March 31, 2001

Mr. Harold W. Keiser
Chief Nuclear Officer and President
PSEG Nuclear LLC - X04
P.O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM GENERATING STATION UNITS 1 AND 2 - NRC INSPECTION REPORT 050000272/2001-002; 05000311/2001-002

Dear Mr. Keiser:

On March 2, 2001, the NRC completed a supplemental inspection at the Salem Generating Station Units 1 and 2 facility. The enclosed report documents the results of the inspection, which were discussed on March 2, 2001, with Mr. D. Garchow and other members of your staff.

This inspection was an examination of your activities associated with a white inspection finding related to carbon dioxide fire suppression system testing for the 4160V switchgear rooms. The inspection was conducted in accordance with NRC Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area."

No findings of significance were identified.

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Sincerely,

/RA/

William H. Ruland, Chief
Electrical Engineering Branch
Division of Reactor Safety

Docket Nos.: 05000272, 05000311
License Nos.: DPR-70, DPR-75

Enclosure: Inspection Report 05000272/2001-02, 05000311/2001-02

cc w/encl:
E. Simpson, Senior Vice President and Chief Administrative Officer
M. Bezilla, Vice President - Technical Support
D. Garchow, Vice President - Operations
G. Salamon, Manager, Licensing
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REGION I

Docket Nos.:	05000272, 05000311
License Nos.:	DPR-70, DPR-75
Report Numbers:	05000272/2001-02, 05000311/2001-02
Licensee:	PSEG Nuclear LLC
Facility:	Salem Generating Station, Units 1 and 2
Location:	P.O. Box 236 Hancocks Bridge, NJ 08038
Dates:	February 26 - March 2, 2001
Inspector:	R. Fuhrmeister, Senior Reactor Inspector
Approved By:	William H. Ruland, Chief Electrical Engineering Branch Division of Reactor Safety

SUMMARY OF FINDINGS

Salem Generating Station Units 1 and 2

IP 05000272-01-02 & 05000311-01-02, on 02/26 - 03/02/2001, PSEG Nuclear LLC, Salem Generating Station Units 1 and 2, Mitigating Systems

Cornerstone: Mitigating Systems

This supplemental inspection was performed by the NRC to assess the PSEG Nuclear LLC (PSEG) evaluation associated with the failure of the 4160V switchgear room fixed total flooding carbon dioxide fire suppression systems to achieve their 50 percent design concentration during the system acceptance testing in the 1970s. This performance issue was previously characterized as having low to moderate risk significance ("White") in NRC Inspection Report 05000272/1999010, 05000311/1999010. During this supplemental inspection, performed in accordance with Inspection Procedure 95001, the inspector determined that PSEG had performed a comprehensive evaluation of the failure of the carbon dioxide fire suppression system to achieve its design concentration. The failure to achieve design concentration was identified by the NRC during a pilot program fire protection triennial team inspection. PSEG's evaluation determined that the root cause was inadequacies in the processes for reviewing vendor documents and engineering calculations, and test evaluation in use during the 1970s. PSEG review has identified carbon dioxide concentration anomalies for four other total flooding carbon dioxide fire suppression systems. PSEG is currently working to correct carbon dioxide concentrations for the total flooding fire suppression systems, upgrade electrical raceway fire barrier systems (ERFBS), and convert the 4160V switchgear room fire suppression system from manual to automatic.

Based on PSEG's acceptable performance in addressing the switchgear room fire suppression system issue, the White finding associated with this issue will only be considered in assessing plant performance for a total of four quarters in accordance with the guidance in NRC Inspection Manual Chapter 0305, "Operating Reactor Assessment Program." Implementation of PSEG's corrective actions under the Electrical Raceway Fire Barrier Project is the subject of an ongoing review by the Office of Nuclear Reactor Regulation.

Report Details

01 Inspection Scope

This supplemental inspection was performed by the NRC to evaluate the corrective actions undertaken by PSEG Nuclear LLC (PSEG) in response to the White finding issued in NRC Inspection Report (IR) 05000272/1999010 & 05000311/1999010. The inspector reviewed pertinent corrective action documents, discussed the issue with responsible PSEG personnel, and verified the status of selected corrective actions to assess PSEG's response to the White finding.

Description of White Finding

NRC Inspection 05000272&05000311/1999010 was a triennial fire protection team inspection conducted during the pilot program of the revised reactor oversight process. During that inspection, the NRC team determined that when initially tested, the carbon dioxide fire suppression systems for the 4160V switchgear rooms did not achieve, and maintain, the design carbon dioxide concentration of 50 percent.

While performing an evaluation of the significance of this issue, the team evaluated other conditions which existed within the switchgear room which would contribute to, or mitigate, the severity of the condition. Factors which contributed to risk were:

- All three trains of electrical distribution are in the switchgear room
- The ERFBS was degraded, in that the fire barrier wrap did not meet the one hour rating criteria
- The fixed carbon dioxide fire suppression system installed in the room was a manual system, rather than an automatic system (permitted by an exemption issued June 17, 1983, by NRC for the 4160V switchgear rooms).

Conditions which the team determined would mitigate the risk were:

- Excellent performance by the on-site fire company, including drill response to the 4160V switchgear room within the qualifiable time duration for the ERFBS.

02 Evaluation of Inspection Requirements

02.01 Problem Identification

a. Determination of who (i.e., licensee, self-revealing, or NRC) identified the issue and under what conditions.

The failure to meet the 50 percent design carbon dioxide concentration was identified by the NRC during a Revised Reactor Oversight Program Pilot Program fire protection triennial team inspection. The contributing cause of the ERFBS not meeting the criteria for a one hour rating was identified by the NRC during an inspection in 1997. The contributing cause of the carbon dioxide fire suppression system not having the capacity for a full second discharge was identified by PSEG in 1997.

b. Determination of how long the condition existed, and prior opportunities for identification.

PSEG determined that the condition existed since initial construction and testing of the systems (February 1974 for Unit 1, February 1979 for Unit 2). Prior opportunities to identify the condition existed in September 1997, when PSEG determined that the system did not have the capability for a full second discharge, and December 1998, when PSEG determined that the original design and installation contractor had made errors in the calculations for the system.

c. Determination of the plant-specific risk consequences (as applicable) and compliance concerns associated with the issue.

A carbon dioxide concentration less than the 50 percent design concentration does not necessarily indicate that the system will not adequately extinguish a fire. The governing construction code, National Fire Protection Association Standard on Carbon Dioxide Extinguishing Systems (NFPA-12) calls for a 50 percent concentration for deep seated fires (smoldering material). The 46 to 48 percent concentrations in reality probably would extinguish a fire. The inspector reviewed PSEG's evaluation and confirmed its validity.

The Salem fire protection safety evaluation report (SER) issued by the NRC on November 20, 1979, is based on submittals and commitments made by PSEG. The SER states that the total flooding carbon dioxide suppression systems are designed to flood the protected areas with carbon dioxide in concentrations up to 50 percent. By the letter dated September 26, 1978, PSEG committed to hold the carbon dioxide concentration for a period of 30 minutes after discharge. These capabilities have not been demonstrated by test. PSEG currently plans to correct deficiencies in the carbon dioxide system to achieve a 50 percent concentration. PSEG is reevaluating the hold time requirement, in light of the current NFPA-12 guidance which states that the concentration should be maintained for a period not less than 20 minutes. PSEG is also working, in concert with the original system supplier, on a cross-tie between the carbon dioxide storage tanks in Unit 1 and Unit 2 to provide a full second discharge capability for the 4160V switchgear rooms. The inspector reviewed the planned PSEG actions and found them to be reasonable, and appears appropriate to restore compliance with the fire protection requirements for the Salem Generating Station if implemented as described.

02.02 Root Cause and Extent of Condition Evaluation

a. Evaluation of methods used to identify root causes and contributing causes.

PSEG added the White finding to the scope of a pre-existing corrective action evaluation regarding calculation errors in the initial design of the total flooding carbon dioxide fire suppression systems for the 4160V switchgear rooms. PSEG conducted a Level 2 apparent cause evaluation of the addition to this Significance Level 3 condition report. This consisted of document reviews and discussions with the system vendor.

Engineering personnel who performed the calculation reviews are no longer with PSEG, nor the test personnel, so discussions with the cognizant personnel was not possible. The basis for not performing a retest of the suppression system was not documented, and therefore cannot be established with certainty. The inspector determined that PSEG more than met its procedural requirement in evaluating this condition.

b. Level of detail of the root cause evaluation.

PSEG's evaluation was sufficiently detailed to determine that the cause of the immediate discrepancy was a historical human performance error in conjunction with inadequate controls associated with system testing evolutions. Contributing causes identified by PSEG included inadequate control of vendor activities in the 1970s, and an exemption, granted during initial plant licensing, which permitted a manually-actuated fixed suppression system in lieu of an automatic suppression system for the 4160V switchgear rooms. The inspector noted that human performance issues and inadequate process controls led to the extended shutdown of the Salem units in the 1995-1997 time frame for material condition and process improvements.

c. Consideration of prior occurrences of the problem and knowledge of prior operating experience.

PSEG's evaluation of the prior condition (calculation error) identified that an incorrect room size was also used for the 480V switchgear room system calculation. PSEG reviewed the design calculations for the total flooding carbon dioxide suppression systems for other input parameters and determined that the system storage tank did not have sufficient storage capacity for the required second complete discharge in the largest area (4160V switchgear room). Control of vendor activities was one of the process weaknesses previously identified as a contributor to the extended shutdown in the 1995-1997 time frame.

d. Consideration of potential common causes and extent of condition of the problem.

PSEG's evaluation included a review of the acceptance test results for all carbon dioxide suppression system tests in both Salem Units. PSEG identified anomalies in the test results for five of the 26 carbon dioxide suppression systems. The inspector determined that PSEG had appropriately determined the extent of the problems with these non-safety-related fire suppression systems.

02.03 Corrective Actions

a. Appropriateness of corrective actions.

PSEG's immediate corrective actions were to issue impairments for the fixed fire suppression systems in the 4160V switchgear rooms, and add them to the requirements for the pre-existing hourly fire watch tours (due to the degraded ERFBS). PSEG also notified the on-site fire company personnel of the deficiency in the carbon dioxide concentration, and the possible need for a second, partial, system discharge to achieve the intended 50 percent. In addition, administrative controls were implemented to require sufficient inventory in the carbon dioxide storage tanks to ensure a second

(partial) discharge of the system could achieve the required 50 percent concentration in the rooms. This level is greater than the technical specification required volume.

Longer term actions include: (1) revise the system calculations to incorporate correct room dimensions; (2) determine the required carbon dioxide concentration for the existing hazards in the protected areas; (3) perform room leakage testing to determine more accurately the quantity of carbon dioxide needed to achieve design concentrations; (4) prepare a design change package to adjust, as necessary, the discharge quantity; (5) review current NFPA guidance to evaluate whether the PSEG commitment to a 30-minute hold-time is appropriate; (6) convert the suppression system from manual to automatic operation; and (7) upgrade the ERFBS to a qualified one-hour configuration.

b. Prioritization of corrective actions

PSEG's immediate actions to highlight the deficiency to the fire fighters underscored the need to respond within the limited qualifiable time of the degraded ERFBS.

c. Establishment of schedule for implementing and completing the corrective actions.

PSEG has included the fixed fire suppression system corrections in the ERFBS project schedule which had been previously submitted to, and accepted by, NRC. This schedule called for completion of the ERFBS deficiencies by the end of the third outage after restart. The inspector found this approach to be reasonable.

d. Establishment of quantitative or qualitative measures of success for determining the effectiveness of the corrective actions to prevent recurrence.

Measures for determining the effectiveness of corrective actions have not yet been established. This is due, in part, to the modifications still being in the preliminary design phase, and not yet approved. PSEG continues with testing of ERFBS systems which will provide a qualified one-hour barrier and have acceptable ampacity derating for the cables installed at the Salem station.

03. Management Meetings

Exit Meeting Summary

The results of the inspection were discussed at a meeting with Mr. D. Garchow and other members of PSEG management on March 2, 2001.

None of the information reviewed during the inspection was identified as proprietary.

Partial List of Persons contacted

PSEG

D. Garchow, Vice President of Operations
D. Hughes, Manager of Project Engineering
C. Caplinger, Manager of Loss Control
G. Salamon, Manager of Nuclear Safety and Licensing
M. Mancourtois, Supervisor of Technical Support
A. Moudgill, Manager of Special Projects
J. Nagle, Senior Licensing Engineer
B. Thomas, Senior Licensing Engineer
D. Shumaker, Principal Engineer, Fire Wrap Project

USNRC

R. Lorson, Senior Resident Inspector
C. Cahill, Resident Inspector
M. Salley, Senior Fire Protection Engineer

New Jersey Department of Environmental Protection

D. Vann, Nuclear Engineer

Documents Reviewed

Salem Fire Protection Inspection Report No. 50-272; 50-311/97-09
Notice of Violation and Exercise of Discretion, EAs 97-182, 97-257
NRC Inspection Report 05000272/1999010, 05000311/1999010; Final Significance Determination and Notice of Violation
Notification CR981221206, CO_2 System Design Calculation Error
Operation 0010, Revise CO_2 Calculation for Switchgear Room
Operation 0020, Criteria for CO2 Concentration in Switchgear Room
Operation 0030, Review Other CO2 Tests
Operation 0040, CARDOX System Design Calculation Error
Operation 0050, Submit Response to Violation 99-10-01
Operation 0060, Salem 4160 VAC Switchgear Room Assessment
Operation 0070, Submit 4KV Plan and Schedule to NRC
Operation 0080, Evaluations/Recommendations
Operation 0090, Review CO2 System Hold-Time Requirement
Operation 0100, Install Water Suppression in Salem 4KV Switchgear Room
Operation 0110, Revise Salem Licensing Basis for CO2 in 4KV as Appropriate
Operation 0120, El. 78 Electrical Penetration Area Test Status
Operation 0130, Evaluate CO2 for Diesel Control Rooms
Operation 0140, Review Other CO2 Calculations
Operation 0150, El. 78 Electrical Penetration Area Test
Order 60007356, Perform Enclosure Integrity Testing
Order 80009152, Enclosure Integrity Testing for CO2
PSEG Letter LR-N000072, Response to Notice of Violation
PSEG Letter LR-N000259, Followup Reply to Notice of Violation
Engineering Evaluation S-C-FP-EEE-1360, Control Cable Shielding Evaluation
Project Review Board Meeting Minutes for February 6, 2001
Power Point Presentation for February 6, 2001, PRB Meeting
Charging System Cross-Tie Project Scope Statement
Electrical Raceway Fire Barrier Project Level II Project Schedule
DE-PS.ZZ-0001(Q)-A3-SSAR(005), Revision 0, Fire Area Compliance Assessment for 4160V Switchgear Room, Elev. 64', 1-FA-AB-64A
DE-PS.ZZ-0001(Q)-A3-SSAR(007), Revision 0, Fire Area Compliance Assessment, 460V Switchgear Room, Elev. 84', 1-FA-AB-84A
DE-PS.ZZ-0001(Q)-A3-SSAR(015), Revision 1, Fire Area Compliance Assessment for Lower Electrical Penetration Area, Elev. 78', 1-FA-EP-78C

Acronyms Used

ERFBS	Electrical Raceway Fire Barrier System
IR	Inspection Report
LLC	Limited Liability Company
NFPA	National Fire Protection Association
NRC	Nuclear Regulatory Commission
PSEG	Public Service Electric and Gas Company
SER	Safety Evaluation Report