U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report Nos. 50-387/91-16
50-388/91-16

Docket Nos. 50-387; 50-388

License No. NPF-14; NPF-22

Licensee: Pennsylvania Power and Light Company
2 North Ninth Street
Allentown, Pennsylvania 18101

Facility Name: Susquehanna Steam Electric Station, Units 1 & 2

Inspection At: Berwick, Pennsylvania

Inspection Conducted: August 26-30, 1991

Inspectors: J. Rotta 9/27/91
for J. Kottan, Laboratory Specialist, Effluents Radiation Protection Section (ERPS), Facilities Radiological Safety and Safeguards Branch (FRSSB), Division of Radiation Safety and Safeguards (DRSS) — date

Approved by: Thomas V. Vargerm for 9/27/91
R. Bores, Chief, ERPS, FRSSB, DRSS — date

Inspection Summary: Inspection on August 26-30,1991 (Combined Inspection Report Nos. 50-387/91-16 and 50-388/91-16)

Areas Inspected: Routine, unannounced inspection of the radiochemistry program. Areas reviewed included: confirmatory measurements, laboratory QA/QC, and audits.

Results: The licensee had in place an effective program for measuring radioactivity in process and effluent samples. One unresolved item related to the tracking of audits and audit findings was identified. (See Section 5 for details.) No violations or deviations were identified.

DETAILS

1. Individuals Contacted

Principal Licensee Employees

*T. Belles, Chemistry Technician - Instruments
*R. Breslin, Chemistry Supervisor
*P. Capotosto, Sr. Project Engineer, NQA
*A. Feldman, Radiochemist
D. Heffelfinger, Coordinating Engineer, NQA
R. Hock, Health Physicist
*L. Humpf, Assistant Chemistry Foreman
*D. Kennedy, III, Assistant Chemistry Foreman
*T. Nork, Plant Engineering Supervisor - Systems
*B. Rhodes, Chemistry Lab Supervisor
*H. Riley, Health Physics Supervisor
*D. Roth, Sr. Compliance Engineer
*G. Stanley, Superintendent of Plant
*R. Takacs, QA/QC Chemist
*R. Wehry, Compliance

NRC Employees

*J. Stair, NRC Resident Inspector

*Denotes those present at the exit meeting on August 30, 1991. The inspector also interviewed other licensee personnel including members of the chemistry and health physics staffs.

2. Purpose

The purpose of this inspection was to review the following areas.

A. The license's ability to measure radioactivity in plant systems and effluent samples.

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

3. Confirmatory Measurements

During this part of the inspection, liquid, airborne particulate (filter) and iodine (charcoal cartridge), and gas samples were analyzed by the licensee and the NRC for the purpose of intercomparison. The samples were actual split samples with the exception of the liquid radwaste, offgas, and filter samples. In these cases the samples could not be split, and the same samples were analyzed by the licensee and the NRC. Where possible the samples are actual effluent samples or in-plant samples which duplicated the counting geometries used by the licensee for effluent sample analysis. The charcoal cartridge sample was a spiked sample supplied to the licensee by the NRC because no effluent or in-plant charcoal cartridge sample could be obtained which contained radioactive

iodine. 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 and other samples with respect to Technical Specifications and other regulatory requirements.

In additon, a liquid effluent sample was sent to the NRC reference laboratory, Department of Energy, Radiological and Enviromental 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 of these analyses 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 a liquid effluent sample split between the licensee and the NRC during a previous inspection on June 12-16, 1989 (Combined Inspection Report Nos. 50-387/89-16 and 50-388/89-14) were also compared during this inspection.

The licensee's Health Physics Department also possessed a gamma spectrometry system which was used to quantify radioactivity on in-plant samples for radiation protection purposes. During this inspection, the charcoal cartridge and particulate filter were also analyzed by the licensee's Health Physics Department and compared with the NRC results. These types of samples were those normally analyzed by the licensee's Health Physics Department.

The results of the comparisons indicated that, for the gamma isotopic analyses performed by the Chemistry Department, all of the results were in agreement under the criteria used for comparing results. (See Attachment I to Table I.) The Fe-55 result from the liquid sample split during the previous inspection was in disagreement, as were the gamma isotopic analyses of the charcoal cartridge performed by the Health Physics Department. The reason for the Fe-55 disagreement could not be determined during this inspection. However, as stated above, a liquid sample was split for Fe-55 analysis during this inspection, and this result will be compared as soon as received in order to resolve this disagreement. Some possible reasons for the disagreement would be a poor sample split or a matrix effect present in the sample.

With regard to the licensee's Health Physics results, the disagreements were due to the manner in which the licensee calibrated the gamma spectrometry system detectors for the charcoal cartridge counting geometry. These detectors were calibrated with a charcoal cartridge standard in which the radioactivity was distributed uniformly throughout the charcoal cartridge. The NRC-supplied spiked charcoal cartridge, however, had the radioactive material distributed only on the inlet side or "face" of the charcoal cartridge. This type of radioactivity distribution within the cartridge is the type of distribution normally encountered with "real" samples. The inspector discussed this matter with the licensee. The licensee stated that a calibration with a uniformly loaded charcoal cartridge was done so that conservative results would be

obtained when counting only the inlet side of the cartridge. The licensee further stated that this would not result in exceeding any airborne iodine exposure limits because the error introduced by this practice was in a conservative direction. In order to evaluate the licensee's calibration, the inspector requested that the licensee analyze both sides of the NRC cartridge and average the results, a practice normally employed when calibrating with a "uniformally loaded" charcoal cartridge. The licensee complied with the inspector's request and the subsequent results were in agreement with the NRC known value. After further discussions with the licensee, the licensee stated that the current practice of counting charcoal cartridges would continue, but consideration would be given to reviewing the method. The inspector stated that this area will be reviewed during a subsequent inspection.

All of the measurement results are presented in Table I.

3. Laboratory QA/QC

The licensee's radiochemistry laboratory QA/QC program was detailed in a number of procedures. Specifically the following procedures were reviewed by the inspector.

AD-QA-445, Chemistry Program Quality Assurance
CH-QC-001, Criteria for Comparing Radiochemical Measurements Split Samples
CH-QC-002, Interlaboratory Quality Control Program
CH-QC-003, Intralaboratory Quality Control Program
CH-QC-004, Chemistry Computer Software Verfication
CH-QC-005, Replicate Sampling and Analysis
CH-GI-011, Instrument Checks
CH-TP-064, Performance Testing of the ND Gamma Spectral System

These procedures provide for the control of analytical performance through the use of an intralaboratory QC program and an interlaboratory QC program. The intralaboratory program consisted of the use of control charts to assess instrument performance, the analysis of replicate samples, and the analysis of spiked tritium samples provided to the technicians.

The interlaboratory program consisted of the quarterly gamma isotopic analysis of spiked samples received from an offsite laboratory. Also included in the interlaboratory program was the submission of spiked samples on a quarterly basis to the vendor laboratory used for performing effluent sample analyses requiring radiochemical separations. The interlaboratory spiked samples were submitted to the chemistry technicians on a rotating basis and the results of interlaboratory program were tracked both on an individual technician and grand average basis.

The inspector reviewed selected data generated by the licensee's laboratory QC program and noted that the licensee appeared to be implementing the program as required. The inspector also noted that the

licensee now had in place a dedicated individual, the QA/QC chemist, to oversee the laboratory QA/QC program. Additionally, the inspector noted that the licensee was in the process of installing a new computer-based gamma spectrometry system. This new system included QC algorithms and data bases to maintain the results of the QC checks for the gamma spectrometry system detectors. The QC software would also print the control charts for the data maintained in the data base. During this inspection the licensee stated that the control charts were printed every seven days. Based on a demonstration of the QC software and discussions with licensee personnel the inspector determined that the QC software would indentify an out-of-control data point, but would not indentify other trends taking place within the control limits which may indicate a potential problem with the system. The inspector discussed this matter with the licensee and stated that control charts plotted after the fact provide only a review of past performance and do not actively control the measurement process. The licensee responded that the control charts would be printed and reviewed on a daily basis. The inspector had no further questions in the area.

5. Audits

The inspector reviewed recent quality assurance audits of the licensee's radioactivity measurements programs performed by the Nuclear Quality Assurance (NQA) Division. The following audits were reviewed.

Audit No. 91-029, "Chemistry Program", performed May 13-June 10,1991
Audit No. 90-036, "Chemistry Program", performed April 30-May 14, 1990

These audits included the licensee's programs and procedures for the measurement of radioactivity in effluent samples and the laboratory quality assurance program for those measurements. The audits appeared to be of adequate technical depth, were performed using an audit plan and an associated check list, and the audit team included a technical specialist. A single non-safety significant finding was identified as a result of Audit No. 91-029. This finding, however, was not resolved within the time limit required by the licensee's procedures. The failure to resolve this item within the required time limit appeared to be due to a clerical error, in that the audit and audit findings were not entered into the NQA audit tracking system. The inspector stated that although the failure to track and resolve the audit finding as required appeared to be an isolated incident, this would be considered an unresolved item (50-387/91-16-01 and 50-388/91-16-01) and would be reviewed in greater detail during the next inspection of the licensee's QA program. During this inspection the licensee's Chemistry Department initiated actions to resolve the above audit finding. The inspector reviewed the NQA audit schedule and noted that the audits of the chemistry program were scheduled on an annual basis.

The inspector also reviewed a recent NQA audit of the vendor laboratory used for performing analyses of effluent samples requiring wet chemistry. This audit, NQA Audit No. 89-0009, was performed on July 10-14, 1989. Through discussions with licensee personnel the inspector determined that the next audit of the vendor laboratory was scheduled for the fall of 1991 and the audit team would include members of the site Chemistry Department.

The inspector also reviewed the results of selected QA surveillances performed by the NQA/OPS Surveillance Group during 1990 and 1991 to date. The Surveillance Group maintained an 18-month schedule for chemistry surveillance activities which included the following areas: approved materials, waste management, surveillance sample/analysis, reagents, standards, instruments, training, QA program, and start-up/shutdown activities. The surveillances were performed using checklists which were developed to cover the specific surveillance activity and appeared to be of adequate scope. No concerns were identified by the inspector in this area.

6. Exit Meeting

The inspector met with the licensee representatives denoted in Section 1 at the conclusion of the inspection on August 30, 1991. The inspector summarized the purpose scope and findings of the inspection.

TABLE 1

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN TOTAL MICROCURIES		
Offgas (pretreatment) 8-27-91	Kr-87	(1.68 ± 0.15)E-2	(2.3 ± 0.5)E-2	Agreement
0842 hrs	Xe-135m	(4.0 ± 0.5)E-2	(4.0 ± 0.4)E-2	Agreement
(Detector 1)	Xe-135	(6.3 ± 0.6)E-3	(7 ± 2)E-3	No Comparison
1st Count	Xe-138	(1.9 ± 0.3)E-1	(1.48 ± 0.10)E-1	Agreement
Offgas (pretreatment)				
8-27-91	Kr-85m	(2.35 ± 0.14)E-3	(2.44 ± 0.13)E-3	Agreement
0842 hrs	Kr-87	(1.08 ± 0.14)E-2	(1.36 ± 0.11)E-2	Agreement
(Detector 1)	Kr-88	(8.0 ± 0.6)E-3	(8.3 ± 0.5)E-3	Agreement
2nd Count	Xe-135	(7.12 ± 0.14)E-3	(7.4 ± 0.4)E-3	Agreement

TABLE 1 (continued)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN MICROCURIES PER MILLILITER		
Unit 1 RWCU Crud Filter	Cr-51	(2.63 ± 0.11)E-3	(2.68 ± 0.16)E-3	Agreement
8-27-91	Mn-54	(8.86 ± 0.08)E-3	(9.4 ± 0.5)E-3	Agreement
1205 hrs	Co-58	(3.5 ± 0.3)E-4	(3.9 ± 0.3)E-4	Agreement
(Detector 1)	Fe-59	(6.83 ± 0.11)E-3	(6.8 ± 0.2)E-3	Agreement
	Co-60	(1.01 ± 0.03)E-3	(1.04 ± 0.04)E-3	Agreement
Unit 1 RWCU Crud Filter	Cr-51	(2.63 ± 0.11)E-3	(2.55 ± 0.07)E-3	Agreement
8-27-91	Mn-54	(8.86 ± 0.08)E-3	(9.33 ± 0.04)E-3	Agreement
1205 hrs	Co-58	(3.5 ± 0.3)E-4	(3.6 ± 0.2)E-4	Agreement
(Detector 2)	Fe-59	(6.83 ± 0.11)E-3	(6.95 ± 0.06)E-3	Agreement
	Co-60	(1.01 ± 0.03)E-3	(1.04 ± 0.02)E-3	Agreement

TABLE 1 (continued)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN MICROCURIES PER MILLILITER		
Unit 1 Reactor Water Filtrate	I-132	(1.03 ± 0.02)E-4	(1.16 ± 0.08)E-4	Agreement
8-28-91	I-133	(4.37 ± 0.12)E-5	(4.3 ± 0.5)E-5	Agreement
0940 hrs	I-134	(3.15 ± 0.12)E-4	(3.5 ± 0.3)E-4	Agreement
(Detector 1)	I-135	(1.18 ± 0.05)E-5	(1.12 ± 0.10)E-4	Agreement
1st Count				
Unit 1 Reactor Water Filtrate	I-132	(1.00 ± 0.04)E-4	(1.09 ± 0.09)E-4	Agreement
8-28-91	I-133	(4.27 ± 0.11)E-5	(4.1 ± 0.3)E-5	Agreement
0940 hrs	I-135	(1.06 ± 0.05)E-4	(1.07 ± 0.07)E-5	Agreement
(Detector 1)				
2nd Count				
Unit 1 Reactor	I-132	(1.00 ± 0.04)E-4	(1.14 ± 0.07)E-4	Agreement
Water Filtrate	I-133	(4.27 ± 0.11)E-5	(3.8 ± 0.2)E-5	Agreement
8-28-91	I-135	(1.06 ± 0.05)E-4	(8.2 ± 0.7)E-5	Agreement
0940 hrs				
(Detector 2)				
2nd Count				

TABLE 1 (continued)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN MICROCURIES PER MILLILITER		
Liquid Radioactive Waste				
(C&D Collection Tanks)	Co-58	(4.32 ± 0.12)E-3	(4.0 ± 0.2)E-3	Agreement
8-28-91	Fe-59	(5.18 ± 0.04)E-2	(4.33 ± 0.14)E-2	Agreement
1240 hrs	Co-60	(1.002 ± 0.013)E-2	(9.1 ± 0.3)E-3	Agreement
(Detector 1)	Mn-54	(9.80 ± 0.04)E-2	(8.8 ± 0.5)E-2	Agreement
	Cr-51	(3.30 ± 0.08)E-2	(3.1 ± 0.2)E-2	Agreement
Liquid Radioactive Waste	Co-58	(4.32 ± 0.12)E-3	(3.83 ± 0.10)E-3	Agreement
(C&D Collection Tanks)	Fe-59	(5.18 ± 0.04)E-2	(4.59 ± 0.03)E-2	Agreement
8-28-91	Co-60	(1.002 ±0.013)E-2	(9.18 ± 0.12)E-3	Agreement
1240 hrs	Mn-54	(9.80 ± 0.04)E-2	(8.55 ± 0.03)E-2	Agreement
(Detector 2)	Cr-51	(3.30 ± 0.08)E-2	(2.86 ± 0.05)E-2	Agreement

TABLE 1 (continued)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN TOTAL MICROCURIES		
Offgas (pretreatment)				
8-29-91	Kr-85m	(5.8 ± 0.5)E-4	(6.4 ± 1.3)E-4	Agreement
1000 hrs	Kr-87	(3.2 ± 0.2)E-3	(3.6 ± 0.8)E-3	Agreement
(Detector 1)	Kr-88	(1.9 ± 0.2)E-3	(1.8 ± 0.4)E-3	Agreement
Marinelli Beaker	Xe-135	(1.73 ± 0.06)E-3	(1.4 ± 0.2)E-3	Agreement
Counting Geometry	Ar-41	(2.2 ± 0.2)E-3	(2.4 ± 0.2)E-3	Agreement
Offgas (pretreatment)	Kr-85m	(5.8 ± 0.5)E-4	(3.4 ± 0.8)E-4	Agreement
8-29-91	Kr-87	(3.2 ± 0.2)E-3	(3.2 ± 0.3)E-3	Agreement
1000 hrs	Kr-88	(1.9 ± 0.2)E-3	(not identified)	No Comparison
(Detector 2)	Xe-135	(1.73 ± 0.06)E-3	(1.37 ± 0.10)E-3	Agreement
Marinelli Beaker	Ar-41	(2.2 ± 0.2)E-3	(2.4 ± 0.2)E-3	Agreement
Counting Geometry				

TABLE 1 (contined)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
RESULTS IN TOTAL MICROCURIES				
NRC Spiked Charcoal Cartridge (85-01) (Detector 1)	Ba-133	(4.15 ± 0.10)E-2	(4.12 ± 0.16)E-2	Agreement
RESULTS IN MICROCURIES PER MILLILITER				
Liquid Radwaste				
6-14-89	Fe-55	(2.62 ± 0.01)E-3	(2.2 ± 0.1)E-4	Disagreement
1615 hrs	gross alpha	(9 ± 6)E-10	<3E-8	No Comparison
	H-3	(1.92 ± 0.02)E-3	(2.2 ± 0.1)E-3	Agreement
	Sr-89	(3.2 ± 0.3)E-7	(2.6 ± 0.3)E-7	Agreement
	Sr-90	(9 ± 4)E-9	<1E-8	No Comparison

TABLE 1

SUSQUEHANNA VERIFICATION TEST RESULTS (continued)

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN MICROCURIES PER MILLILITER		
Unit 1 RWCU Crud Filter				
8-27-91				
1205 hrs	Cr-51	(2.63 ± 0.11)E-3	(2.8 ± 0.3)E-3	Agreement
Health Physics	Mn-54	(8.86 ± 0.08)E-3	(1.02 ± 0.06)E-2	Agreement
Analysis	Co-58	(3.5 ± 0.3)E-4	(4.2 ± 0.3)E-4	Agreement
(Detector 1)	Fe-59	(6.83 ± 0.11)E-3	(7.6 ± 0.4)E-3	Agreement
	Co-60	(1.01 ± 0.03)E-3	(1.08 ± 0.05)E-3	Agreement
Unit 1 RWCU Crud Filter				
8-27-91				
2205 hrs	Cr-51	(2.63 ± 0.11)E-3	(2.6 ± 0.2)E-3	Agreement
Health Physics	Mn-54	(8.86 ± 0.08)E-3	(1.03 ± 0.06)E-2	Agreement
Analysis	Co-58	(3.5 ± 0.3)E-4	(4.1 ± 0.3)E-4	Agreement
(Detector 2)	Fe-59	(6.83 ± 0.11)E-3	(7.7 ± 0.4)E-3	Agreement
	Co-60	(1.01 ± 0.03)E-3	(1.07 ± 0.05)E-3	Agreement

TABLE 1 (continued)

SUSQUEHANNA VERIFICATION TEST RESULTS

SAMPLE	ISOTOPE	NRC VALUE	LICENSEE VALUE	COMPARISON
		RESULTS IN TOTAL MICROCURIES		
NRC Charcoal Cartridge				
(85-01)	Ba-133	(4.15 ± 0.10)E-2	(5.9 ± 0.4)E-2	Disagreement
Health Physics				
Analysis	*Ba-133	(4.15 ± 0.10)E-2	(4.5 ± 0.3)E-2	Agreement
(Detector 1)				
NRC Charcoal Cartridge				
(85-01)	Ba-133	(4.15 ± 0.10)E-2	(5.6 ± 0.4)E-2	Disagreement
Health Physics	*Ba-133	(4.15 ± 0.10)E-2	(4.4 ± 0.3)E-2	Agreement
Analysis				
(Detector 2)				

Note: Reported uncertainties are one standard deviation counting uncertainties for both NRC and licensee results.

* Results from averaging counting results from both sides of cartridge to reflect actual calibration geometry. (See Section 3.)

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 value to its associated uncertainty. As the 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]
< 4	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 Value/NRC Value 1S Counting Uncertainty)
[2]Ratio = (Licensee's Result/NRC Result)