedures use an amplitude-based technique and a known reflector. The proposed alternate UT method was established independently from the acceptance standards for flaw size found in ASME Section XI.

The PDI qualified sizing method is considered more accurate than the method used in ASME Section V Article 4[.] The proposed alternate UT examination technique provides an acceptable level of quality and examination repeatability as compared to the Article 4 requirements[.]

The PDI Program's PDQS No. 404 attests that WesDyne procedure PDI-ISI-254 complies with the detection and sizing requirements of Appendix VIII. The PDI qualification method involves a blind test on realistic flawed samples using testing parameters strictly defined in the procedure. The sensitivity of the examination procedure is greater than specified by ASME Code Section V, Article 4 because interpretation and investigation of defects is carried out down to the baseline response level and is not subject to an amplitude threshold as is the case in the Code methodology[.]

The examination and sizing procedure use echo-dynamic motion and tip diffraction characteristics of the flaw instead of the amplitude characteristics required by ASME Section V Article 4. The search units interrogate the same examination volume as depicted by ASME Section XI, Figure IWB 2500-4, Shell-to-Flange Weld Joint.

The use of procedures for satisfying the requirements of ASME Section V Article 4 for the UT examination of the RPV to flange weld from the vessel shell has not received the same qualifications as PDI qualified procedure.

The use of Appendix VIII Supplements 4 and 6 for the completion of the RPV vessel-to-flange weld from the shell side (with PDI qualified procedures) is expected to reduce examination time, which translates to reduce personnel radiation exposure.

Additionally, this relief would allow a smooth transition to the welds adjacent to the RPV circumferential and longitudinal welds (welds B1.11 and B1.12) which do require an examination in accordance with Appendix VIII Supplement 4 and 6. This would eliminate the need to switch to the different calibration, procedure and techniques required by ASME Section V Article 4 and the Regulatory Guide 1.150 Rev 1. This would result in a reduction in transition time to the different calibration, procedure and techniques required which translates to reduce personnel radiation exposure and is more cost effective.

The coverage for the RPV-to-flange weld from the shell side is 96% of the required volume as depicted in figure IWB-2500-4 and would be the same for both examinations (either the ASME Section V Article 4 or the proposed ASME Section XI Appendix VIII Supplement 4 and 6 as modified by the Final Rule).

The coverage for the RPV-to-flange weld from the shell during the first interval was 60%. The improvement in coverage to 96% is due to the fact the

transducers are no longer mounted together in one sled but rather they are spring loaded and individually suspended, allowing for more flexibility in the shell transition area.

The examination performed from the Reactor Pressure Vessel (RPV) flange surface earlier during this second interval provided 100% of the required volume from the flange surface.

It is concluded that the examination coverage of RPV-to-flange weld meets the requirements of Code Case N-460, *Alternative Examination Coverage for Class 1 and Class 2 Welds*, which requires the examination coverage of Class 1 welds be greater than 90%.

4.0 EVALUATION

The 1983 Edition of Section XI requires the examination of vessel welds to comply with Article 4 of Section V as amended by IWA-2232 of Section XI. PSEG is requesting relief from the Code-required examination for the RPV-to-flange weld. PSEG performed an ASME Code UT examination of the weld from the flange, and proposed a performance-based UT technique alternative to the prescriptive UT technique required by Code for examination from the vessel. Examination coverage is the sum of the volume examined from the flange and vessel sides of the weld.

In its letter dated February 11, 2002, PSEG stated that an examination of the RPV-to-flange weld was performed from the flange surface during the 2nd ISI interval. The coverage was 100% from the flange side of the weld. In order to complete the examination from the vessel side of the weld, PSEG proposed using procedures and personnel qualified according to the 1995 Edition with 1996 Addenda of the Code, Section XI, Appendix VIII, Supplements 4 and 6. These are the same procedures that will be used to examine the RPV shell welds. The licensee stated that 96% of the volume as depicted in Figure IWB-2500-4 will be examined from the vessel side of the weld. Therefore, with the combined coverage from the flange and vessel sides of the weld, PSEG will obtain essentially full coverage of the RPV-to-flange weld.

The staff has reviewed and evaluated PSEG's alternative to use a UT technique (personnel, equipment, and procedures) qualified to Appendix VIII, Supplements 4 and 6 (See Table 1). The Appendix VIII criteria was developed to ensure the effectiveness of UT examinations within the nuclear industry by means of a rigorous, item-specific performance demonstration. The performance demonstration was conducted on RPV mockups containing flaws of various sizes and locations. 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 the proposed UT technique is equal to or surpasses the requirements of the Code and the recommendations of RG 1.150. Therefore, the staff has determined that the alternative provides an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(a)(3)(i), the proposed alternative is authorized for the RPV-to-flange weld examination from the vessel shell side of the weld for the second 10-year ISI interval at Salem, Unit No. 2.

Staff's Conclusion

Based on its review, the NRC staff finds that the proposed alternative described in PSEG's letter dated November 7, 2001, as supplemented on February 11, 2002, provides an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the staff authorizes the proposed alternative for Salem, Unit No. 2, ASME Section XI, Class 1, RPV-to-flange weld examination for the second 10-year ISI interval.

Principal Contributor: R. Fretz

Date: March 21, 2002

TABLE 1 - COMPARISON OF REACTOR PRESSURE VESSEL SHELL WELD EXAMINATION TECHNIQUES

Description (Code Reference)	**ASME Section V, Article 4, 1983 Summer Edition ASME Section XI, 1983 Summer Edition NRC Regulatory Guide 1.150, Revision 1, 1983**	**WesDyne Examination Procedure PDI-ISI-254 Requirements**
Examination Angle	Section V, Article 4, T-441 requires the volume of weld and adjacent base material be scanned by straight and angle beam techniques. Two angle beams, having nominal angles of 45 and 60 degrees with respect to a perpendicular to the examination surface shall generally be used. Other pairs of angle beams are permitted provided the measured difference between the angles is at least 10 degrees.	Examinations are conducted with angles of 45 degree Longitudinal wave; dual element, 45 degree Longitudinal wave single element and a 45 degree shear wave single element transducer. These three transducer types were qualified to examine the 11" thick Supplement 4 and Supplement 6 test specimens.
Instrument Calibrations	Section V, Article 4, T-431 requires that instrument screen height and amplitude linearity be evaluated at least every 3 months. Section XI, IWA-2232 requires that these screen height and linearity checks be performed at the beginning and end of the weld examination performed on a vessel during one outage.	Instrument screen height and amplitude linearity are checked prior to and following completion of the examinations of the PSEG Nuclear Salem Unit 2 reactor vessel.
System Calibrations	Section V, Article 4, T-432 requires that the original system calibration be performed on the Code basic calibration block. T-432 allows the use of different types of reference blocks and electronic simulators to perform system calibration verifications.	System calibrations are conducted on a generic calibration block designed to be a conservative representation of vessel shell materials. The basic reflectors are side-drilled holes of smaller diameter than those specified by Code. Interim and final checks are performed by comparative histogram analysis of vessel material noise levels.
Scanning Sensitivity	Section V, Article 4, T-425 permits scanning to be performed at the reference level when electronic distance-amplitude correction (DAC) is used with automated recording.	Compared to ASME levels, scanning is performed at less than the 10% of DAC level.

TABLE 1 - CONTINUED

Description (Code Reference)	ASME Section V, Article 4, 1983 Summer Edition ASME Section XI, 1983 Summer Edition NRC Regulatory Guide 1.150, Revision 1, 1983	WesDyne Examination Procedure PDI-ISI-254 Requirements
Recording Level	Section V, Article 4, T-441 requires recording and evaluation of reflectors that produce a response equal to or greater than 50% DAC. Regulatory Guide 1.150 requires recording and evaluation at 20% DAC for the inner 25% of material thickness.	For all inspection zones, all indications interpreted as flaws are subject to measurement and assessment, regardless of amplitude.
Scan Index and Pulse Repetition Rate	Section V, Article 4, T-425 requires each pass of the search unit overlap a minimum of 10% of the transducer piezoelectric element dimension perpendicular to the direction of the scan. Section XI, IWA-2232 requires each pass of the search unit overlap at least 50% of the transducer piezoelectric element dimension perpendicular to the direction of the scan. NRC Regulatory Guide 1.150 requires a 25% maximum overlap for detection and 0.25-inch maximum increments for sizing.	A scan index of 0.5" is used for detection and indication measurement. This scan index meets the requirements of T-424, IWA-2232 and Regulatory Guide 1.150.
Flaw Sizing and Evaluation	Section V, article 4, T-441 requires amplitude based sizing at 50% DAC. Section V, Article 4, T-451 permits evaluation to alternative standards.	All indications are characterized as valid or non-valid. Diffraction signals and responses from indication features are used for determining the bounding size of the flaw. Length sizing is accomplished by determining the number of scanning sweeps where features are present.