Public Service
Electric and Gas
Company

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Vice President and Chief Nuclear Officer

May 27, 1988

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United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Gentlemen:

RESPONSE TO GENERIC LETTER 88-05
SALEM GENERATING STATION
UNIT NOS. 1 AND 2
DOCKET NOS. 50-272 AND 50-311

Public Service Electric and Gas Company's (PSE&G) response to the subject NRC Generic Letter regarding boric acid corrosion of carbon steel reactor pressure boundary components in PWR plants is attached. The concern of boric acid corrosion is presently under extensive review at Salem. Changes resulting from this review have already proven effective in locating small boric acid leaks in the containment. These improvements and our program for assuring that the integrity of the reactor coolant pressure boundary is maintained within the licensing basis are included in Attachment 1 to this letter.

Should you have any questions with regard to this transmittal, please do not hesitate to contact us.

Sincerely,

Steven E Miltenberger

Attachment

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C Mr. D. C. Fischer
USNRC Licensing Project Manager

Mr. R. W. Borchardt
USNRC Senior Resident Inspector

Mr. W. T. Russell, Administrator
USNRC Region I

Mr. D. M. Scott, Chief
Bureau of Nuclear Engineering
Department of Environmental Protection
380 Scotch Road
Trenton, NJ 08628

Ref:

STATE OF NEW JERSEY)
) SS.
COUNTY OF SALEM)

Steven E. Miltenberger, being duly sworn according to law deposes and says:

I am Vice President and Chief Nuclear Officer of Public Service Electric and Gas Company, and as such, I find the matters set forth in our letter dated May 27, 1988 , concerning Facility Operating Licenses DPR-70 and DPR-75 for Salem Generating Station, are true to the best of my knowledge, information and belief.

Steven E Miltenberger

Subscribed and Sworn to before me
this 27th day of May , 1988

Eileen M. Ochs
Notary Public of New Jersey

EILEEN M. OCHS
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires July 16, 1992

My Commission expires on ______________

ATTACHMENT 1

NRC Generic Letter 88-05 expresses concern as to whether pressurized water reactors (PWRs) continue to meet the requirements of General Design Criteria 14, 30 and 31 of 10 CFR 50 Appendix A when concentrated boric acid solution corrodes the reactor coolant pressure boundary. Recent incidents demonstrate that, although licensees had detected the existence of leakage, their relative safety significance was not evaluated nor had prompt corrective action been taken.

The potential for boric acid corrosion of the carbon steel reactor coolant pressure boundary has been a recognized problem for some time. However, the recent incidents along with experimental results (revealing corrosion rates up to 400 mils/month) have demonstrated the potential adverse consequences of boric acid corrosion.

In light of this, the NRC believes that boric acid leakage potentially affecting the integrity of the reactor coolant pressure boundary should be procedurally controlled. Consequently, Generic Letter 88-05 requests assurance that a program has been implemented consisting of systematic measures to ensure that boric acid corrosion does not lead to degradation of the assurance that reactor coolant pressure boundary will have an extremely low probability of abnormal leakage, rapidly propogating failure or gross rupture. The program should include:

1. A determination of the principal locations where leaks that are smaller than the allowable technical specification limit can cause degradation of the primary pressure boundary by boric acid corrosion. Particular consideration should be given to identifying those locations where conditions exist that could cause high concentrations of boric acid on pressure boundary surfaces.

2. Procedures for locating small coolant leaks (i.e., leakage rates at less than technical specification limits). It is important to establish the potential path of the leaking coolant and the reactor pressure boundary components it is likely to contact. This information is important in determining the interaction between the leaking coolant and reactor coolant pressure boundary materials.

3. Methods for conducting examinations and performing engineering evaluations to establish the impact on the reactor coolant pressure boundary when leakage is located. This should include procedures to promptly gather the necessary information for an engineering evaluation before the removal of evidence of leakage, such as boric acid crystal buildup.

4. Corrective actions to prevent recurrences of this type of corrosion. This should include any modifications to be introduced in the present design or operating procedures of the plant that (a) reduce the probability of primary coolant leaks at the locations where they may cause corrosion damage and (b) entail the use of suitable corrosion resistant materials or the application of protective coatings/claddings.

RESPONSE:

In identifying the principal locations of boric acid leaks at Salem, the piping systems which carry boric acid in containment have been divided into two groups; inside the bio-shield and outside the bio-shield. Valves and components located outside the bio-shield are readily accessible for inspection. These areas receive visual inspections during our routine containment entries (approximately once per week) such that significant boric acid leakage/buildup would be noticed. Valves and components located inside the bio-shield, were further reviewed to identify significant boric acid leak locations. These locations were selected based on actual and potential boric acid leakage succeptability and the possible impact on any Reactor Coolant System (RCS) pressure boundary. The impact on safety related components was also reviewed. As a result of this review the Reactor Coolant Pump (RCP), Steam Generator (SG), Reactor Head and the Pressurizer (PZR) areas have been identified by engineering as the critical areas of concern.

A comprehensive walkdown of containment was performed by engineering and detailed photographs were taken of the critical areas. The photographs and general arrangement drawings were evaluated in conjunction with valve location lists to generate inspection maps to identify specific areas/components that should be inspected for boric acid leakage during containment inspections. A draft procedure has been developed which incorporates the inspection maps and provides guidance to inspect the specific areas and components of concern. This procedure should be approved and in effect within the next two weeks. Presently, our procedures require a containment inspection in Mode 3 after all shutdowns if not performed in the previous 72 hours. Following a refueling outage procedures require an inspection when the RCS pressure is at 1000 psig and 2235 psig. Presently, the primary system engineers have been assisting on the inspections to ensure that critical areas are inspected.

Presently, both Salem units imploy the following RCS leak detection systems:

1. The containment atmospheric particulate radioactivity monitor, R11a - monitored continuously.

2. The containment atmospheric gaseous radioactivity monitor, R12a - monitored continuously.

3. The containment sump level monitoring system - monitored at least once per 12 hours.

4. The containment fan cooler condensate flow rate monitoring system - monitored continuously.

5. The reactor coolant drain tank level monitoring system - monitored at least once per 24 hours.

6. The reactor sump level monitoring system - monitored at least once per 24 hours.

7. The RCS water inventory balance, monitored once every 24 hours.

8. Monitoring of the reactor head flange leakoff system - monitored at least once per 24 hours.

9. Monitoring the accumulator levels - monitored once every 12 hours.

These systems are capable of detecting RCS leakage well below the allowed Technical Specification limits. However, the more recent boric acid leakage incidents demonstrate that these systems must be complimented by close monitoring techniques/procedures and specific inspection criteria to be effective in the new range of concern.

Although increased attention has been given to RCS leak rate trending based on containment sump, reactor sump and RCS inventory balances it is evident that small boric acid leaks might still go undetected. Consequently, Salem has increased its trending of the containment particulate activity monitor (R11A) to once every four hours. If the R11A activity increases at a rate of 1,000 cpm or more for three consecutive four hour intervals, with a baseline level of at least 10,000 cpm, Radiation Protection personnel are specifically directed by procedure to:

1. Notify the Senior Shift Supervisor to look at activities which may have caused the increase (i.e., reactor power fluctuation, fan coil unit stop/starts, iodine removal unit stop/starts, pressure/vacuum reliefs, etc.)

2. Verify the instrument is performing properly.

3. Obtain a fission gas sample to verify R11A activity.

4. Increase the surveillance of R11A to see if an increase in activity corresponds to an increase in RCS leak rate.

If R11A readings are sustaining at a higher level and the increase cannot be accounted for, an inspection team consisting of Radiation Protection, Operations and Maintenance personnel, perform a containment inspection.

In addition to closer monitoring of the aforementioned leakage detection system, two significant design changes were added to Unit 1 during the last (7th) refueling outage. These modifications were the result of action taken after recent boric acid leaks on Salem Unit 1 spare Control Rod Drive Mechanism (CRDM) columns and a Salem Unit 2 Thermocouple column.

1. CRDM shroud doors have been installed on the CRDM ventilation shroud to allow the reactor head penetration to be visually inspected while the unit is in Mode 3. These doors have already been proven effective as they were utilized to identify spare CRDM penetration leaks, during a Mode 3 inspection, following the last Unit 1, refueling outage.

2. A reactor head leakage detection system has been installed in Unit 1. This experimental system monitors the CRDM ventilation shroud. Continuous indication (in CPM) is provided in the control room and the Radiation Protection department trends the indication every four hours. At present the detector is undergoing final calibration and background levels are being established. Due to the unique design of the monitoring system, PSE&G considers this an experimental system. However, preliminary indications look promising.

Both of these modifications will be installed in Unit 2 during its fourth refueling outage.

Another administrative change resulting from PSE&G's boric acid leakage experience is the development of a detailed Containment Inspection Procedure. As mentioned earlier, this procedure will provide guidance to ensure a thorough containment inspection is performed. The most critical components will be specifically identified and all critical areas will be emphasized. Specific guidance will be given to ensure that any identified boric acid problem is promptly evaluated, cleaned up and repaired, if necessary. Representatives of Operations, Maintenance, Planning, Radiation Protection and the Technical Departments are included in the Mode 3, after shutdown, inspection to ensure the proper expertise is available to promptly address the situation.

Salem has placed specific emphasis on repairing boric acid leaks as quickly as possible. Quick response to boric acid leakage situations is critical to support our aggressive monitoring and inspection process. The engineering department has been tasked with continuing to investigate and develop improved designs, controls and procedures to provide further protection against boric acid corrosion.

PSE&G feels that one of the primary means of preventing boric acid corrosion of the Reactor Pressure Boundary is to minimize RCS leaks. At Salem the process of eliminating leaks has been the objective of the following design changes:

1. The Chesterton repacking program was initiated two years ago to utilize live load graphoil packing which exhibits significantly improved resistance to stem leakage. Experience has demonstrated a significant reduction of packing leaks in critical areas. The program goal is to have Chesterton packing in all valves at Salem.

2. During the Unit 1, Seventh Refueling Outage, the RTD Bypass Manifold piping was removed and new T-hot and T-cold thermocouples and thermowells were installed. This modification eliminated a total of 64 valves. These valves were in a critical area and were prone to excessive packing leakage. The modification also eliminated the flow orifaces in the bypass loops. These orifices were another major contributor to boric acid leakage. This modification will be performed during the Unit 2, Fourth Refueling Outage.

3. The five top mounted Thermocouple Columns were removed during the Unit 1, Seventh Refueling Outage. The thermocouple columns were replaced by 58 new bottom entry thimbles with built in thermocouple. This modification eliminates the possibility of conoseal leaks and lower canopy seal weld leaks on the thermocouple columns. The five top mounted thermocouple columns on Unit 2 will be removed during the Fourth Refueling Outage.

To further minimize the impact of boric acid leaks on the RCS pressure boundary or safety related equipment, Salem is developing a program to emphasize identification of boric acid leaks and the need for prompt correction of leaks that are found. In addition, equipment history and system performance procedures will be developed and coordinated with the present work order tracking history to identify recurring components with boric acid leaks. Furthermore, Salem is investigating the use of boric acid resistance coatings to be applied to carbon steel and high alloy steel fasteners. Alternate bolting materials are also under investigation.

PSE&G has had two recent experiences with boric acid leaks in the reactor head region. In August 1987 Unit 2 was found to have a leak on the thermocouple column lower canopy seal weld. Significant effort was spent on developing a good repair program. This effort included significant utility, vendor, and regulatory interface. A split canopy repair was utilized and the repair program was presented to Region I on September 29, 1987.

In February 1988 three spare CRDM columns were found to be leaking on Unit 1 following the seventh refueling outage. An indepth visual inspection identified three more spare CRDM's as possible weepers. The CRDM Shroud Inspection doors (a design change evolving from the Unit 2 event) were utilized to find the leaks.

The six leaking spare CRDM's and six other CRDM's received four layers of weld buildup as the repair. The last spare CRDM was repaired with a split canopy weld repair to preserve any defects for future evaluation if needed. The repair program was also presented to Region I on January 28, 1988.

As a precautionary measure all eight spare CRDM's on Unit 2 will have special seal clamp assemblies installed during the fourth refueling outage. The thermocouple column that was previously leaking (August 1987) will be removed and sent to Westinghouse for analysis.

The weld buildup and the seal clamp assembly are not intended as permanent fixes. The repairs are used to protect the reactor head from boric acid leakage until NDE techniques are developed and/or proven cutting, capping, and welding repair techniques are developed. The recent involvement at the Westinghouse Owners Group along with the forthcoming analysis results of similar failures at other utilities, should aid significantly in developing improved techniques to further reduce the effects of boric acid corrosion.