U.S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-272/89-08
50-311/89-07

Docket No. 50-272
50-311

License No. DPR-70
DPR-75 Priority - Category C

Licensee: Public Service Electric and Gas Company
80 Park Plaza
Newark, New Jersey, 07101

Facility Name: Salem Nuclear Generating Station, Units 1 and 2

Inspection At: Hancocks Bridge, New Jersey

Inspection Conducted: April 24 - May 1, 1989

Inspectors: N. T. McNamara
N. McNamara, Laboratory Assistant — 5-31-89 date

J. J. Kottan
J. Kottan, Laboratory Specialist — 5-31-89 date

Approved by: Robert J. Bores
R. J. Bores, Chief, Effluents Radiation Protection Section — 5-31-89 date

Inspection Summary: Inspection on April 24 - May 1, 1989 (Combined Inspection Report Nos. 50-272/89-08 and 50-311/89-07)

Areas Inspected: Routine unannounced inspection of the radiological and non-radiological chemistry program. Areas reviewed included: confirmatory measurements - radiological, standards analyses - chemistry, and laboratory QA/QC.

Results: Of the areas reviewed, no violations were identified.

DETAILS

1. Individuals Contacted

Principal Licensee Employees

*D. Schultz, Licensing Engineer
*J. Balletto, Environmental Licensing
*J. Russell, Engineer
*P. McNulty, Effluent Engineer
*J. Wray, Radiation Protection Engineer
*S. Branosky, Supervisor, Maintenance
*W. Lowry, System Engineer
*L. Rajkowski, System Engineer
*R. Watson, Supervisor, Maintenance
*D. Perkins, Manager, Station QA
*E. Galbraith, Chemistry Services
*G. Dziuba, Senior Engineer
*F. Thompson, Licensing
*J. Dierickx, Counting Room Supervisor
*C. Gregory, I&C Supervisor
*L. Miller, General Manager, Salem Operations
*B. Preston, Manager, Licensing and Regulation
S. Lehman, Chemistry Technician
M. Kubiak, Chemistry Technician
D. Robinson, Chemistry Technician
D. Hurka, Chemistry Technician

*denotes those personnel who attended the exit meeting on May 1, 1989.

2. Purpose

The purpose of this routine inspection was to review the following areas:

The licensee's ability to measure radioactivity and non-radiological chemistry parameters, and

The licensee's ability to demonstrate the acceptability of his analytical results through implementation of a laboratory QA/QC program.

3. Radiological and Non-Radiological Chemistry

3.1 Confirmatory Measurements (Radiological)

During this part of the inspection, liquid, airborne particulate (filter) and iodine (charcoal cartridge), and gas samples were split

between the licensee and the NRC for the purpose of intercomparison. Where possible, the split samples are actual effluent samples or inplant samples which duplicated the counting geometries used by the licensee for effluent sample analyses. The samples were analyzed by the licensee using routine methods and equipment and by the NRC:I Mobile Radiological Measurements Laboratory. Joint analyses of actual effluent samples are used to verify the licensee's capability to measure radioactivity in effluent samples with respect to Technical Specification and other regulatory requirements.

In addition, a liquid effluent sample was sent to the NRC reference laboratory, Department of Energy, Radiological and Environmental Sciences Laboratory (RESL), for analyses requiring wet chemistry. The analyses to be performed on the sample are: Sr-89, Sr-90, Fe-55, gross alpha, and tritium. The results will be compared with the licensee's results when received at a later date and will be documented in a subsequent inspection report.

The results of an effluent sample split between the licensee and the NRC during a previous inspection on February 29 - March 4, 1988 (Inspection Report Nos. 50-272/88-10 and 50-311/88-10) were also compared during this inspection.

The results of the sample measurements comparison indicated that all of the measurements were in agreement under the criteria used for comparing results (see Attachment 1) with the exception of one measurement result. The result in disagreement was an Fe-55 analysis of a liquid radioactive waste sample. The inspector noted that the Fe-55 result from the previous inspection in this area was also in disagreement. The inspector stated that in addition to the sample split during this inspection, an Fe-55 spiked sample would be sent to the licensee from the NRC reference laboratory (RESL) so that the reason for the disagreements could be determined. It should be noted that although the licensee's Fe-55 results have been in disagreement with the NRC results, the licensee's results have been higher than the NRC results and, therefore, would not have resulted in the licensee exceeding any effluent release limits. The results of the RESL spiked sample will be documented in a subsequent inspection report. The results of the comparisons are listed in Table I.

The particulate filter results are reported for a sample counted both on the detector and approximately five centimeters away from the detector. The inspector discussed with the licensee the geometry related problems associated with counting these types of samples directly in contact with or very near the face of the detector. In addition, the inspector and the licensee reviewed the comparison results from both counting geometries and noted the

differences associated with counting the particulate filter near and away from the detector. The licensee responded to this discussion by stating that this area would be reviewed and appropriate actions would be taken.

The inspector had no further questions in this area. No violations were identified.

3.2 Standards Analyses (Non-Radiological Chemistry)

During this part of the inspection, standard chemical solutions were submitted to the licensee for analysis. The standard solutions were prepared by Brookhaven National Laboratory (BNL) for the NRC and were analyzed by the licensee using routine methods and equipment. The analysis of standards is used to verify the licensee's capability to monitor chemical parameters in various plant systems with respect to Technical Specifications and other regulatory requirements. In addition, the analysis of standards is used to evaluate the licensee's procedures with respect to accuracy and precision.

Also, a spiked sample was sent to BNL for analysis. The analyses to be performed on the sample are chloride, fluoride, and sulfate. The licensee will perform the same analyses, and the NRC results will be compared with the licensee's results when received at a later date and will be documented in a subsequent inspection report. The analysis of an actual spiked sample permits comparison of results from an actual sample matrix.

The results of the standards measurements comparison indicated that 14 of 45 measurements were in disagreement under the criteria used for comparing results. (See Attachment 2.) The results of the comparisons are listed in Table II. The standards were submitted to the licensee for analysis in triplicate at three concentrations spread over the licensee's normal calibration range. Of the 14 results in disagreement under the NRC criteria, 12 of the results were within ten percent of the NRC known value. These disagreements were due to the statistical nature of the NRC comparison criteria and were not judged to be significant. The silica measurement at 53 ppb differed from the NRC known value by 18 percent. In fact, all of the silica measurements were lower than the NRC known value, with the values at 104 ppb and 157 ppb differing from the NRC values by 10% each. This bias in the data suggests a discrepancy with the spectrophotometer calibration curve. The inspector discussed this with the licensee, and the licensee stated that the silica calibration curve would be reevaluated. The other measurement result which differed from the NRC known value by greater than 10% was the ammonia value at 104 ppb. This disagreement was attributed to sampling/dilution error.

During the previous inspection in this area several concerns were identified by the inspector including: calibration of Oxford pipets, single point calibrations at concentrations well above those encountered in routine samples, large calibration ranges for multi-point calibrations exceeding the concentrations normally encountered in real samples and obscuring nonlinearity, and the failure to statistically fit calibration curves. The inspector noted, during this inspection that the licensee had responded to the above concerns. The Oxford pipets had been calibrated, instrument calibrations were performed over the concentration range expected for real samples, and the calibration curves were statistically fit. In addition, the inspector noted that where single point calibrations were performed, the concentrations were near those expected in various samples. The inspector discussed the single point calibration techniques with the licensee. The licensee stated single point calibrations were performed on some instruments such as the atomic absorption spectrophotometer (AA) and ion chromatograph (IC) because of limitations with the capability of the instrument for storing calibration data. The licensee stated that a new AA had been purchased and received which would permit multipoint calibrations with curve fitting. The licensee further stated that evaluations were underway regarding a computer interface to the IC which would permit multipoint calibrations with curve fitting techniques.

The inspector noted the licensee's responsiveness to NRC identified concerns and stated that the above area, single point calibrations, would be reviewed during a subsequent inspection. The inspector further noted that the licensee is also in the process of gathering and assessing random uncertainty data for several analytical instruments used for chemical analyses so that the detection limit and limit of quantification can be determined. The inspector also toured the licensee's new planned secondary side laboratory and noted that the new laboratory would provide needed additional space, particularly for instrumentation.

3.3 Laboratory QA/QC Program

The licensee's chemistry and radiochemistry laboratory QA/QC programs are contained in a number of licensee procedures. Specifically, the following procedures were reviewed by the inspector.

CH-3.8.004,	Interlab Comparison Analysis
CH-3.8.043,	Interlab Agreement Criterion
CH-3.9.017,	Chemistry Laboratory Quality Control Requirements
CH-3.8.058,	Quality Control Preparation and Evaluation of Count Room Equipment

These procedures provide for the control of analytical performance through a variety of mechanisms including: an interlaboratory program

of split samples for radioactivity analyses, including acceptance criteria; an intralaboratory spike program for chemical analyses; and the use of control charts to assess instrument performance. The procedures provide guidance in both the construction and use of the control charts.

The inspector reviewed selected data generated by the licensee's QA/QC program for 1988 and 1989 to date, and noted that the licensee appears to be implementing the program as required by his procedures. In particular, the inspector also noted that the licensee had a contractor perform a statistical assessment of his previous years' chemistry laboratory control charts. The inspector further noted that this was a good initiative on the part of the licensee and provided a mechanism for chemistry management to review and assess this particular aspect of the laboratory QA/QC program. In reviewing the QC data the inspector noted that the licensee does not participate in an interlaboratory QC program using spiked samples in either the chemistry or radiochemistry area. Discussions with the licensee indicated that during the first quarter of 1989 spiked radioactivity samples were received from an outside laboratory and were sent to the licensee's vendor laboratory which is used for effluent radioactivity analyses in order to assess the performance of this laboratory. Also, the licensee receives known chemistry standards from another outside laboratory on a quarterly basis, and these are used as part of the licensee's chemistry intralaboratory spike program. The inspector stated that the use of these standards as part of an interlaboratory program to assess accuracy should be formally documented in the licensee's laboratory QA/QC procedures and a formal schedule for their use established. This area will be reviewed during a subsequent inspection. The inspector observed that the licensee is participating in an intercomparison program with NIST (National Institutes of Standards and Technology, formerly NBS) for radioactivity measurements. The inspector had no further questions in the area. No violations were identified.

4. Exit Interview

The inspectors met with the licensee representatives (denoted in Section 1) at the conclusion of the inspection on May 1, 1989. The inspectors summarized the purpose, scope, and findings of the inspection.

TABLE I

SALEM UNITS I & II

Verification Test Results

Sample	Isotope	NRC Value	Licensee Value	Comparison
		Results in Microcuries Per Milliliter		
Reactor Coolant 4-25-89 0930 hours (Detector #2)	I-131	(7.1±1.6)E-4	(5.8±19.2%)E-4	Agreement
	I-132	(1.39±0.02)E-2	(1.37±3%)E-2	Agreement
	I-133	(9.2±0.2)E-3	(8.1±6.39%)E-3	Agreement
	I-134	(2.92±0.09)E-2	(2.72±2.55%)E-2	Agreement
	I-135	(1.78±0.08)E-2	(1.62±3.65%)E-2	Agreement
	Na-24	(1.9±0.2)E-3	(1.63±9.14%)E-3	Agreement
Liquid Radioactive Waste #22 WMHT 4-24-89 0800 hours Unit 2 (Detector #4)	Co-58	(1.76±0.02)E-4	(1.76±5.07%)E-4	Agreement
	Co-60	(1.18±0.06)E-5	(1.30±3.99%)E-5	Agreement
	Sb-125	(2.2±0.2)E-5	(2.23±5.72%)E-5	Agreement
	Cs-137	(7.6±0.7)E-6	(8.33±7.10%)E-6	Agreement
	Mn-54	(1.00±0.05)E-5	(1.04±5.65%)E-5	Agreement
Containment Particulate Filter 4-24-89 Unit 1 (Detector #4) (counted away from detector)	Mn-54	(6.7±0.3)E-3	(6.42±7.83%)E-3	Agreement
	Co-58	(1.048±0.007)E-1	(9.80±4.98%)E-2	Agreement
	Co-60	(7.97±0.08)E-2	(7.37±3.55%)E-2	Agreement
	Cs-134	(3.3±0.3)E-3	(2.76±13.64%)E-3	Agreement
	Cs-137	(3.6±0.3)E-3	(3.15±12.06%)E-3	Agreement
	Zr-95	(3.8±0.4)E-3	(3.96±10.29%)E-3	Agreement
Containment particulate filter Unit 1 4-24-89 (Detector #6) (counted on detector)	Mn-54	(6.7±0.3)E-3	(8.11±6.31%)E-3	Agreement
	Co-58	(1.048±0.007)E-1	(1.18±4.77%E-1	Agreement
	Co-60	(7.97±0.08)E-2	(9.31±3.38%)E-2	Agreement
	Co-134	(3.3±0.3)E-3	(2.77±7.67%)E-3	Agreement
	Cs-137	(3.6±0.3)E-3	(4.10±9.25%)E-3	Agreement
	Zr-95	(3.8±0.4)E-3	(4.40±7.34%)E-3	Agreement
GDT #11 4-26-89 1026 hours (Detector #4)	Xe-133	(7.84±0.08)E-4	(7.31±12.7%)E-4	Agreement

TABLE I
(Continued)

SALEM UNITS I & II

Verification Test Results

Sample	Isotope	NRC Value	Licensee Value	Comparison
		Results in Microcuries Per Milliliter		
GDT #12 4-25-89 1405 hours (Detector #2)	Xe-133	(9.53±0.07)E-4	(8.52±12.6%)E-4	Agreement
GDT #11 4-27-89 0912 hours (Detector #4) (Gas Marinelli)	Kr-85 Xe-133 Xe-135 Xe-131m	(5.4±0.2)E-4 (8.99±0.02)E-4 (1.1±0.2)E-7 (8.5±0.2)E-5	(6.46±9.05%)E-4 (9.85±8.45%)E-4 (1.63±19.22%)E-7 (1.05±8.72%)E-4	Agreement Agreement Agreement Agreement
Charcoal Cartridge U-1 Aux. Bldg. 4-25-89 0800 hours (Detector #6)	I-131	(1.05±0.12)E-3	(9.39±9.11%)E-4	Agreement
Liquid Radioactive Waste 3-10-88 1350 hours	H-3 Gross Alpha Fe-55 Sr-90 Sr-89	(1.42±0.02)E-2 (1.6±0.8)E-8 (1.66±0.02)E-5 (5.0±0.9)E-8 (2.4±0.7)E-8	(1.6±0.1)E-2 <5 E-8 (2.6±0.1)E-4 (4.0±0.5)E-8 (9.8±2.1)E-8	Agreement No Comparison Disagreement Agreement No Comparison

TABLE II

SALEM UNITS 1 and 2

Chemistry Test Results

Chemical Parameter	*Method of Analysis	NRC Known Value	Licensee Measured Value	Ratio (LIC/NRC)	Comparison
		Results in parts per billion (ppb)			
Ammonia	IC (2020i)	104±5	122±3	1.17±0.06	Disagreement
		301±3	299±2	0.993±0.012	Agreement
Fluoride	ISE	22.5±0.2	21.7±0.6	0.96±0.03	Agreement
		42.3±0.4	41.8±0.8	0.99±0.02	Agreement
		83±2	84±4	1.01±0.05	Agreement
Chloride	IC (#16)	18.5±0.1	19.9±0.3	1.08±0.02	Disagreement
		37.3±0.3	41±2	1.10±0.05	Agreement
		76.5±1.2	82.3±0.6	1.08±0.02	Disagreement
Chloride	IC (2020i)	1.85±0.01	1.8±0.2	0.97±0.11	Agreement
		3.73±0.03	3.55±0.15	0.95±0.04	Agreement
		0.765±0.012	0.8±0.2	1.0±0.3	Agreement
Sulfate	IC (#16)	19.5±1.4	24±2	1.23±0.14	Agreement
		38±3	43.6±1.5	1.15±0.10	Agreement
		78±2	77.0±0.7	0.99±0.03	Agreement
Sulfate	IC (2020i)	1.95±0.14	2.09±0.15	1.07±0.11	Agreement
		3.8±0.3	4.3±0.6	1.1±0.2	Agreement
		0.78±0.02	0.9±0.2	1.2±0.3	Agreement
Hydrazine	SP	19.9±0.3	21±0	1.06±0.02	Disagreement
		49.9±0.5	52±0	1.042±0.010	Disagreement
		100±1	103.7±0.6	1.037±0.012	Disagreement
Sodium	IC (2020i)	0.61±0.07	1.3±0.7	-	No Comparison
		1.06±0.06	1.8±0.5	1.7±0.7	Agreement
		1.58±0.09	2.5±0.5	1.6±0.3	Agreement

TABLE II
(Continued)

SALEM UNITS 1 and 2

Chemical Parameter	*Method of Analysis	NRC Known Value	Licensee Measured Value	Ratio (LIC/NRC)	Comparison
		Results in parts per billion (ppb)			
Silica	SP	53±3	43.7±0.6	0.82±0.05	Disagreement
		104±4	93.7±0.6	0.90±0.04	Disagreement
		157±2	142.3±1.2	0.904±0.014	Disagreement
		Results in parts per million (ppm)			
Boron	Tit.	1040±10	999±2	0.961±0.009	Disagreement
		3100±100	2973±6	0.96±0.03	Agreement
		5000±90	4868±7	0.97±0.02	Agreement
Iron	AA	1.86±0.05	1.92±0.03	1.03±0.03	Agreement
		3.98±0.05	3.91±0.04	0.98±0.02	Agreement
		0.585±0.015	0.583±0.015	1.00±0.04	Agreement
Chromium	AA	1.98±0.05	1.917±0.006	0.97±0.02	Agreement
		1.155±0.015	1.217±0.015	1.05±0.02	Disagreement
		3.85±0.05	3.97±0.04	1.03±0.02	Agreement
		0.58±0.01	0.627±0.006	1.08±0.02	Disagreement
Copper	AA	2.00±0.03	2.000±0.010	1.00±0.02	Agreement
		4.03±0.15	4.00±0.05	0.99±0.04	Agreement
		0.600±0.015	0.603±0.006	1.00±0.03	Agreement
Lithium	AA	0.197±0.004	0.211±0.003	1.07±0.03	Disagreement
		0.300±0.007	0.327±0.002	1.09±0.03	Disagreement
		1.65±0.04	1.640±0.014	0.99±0.02	Agreement

*Note: ISE = Ion Specific Electrode
AA = Atomic Absorption Spectrophotometry
IC = Ion Chromatography
SP = Spectrophotometry
Tit. = Potentiometric Titration

ATTACHMENT 1

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This attachment provides criteria for comparing results of capability tests and verification measurements. The criteria are based on an empirical relationship which combines prior experience and the accuracy needs of this program.

In these criteria, the judgement limits are variable in relation to the comparison of the NRC Reference Laboratory's value to its associated uncertainty. As that ratio, referred to in this program as "Resolution", increases the acceptability of a licensee's measurement should be more selective. Conversely, poorer agreement must be considered acceptable as the resolution decreases.

Resolution[1]	Ratio For Agreement[2]
<3	No Comparison
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

[1]Resolution = (NRC Reference Value/Reference Value Uncertainty)
[2]Ratio = (License Value/NRC Reference Value)

ATTACHMENT 2

CRITERIA FOR COMPARING ANALYTICAL MEASUREMENTS

This attachment provides criteria for comparing results of capability tests. In these criteria the judgement limits are based on the uncertainty of the ratio of the licensee's value to the NRC value. The following steps are performed:

(1) the ratio of the licensee's value to the NRC value is computed

$$\left(\text{ratio} = \frac{\text{Licensee Value}}{\text{NRC Value}}\right);$$

(2) the uncertainty of the ratio is propagated.[1]

If the absolute value of one minus the ratio is less than or equal to twice the ratio uncertainty ($|1-\text{ratio}| \leq 2$ uncertainty), the results are in agreement.

[1] $Z = \frac{x}{y}$, then $\frac{S^2z}{Z^2} = \frac{S^2x}{x^2} + \frac{S^2y}{y^2}$

[1](From: Bevington, P. R., Data Reduction and Error Analysis for the Physical Sciences, McGraw-Hill, New York, 1969)