September 30, 2005

Mr. William Levis
Senior Vice President & Chief Nuclear Officer
PSEG Nuclear LLC - X04
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 1, EVALUATION OF RELIEF REQUESTS S1-RR-04-V01 AND S1-RR-04-V02 RELATED TO THE THIRD 10-YEAR INTERVAL INSERVICE TESTING PROGRAM (TAC NO. MC3855)

Dear Mr. Levis:

By letter dated July 9, 2004, as supplemented on January 6, 2005, and August 18, 2005, PSEG Nuclear, LLC (the licensee) submitted proposed revisions to its Inservice Testing (IST) Program for Salem Nuclear Generating Station, Unit 1 (Salem 1). The proposed revisions to the IST Program, Relief Requests S1-RR-04-V01 and S1-RR-04-V02, were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(f)(5)(iii), based on the impracticality of performing testing in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requirements. In the relief requests, PSEG requested approval to use an alternative to the ASME Code, Section XI, requirements pertaining to the safety injection (SI) accumulator outlet check valves 11SJ55, 12SJ55, 13SJ55, 14SJ55, 11SJ56, 12SJ56, 13SJ56, and 14SJ56. Specifically, PSEG proposed use of a calculation method together with a partial accumulator dump test to verify that each check valve disk is exercised to the full-open position.

The staff has reviewed S1-RR-04-V01 and S1-RR-04-V02 associated with the third 10-year IST program plan for pumps and valves at Salem 1, and has determined that the licensee's request for relief may be granted pursuant to 10 CFR 50.55a(f)(6)(i) on the basis that compliance with the ASME Code requirements is impractical. Pursuant to 10 CFR 50.55a(f)(6)(i), relief is granted with the stipulation that if the acceptance criterion is exceeded during testing, both of the accumulator outlet check valves, SJ55 and SJ56, associated with the affected accumulator must be subject to corrective action. The staff further concludes that granting the relief will not endanger life or property or the common defense and security and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The staff's Safety Evaluation is attached.

If you have any question regarding this matter, please contact me at (301) 415-1321.

Sincerely,

/RA/

Stewart N. Bailey, Sr. Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-272

Enclosure: As stated

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUESTS S1-RR-04-V01 AND S1-RR-04-V02

THIRD 10-YEAR INSERVICE TESTING INTERVAL

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 1

DOCKET NO. 50-272

1.0 INTRODUCTION

By letter dated July 9, 2004, as supplemented on January 6, 2005, and August 18, 2005, PSEG Nuclear, LLC (PSEG or the licensee) submitted proposed revisions to its Inservice Testing (IST) Program for Salem Nuclear Generating Station, Unit 1 (Salem 1). The proposed revisions to the IST Program, Relief Requests S1-RR-04-V01 and S1-RR-04-V02, were submitted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(f)(5)(iii), based on the impracticality of performing testing in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requirements. In the relief requests, PSEG requested approval to use an alternative to the ASME Code, Section XI, requirements pertaining to the safety injection (SI) accumulator outlet check valves 11SJ55, 12SJ55, 13SJ55, 14SJ55, 11SJ56, 12SJ56, 13SJ56, and 14SJ56. Specifically, PSEG proposed use of a calculation method together with a partial accumulator dump test to verify that each check valve disk is exercised to the full-open position.

2.0 REGULATORY EVALUATION

Section 50.55a of 10 CFR requires that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed at 120-month (10-year) IST program intervals in accordance with the specified ASME Code incorporated by reference in the regulations, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Nuclear Regulatory Commission (NRC or the Commission) pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In accordance with 10 CFR 50.55a(f)(4)(ii), licensees are required to comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in the regulations 12 months prior to the start of each 120-month IST program interval. In accordance with 10 CFR 50.55a(f)(4)(iv), IST of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in 10 CFR 50.55a(b), subject to NRC approval. Portions of editions or addenda may be used

provided that all related requirements of the respective editions and addenda are met. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a of 10 CFR authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making necessary findings. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to ASME Code requirements which are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, "Guidance for Inservice Testing at Nuclear Power Plants."

The Salem 1, third 10-year IST interval commenced August 31, 1999. The program was developed in accordance with the 1989 Edition of the ASME Code, Section XI. The 1989 ASME Code, Section XI, references ASME Operations and Maintenance of Nuclear Power Plants (OM) Standards Part 1 (OM-1), Part 6 (OM-6), and Part 10 (OM-10) for its IST requirements. By letter dated July 9, 2004, as supplemented on January 6, 2005, and August 18, 2005, the licensee requested relief from certain requirements of OM-10 for the Salem 1, third 10-year IST interval.

3.0 TECHNICAL EVALUATION

Relief Requests S1-RR-04-V01 and S1-RR-04-V02 propose the same alternative testing, therefore, a single evaluation will be provided for both relief requests. The ASME Code of record for the Salem 1, IST program for pumps and valves is the 1989 Edition of the ASME Code, Section XI. The 1989 ASME Code, Section XI, references OM-10 for IST of valves.

3.1 Relief Requests S1-RR-04-V01 and S1-RR-04-V02

3.1.1 Component Identification

Check valves 11SJ55, 12SJ55, 13SJ55, 14SJ55, 11SJ56, 12SJ56, 13SJ56, and 14SJ56 for Salem 1 (eight check valves total), are located in the discharge lines downstream from the SI accumulators and the branch connection of the residual heat removal (RHR) system. The valves must be capable of opening during a large break loss-of-coolant accident (LOCA) to provide a flow path for the SI accumulator discharge into the reactor coolant system (RCS) cold legs. The valves must also be capable of opening to provide a path for low-head SI flow and cold leg recirculation flow. Additionally, these valves serve as RCS pressure isolation valves by preventing SI accumulators and RHR system piping from being exposed to RCS pressure.

All eight check valves are ASME Code Class 1, Category C. The licensee requests relief from the requirements in Paragraph 4.3.2.1 of OM-10, which requires that check valves be exercised at least once every three months. In addition, OM-10, subparagraph 4.3.2.4(a), requires that normally-closed check valves whose function is to open on reversal of pressure differential shall be tested when the closing differential pressure is removed and flow through the valve is initiated. Relief from the exercise procedure requirements of OM-10, subparagraph 4.3.2.4(a), is also necessary because the licensee's test method does not appear to be in accordance with either the ASME Code requirement nor the staff's guidance in GL 89-04, Position 1, for verifying valve obturator movement. The licensee has proposed to use a partial accumulator

dump test every refueling outage for all eight valves. The test acceptance criterion for the accumulator pressure decay time is developed by a calculation method.

3.1.2 Licensee's Basis for Requesting Relief

During power operation, these valves are maintained in the closed position by RCS pressure on the downstream side of the valve disk. Exercising these valves quarterly to the full or partially open position during power operation is impracticable because the only flow path is into the RCS. The operating accumulator pressure cannot overcome normal operating RCS pressure to establish flow. Full-stroke exercising of these valves at cold shutdown is impracticable because of the potential for low temperature overpressurization of the RCS due to insufficient expansion volume in the RCS to accept the required flow. This testing could also result in the intrusion of nitrogen into the core which could interrupt the normal circulation of cooling water flow. The associated motor-operated valve (MOV) cannot be partially stroked, but must complete a full stroke before changing direction. This could cause a complete discharge of the water volume in the accumulator and possibly inject nitrogen into the RCS, causing gas binding of the RHR pumps and a subsequent loss-of-shutdown cooling. The accumulator outlet check valves are also verified to close by leak testing in accordance with plant technical specifications (TSs). Reverse exercising these check valves at any time other then refueling is burdensome without a commensurate increase in the level of quality and safety.

In attempting to use the guidance of NUREG 1482, Section 4.1.2, "Exercising Check Valves with Flow and Nonintrusive Techniques," the licensee used nonintrusive equipment during informational testing. These valves are Darling Valve & Manufacturing Co. "Clear Waterway" swing checks that are fabricated without a backstop. The valve design permits the disk to move sufficiently out of the flow path without contacting the valve body. Nonintrusive testing using acoustic and magnetic technology provides sufficient data for monitoring degradation on a periodic basis; however, full-open acoustic indication is not detected nor is it expected to show on the test trace. Nonintrusive testing does not verify full-stroke exercising; however, occasional use of this equipment during the pressure decay test provides useful condition monitoring information.

Regarding reverse flow exercise testing, these valves will be verified in the closed position during the process of performing seat leakage testing at the frequency specified in Salem 1 TS 4.4.6.3 and Salem 2 TS 4.4.7.2.2.

3.1.3 Alternative Testing

The licensee proposed to full-stroke exercise these check valves to the open position during refueling outages utilizing a reduced pressure, partial accident flow test method. This controlled method is performed with the reactor vessel head removed. The test method establishes accumulator pressure between 67 and 70 psig, accumulator level between 96 and 100% and refueling cavity level between 125.5 and 126.5 feet. After establishment of the fixed parameters, the test then measures the time interval required for the pressure in the associated SI accumulator to drop from an initial pressure to 35 psig. Engineering calculation S-1-SJ-MDC-I539, "Accumulator Pressure Decay Time during Discharge Test," establishes the test conditions and acceptance criterion and concludes that this methodology is adequate in determining that the associated check valve disk moves to the full-open position. The valves will be verified in the closed position during the process of performing seat leakage testing at

the frequency specified in Salem 1 TS 4.4.6.3 and Salem 2 TS 4.4.7.2.2. Valves 11SJ56, 12SJ56, 13SJ56, and 14SJ56 will be partial stroked at cold shutdown during normal RHR shutdown cooling operations.

3.1.4 Evaluation

The NRC staff evaluated Relief Requests S1-RR-04-V01 and S1-RR-04-V02 against the requirements of the ASME Code of record for the third IST interval at Salem 1. The 1989 Edition of the ASME Code, Section XI, references OM-10 for IST of valves. Category C accumulator check valves shall be operated and maintained in accordance with OM-10, Paragraph 4.3.2.1, which requires that each valve be exercised nominally every three months. The intent of this requirement is to ensure that the check valves will function as needed during a LOCA. In accordance with 10 CFR 50.55a(f)(5)(iii), the licensee has requested relief from the above requirements in order to exercise the check valves only during refueling outages.

The NRC staff finds that quarterly testing of these check valves during power operation is impractical. During power operation, the valves are maintained in a closed position by the significant pressure differential between the RCS and the SI accumulators. The valves are only capable of being exercised when the operating accumulator pressure overcomes the RCS pressure holding the valves shut. Additionally, exercising during cold shutdowns may not be practical because the RCS lacks adequate expansion volume to accommodate the required flow.

The NRC staff has reviewed the licensee's proposed alternative and has determined that exercising the eight applicable accumulator check valves during refueling outages meets the intent of OM-10, Paragraph 4.3.2.2(e). This paragraph states that if it is not practical to exercise Category C check valves during plant operation or cold shutdowns, they may be exercised during refueling outages. Therefore, exercising the check valves during refueling outages is permitted by OM-10.

OM-10, Paragraph 4.3.2.4(a), "Valve Obturator Movement," which applies to all Category C check valves, requires that the necessary valve obturator movement shall be demonstrated by exercising the valve and observing that either the obturator travels to the seat on cessation or reversal of flow, or open to the position required to fulfill its function, or both. Confirmation of the disk moving away from the seat shall be by a position-indicating device, changes in system pressure, flow rate, level, temperature, seat leakage testing, or other positive means. However, in accordance with 10 CFR 50.55a(f)(5)(iii), the licensee has requested relief from the above requirements so that they may use a calculation method together with a partial accumulator dump test to verify that each check valve disk is exercised to the full open position.

Additional guidance for exercising Category C check valves has been provided by the NRC staff in GL 89-04 and in NUREG 1482. GL 89-04, Position 1, states that a check valve's full stroke to open is valid when a known flow rate is passed through the valve which exceeds the maximum flow rate. The applicable accumulator check valves, however, can only pass the maximum accident flow through the check valves in certain plant conditions. The valves were not equipped with a mechanical exerciser or position indication devices. In addition, due to the lack of a backstop, the licensee indicated that the guidance of NUREG 1482, Section 4.1.2, might not be applicable because the test does not provide sufficient indication that the check valves have been full-stroke exercised. The licensee stated that nonintrusive testing, using

acoustic and magnetic technology, provides sufficient data for monitoring degradation on a periodic basis; however, full open acoustic indication is not detected, nor is it expected to show on the test trace.

The licensee proposes to use a timed partial accumulator dump test to verify that each pair of accumulator check valves is exercised to the position required to fulfill their safety functions. The acceptance criterion, the time it takes for the accumulator pressure to decay from 70 psig to 35 psig, was mathematically derived through calculations. The NRC staff has stated that use of a combination of tests and analyses to verify check valve forward exercising meets the intent of the ASME Code requirements for similar check valve applications at other facilities.

The licensee's calculation method was previously reviewed and approved by the NRC staff by a letter dated March 12, 1999, "RRs V-24 and V-25 Regarding Testing of Accumulator Check Valves, Salem Nuclear Generating Station, Unit Nos. 1 and 2." However, since that time a design change was implemented to change the stroke time of the accumulator outlet MOVs. The consequence of this design change was a lengthened MOV stroke time which in effect caused a slower accumulator pressure decay during check valve testing.

The stroke time modification does not invalidate the conclusions of the previously-approved Relief Requests, V-24 and V-25, because the new calculation method is conceptually identical to the previous method. The new calculation is a one-dimensional analysis of the motion of applicable check valve disks; flow of water from the accumulator to the reactor vessel, including accounting for resistance from valves and piping; change in nitrogen pressure of the accumulator; and the effect on the water level in the accumulator and reactor vessel or pressurizer (depending on the analysis). A series of equations were derived and solved simultaneously in a computer program. Accumulator pressures as a function of time for various check valve maximum swing angles (angle of check valve disk in flow stream) were plotted. Discharge flow rate as a function of time was also plotted for various disk angles. The established acceptance criterion ensures that the flow rate required for full disc lift is exceeded during the partial accumulator dump test.

The NRC staff finds that the calculation method PSEG used to establish the proposed check valve acceptance criterion is an acceptable alternative to the ASME Code requirements. PSEG's method is acceptable because, if a check valve's condition degrades or the valve otherwise becomes obstructed, the time it takes for the associated accumulator pressure to decay to 35 psig is expected to increase. Thus, if accumulator decay time increases to the point where it will no longer meet the proposed acceptance criterion, the two check valves connected to that accumulator will no longer be considered to be in an acceptable operating condition. Both check valves would be considered to be degraded because the proposed alternative testing is unable to discern which valve is the cause for the increased pressure decay time.

When the NRC previously granted Relief Requests V-24 and V-25, the NRC staff imposed a requirement that both of the accumulator outlet check valves, SJ55 and SJ56, associated with the affected accumulator be subject to corrective action if the test acceptance criterion was exceeded. PSEG was not explicit in its description of proposed testing for Relief Requests S1-RR-04-V01 and S1-RR-04-V02, and did not state whether or not it would require corrective action for both check valves if the acceptance criterion was exceeded. Therefore, because the proposed partial accumulator dump test is unable to determine whether or not a specific check

valve has degraded, the NRC staff is imposing a requirement, in accordance with 10 CFR 50.55a(f)(6)(i), that both check valves, SJ55 and SJ56, associated with the affected accumulator be subject to corrective action in the event that the acceptance criterion is exceeded.

The licensee's test method of using a calculation does not fully meet the ASME Code requirements because it does not verify directly that the check valve has moved to its safety position or passed the required accident flow rate. However, the NRC staff finds that the licensee's test methodology meets the intent of OM-10, Paragraph 4.3.2.4(a), for verifying obturator movement, and will provide reasonable assurance of operational readiness of the applicable accumulator check valves with the condition that both the SJ55 and SJ56 check valves be subject to corrective action if the test acceptance criterion is exceeded. Therefore, in accordance with 10 CFR 50.55a(f)(6)(i), the NRC staff grants relief from the requested ASME Code requirements.

4.0 CONCLUSION

The NRC staff concludes that the licensee's request to test the SI accumulator check valves every refueling outage in lieu of every three months meets the requirements in OM-10, Paragraph 4.3.2.2(e). The licensee's request for relief from the exercise procedure requirements of OM-10, Paragraph 4.3.2.4(a), in order to use a partial accumulator dump test to verify that the check valve is exercised to its safety position, is granted pursuant to 10 CFR 50.55a(f)(6)(i) on the basis that the alternative testing meets the intent of the ASME Code requirements and will provide reasonable assurance of the check valve's operational readiness. Additionally, the following condition is imposed by the NRC staff pursuant to 10 CFR 50.55a(f)(6)(i): PSEG's IST program must include the condition that, when the acceptance criterion is exceeded during testing, both accumulator outlet check valves, SJ55 and SJ56, associated with the affected accumulator will be evaluated for the need for corrective action. The NRC staff has determined that granting relief, pursuant to 10 CFR 50.55a(f)(6)(i), is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Principal Contributor: W. Poertner

Date: September 30, 2005