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 NOS. 1 AND 2 - RELIEF FROM ASME CODE REQUIREMENTS RELATED TO THE INSERVICE INSPECTION OF REACTOR PRESSURE VESSEL NOZZLE INNER RADIUS SECTIONS, RELIEF REQUEST SC-RR-B06 (TAC NOS. MB4071 AND MB4072)

Dear Mr. Keiser:

By letter dated 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 (Code), Section XI, requirements for certain inservice inspection (ISI) requirements associated with the Salem Nuclear Generating Station, Unit Nos. 1 and 2 (Salem), Reactor Pressure Vessel (RPV) nozzles inner radius sections. In the letter, PSEG requested use of alternative requirements by performing a remote enhanced VT-1 (EVT) visual examination of the M-N surface as shown in ASME Code, Section XI, Figures IWB-2500-7 (a) through (d) in lieu of the volumetric examination requirements of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.100. Relief was requested for Salem, Unit No. 2, for the second 10-year ISI interval, and for Salem, Unit No. 1, for the third 10-year ISI interval.

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, Unit Nos. 1 and 2, for the third and second 10-year ISI intervals respectively, 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 Nos. 50-272 and 50-311

Enclosure: Safety Evaluation

cc w/encl: See next page

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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 EXAMINATION OF

REACTOR PRESSURE VESSEL (RPV) NOZZLE INNER RADIUS INSPECTIONS

IN ACCORDANCE WITH RELIEF REQUEST SC-RR-B06

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-272 AND 50-311

1.0 INTRODUCTION

By letter dated 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 (Code), Section XI, requirements for certain inservice inspection (ISI) requirements associated with the Salem Nuclear Generating Station, Unit Nos. 1 and 2 (Salem), Reactor Pressure Vessel (RPV) nozzles inner radius sections. In the letter, PSEG requested use of alternative requirements by performing a remote enhanced VT-1 visual testing (EVT) of the M-N surface as shown in ASME Code, Section XI, Figures IWB-2500-7 (a) through (d) in lieu of the volumetric examination requirements of ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.100.

Relief was requested for Salem, Unit No. 2, for the second 10-year ISI interval scheduled for the spring 2002 refueling outage, and for Salem, Unit No. 1, for the third 10-year ISI interval.

2.0 BACKGROUND

Regulatory Requirements

The inservice inspection (ISI) of 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

PSEG is requesting relief from ASME Section XI, Class 1, RPV Nozzle Inner Radius examination requirements for the following Salem, Unit Nos. 1 and 2, components:

	Summary Number	**Examination Area Identification**	**Configuration**
Salem Unit No. 1 Outlet Nozzle Inner Radius Sections	002900	29-RPV-1110-IRS	Outlet Nozzle @ 202 degrees
	003100	29-RPV-1120-IRS	Outlet Nozzle @ 338 degrees
	003300	29-RPV-1130-IRS	Outlet Nozzle @ 158 degrees
	003500	29-RPV-1140-IRS	Outlet Nozzle @ 22 degrees
Salem Unit No. 1 Inlet Nozzle Inner Radius Sections	003000	27.5-RPV-1110-IRS	Inlet Nozzle @ 247 degrees
	003200	27.5-RPV-1120-IRS	Inlet Nozzle @ 293 degrees
	003400	27.5-RPV-1130-IRS	Inlet Nozzle @ 113 degrees
	003600	27.5-RPV-1140-IRS	Inlet Nozzle @ 67 degrees
Salem Unit No. 2 Outlet Nozzle Inner Radius Sections	002900	29-RPV-1110-IRS	Outlet Nozzle @ 202 degrees
	003100	29-RPV-1120-IRS	Outlet Nozzle @ 338 degrees
	003300	29-RPV-1130-IRS	Outlet Nozzle @ 158 degrees
	003500	29-RPV-1140-IRS	Outlet Nozzle @ 22 degrees
Salem Unit No. 2 Inlet Nozzle Inner Radius Sections	003000	27.5-RPV-1110-IRS	Inlet Nozzle @ 247 degrees
	003200	27.5-RPV-1120-IRS	Inlet Nozzle @ 293 degrees
	003400	27.5-RPV-1130-IRS	Inlet Nozzle @ 113 degrees
	003600	27.5-RPV-1140-IRS	Inlet Nozzle @ 67 degrees

3.2 ASME Code Examination Requirement for which Relief is Requested

Salem Unit No. 1

The ASME Code requirement for Salem Unit No. 1 is: ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” 1995 Edition up through and including 1996 Addenda; IWB-2500-1, Examination Category B-D, Full Penetration Welded Nozzles In Vessels, Code Item B3.100, Figures IWB-2500-7 (a) through (d).

Salem Unit No. 2

The ASME Code requirement for Salem Unit No. 2 is: ASME Code, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components,” 1986 Edition with no Addenda; IWB-2500-1, Examination Category B-D, Full Penetration Welds Of Nozzles In Vessels, Code Item B3.100, Figures IWB-2500-7 (a) through (d).

3.3 PSEG’s Proposed Alternative to ASME Code (as stated)

> PSEG Nuclear, LLC proposes to perform a remote visual examination of the M-N surface as shown in Figures IWB-2500-7 (a) through (d) in lieu of the volumetric examination requirements of ASME Section XI, Table IWB-2500-1, Examination Category B-D, Item No. B3.100.
>
> PSEG Nuclear proposes to perform an enhanced VT-1 (EVT) visual examination with essentially 100-percent coverage upon examination surface M-N. The enhanced aspect of the examination is to use 8x magnification video equipment to examine the inner radii. The resolution sensitivity for this remote examination will be established using a 1-mil diameter wire.
>
> Crack-like surface flaws exceeding the acceptance criteria of Table IWB-3512-1 are unacceptable for continued service unless the reactor vessel meets the requirements of IWB-3142.2, IWB-3142.3 or IWB-3142.4.

3.4 PSEG’s Basis for the Proposed Alternative

In its letter dated February 11, 2002, PSEG provided its revised basis for requesting relief (as stated):

> Pursuant to 10 CFR 50.55a(a)(3)(i), relief is requested on the basis that the proposed alternative examination provides an acceptable level of quality and safety and the granting of relief should not jeopardize the health and safety of the public.
>
> As an alternative to ASME Section XI Table IWB-2500-1, Examination Category B-D, Item B3.100, which requires volumetric examination (Ultrasonic - UT) for Inner Radius of Class 1 Reactor Vessel Nozzles at Salem Units 1 & 2, PSEG Nuclear LLC proposes to perform a VT-1, Visual Examination of the surface M-N shown in Figures IWB-2500-7 (a) through (d) for those components previously identified above.

PSEG Nuclear Salem Units 1 and 2 are currently required to perform inservice examinations of these selected areas in accordance with the requirements of 10CFR50.55a, and ASME Section XI (Code Editions and Addenda are previously listed above). According to a NRC memorandum[[1]], the NRC staff indicated that an ultrasonic examination could be replaced by a VT-1 visual examination for the proposed nozzle inspections on the basis surveillance is maintained and VT-1 visual examination is performed.

The implementation of this relief is also expected to reduce vessel examination time by approximately 24 hours, which translates to significantly reduced personnel radiation exposure and cost savings.

In [the] NRC memorandum [ ], the NRC staff indicated that an ultrasonic examination could be replaced by VT-1 visual examination for the proposed RPV nozzle inspection on the basis surveillance is maintained and VT-1 visual examination is performed.

4.0 EVALUATION

In the mid 1970s, fatigue-initiated cracking was discovered in the nozzle inner radius section of feedwater nozzles at 18 boiling water reactors (BWRs). Ultrasonic testing (UT) did not reveal the presence of these cracks. This situation prompted the NRC to prepare NUREG-0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking," which modified inspection guidance for these components.

In NUREG-0619, the NRC staff concluded that UT of the vessel nozzle inner radius section involves complex geometries, long examination metal paths, and inherent UT beam spread, scatter, and attenuation. During the intervening years, improvements in UT technologies were introduced (e.g., computer modeling, tip diffraction, and phased array scanning), which improved the quality of the examination for this component. However, the area remains difficult to examine completely.

The NRC staff finds that even with vessel examinations using improved NDE technology from the outside surface, the complex geometry of the RPV nozzle inner radius sections prevents complete UT coverage. The licensee proposed to perform an enhanced VT-1 (EVT) visual examination with essentially 100-percent coverage in lieu of the UT. The enhanced aspect of the examination is to use 8x magnification video equipment to examine the inner radii. The resolution sensitivity for this remote, in-vessel exam will be established using a 1-mil diameter wire.

The primary degradation mode in RPV nozzles is thermal fatigue, which produces hairline surface indications along the nozzle's inner radius section. Given the 1-mil resolution capability of the EVT, it is highly unlikely that the licensee would not detect such flaws using high magnification cameras that can examine 100 percent of the nozzle inner radius section surface

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1 NRC Memorandum from K.R. Wichman to W.H. Bateman dated May 25, 2000; Subject: The Third Meeting with the Industry to Discuss the Elimination of RPV Inner Radius Inspection (ADAMS Accession No. ML003718630).

area. The staff has determined that the high resolution image from the camera may be used in lieu of UT of the inner nozzle radius. PSEG has also committed to adhere to the allowable flaw length criteria in Table IWB-3512-1 of the ASME Code, Section XI, for the disposition of any linear flaws. This would require the licensee to declare a flaw found in the inside corner region unacceptable for continued service, unless the flaw was further determined to be acceptable through supplemental examinations, corrective measures (repair and/or replacement), or by analytical evaluation, in accordance with ASME Code, Section XI, IWB-3142. Therefore, the proposed alternative provides reasonable assurance of structural integrity.

Staff's Conclusion

Based on its review, the NRC staff finds that the proposed alternative described in PSEG's letter dated 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 the Salem, Unit No. 2, second 10-year ISI interval, and the Salem, Unit No. 1, third 10-year ISI interval. This authorization is limited to the RPV nozzle inner radius sections previously described in Section 3.1 of this Safety Evaluation.

Principal Contributor: R. Fretz

Date: March 21, 2002