U.S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS. 50-272/95-18; 50-311/95-18

LICENSEE: Public Service Electric and Gas Company

FACILITY: Salem Nuclear Generating Station, Units 1 and 2

LOCATION: Hancocks Bridge, New Jersey

DATES: September 18 - 22, 1995

INSPECTOR: J. Noggle, Sr. Radiation Specialist
Radiation Safety Branch
Division of Reactor Safety
Date: 10/16/95

APPROVED: J. White, Chief
Radiation Safety Branch
Division of Reactor Safety
Date: 10/18/95

Areas Reviewed: Announced inspection of the radiation control program, during outage conditions including: training and qualifications, external exposure control, internal exposure control, and exposure reduction.

Results: The licensee's radiation control program elements generally were of very good quality. Areas for improvement in the as low as is reasonably achievable (ALARA) program are described in the attached report. No safety concerns or violations of regulatory requirements were identified.

DETAILS

1.0 INDIVIDUALS CONTACTED

1.1 Principal Licensee Employees

K. Dzuibela, Salem Licensing
C. Fricker, Salem Quality Assurance
R. Gary, Hope Creek Radiation Protection Operations
E. Lawrence, Salem Quality Assurance
K. O'Hare, Salem Radiation Protection, As Low As Reasonably Achievable (ALARA)
D. Parks, Nuclear Training
D. Tauber, Salem Quality Assurance Manager
E. Villar, Salem Licensing

1.2 NRC Employees

T. Fish, Resident Inspector

The above individuals attended the inspection exit meeting on September 22, 1995.

The inspector also interviewed other individuals during the inspection.

2.0 PURPOSE OF INSPECTION

The purpose of this inspection was to review implementation of the radiation control program during outage conditions at the Salem Nuclear Generating Station.

3.0 PREVIOUSLY IDENTIFIED ITEMS

3.1 (Closed) Unresolved (50-272/93-10-01)

During a previous inspection, the inspector reported a licensee-identified computer problem that allowed an individual to exceed the licensee's lifetime administrative dose limit of 2(N-17), where N represents the individual's age. No exposures above NRC limits were identified.

During this inspection, the inspector reviewed the licensee's evaluation and corrective actions associated with this issue. The licensee reviewed all active personnel records and identified a number of individuals that were above the 2(N-17) administrative exposure limit, however, none were above the NRC limits. The licensee identified a computer software "bug" in the Personnel Radiation Exposure Management System (PREMS). The licensee's evaluation determined that the original PREMS program had been modified in 1989 to provide lifetime exposure history data. The program modification was made without sufficient process knowledge of exposure record management and inadequate program testing prior to implementing the program changes. Approximately 1800 individuals' lifetime exposure records were found to be incorrectly calculated by PREMS, however, exposure control and reporting were unaffected by the lifetime exposure calculations and none of the individuals had exceeded the NRC lifetime exposure limits in affect at that time. The

licensee's corrective actions included a complete review of the PREMS processes and incorporation of the revised 10 CFR 20 exposure limits/reporting requirements and corresponding licensee administrative exposure limits. In addition, the licensee developed a PREMS comprehensive test plan that was designed to test all program processes. Two PREMS test procedures were written: ND.IN-TS.ZZ-1003, "Test Plans"; and ND.IN-TS.ZZ-1005, "Testing and Installation". The inspector determined that the licensee was in compliance with the applicable regulations and had taken effective corrective actions to prevent similar problems. This item is closed.

3.2 (Closed) Unresolved (50-272/93-22-02)

During a previous inspection, the inspector determined that several of the Salem Station's radiation monitors were calibrated in two phases that were in some cases performed several months apart. The inspector had questioned if this was in conformance with the Technical Specification requirements for calibration.

During this inspection, the inspector reviewed this issue with the licensee. The licensing staff indicated that Technical Specifications (TS) Section 1.4 states, "The Channel Calibration may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated." The two phase calibrations were performed on separate 18 month frequencies and the licensee maintained that this satisfies the definition of instrument calibration found in TS Section 1.4.

In addition, the licensee has decided to simplify the instrument calibration process to consolidate the electronic calibration and the detector calibration into one procedure with a single calibration date indicated. Due to the number of instrument types affected, this effort has not yet been completed. However, out of 129 procedures that require revisions, 90 procedures had been completed and approved at the time of this inspection. The licensee indicated that the remaining 39 procedures would be revised before Salem Station restart commences. The inspector determined that in light of the above Technical Specification wording, there was no violation of requirements and due to the licensee's intention (and actions) to address and correct the concern, this issue is being effectively resolved and this issue is closed.

4.0 ORGANIZATION

During the current long-term plant shutdown, the RP organization has been expanded to include 63 senior contractor RP technicians, 14 junior contractor RP technicians, 35 Salem RP technicians, 4 Hope Creek RP technicians, 8 Salem RP supervisors and 2 Hope Creek RP supervisors to provide around-the-clock coverage. Salem Station was laid out into plant areas of RP responsibility and RP supervisors directed appropriate numbers of RP technicians that included representation from the permanent Salem RP technician group as well as contractor RP technicians. The RP outage workforce maintained twelve-hour shifts 5-days per week. The inspector determined that appropriate RP resources were available to protect the outage workforce and no discrepancies were noted.

5.0 TRAINING AND QUALIFICATIONS

The inspector reviewed selected contractor RP technician resumes and training qualification records with respect to ANSI N18.1-1971 and in accordance with licensee procedures. RP technician records were selected based on the level of worker safety responsibility assumed by the individual contractor. All of the resumes reviewed met the experience requirements as specified in the ANSI standard. For the same individuals, the inspector reviewed results of the RP screening examination. Salem Station utilizes the Mid-Atlantic Nuclear Training Group (MANTG) RP technician examination to test incoming contract RP technician's basic RP knowledge. All contractor records reviewed had successfully passed the examination with at least an 80% passing grade within the past three years, as required by procedure.

Plant specific training for contractor RP technicians consisted of three parts. First, the contractor RP technicians were provided with a required reading list of 29 RP procedures. Second, the licensee provided a one-day classroom training class briefing on some aspects of the same procedures followed by a written examination. The inspector reviewed this examination. It consisted of only 40 questions that tested knowledge of various exposure control limits and most of the questions were very general and did not require a detailed knowledge of the procedures. The third part of the contractor RP technician training, consisted of an oral examination/practical examination of selected tasks. Two or three trainees at a time were given a two hour oral examination on selected topics chosen from a broad list of RP technician tasks. Successful completion of this oral examination, completed the training and qualification requirements for contractor RP technician. The documentation of the above training program was found complete for each of the selected RP technicians reviewed with no discrepancies noted.

The inspector also reviewed the continuing training curriculum for the qualified RP technician staff at the station. The training program requires only four days of training per year. This is a very small training allotment compared to similar nuclear power plants. Fortunately, the licensee has traditionally provided for more training opportunities for RP technicians than the minimal four-day requirement. During 1995, the continuing training program for RP technicians included training on: radiation detection, radiation work permit generation, radiation interactions with matter, breathing air systems, new procedure revision reviews, recent radiological events, noble gas exposure, rigging, reactor coolant system crud bursts, cavity decontamination, instrument operations, and remote dosimetry. In addition, the licensee made available optional vendor training on preparation for taking the National Registry of Radiation Protection Technologists examination and a two-day radwaste/transportation course.

The inspector reviewed the RP training relationship to the station with respect to the Systems Approach to Training (SAT) as described in NUREG-1220. The inspector noted that the RP training instructors rotate into the plant to perform various line RP functions on an every other year basis. Feedback from students is obtained through the use of training surveys at the end of each class. RP supervisors attend the same training classes as the RP technicians and provide their feedback directly to the instructors. The Radiation

Protection Manager (RPM) periodically hosts RP training curriculum meetings with the training group to ensure the RP training is up to date and closely tailored to the station's needs. The inspector determined that the RP training area was very well aligned with the SAT approach and that the current RP training program was of good quality.

6.0 RADIOLOGICAL OCCURRENCE REPORTS (ROR)

The inspector reviewed the licensee's ROR program to determine the effectiveness of the licensee's radiological problem solving capability and the use of radiological events as feedback on the RP program. The licensee has two programs that capture radiological problems and their resolution. Radiological Occurrence Reports (RORs) are administered by the Radiation Protection Department. An ROR is generated at a very low threshold of radiological significance. They are tracked, investigated, corrected and trended. The ROR program has provided the RP Department with a very good tool for monitoring of station radiological performance. The other station program that captures radiological problems is the Corrective Action Program. This station-wide program provides an inter-departmental approach to identify and resolve station problems. This program provides the added benefit of tracking and enforcing corrective action commitments across station departments. The ROR program and the Corrective Action Program have proven to be very effective processes for identifying and resolving performance deficiencies.

The inspector reviewed a sample of RORs that were generated since the last inspection in this area as well as one ROR that was resolved through the Corrective Action Program. Since the last radiation controls inspection in early August 1995, the licensee documented 16 RORs not including minor personnel contamination incidents. The inspector reviewed 12 of these reports. The incidents included: several entries into the radiological controlled area (RCA) without dosimetry monitoring, differences in instrument sensitivities for the release of material from the RCA, a minor high radiation area discrepancy, and minor RWP infractions. All of the RORs were effectively investigated and resolved and none of the reports reviewed were indicative of any programmatic breakdown.

One ROR was written due to an inadvertent spill from the containment spray system. This ROR was resolved utilizing the Corrective Action Program. An Action Request was written to the operations group for resolving this incident. The inspector reviewed the actions taken by the Operations Department. The licensee's investigation determined that the inadvertent spill occurred due to an improperly synchronized drain and vent tagging sequence that occurred during a reactor coolant system mid-loop drain down. The licensee had combined several different system tag out sequences into one global station tagout without proceduralizing and properly sequencing the combined tagout. The corrective action involved the development of a global tagging procedure to address mid-loop venting and draining and for training of the operations staff during the next requalification training cycle. The inspector determined that the licensee demonstrated effective resolution of the inadvertent spill incident. This ROR was effectively written and closed

out using the Corrective Action Program. The inspector determined that the licensee continues to utilize a very effective ROR program and Corrective Action Program to resolve radiological events and to provide important RP program feedback. No discrepancies or violations were identified.

7.0 RADIOLOGICAL WORK CONTROL

The inspector toured the major work areas of Salem Station and observed the radiological control of work in progress during this inspection. The licensee manned a central personnel RP access point to the radiological controlled area (RCA) and stationed RP technicians at various satellite RP control points on a continuous basis to provide the radiological safety needs of the radiation workers. The inspector observed conscientious involvement of the RP technicians with the radiation workers both at the RP access point to the RCA and by RP technicians working inside the RCA. The inspector determined that inside the Unit 1 containment, the licensee provided adequately posted work areas.

While touring the Unit 2 containment, the inspector observed two workers on their hands and knees sanding the basement floor of containment in full protective clothing, but without respiratory equipment or air sampling being provided. After identification by the inspector, the licensee promptly instituted air sampling of the area and investigated the radiological hazard in the area. The licensee had determined that the "smearable" contamination hazard was very low, but had not made an attempt to determine the level of fixed contamination present in the floor's surface. At the inspector's request, the licensee took a sample from a vacuum cleaner that was used to vacuum the floor sanding debris, and counted the sample. Results indicated 1.9E-3 uCi/ml. Followup licensee-conducted evaluations determined that this activity corresponded to a surface concentration level of approximately 2,000 dpm/100 cm^2. In addition, the licensee subsequently performed bioassay measurements on three of the painters and took three air sample measurements during floor sanding and detected no radioactivity from these measurements. The licensee stated that they would enhance monitoring by providing direct floor survey measurements prior to floor sanding to identify areas of high radiological hazard. The inspector determined that the licensee had not provided thorough radiological monitoring of the painters and had overlooked evaluation of the fixed contamination hazards of that job. The inspector was concerned that the containment floor areas may have widely varying fixed contamination hazards depending on the location and that the licensee had not effectively surveyed the floor conditions. The safety significance of the oversight was very low in this instance, therefore a failure to survey citation will not be issued in this case. The inspector observed that the Unit 2 containment did not have dedicated satellite RP control points, and work coverage was provided by RP technicians from the control RP access point. In conclusion, the inspector observed very good radiological control of work performed in the major Unit 1 outage areas that were provided with focused satellite RP control points. For the less RP focused non-outage areas, the licensee did not always provide the same thoroughness of radiological controls.

7.1 Radiological Conditions

The inspector reviewed station radiological surveys to determine the extent of radiological hazards in the workplace and to determine the quality and currency of licensee surveys.

In the Unit 1 and Unit 2 Auxiliary Buildings, the radiation levels were generally less than 10 mrem/hr with slightly elevated readings up to approximately 30 mrem/hr in the residual heat removal rooms, the letdown seal water heat exchanger room, the chemical volume control system monitor room, and the waste holdup tank rooms. Contamination levels were generally less than 50,000 dpm/100 cm^2 in all areas.

In the Unit 1 and Unit 2 Fuel Handling Buildings the radiation levels were less than 5 mrem/hr with contamination levels less than 50,000 dpm/100 cm^2 in all areas.

The Unit 1 containment areas were actively being worked and had been provided with some temporary work area shielding and area radiation postings were provided in the work areas. General refueling floor and all elevations outside of the bioshield area indicated low radiation levels of less than 10 mrem/hr and very low contamination levels of approximately 1,000 dpm/100 cm^2. Elevated radiation and contamination levels were found inside the reactor cavity area (40 mrem/hr and extremely high contamination found in the lower transfer canal area of 400 mrad/hr/100 cm^2) and inside the bioshield areas of the pressurizer (up to 120 mrem/hr and 20 mrad/hr/100 cm^2) and inside the lower containment bioshield areas near the reactor coolant system (up to 50 mrem/hr and low contamination of approximately 2,000 dpm/100 cm^2). The regenerative heat exchanger area was shielded with an average of one and one-half layers of lead blankets (three-sixteenths of an inch equivalent thickness) and exhibited dose rates of 400-700 mrem/hr in its vicinity. The steam generator maintenance was principally complete at the time of this inspection.

The Unit 2 containment was minimally posted. The Unit 2 containment had not been posted with informational radiation area postings and was also devoid of temporary shielding. The licensee indicated that very limited work was being authorized inside of the Unit 2 containment at the time of this inspection and that additional shielding resources were being procured to allow for work area shielding to be installed prior to beginning major work to occur in the high exposure areas. The inspector reviewed the radiological conditions of the Unit 2 containment and they were generally the same as in the Unit 1 containment, but with slightly higher dose rates in some reactor coolant pump platform areas and in the vicinity of the regenerative heat exchanger.

In general, the inspector determined that surveys were generally of very good quality and were current. Salem Station exhibited relatively moderate radiation levels for the 14 and 18 year old pressurized water reactors. Contamination levels were generally below concern with respect to a personnel exposure hazard. Continued emphasis on system breaches and control of radioactive system component removal remain the principal radiological control challenges.

7.2 Radiation Work Permits (RWPs)

The inspector reviewed selected RWPs with respect to the radiological hazards in the workplace and with respect to the intended workscope to evaluate the level of applied radiological controls imposed by the licensee to protect the workforce from the radiological hazards.

The licensee generated RWPs from historical records and edited for use by a qualified RP technician and approved by an RP supervisor. Each RWP required the use of an electronic pocket dosimeter (EPD) for entry and each RWP provided specific alarm setpoints for accumulated dose and dose rate. The licensee established a limited number of general use RWPs for routine activities performed by the RP, chemistry, operations, and radwaste groups, with a limited workscope RWP allowed for minor maintenance work activities.

Specific RWPs were issued to control work evolutions involving potentially significant radiological hazards. At the time of this inspection, specific RWPs that were issued for the Unit 1 outage included: reactor disassembly, steam generator maintenance, regenerative heat exchanger valve work, pressurizer valve work, miscellaneous valve work, fuel transfer system upgrade, insulation removal and scaffold erection. Specific RWPs issued for Unit 2 included: preparation and painting of floor and wall surfaces, system walkdowns, snubber inspection, insulation removal and scaffold erection work. The inspector reviewed several specific RWPs and noted that the ALARA requirements were attached. The RWPs indicated if a pre-job meeting with RP personnel was required. This was enforced by an automatic computer check during RCA entry by the worker. The inspector determined that the RWPs that were reviewed contained a good level of radiological control and exposure reduction instructions. The instructions were clear and in standard wording. EPD setpoints were varied and in most cases, represented good control levels with respect to the work area dose rates. No discrepancies were noted.

7.3 Internal Exposure Control

The inspector reviewed the results of air sample monitoring during the Unit 1 outage. During a 10-day outage period, the inspector determined an average of 36 air samples were taken each day with almost all air samples resulting in no measurable derived air concentration (DAC) or airborne radioactive material. The licensee measured one air sample at 3.41 DAC taken during cutting out of a pressurizer valve. The licensee had performed backup air samples that indicated approximately 0.04 DAC. The inspector reviewed the licensee's handling of the air sample with respect to internal exposure assessment of workers in the area. The licensee had researched the individuals working on the pressurizer valve removal RWP and, based on 0.5 hour stay time, had assigned the three workers a DAC-hour assignment of 1.705 DAC-hours (below official recording level). No other Unit 1 outage internal exposure assessments had been made at the time of this inspection. The inspector reviewed the licensee's procedure, SC.RP-TI.ZZ-0206(Q), Rev. 2, "DAC-Hour Accountability", and noted that aside from providing the equation for determining DAC-hour exposures, the procedure does not provide instructions on how to obtain a list of affected workers and assign stay times. This is an area that could be enhanced in the event that internal exposure assignments

become more commonplace or in the event of an emergency. In summary, the licensee has demonstrated good contamination control in the workplace and results indicate very low airborne radioactivity levels and no measureable internal exposures. No discrepancies were noted.

8.0 AS LOW AS REASONABLY ACHIEVABLE (ALARA)

8.1 Shielding Program

The inspector toured the major work locations during the outage and in the Unit 1 containment, observed comprehensive efforts by the licensee to provide some temporary shielding for high dose rate components. In Unit 1 containment, the temporary shielding was found to be consistently limited to 1 layer of lead blankets (one-eighth inch lead equivalent thickness) with almost all shielded areas continuing to provide elevated dose rates and exposure gradients in the vicinity of the shielded location. The one layer lead shield approach was found for a variety of dose rate situations. One area of shield application improvement involved the Unit 1 containment basement area near the elevator. The licensee had provided a one layer lead blanket shadow shield to lower the transit dose rates along a major transit area that was not an identified work area. This application showed some attention to the need to shield high occupancy areas that are not high dose rate areas. This is an improvement over past licensee shielding performance. In Unit 2 containment, no shielding had been provided at the time of this inspection. The licensee indicated that the unplanned forced shutdown situation left the licensee unprepared without the lead shielding resources on hand to support both Units simultaneously. The leasing services of shielding materials had been obtained and the additional lead blanket hangers ("S" hooks) were being manufactured to allow for simultaneous shielding of both Salem Station containments. The inspector noted that the licensee utilized generally one lead blanket thickness for all shielded areas with between one and two lead blanket thickness provided for the regenerative heat exchanger. The inspector also noted that significant dose rate gradients continued to exist near the shielded areas and that the same shielding approach appeared to be used regardless of the dose rate value of the component being shielded.

The inspector reviewed several shielding evaluations utilized during this outage. These included the pressurizer spray line, pressurizer surge line, the Unit 1 containment basement annulus transit area, and the regenerative heat exchanger. Each shielding evaluation consisted of a cost/benefit analysis to determine if there was a net exposure savings based on the estimated occupancy time due to a maintenance task with and without shielding, while accounting for the exposure cost for installing and removing the shielding. In the shielding evaluations, two layers of lead blankets were specified for each shielding application. No rationale was given for whether two layers of lead blankets was ALARA or why each shield location observed in the station consisted of less than the prescribed amount of shielding.

The inspector reviewed the licensee's approach for designing the shielding and the approval process taken to ensure the safety of plant components. The inspector reviewed the RP procedure, SC.RP-TI.ZZ-0701(Q), "Use and Control of

Temporary Lead Shielding" and the engineering procedure, ND.DE-PS.ZZ-0007(Q)-A56, "Programmatic Standard for Pipe Stress Analysis, Appendix A56: Temporary Lead Shielding Evaluations". The inspector also interviewed cognizant RP and engineering personnel. The RP group essentially determines the shielding design requirements and requests engineering approval for the application of shielding. The value of the exposure reduction problem (either in exposure savings or in dollars) was not communicated and the engineering group was not provided with the opportunity to design the shielding application. The engineering group reviewed the pipe support design basis calculations to determine the additional loading allowable based on the original stress calculation.

The inspector noted that the RP group did not always evaluate the shielding applications on a comprehensive basis to include all maintenance tasks in the area and did not provide the engineering group with an indication of the value of the shielding application either for the current outage application, or for permanent shielding application, and did not provide life-of-the-plant dollar values for the exposure savings that would be estimated. Also, the RP group did the shielding design work and did not allow the engineers the opportunity to provide shielding design options. Better attention to the RP-to-engineering interface could enhance the resulting exposure reduction initiatives at Salem Station. The licensee agreed to reevaluate the amount of engineering involvement to optimize exposure reduction evaluations.

8.2 ALARA Tracking and Scheduling

The inspector reviewed the licensee's ALARA tracking methodology and scheduling bases for focusing and prioritizing ALARA exposure reduction efforts. During this outage period, the ALARA group published a daily ALARA Status Report. Collective personnel exposure was tracked against a linear straight line estimate to a final ALARA goal of 205.5 person-rem allocated for the Unit 1 outage. Principal job categories were listed indicating the dose estimate, actual dose, and percent of job completion. This report provided station management with the basic personnel exposure information for the major work evolutions to indicate areas requiring additional focus. The timeline graph of actual versus estimated personnel exposures was found not to be directly based on the schedule of work to be done. The licensee indicated that the circumstances imposed by the unplanned mandatory shutdown and extended outage condition, did not provide the station with sufficient time to plan all of the outage maintenance tasks in advance. The ALARA staff indicated that during this outage, the RP group was generally given only one week advance notice of scheduled maintenance work. The ALARA planning and exposure tracking effort is performed independent of the station planning and scheduling although it is affected directly by it. When maintenance planning does not project ahead by more than one week, then neither can ALARA planning.

The licensee has very recently revised the maintenance planning methodology that had not been implemented at the time of this inspection. The licensee procedure SC.SA-SD.ZZ-11, Rev. 0, "Work Management Manual", provides a fundamentally new approach to work planning at Salem Station. This procedure provides for a rolling 36-month schedule that allow for surveillances and preventive maintenance to be scheduled far in advance. The procedure also

specifies formalizing scheduled outages six months prior to the outage. Further guidance was provided for day-to-day work scheduling. An eight-week look ahead schedule of work to be performed allows for RP and ALARA to be involved seven weeks prior to an emerging work evolution, area-based planning performed six weeks prior to performance of the work, and RWPs assigned five weeks prior to beginning the maintenance work. This maintenance planning framework, when implemented effectively, should provide an improved planning window to allow the ALARA group enough time to properly evaluate exposure reduction techniques and to develop a timeline schedule of estimated exposures based on the projected work plan.

The inspector determined that the ALARA planning and scheduling results have been limited due to the one week maintenance planning lead time and due to the exposure tracking timeline being tracked independent of the station schedule. The new "Work Management Manual" should improve the advance notification difficulties, but further improvements should be evaluated with respect to closer interfacing with the station work schedule for improving the exposure estimate timeline.

9.0 EXIT MEETING

The inspector met with licensee representatives (denoted in Section 1.0) on September 22, 1995. The inspector summarized the purpose, scope and findings of the inspection. The licensee acknowledged the inspection findings.