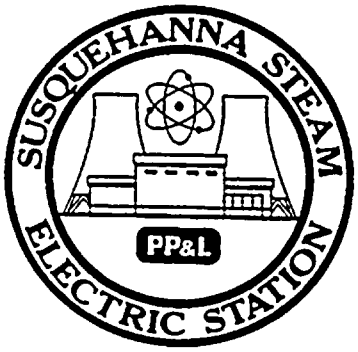

Susquehanna Steam Electric Station
Units 1 & 2

1991 Annual Environmental Operating Report (Nonradiological)

Facility Operating License Nos. NPF-14 & NPF-22
Docket Nos. 50-387 & 50-388

prepared by
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April 1992

SUSQUEHANNA STEAM ELECTRIC STATION

ANNUAL ENVIRONMENTAL OPERATING REPORT

(NONRADIOLOGICAL)

1991

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FOREWORD

The Susquehanna Steam Electric Station (Susquehanna SES) consists of two boiling water reactors, each with a net electrical generating capacity of 1,050 megawatts. The 1,500 acre site is located in Salem Township, Luzerne County, Pennsylvania approximately five miles northeast of Berwick, Pennsylvania. Under terms of an agreement finalized in January 1978, 90% of the Susquehanna SES is owned by the Pennsylvania Power and Light Company (Licensee) and 10% by the Allegheny Electric Cooperative, Inc.

The 1991 Annual Environmental Operating Report (Nonradiological) for Units 1 and 2 describes results of programs necessary to meet requirements of Section 2F of the Operating License, Protection of the Environment, and Appendix B, Environmental Protection Plan, as well as commitments in the Final Environmental Statement related to operation (NUREG-0564), June 1981. This report discusses environmental commitments and impacts from January 1, 1991, through December 31, 1991.

TABLE OF CONTENTS

SUSQUEHANNA STEAM ELECTRIC STATION
ANNUAL ENVIRONMENTAL OPERATING REPORT
1991

TABLE OF CONTENTS

TABLES

FIGURES

1.0 OBJECTIVES

The Licensee submitted an Environmental Report-Operating License Stage for the Susquehanna SES to the U.S. Nuclear Regulatory Commission (NRC) in May, 1978. This report reviewed the results of the preoperational impacts of construction and described the preoperational and proposed operational environmental monitoring programs. The NRC and other agencies reviewed this report and made recommendations for operational environmental monitoring programs which were listed in the Final Environmental Statement (FES) related to the operation of the Susquehanna SES, Unit 1 and 2, NUREG-0564, June 1981. In addition, the Licensee developed procedures and guidelines to ensure that operation of the Susquehanna SES does not adversely affect the environment in the vicinity of the station.

Procedures were developed to allocate responsibilities and interfaces necessary to monitor environmental impacts. These include coordination of NRC requirements and consistency with other federal, state, and local requirements for environmental protection. To keep the NRC informed of other agency activities, copies of environmental correspondence are routinely provided. In addition, this 1991 Annual Environmental Operating Report (Nonradiological) provides a summary of both environmental programs and procedures as required in the FES and Appendix B - Environmental Protection Plans (EPP) to Operating Licenses, No. NPF-14 and No. NPF-22. The 1991 report is the tenth Annual Environmental Operating Report (Nonradiological) submitted to meet EPP requirements.

2.0 ENVIRONMENTAL ISSUES

2.1 AQUATIC ISSUES

The aquatic monitoring program for operation of the Susquehanna SES is divided into two phases. Phase 1 includes effluent monitoring required by a National Pollutant Discharge Elimination System (NPDES) permit issued by the Pennsylvania Department of Environmental Resources (PaDER). Monthly discharge monitoring reports are submitted to the PaDER as part of the permitting requirements. The station operational NPDES permit No. PA-0047325 was reissued on January 22, 1990, and expires on January 21, 1995. Phase 2 of the aquatic monitoring program deals with programs listed in the FES involving environmental monitoring.

The PaDER in Phase 1 is responsible for regulating the water quality permit for the Susquehanna SES. The NPDES permit deals with discharge parameters for the Susquehanna SES sewage treatment plant, cooling tower blowdown, and miscellaneous low volume waste discharges. The cooling tower blowdown also includes in-plant process streams which discharge to the Susquehanna River. Various low volume waste sumps discharge to the storm sewers which flow into Lake Took-a-while, and eventually into the Susquehanna River.

The parameters monitored in the sewage treatment plant effluent limits are as follows:

Flow
pH
Total Suspended Solids (TSS)
Carbonaceous Biochemical Oxygen demand (CBOD-5)
Fecal Coliforms

In-plant process effluents combine with the cooling tower blowdown before being released to the Susquehanna River. These process effluents are monitored for flow, TSS, and oil and grease. Parameters monitored in the combined cooling tower blowdown to the Susquehanna River are:

Flow
pH
Free Available Chlorine
Chromium
Zinc

The parameters monitored in the various low volume waste sumps and drains that discharge to storm sewers leading to Lake Took-a-while are:

Flow
pH
TSS
Oil and Grease

Phase 2 of aquatic monitoring programs, identified in the FES and Appendix B of the Operating License for the Susquehanna SES, included monitoring algae

and benthic macroinvertebrates both above the intake from and below the discharge to the Susquehanna River. Requirements for these activities were completed in 1988.

In the spring of 1991, the Susquehanna Anadromous Fish Restoration Committee directed the capture of 27,227 American shad in the two fish lifts below the Conowingo Dam on the Susquehanna River. Of these, 24,662 shad were transported and stocked upstream of all major dams, with less than 3% mortality (Ref. 2.1-1). River flow was extremely low from May through October 1991 because of the drought in Pennsylvania. Consequently, there was little chance that any of these fish migrated upriver beyond Berwick, Pennsylvania. The autumn monitoring program for impinged juvenile American shad at the Susquehanna SES river intake was, therefore, cancelled in 1991 (Exhibit 1) with the concurrence of Richard St. Pierre, Susquehanna River Coordinator for the U.S. Fish and Wildlife Service.

The monitoring program for the asiatic clam, Corbicula fluminea, continued in 1991. However, the program was expanded to include monitoring for another biofouling mollusk, the zebra mussel, Dreissena polymporpha. Young of this species was reported in the Susquehanna River near Johnson City, New York, in July 1991. Specific techniques for zebra mussel monitoring at Susquehanna SES will include: examination of water samples, natural and artificial substrates, and a side-stream sampler to be installed at the River Intake Structure.

2.2 TERRESTRIAL ISSUES

2.2.1 STUDIES PREVIOUSLY COMPLETED

Terrestrial environmental studies completed prior to 1989 included cooling tower bird impaction and sound level surveys.

2.2.2 MAINTENANCE OF TRANSMISSION LINE CORRIDORS

During 1991, trees and brush in the transmission line corridors were maintained with herbicides and by manual clearing. The terrestrial monitoring program for the Susquehanna SES transmission lines was initiated in response to commitments in Section 5.3.5 of the FES. Three major transmission lines are associated with the Susquehanna SES: 1) Stanton-Susquehanna No. 2-500 kV line, 2) Sunbury-Susquehanna No. 2-500 kV line and 3) Susquehanna-Wescosville 500 kV line (former Susquehanna-Siegfried line). These lines may be operated at either 230 kV or 500 kV. The maintenance program for transmission line corridors is discussed in detail in subsection 4.2.1 of this report.

The schedule for conducting periodic erosion control inspections of these lines and access roads is based on the age of the line. Susquehanna's transmission lines are inspected twice per year by foot patrols and three times per year by helicopter patrols. A comprehensive overhead inspection is performed once every five years.

In 1991, the three transmission lines and corridors were inspected by helicopter and foot patrols with no adverse impacts reported.

A 1991 Transmission Line Environmental Audit showed that no corrective actions were necessary along these rights-of-way. These audits are conducted biennially. The next one is scheduled for 1993.

2.3 CULTURAL RESOURCES ISSUES

Environmental Protection Plan actions required to satisfy Title 36, Code of Federal Regulations Part 800, relating to archeological sites, were completed in 1987. The Advisory Council on Historic Preservation (ACHP), in accordance with 36 CFR 800.6 (a)(1), approved the NRC's determination of "no adverse effect" for archeological sites SES-3, SES-6, SES-8, and SES-11 located on the Licensee's property (NRC letter dated October 28, 1987, to ACHP).

As part of the determination of effect process, the Licensee committed to and is taking appropriate measures to mitigate impacts from plant maintenance and operation to sites SES-3, SES-6, SES-8 and SES-11. There was no impact to these sites from plant maintenance and operation in 1991.

REFERENCES

2.1-1 Restoration of American Shad to the Susquehanna River, Annual Progress Report-1991, Susquehanna River Anadromous Fish Restoration Committee, February 1992.

3.0 CONSISTENCY REQUIREMENTS

3.1 PLANT DESIGN AND OPERATION

In accordance with the Environmental Protection Plan (EPP), the Licensee shall prepare and record an environmental evaluation of proposed changes in plant design, operation, or performance of any test or experiment which may significantly affect the environment. Before initiating such activities, the Licensee shall provide a written evaluation and obtain prior approval from the Director, Office of Nuclear Reactor Regulation. Criteria for the need to perform an environmental evaluation include: (1) a significant increase in any adverse environmental impact previously evaluated by the NRC or Atomic Safety and Licensing Board, (2) a significant change in effluent or power level, or (3) a matter not previously evaluated which may have a significant adverse environmental impact.

The EPP requires that if an activity meets any of the criteria to perform an environmental evaluation, the NRC will be notified. If the change, test, or experiment does not meet any of these criteria, the Licensee will document the evaluation and allow the activity to occur.

During operation of the Susquehanna SES in 1991, there were twelve proposed activities which the Licensee reviewed as part of the unreviewed environmental question program. None of these 12 activities were determined to be an unreviewed environmental question. These were:

1. Circulating Water Discharge to Storm Drains - Discharge of circulating water from fire pump tests was discharged to the storm drains until a valve can be replaced in the next Unit 1 (1992) refueling outage. This discharge was approved by the PaDER.

2. Discharge of River Water From Side-Stream Sampler - A side-stream sampler to monitor Zebra mussels and Asiatic clams will be installed at the river intake structure. The river water from the samples will be discharged to the intake bay. This sampler will be installed to meet the requirement of NRC Generic Letter 89-13.

3. Discharge of Freon 22 to Atmosphere - Freon 22 from Emergency Switch Gear Room Cooler DX units was discharged into the atmosphere during maintenance. Actions will be undertaken to meet the Clean Air Act Amendment (1990) requirements to eliminate any discharge of freon to the environment.

4. Scale Removal From Unit 2 Condenser - The purpose of descaling Unit 2 condenser was to bring power up to licensed level to restore an approximate loss of 8 MWe due to scaling. Approval was received from the PaDER.

5. Discharge of Diesel Generator Cooling Water System flush water to Sewage Treatment Plant - E Diesel Generator flush water containing phosphates was discharged to the Sewage Treatment Plant prior to

discharge to the river. This was the preferred disposal route for treatment. A total of 3000 gallons was discharged over a two-week period. This activity was included in the NPDES permit application submitted to the PaDER.

6. Discharge of Nitrited Water to Cooling Tower Basin - Closed cooling system water containing nitrites and slimicide C-68 was discharged to the Cooling Tower and then to the river. This activity has been previously reported to the PaDER, and we do not expect any additional impacts not addressed in the NPDES permit application.

7. Construction of Storage Building - An ash storage facility capable of providing storage for 300 to 500 tons of ash for use as anti-skid material was to be located near the S-2 Pond access road. A wetlands evaluation determined this facility would not impact on any wetland areas. This project has since been cancelled.

8. Testing of Water Treatment Chemicals - No impact was expected from testing chemicals to support the station circulating water system chemical treatment program. Chemicals tested included dispersants, scale inhibitors, and carbon steel corrosion inhibitors. The maximum amounts of chemical from each category, respectively, to be discharged daily, as active reagent was 0.08, 0.04 and 0.06 lbs/day. The PaDER was provided the details of the test plan.

9. Discharge of Fire Hydrant Water to Storm Drains - There will be a discharge of 75,000 gallons of water to storm drains during the annual fire hydrant test. Any treatment chemicals in the water would be dissipated prior to entering onsite Lake Took-a-while, the recreation pond about 0.75 miles away. This activity was similar to number one above. Also, the PaDER approved this discharge activity.

10. Installation of Blowdown Flow Instrumentation - Installation of Unit 1 and Unit 2 blowdown flow instrumentation will replace existing cooling tower blowdown flow meters for improved reliability.

11. Flow Tests Using Dye - Periodic use of Rhodamine WT liquid dye for flow tests and environmental studies. The U.S. Environmental Protection Agency indicated Rhodamine WT was safe in drinking water up to 100 ppb. We will not exceed this level in tests or studies.

12. Upgrade of Production Facility - Construction activities for upgrade of this facility will be within protected areas onsite previously addressed in the construction permit. There is no additional impact from construction activities.

None of these activities required U.S. Nuclear Regulatory Commission approval.

3.2 REPORTING RELATED TO NPDES PERMITS & STATE CERTIFICATIONS

All reports and information required by the NPDES Permit were submitted to both the NRC and PaDER. Pennsylvania is a NPDES Permitting Agreement State with the U.S. Environmental Protection Agency, therefore, State Certification pursuant to Section 401 of the Clean Water Act is not required.

3.3 CHANGES REQUIRED FOR COMPLIANCE WITH OTHER ENVIRONMENTAL REGULATIONS

During 1991, three air quality control permits were renewed and a new Public Water Supply Identification Number was received. These permits are:

Renewals - Air Quality	Permit No.	Expiration Date
Air Blasting Operation	40-399-024	9-30-92
Four Diesel Generators (5,580 Horse Power Each)	40-306-005	9-30-92
Diesel Generator 6,948 Horse Power)	40-306-004	9-30-92

New Permit - Drinking Water	PWS ID	Expiration Date
Emergency Operations Facility	2400938	None

4.0 ENVIRONMENTAL CONDITIONS

4.1 UNUSUAL OR IMPORTANT ENVIRONMENTAL EVENTS

During 1991, four operating occurrences were reviewed as part of the significant environmental event evaluation. None of these events were reportable to the NRC since there were no adverse environmental effects from these activities.

These four events were as follows:

1. Sewage Discharge From Manhole - A blocked sewage pipe discharged about 1,000 gallons of sewage on to the ground. The pipe was cleared soon after the overflow and sewage flow was once again directed to the Sewage Treatment Plant. The PaDER was notified of this event and their recommendation to lime the affected area was followed.

2. Capacitor Oil Leak - There was a leak from a capacitor in the Upper Relay Room in the Control Structure. Oil was tested for PCBs and determined to be non-PCB. Equipment was then repaired upon clean-up of the oil.

3. Diesel Fuel Spill - Approximately 150 gallons of No. 2 diesel fuel spilled from a tank behind a local used car dealership. The fuel was stored in a tank used by a grounds keeping contractor. It was felt that warm weather caused an expansion of the fuel in the tank forcing the fuel through the fuel hose and onto the ground. The release was not reportable to outside agencies since it was nonhazardous and did not enter the waters of Pennsylvania. The spill was immediately contained and cleaned up.

4. Auto/Truck Accident Sampling Strategy - There was a traffic accident on U.S. Route 11 in the vicinity of the site which spilled approximately 100 gallons of diesel fuel onto the highway. Most of the fuel spilled was contained and removed from the highway. None of the fuel spilled onto site property or into Lake Took-a-while causing any environmental impact.

There was one occurrence in August, not related to station operation, in the former North Branch Canal adjacent to the recreational pond located on the floodplain. Treatment of the pond for an overgrowth of algae and weeds with copper sulfate caused a fish kill. The Pennsylvania Fish Commission was notified of this incident. Forty-seven fish were killed, including carp, gizzard shad, white sucker, brown bullhead, and golden shiner. Fortunately, largemouth bass, bluegill, and crappie, the most commonly sought after game fish in the canal, survived the treatment in excellent condition.

The combination of water hardness in the canal requiring a higher concentration of copper sulfate and very hot and humid weather was felt to be the cause of this fish kill. In the future, control treatment for algae and weeds will be conducted earlier in the season before the growth becomes too extensive. This would allow for the use of lower concentrations of copper sulfate to avoid this problem.

4.2 ENVIRONMENTAL MONITORING

4.2.1 MAINTENANCE OF TRANSMISSION LINE CORRIDORS

4.2.1.1 HERBICIDES USED

All herbicides utilized to control incompatible vegetation within the Susquehanna SES transmission line corridors are approved for use by the U. S. Environmental Protection Agency. In addition, all major manufacturers or formulators have had these products registered for distribution by the Commonwealth of Pennsylvania under the authority of the Pennsylvania Pesticide Control Act of 1973.

The following herbicides are specified for use in the Licensee's programs and are applied according to the instructions on the label.

Commercial Name	Active Ingredients	EPA Registration Number
Krenite UT	Fosamine Ammonium	352-395
Tordon 101	2, 4-D, Picloram	464-306
Pathway (Formerly Tordon RTU)	2, 4-D, Picloram	62719-31
Garlon 3A	Triclopyr	62719-37
Access	Triclopyr, Picloram	464-576
Garlon 4	Triclopyr	464-554
Accord	Glyphosate	524-326-AA

Additional herbicides may be needed if the level of control (i.e., new/different species, sudden increases, resistance to established chemicals) changes.

4.2.1.2 RECORDS

Records of herbicide use are maintained for a period of at least five years in appropriate Division Offices of the Licensee. These records include the following:

1. Copies of labels of specified herbicides which designate commercial names, active ingredients, rates of application, warnings, and storage and handling requirements

2. Concentrations of active ingredient formulations diluted for field use

3. Diluting substances (carriers)

4. Rates of application

5. Methods of application

6. Locations and dates of application

4.2.1.3 TYPES OF MAINTENANCE REPORTED

A. Selective Herbicide Applications

In 1991, herbicides were applied on all of the three transmission line corridors - Sunbury-Susquehanna No. 2, Susquehanna-Wescosville, and Stanton-Susquehanna No. 2 lines. Herbicides used, their active ingredient, acid equivalent, amount of concentrate in a designated carrier, drift retardant, and wetting agents are summarized in Table 4.2-1.

Application data for all three lines are presented by number of acres on which herbicides were applied, total amount of solution used, rate of application in gallons per acre, total amount of concentrate used, average gallons of concentrate applied per acre, total pounds of acid equivalent, and average pounds per acre applied. Dates and locations by structure number of all applications are listed with the title of the responsible Division Manager, the phone number, and the mailing address.

B. Vegetation Maintenance by Manual Methods

Maintenance of Transmission Line Corridors, Table 4.2-2, summarizes vegetation maintenance activities other than the utilization of herbicides. The manual activities used in 1991 were as follows:

1. Selective Reclearing - cutting incompatible vegetation where herbicide applications are restricted.

2. Side/Top Trimming - trimming of trees on the edge of or within the right-of-way, which through yearly growth encroach on the line conductors.

3. Screen Trimming - trimming of trees left intentionally on the right-of-way for aesthetic purposes or otherwise to maintain safe clearances to the line conductors.

4. Danger Tree Removals - cutting those trees outside of the cleared right-of-way which are of such a height and position that they create a potentially hazardous condition which could interrupt the line.

4.2.2 AQUATIC PROGRAMS

The aquatic monitoring requirements, identified in the FES and Appendix B of the operating license for the Susquehanna SES, have been completed and confirm that effects on aquatic biota and water quality due to plant operation were no greater than predicted.

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Susquehanna-Wescosville 500 KV	Central
Year	Line Names	Division

Herbicides					Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
1	Garlon 3A Tordon 101	Triclopyr Picloram 2,4-D	3#/Gal .54#/Gal. 2#/Gal.	1/2 Gal. 1/2 Gal.	Clean Cut	1/4 Gal.	Water	98 3/4
4	Accord	Glyphosate	3#/Gal.	1 Gal.	Aquatic Surfactant	1/2 Gal.	Water	98 1/2

Application Data

Alt. No.	No. of Acres	Total Gallons(*) Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
1	408.8	32,600	79.7	Garlon 3A -163.0 Tordon 101-163.0	.40 .40	Triclopyr -489.0 Picloram - 88.0 2,4-D -326.0	1.20 .21 .80
4	26.8	2,050	76.5	Accord - 20.5	.76	Glyphosate- 61.5	2.29

(*) Partial estimates due to incomplete contractor reporting.

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
	See Attached		See Attached	

Line Clearance Forester	717-459-7415	344 S. Poplar St., Hazleton, PA 18201
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES

Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991 (Year) — Susquehanna-Wescosville 500 KV (Line Names) — Central (Division)

ALT No.	Application Dates		Location By Grid No.	
	From	To	From	To
1	6/12/91		53573N32436	53597N32175
	6/13/91		53597N32175	53606N32053
	6/13/91		53700N32007	54064N31829
	6/14/91		54064N31829	54525N31603
	6/17/91		54395N31665	55114N31227
	6/18/91		54761N31466	54900N31370
	6/18/91		55114N31227	55469N31083
	6/20/91		55469N31083	55785N30817
	6/24/91		55745N30972	56140N30453
	6/24/91		54900N31370	55006N31300
	6/25/91		56140N30453	56422N30457
	6/26/91		56422N30457	56825N30341
	6/27/91		56825N30341	57068N30112
	6/27/91		57452N29887	57820N29622
	6/28/91		57820N29622	58138N29379
	7/1/91		58138N29379	58457N28991
	7/2/91		58457N28991	58640N28590
	7/8/91		57318N29950	57542N29843
	7/9/91		59231N27672	59317N27540
	7/10/91		59231N27672	59317N27540
	7/11/91		59317N27540	59390N27432
	7/11/91		59627N26380	59674N26216

Line Clearance Forester (Title) — 717-459-7415 (Phone) — 344 S. Poplar St., Hazleton, PA 18201-0558 (Address)

TABLE 4.2-1

SUSQUEHANNA SES

Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991 (Year) — Susquehanna-Wescosville 500 KV (Line Names) — Central (Division)

ALT No.	Application Dates From	Application Dates To	Location By Grid No. From	Location By Grid No. To
1	7/12/91		59745N25977	59839N25732
	7/12/91		59958N25420	60109N25310
	7/15/91		60109N25310	60494N25232
	8/1/91		57459N29887	57068N30112
	8/2/91		55469N31093	55745N30972
	8/2/91		57068N30112	56911N30258
	8/5/91		50196N34601	50737N34661
	8/6/91		50737N34661	51142N34745
	8/7/91		51142N34745	51284N34774
	8/7/91		51933N34897	52249N34958
	8/8/91		52249N34958	54526N31604
4	6/21/91		53585N32308	53597N32175
	6/21/91		53606N32053	53700N32007
	6/21/91		54395N31605	54525N31603
	6/25/91		55329N31080	55469N31083
	7/2/91		58640N28590	58718N28470
	7/9/91		58718N28470	58981N28045
	8/8/91		52073N34925	52249N34958
	8/8/91		54526N31604	54395N31665

Line Clearance Forester (Title) — 717-459-7415 (Phone) — 344 S. Poplar St., Hazleton, PA 18201-0558 (Address)

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Susquehanna-Wescosville 500 KV	Susquehanna
Year	Line Names	Division

Herbicides					Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
1	Garlon 3A Tordon 101	Triclopyr Picloram 2,4-D	3#/Gal .54#/Gal 2#/Gal	1/2 Gal. 1/2 Gal.	Clean Cut (Arborchem)	1/4 Gal.	Water	98-3/4
4	Accord	Glyphosate	3#/Gal	1 Gal.	Aquatic Surfactant (Arborchem)	1/2 Gal.	Water	98-1/2

Application Data

Alt. No.	No. of Acres	Total Gallons Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
1	23.6	1575	66.7	Garlon-7.9 Tordon-7.9	.33 .33	Triclopyr-23.7 Picloram - 4.3 2,4-D -15.8	1.00 .18 .67
4	6.6	100	15.1	Accord-1.0	.15	Glyphosate-3.0	.45

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
1	6/10/91	6/11/91	44113N33916	44656N33205(RT 239)
4	6/10/91	6/11/91	44136N33589	SUSQUEHANNA RIVER

Line Clearance Forester	717-368-5219	P.O. Box 158, Montoursville, PA 17754
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Susquehanna-Wescosville 500 KV	Lehigh
Year	Line Names	Division

Herbicides					Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
4	Accord	Glyphosate	3#/Gal	1 Gal.	Ortho X-77	1/2 Gal.	Water	98-1/2 Gal.

Application Data

Alt. No.	No. of Acres	Total Gallons Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
4	150.55	2450	16.27	24.50	.16	Glyphosate-73.50	.49

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
4	6/27/91	6/27/91	60722N24367	60634N24814
	6/28/91	6/28/91	60576N24925	60743N24314
	7/9/91	7/9/91	60533N24994	61248N53740
	7/10/91	7/10/91	61248S53740	61376S53510
	7/11/91	7/11/91	61376S53510	61453S53198

Line Clearance Forester	215-774-3258	P.O. Box 3500, Allentown, PA 18106-0500
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES

Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Susquehanna-Wescosville 500 KV	Lehigh
Year	Line Names	Division

ALT No.	Application Dates		Location By Grid No.	
	From	To	From	To
4	7/12/91	7/12/91	61565S52958	62017S52053
	7/15/91	7/15/91	62081S51792	61808S51118
	7/16/91	7/16/91	61987S50771	SIEG. SUB STATION

Line Clearance Forester	215-774-3258	P.O. Box 3500, Allentown, PA 18106-0500
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Stanton-Susquehanna #2	Central
Year	Line Names	Division

Herbicides					Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
3	Access	Triclopyr Picloram	2#/Gal 1#/Gal.	12-1/2 Gal.			Arbochem Basal oil	75
	Garlon 4	Triclopyr	4#/Gal.	12-1/2 Gal.				

Application Data

Alt. No.	No. of Acres	Total Gallons Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
3	5.6	8.6	1.5	Access-1.07	.19	Triclopyr - 2.14 Picloram - 1.07	.38 .19
				Garlon-1.07	.19	Triclopyr - 4.28	.76

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
3	9/27/91	10/1/91	45029N34056	44970N34183
			44966N34349	44977N34222
			44877N34222	44970N34183
			44965N34286	44918N34386
			44918N34386	44858N34387
			44858N34387	44777N34376
			44777N34487	44655N34488

Line Clearance Forester	717-459-7415	344 S. Poplar St., Hazleton, PA 18201
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Sunbury-Susquehanna #2	Susquehanna
Year	Line Names	Division

Herbicides					Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
1	Garlon 3A Tordon 101	Triclopyr Picloram 2,4-D	3#/Gal .54#/Gal 2#/Gal	1/2 Gal. 1/2 Gal.	Clean Cut (Arborchem)	1/4 Gal.	Water	98-3/4
4	Accord	Glyphosate	3#/Gal	1 Gal.	Aquatic Surfactant (Arborchem)	1/2 Gal.	Water	98-1/2

Application Data

Alt. No.	No. of Acres	Total Gallons Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
1	346.8	26,860	77.4	Garlon-134.3 Tordon-134.3	.39 .39	Triclopyr-402.9 Picloram - 72.5 2,4-D -268.6	1.16 .21 .77
4	61.5	5,552	90.3	Accord-55.5	.90	Glyphosate-166.5	2.71

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
1	6/10/91	9/30/91	44101N33916	25791N24175
4	6/10/91	9/30/91	44101N33916	25791N24175

Line Clearance Forester	717-368-5219	P.O. Box 158, Montoursville, PA 17754
Title	Phone	Address

TABLE 4.2-1

SUSQUEHANNA SES
Maintenance of Transmission Line Corridors
Selective Herbicide Application

1991	Sunbury-Susquehanna #2	Susquehanna
Year	Line Names	Division

Herbicides				Additives		Carrier	
Alt. No.	Commercial Name	Active Ingredient	Acid Equiv.	Spec. Amt. Per 100 Gal Solution	Commercial Name	Spec. Amt. Per 100 Gal Solution	Name	Spec. Amt. Per 100 Gal Solution
3	Access	Triclopyr Picloram	2#/Gal 1#/Gal	12-1/2 Gal.			Arborchem Basal Oil	75
	Garlon 4	Triclopyr	4#/Gal	12-1/2 Gal.				

Application Data

Alt. No.	No. of Acres	Total Gallons Solution	Application Rate Gal./A	Total Gallons Concentrate	Rate Gal./A	Total Pounds Acid Equivalent	Pounds Per Acre
3	3.5	20.6	5.9	Access-2.6	.74	Triclopyr- 5.2 Picloram - 2.6	1.49 .74
				Garlon-2.6	.74	Triclopyr-10.4	2.97

Alt. No.	Application Date		Location By Grid No.	
	From	To	From	To
3	6/20/91	7/16/91	44101N33916	25791N24175

Line Clearance Forester	717-368-5219	P.O. Box 158, Montoursville, PA 17754
Title	Phone	Address

TABLE 4.2-2

SUSQUEHANNA SES
MAINTENANCE OF TRANSMISSION LINE CORRIDORS

1991	Susquehanna-Wescosville 500 KV	Central
Year	Line Names	Division

Selective Reclearing

Dates From	Dates To	Grid Location From	Grid Location To	Acres
7/3		52863N34549		.275
6/25		53931N31895	(Tower Base)	.918

Side Trimming

Dates From	Dates To	Grid Location From	Grid Location To	Lin. Ft.

Danger Tree Removals

Dates From	Dates To	Grid Location From	Grid Location To	Trees

Screen Trimming

Dates From	Dates To	Grid Location From	Grid Location To

Line Clearance Forester	717-459-7415	344 S. Poplar St., Hazleton, PA. 18201-0558
Title	Phone	Address

TABLE 4.2-2

SUSQUEHANNA SES
MAINTENANCE OF TRANSMISSION LINE CORRIDORS

1991	Susquehanna-Wescosville 500 KV	Lehigh
Year	Line Names	Division

Selective Reclearing

Dates		Grid Location		
From	To	From	To	Acres
1/9/91		60457/S47964	60424/S47980	.18
1/11/91		60457/S47964	60424/S47980	.09
		60499/S47819	60457/S47964	.02
1/16/91		60499/S47819	60457/S47964	.19
1/21/91		60457/S47964	60499/S47819	.20
1/30/91		60499/S47819	60452/S47964	.08
2/14/91		60210/S48965	60241/S48946	.09
2/19/91		60141/S49046	60110/S49165	.13
8/21/91		60781/S50456	60697/S50369	.03
9/10/91		60777/S47041	60742/S47154	.22

Top/Side Trimming

Dates		Grid Location		Trees
From	To	From	To	
2/11/91		60814/S46919	60777/S47041	3
2/11/91		60745/S47155	60718/S47251	24
2/12/91		60843/S46822	60886/S46740	7

Danger Tree Removals

Dates		Grid Location		Trees
From	To	From	To	
1/30/91		61670/S47337	61674/S47323	1
2/5/91		60814/S46919	60777/S47041	3
2/12/91		60843/S46822	60886/S46740	1

Screen Trimming

Dates		Grid Location		Trees
From	To	From	To	
2/5/91		60814/S46919	60777/S47041	46

Line Clearance Forester (Title) | 215-774-3258 (Phone) | P.O. Box 3500, Allentown, PA. 18106-0500 (Address)

5.0 ENVIRONMENTAL PROTECTION PLAN REPORTING REQUIREMENTS

5.1 REVIEW AND AUDIT

The Licensee has established procedures for an independent group to review and audit compliance with the EPP. Audits of EPP compliance are conducted by Environmental Management Division (EMD) and Nuclear Quality Assurance. The Auditing Organizational Chart (Fig. 5.1-1) lists the various groups utilized in environmental reviewing and auditing of the Susquehanna SES environmental monitoring programs. The Manager-Nuclear Technology is responsible for off-site environmental monitoring and for providing any related support concerning licensing. The Superintendent of Plant-Susquehanna is responsible for on-site environmental matters. The Manager-Nuclear Quality Assurance with support from the Manager-Environmental Management Division of the System Power and Engineering Department is responsible for verifying compliance with the EPP.

Audits of the EPP are conducted every other year. There was an audit of the EPP in June and July 1991. There was one finding from 1989 and one from 1990. These findings were:

- 1989 - After four-hour NRC notification of PCB spill, there was no 30-day follow-up report. Reporting procedures have been updated to close out this finding.

- 1990 - A copy of the most recent NPDES permit (January 1990) was not submitted to the NRC. It has since been submitted closing out this finding.

5.2 RECORDS RETENTION

Records and logs relative to environmental aspects of plant operation and audit activities are retained in the Susquehanna Records Management System. This system provides for a convenient review and inspection of environmental documents which are available to the NRC upon request.

All records concerning modifications of plant structures, systems and components which are determined to potentially affect the continued protection of the environment, shall be retained for the life of the plant. All other records, data, and logs relating to the environmental programs and monitoring shall be retained for at least five years or, where applicable, in accordance with the requirements of other agencies.

5.3 CHANGES IN ENVIRONMENTAL PROTECTION PLAN

There were no requests for changes in the EPP during 1991.

5.4 PLANT REPORTING REQUIREMENTS

5.4.1 ROUTINE REPORTS

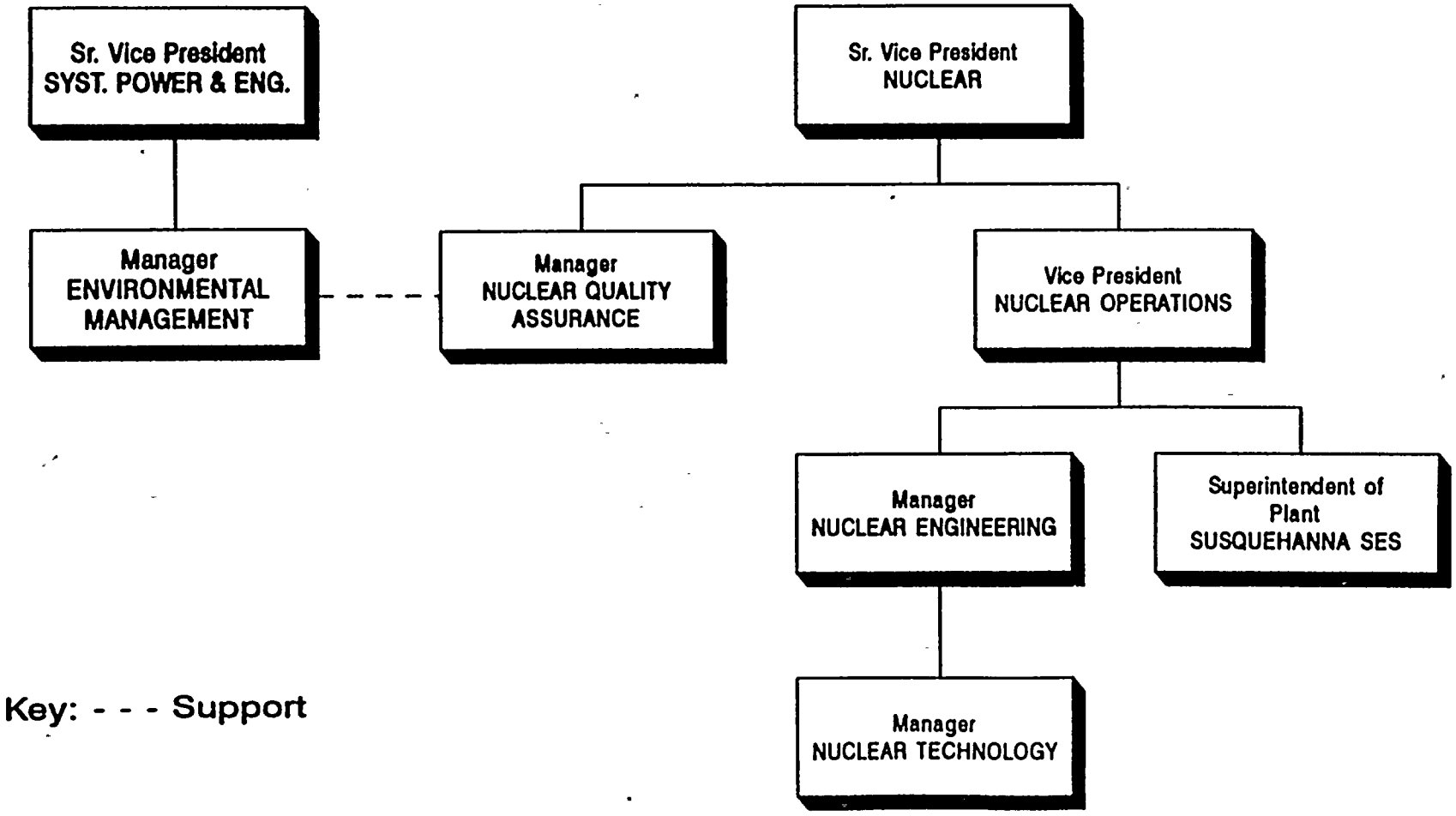
This Annual Environmental Operating Report (Nonradiological) was prepared to meet routine reporting requirements of the EPP for 1991. It provides summaries and analyses of environmental protection activities required in Subsection 4.2 of the EPP for the reporting period.

5.4.2 NONROUTINE REPORTS

There were no nonroutine events in 1991.

Figure 5.1-1

AUDITING ORGANIZATION CHART



Ecology III, Inc.

ENVIRONMENTAL SERVICES

SUSQUEHANNA SES ENVIRONMENTAL LABORATORY

R.R.#1 — Berwick, PA 18603
(717) 542-2191
FAX NO. (717) 542-2193

19 September 1991

Mr. Richard St. Pierre
U.S. Fish & Wildlife Service
1721 North Front Street, Suite 105
Harrisburg, PA 17102

Dear Dick:

Pursuant to our discussion on 11 September 1991, Ecology III will cancel its autumn 1991 monitoring program for impinged juvenile American shad at the Susquehanna River water intake of the Pennsylvania Power and Light Company's Susquehanna Steam Electric Station near Berwick. As you pointed out, there is very little likelihood that many of the adult shad stocked above the York Haven Dam this spring dispersed this far up river to spawn because of low river flows caused by the ongoing drought in Pennsylvania. We have rescheduled impingement monitoring for autumn 1992 in anticipation that the drought will be over by then.

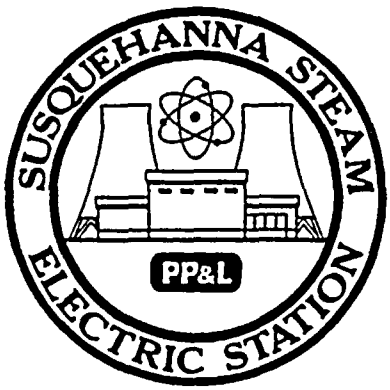
If you have any questions or comments, please contact me at your convenience.

Sincerely yours,

Theodore V. Jacobsen,
President

/msh

c: J. S. Fields (PP&L)



Susquehanna Steam Electric Station

Units 1 & 2

Radiological Environmental Monitoring Program

1991 Annual Report

PP&L

Pennsylvania Power & Light Company

Allentown, PA

April 1992

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

I. EXECUTIVE SUMMARY

In 1991, there were approximately 1,500 routine samples collected at more than 150 locations, and about 3000 routine analyses performed in support of the Radiological Environmental Monitoring Program (REMP). The extent of the sampling met or exceeded the requirements of the technical specifications for the Susquehanna Steam Electric Station (SSES). The types of analyses performed on these samples for the identification and quantification of radioactivity also met or exceeded SSES technical specifications requirements. The result of this effort was verification of the SSES Effluent Monitoring Program data that indicate that the operation of SSES has no deleterious effect on the health and safety of the public or the environment.

The amounts of the radionuclides detected in 1991 are so small, as in past years, that the maximum dose to an individual in the general public is only a small fraction of one percent of the dose limits established by the Nuclear Regulatory Commission as stated in 10CFR50, Appendix I. The maximum potential off-site dose from radionuclides detected in the REMP was calculated to be less than 0.001 millirem/year attributable to the SSES operations. This is negligible compared to the public's exposure from natural background radiation of approximately 300 millirem/year effective dose equivalent.

II. INTRODUCTION

The preoperational radiological environmental monitoring program (REMP) for Pennsylvania Power & Light Company (PP&L) at the Susquehanna Steam Electric Station (SSES) was conducted from April 1972 to September 1982. On September 10, 1982, Unit #1 became critical, thereby initiating the operational phase of the program. The preoperational phase of the program, as well as the initial phase of the operational program (September 10, 1982 through June 1983), was conducted by Radiation Management Corporation (RMC).

NUS Corporation conducted the REMP from June 1983 until August 1984 when Teledyne Isotopes (TI) took over the REMP. Also, starting in August 1984, Ichthyological Associates (PP&L's biological consultants) assumed responsibility for the sample collection portion of the program. In June 1985, Ecology III became PP&L's biological consultants (essentially utilizing the same staff) and they continued to perform sample collection activities through 1991. Except for a period of one year (March 1990 through February 1991), Teledyne Isotopes has performed the analysis of routine REMP samples since August 1984. (Controls for Environmental Pollution analyzed the samples from March 1990 through February 1991.)

This report covers the period from December 31, 1990 through January 6, 1992. Teledyne Isotopes and Controls for Environmental Pollution performed all the analyses except the thermoluminescent dosimetry (TLD) program which is conducted by PP&L. A detailed Quality Control and Quality Assurance Program is conducted along with the Radiological Program. Data from programs conducted in prior years have been presented in a series of annual reports. See Section XI of this report for a detailed listing of these reports.

A. Site and Station Description

The Susquehanna Station contains two BWR generating units, each with a capacity of about 1050 MWe. Unit #1 achieved initial criticality on September 10, 1982. Unit #2 achieved initial criticality on May 8, 1984. The site is located on an approximately 1500 acre tract along the Susquehanna River, five miles northeast of Berwick in Salem Township, Luzerne County, Pennsylvania.

The area surrounding the site can generally be characterized as rural, with forest and agricultural lands predominating. More specific information on the demography, hydrology, meteorology and land use characteristics of the local area may be found in the Environmental Report[14], the Final Safety Analysis Report[15] and the Final Environmental Statement[16] for the SSES.

B. Fundamentals of Radiological Environmental Monitoring Programs

Radioactive materials are present in man's environment as the result of both natural processes and of man's technological developments. Normally, people and organisms are continually exposed to naturally occurring radiation and radionuclides from internal, terrestrial, and cosmic sources. The main contribution to the exposure of members of the general public from man-made sources is from the medical services field (x-rays, radioactive medical treatments, etc.).

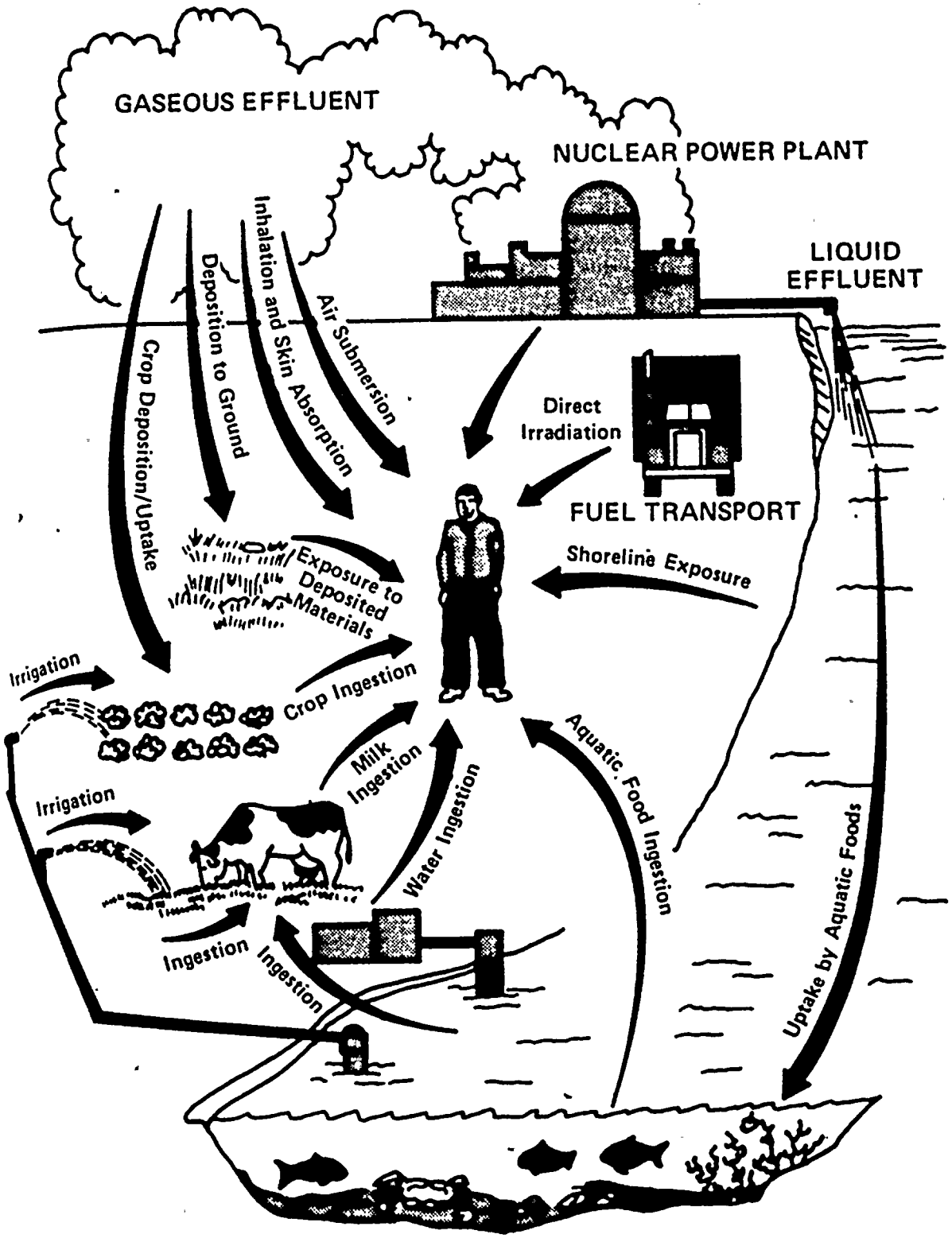
Background levels vary with time and location as they are influenced by external events such as cosmic ray bombardment, weapons test fallout, and seasonal variations. These levels also can vary significantly within relatively short distances due to variations in the mineral composition of the earth's crust and other factors. Because of these spatial and temporal variations, the environmental radiological surveys in the vicinity of the SSES are divided into preoperational and operational phases. The preoperational phase of the program of sampling and measuring radioactivity in various media permits a characterization of the radiation levels and concentrations prior to plant operation along with an indication of the degree of natural variation to be expected. The operational phase of the program obtains data which, when considered along with the data obtained in the preoperational phase, assist in the evaluation of the radiological impact of plant operation.

From a nuclear power plant such as the SSES, there are three basic pathways in which a member of the public has the potential to be exposed to radioactivity. Figure 1 depicts these pathways of radioactive material uptake: 1) inhalation (breathing); 2) ingestion (eating, drinking); and 3) whole body irradiation directly from the plant or from immersion in airborne effluents.

To effectively monitor the radioactivity in the environment, media are sampled which have the potential to affect the human body either directly or indirectly. Media normally sampled to meet radiological environmental monitoring program requirements may be categorized as either atmospheric or aquatic.

FIGURE 1

EXPOSURE PATHWAYS TO HUMANS



Atmospheric Sampling - Air is sampled to evaluate potential radiation exposures from inhaled radionuclides in gaseous (iodine) or particulate form. Direct radiation and air submersion exposures are also monitored. Precipitation is sampled to follow the movement of radionuclides from air to terrestrial and aquatic media.

Terrestrial Sampling - Plant life, primarily in the form of food products (fruits, vegetables, etc.), is sampled because it is a primary source for ingestion of radionuclides. Common game animals normally hunted for food (deer, squirrels) are also sampled.

Dairy products are sampled because they are widely consumed. Milk is one of the few foods commonly consumed soon after production which may therefore contain relatively short-lived radionuclides when consumed.

Soil samples are also collected to provide an additional means of monitoring the air-to-ground pathway.

Aquatic Sampling - River water is sampled to verify the results of any liquid releases of radionuclides from the facility, and drinking water supplies are sampled to identify and evaluate any potential radiation exposure through ingestion.

Fish are sampled since they are a primary aquatic food source. Algae and sediment are collected since they are indicators and accumulators of radionuclides in the aquatic system.

C. Objectives of the SSES REMP

The objectives of the SSES Operational Radiological Environmental Monitoring Program are:

1. To identify, measure and evaluate existing radionuclides in the environs of the SSES, and to determine whether any significant increase occurs in the concentration of radionuclides in critical pathways.

2. To verify that SSES operations have adequate reactor effluent control.

3. To assess actual or potential dose impacts to the public.

4. To verify that SSES operations have no detrimental effects on the health and safety of the public or on the environment.

5. To fulfill the obligations of the radiological environmental surveillance sections of the SSES Technical Specifications.

D. Regulatory Overview

United States Nuclear Regulatory Commission (USNRC) regulations require that nuclear power plants be designed, constructed, and operated to keep levels of radioactive material in effluents to unrestricted areas as low as reasonably achievable (ALARA) (10 CFR 50.34 and 10 CFR 20.1c). To ensure that these criteria are met, each license authorizing reactor operation includes technical specifications (10 CFR 50.36a) which contain requirements governing radioactive effluents.

In-plant monitoring is used to ensure that predetermined release limits are not exceeded. However, as a precaution against unexpected and undefined processes which might allow undue accumulation of radioactivity in any sector of man's environment, a program for monitoring the environment in the vicinity of the SSES is also included in the SSES Technical Specifications. The regulations governing the quantities of radioactivity in reactor effluents allow nuclear power plants to contribute, at most, only a few percent increase above normal background radioactivity.

The SSES REMP was designed on the basis of the USNRC Radiological Assessment Branch Technical Position on radiological environmental monitoring as described in Revision 1, November 1979.[17] PP&L has expanded the basic program required by the NRC to aid in the characterization of area radiation levels and any possible impact from the SSES operation.

E. Scope of the SSES REMP

The table below summarizes the radioactive materials/radiation levels and the media in which they were routinely examined by the SSES Radiological Environmental Monitoring Program (REMP) during 1991.

SSES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Type of Monitoring	Media Monitored
Gross Alpha Activity	All Waters Air Particulates Coarse Sediment Flocculated Sediment
Gross Beta Activity	All Waters Air Particulates Coarse Sediment Flocculated Sediment Fish
Activities of Gamma-Emitting Radionuclides	All Media
Tritium Activity	All Waters
Iodine-131 Activity	Surface Water Drinking Water Air Milk
Strontium-89/90 Activities	Milk
Exposure Rates (by Thermoluminescent Dosimeters & Pressurized Ion Chambers)	Ambient

There were nearly 1,500 routine samples collected and more than 3,000 routine analyses performed in support of the REMP in 1991. These numbers exclude duplicate and split sampling, as well as non-routine sampling and analysis.

Sampling locations are selected on the basis of local ecology, meteorology, physical characteristics of the region, and demographic and land use features of the site vicinity.

III. PROGRAM DESCRIPTION

One-hundred fifty-eight locations were included in the SSES monitoring program for 1991. Environmental sampling locations were divided into two classes, indicator and control. Indicator samples are those collected at locations which are expected to manifest station effects, if any exist, and are selected on the basis of distance from the site, topography, hydrology, meteorology, demography, and drainage characteristics. Control samples are collected at locations which are expected to be less likely to be affected by station operation. These control samples provide a basis by which to evaluate fluctuations in radioactivity at indicator locations in relation to natural phenomena and fallout. The number and locations of monitoring points were determined by considering the locations where the highest off-site environmental concentrations have been predicted from plant effluent source terms, site hydrology, and site meteorological conditions. Other factors considered were applicable regulations, population distribution, ease of access to sampling stations, security and future program integrity.

The operational environmental radiological program for the SSES is summarized in Table 1. Tables 2 and 3 describe monitoring locations, associated media, and approximate distances and directions from the site. Figures 2, 3, 4, 5, 6, and 7 illustrate the locations of sampling stations relative to the SSES.

In addition to the described analytical program, a milk animal, vegetable garden, and residence survey was performed in 1991. This survey identified the dairy animals within the five-mile radius of the SSES and the nearest garden and residence in each sector. These land use parameters are used in the assessment of potential radiological doses to hypothetical individuals and populations of the stated regions.

TABLE 1
(Page 1 of 3)

Annual Analytical Schedule for the
Susquehanna Steam Electric Station (PP&L)
Radiological Environmental Monitoring Program - 1991

Media & Code	No. of Locations	Sample Freq.(a)	Analyses Required	Analysis Freq.(b)
Airborne Particulates	10	W	Gross Beta (c)	W
			Gross Alpha	QC
			Gamma Spectrometry	QC
Airborne Iodine	10	W	I-131	W
Sediment	6	SA	Gross Alpha	SA
			Gross Beta	SA
			Gamma Spectrometry	SA
Flocculated Sediment	2	SA	Gross Alpha	SA
			Gross Beta	SA
			Gamma Spectrometry	SA
Fish	3	SA	Gross Beta	SA
			Gamma Spectrometry (on edible portion)	SA
Surface Water (d)	9	MC or M	Gross Alpha	M
			Gross Beta	M
			I-131	BW
			Gamma Spectrometry	M
			Tritium	M
Well (ground) Water	8	M	Gross Alpha	M
			Gross Beta	M
			Gamma Spectrometry	M
			Tritium	M
Drinking Water (e)	2	MC	Gross Alpha	M
			Gross Beta	M
			I-131	BW
			Gamma Spectrometry	M
			Tritium	M

Note: See footnotes at end of table.

TABLE 1
(Page 2 of 3)

Annual Analytical Schedule for the
Susquehanna Steam Electric Station (PP&L)
Radiological Environmental Monitoring Program - 1991

Media & Code	No. of Locations	Sample Freq.(a)	Analyses Required	Analysis Freq.(b)
Precipitation	10	QC	Gross Alpa	Q
			Gross Beta	Q
			Gamma Spectrometry	Q
			Tritium	Q
Cow Milk	10	M, SM(f)	Gross Beta-K-40	SM, M
			Strontium-89/90	SM, M
			I-131	SM, M
			Gamma Spectrometry	SM, M
Food Products (Various Fruits and Vegetables)	15	A	Gamma Spectrometry	A
Game	8	A	Gamma Spectrometry	A
Poultry and Eggs	2	A	Gamma Spectrometry	A
Soil	10	A	Gamma Spectrometry	A
Vegetation	10	A	Gamma Spectrometry	A

Note: See footnotes at end of table.

TABLE 1
(Page 3 of 3)

Annual Analytical Schedule for the
Susquehanna Steam Electric Station (PP&L)
Radiological Environmental Monitoring Program - 1991

Media & Code	No. of Locations	Sample Freq.(a)	Analyses Required	Analysis Freq.(b)
Direct Radiation	92	Q	TLD	Q
	1	A	TLD	A
Algae	2	M	Gamma Spectrometry	M

(a) W = weekly, BW = bi-weekly, M = monthly, SM = semi-monthly, Q = quarterly, QC = quarterly composite, SA = semi-annually, A = annually, MC = monthly composite.

(b) Codes are the same as for sample frequency.

(c) If the gross beta activity is greater than 10 (ten) times the yearly mean of the control sample, gamma analysis should be performed on the individual filter. Gross beta analysis is performed 24 hours or more following filter change to allow for radon and thoron daughter decay.

(d) Stations 6S6 and 6S7 are checked weekly to ensure automatic composite sampler operation which is time proportional. Station 6S5 is grab sampled weekly. Individual composites of the weekly samples are made both monthly (MC) and bi-weekly for analysis.

(e) Water from stations 12H2 RAW and 12H2 TREATED is collected weekly. Individual composite samples of the weekly collections are made both monthly (MC) and bi-weekly for analysis. 12H2 RAW is a time proportional automatic composite sampler. 12H2 TREATED is a daily grab sample.

(f) Stations 12B3, 12D2, 14B1, and 10G1 were analyzed semi-monthly from April through October.

TABLE 2

TLD Monitoring Locations for the SSES Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
			Less Than One Mile from the SSES[a] (See Figure 2)
1S2	0.2	N	Perimeter Fence
2S2	0.9	NNE	Energy Information Center
2S3	0.2	NNE	Perimeter Fence
2S5	0.9	NNE	Energy Information Center (PIC 2)
3S3	0.9	NE	Recreational Area
3S4	0.3	NE	Perimeter Fence
3S6	0.5	NE	SSES Backup Met Tower
4S1	1.0	ENE	Susquehanna River Flood Plain
4S3	0.2	ENE	Perimeter Fence
5S1	0.8	E	North of Environmental Laboratory
5S4	0.8	E	West of Environmental Laboratory
5S7	0.3	E	Perimeter Fence
6S4	0.2	ESE	Perimeter Fence
6S8	0.2	ESE	Site Pole No. 44316/N34036
6S9	0.2	ESE	Perimeter Fence (south)
7S6	0.2	SE	Perimeter Fence
8S2	0.2	SSE	Perimeter Fence
9S2	0.2	S	Security Fence
10S1	0.4	SSW	Perimeter Fence (steel post)
10S2	0.2	SSW	Security Fence
11S2	0.4	SW	Golomb House (44016/N33986)
11S3	0.3	SW	Security Fence
11S6	0.5	SW	SW ANSP Garden
12S3	0.4	WSW	Perimeter Fence
13S2	0.4	W	Perimeter Fence
13S4	0.4	W	Security Fence (LLRWHF-south)[b]
13S5	0.4	W	Security Fence (LLRWHF-north)[b]

TABLE 2

TLD Monitoring Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 2)	
14S5	0.5	WNW	Site Pole No. 43996/N34230
14S6	0.7	WNW	Site Pole No. 43869/N34174
15S4	0.6	NW	Transmission Line
15S5	0.4	NW	Perimeter Fence
16S1	0.3	NNW	Perimeter Fence (east)
16S2	0.3	NNW	Perimeter Fence (west)
6A4	0.6	ESE	former State Police Bldg.
7A1	0.4	SE	Kline Residence
7A2	0.6	SE	Bell Bend Pole No. 44437/N33887
8A3	0.9	SSE	PP&L Wetlands Sign
15A3	0.9	NW	Serafin Farm
16A2	0.8	NNW	Rupinski Farm
		From One to Five Miles from the SSES[a] (See Figure 3)	
1B1	1.4	N	Mingle Inn Road
2B3	1.3	NNE	Durabond Corporation
2B4	1.4	NNE	Durabond Corporation
4B1	1.2	ENE	Stone Crusher Trail
5B2	1.4	E	Pa. Route 239 Intersection
6B2	1.4	ESE	Wapwallopen
7B3	1.7	SE	Council Cup
7B4	1.5	SE	Heller's Orchard Store
8B2	1.4	SSE	Lawall Residence
8B3	1.5	SSE	Wapwallopen Post Office

TABLE 2

TLD Monitoring Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 4)	
12G1	15	WSW	PP&L Service Center, Bloomsburg
12G4	10	WSW	Naus Residence

a) All distances from the SSES to monitoring locations are measured from the standby gas treatment vent at 44200/N34117 (Pa. Grid System). The location codes are based on both distance and direction from the SSES. The letters in the location codes indicate if the monitoring locations are on site (within the site boundary) or, if they are not on site, the approximate distances of the locations from the SSES as described below:

S - on site	E - 4-5 miles
A - <1 mile	F - 5-10 miles
B - 1-2 miles	G - 10-20 miles
C - 2-3 miles	H - >20 miles
D - 3-4 miles	

The numbers preceding the letters in the location codes provide the directions of the monitoring locations from the SSES by indicating the sectors in which they are located. A total of 16 sectors (numbered 1 through 16) equally divide an imaginary circle on a map of the SSES and its vicinity, with the SSES at the center of the circle. The middle of sector 1 is directed due north (N). Moving clockwise from sector 1, the sector immediately adjacent to sector 1 is sector 2, the middle of which is directed due north, northeast (NNE). Continuing to move clockwise, the sector numbers increase to 16, which is the north, northwest sector.

The numbers following the letters in the location codes are used to differentiate sampling locations found in the same sectors at approximately the same distances from the SSES.

b) LLRWHF is the Low Level Radioactive Waste Handling Facility.

TABLE 2

TLD Monitoring Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 3)	
9B1	1.3	S	Transmission Line east of Rte. 11
10B2	2.0	SSW	Algatt Residence
10B3	1.7	SSW	General Tank Equip. Co.
10B4	1.4	SSW	General Tank Equip. Co.
12B4	1.7	WSW	Shultz Farm
12B5	1.8	WSW	Intersection (Pole #43401/N33620)
13B1	1.3	W	Walker Run Creek (Tele.Pole #36)
14B2	1.7	WNW	Walker Run Creek (Pole #43364/ N34380)
15B1	1.7	NW	Mingle Inn Trailer Park
16B1	1.6	NNW	Walton Power Line
16B2	1.7	NNW	High Tension Lines
11C1	2.0	SW	Salem Township Fire Company
1D2	4.0	N	near Mocanaqua Substation
3D1	3.4	NE	Pond Hill
8D3	4.0	SSE	Mowry Residence
9D4	3.6	S	Country Folk Store
10D2	3.0	SSW	Ross Ryman Farm
12D3	3.7	WSW	Dagostin Residence
1E1	4.5	N	Lane Residence
1E2	4.2	N	Shickshinny Municipal Bldg. (PIC 3)
4E1	4.8	ENE	Ruckles Hill Rd. (Pole #46422/N35197)
5E2	4.5	E	Bloss Farm

TABLE 2

TLD Monitoring Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 3)	
6E1	4.7	ESE	St. James Church
7E1	4.2	SE	Harwood Trans. Line Pole #2
11E1	4.7	SW	Thomas Residence
12E1	4.7	WSW	Berwick Hospital
13E4	4.1	W	Kessler Farm
14E1	4.1	WNW	Canouse Farm
	Greater than Five Miles from the SSES[a]		
		(See Figure 4)	
2F1	5.9	NNE	St. Adalberts Cemetery
3F1	9.1	NE	Valania Residence
3F2	9.9	NE	Sheatown Intersection
8F2	8.5	SSE	Huff Residence
12F2	5.2	WSW	Berwick Substation
12F4	5.2	WSW	Berwick City Hall (PIC 1)
15F1	5.4	NW	Zawatski Farm
16F1	7.8	NNW	Hidlay Residence
3G2	10.7	NE	Nanticoke Municipal Bldg. (PIC 4)
3G3	16	NE	WB Horton St. Substation
3G4	17	NE	WB Service Center
4G1	14	ENE	Mountaintop - Industrial Park
7G1	14	SE	Hazleton Chem Lab
7G2	12	SE	Hazleton (Pole #31852-H)

FIGURE 2

1991 TLD MONITORING LOCATIONS

WITHIN ONE MILE OF THE SSES

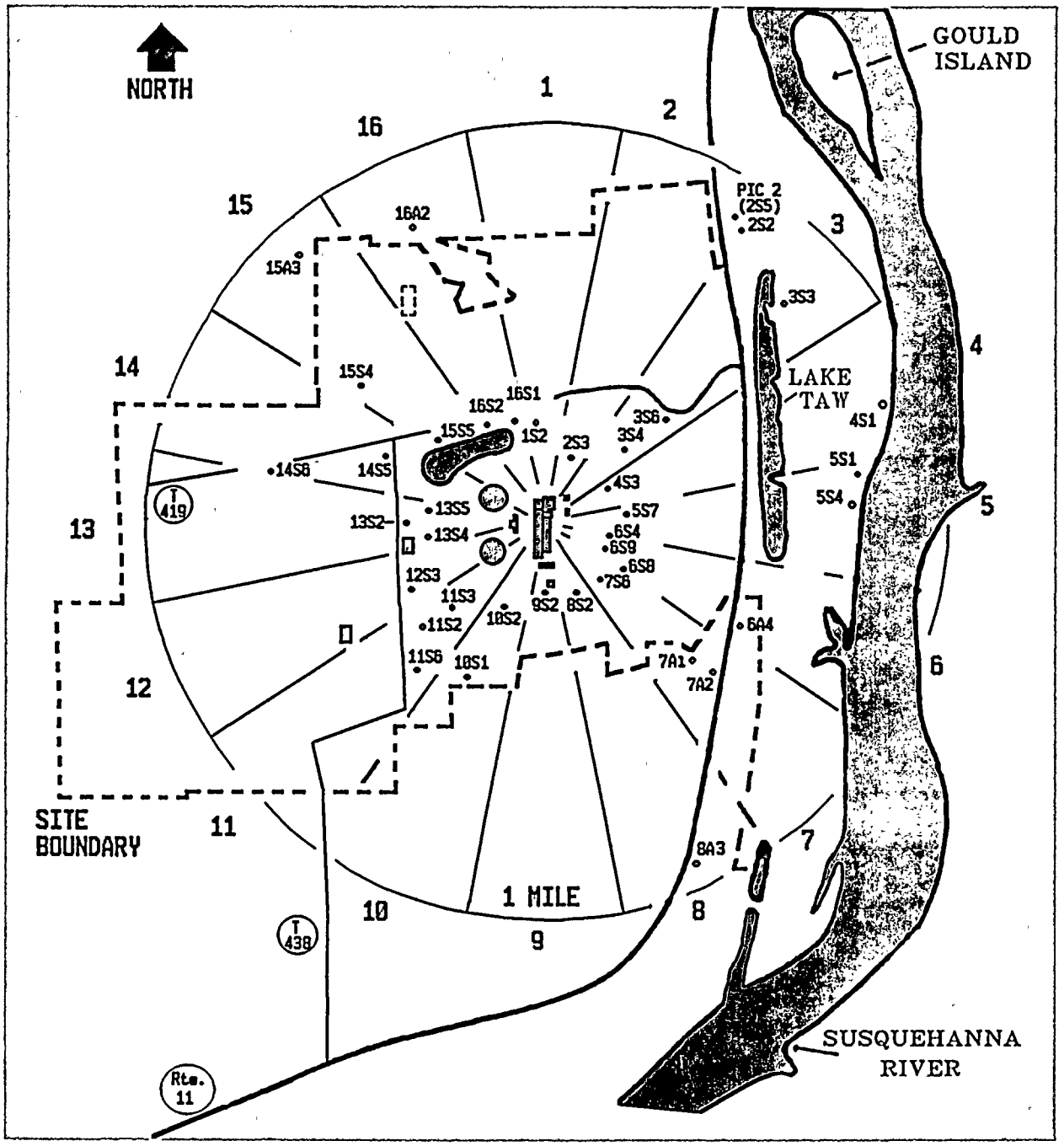


FIGURE 3
1991 TLD MONITORING LOCATIONS
FROM ONE TO FIVE MILES OF THE SSES

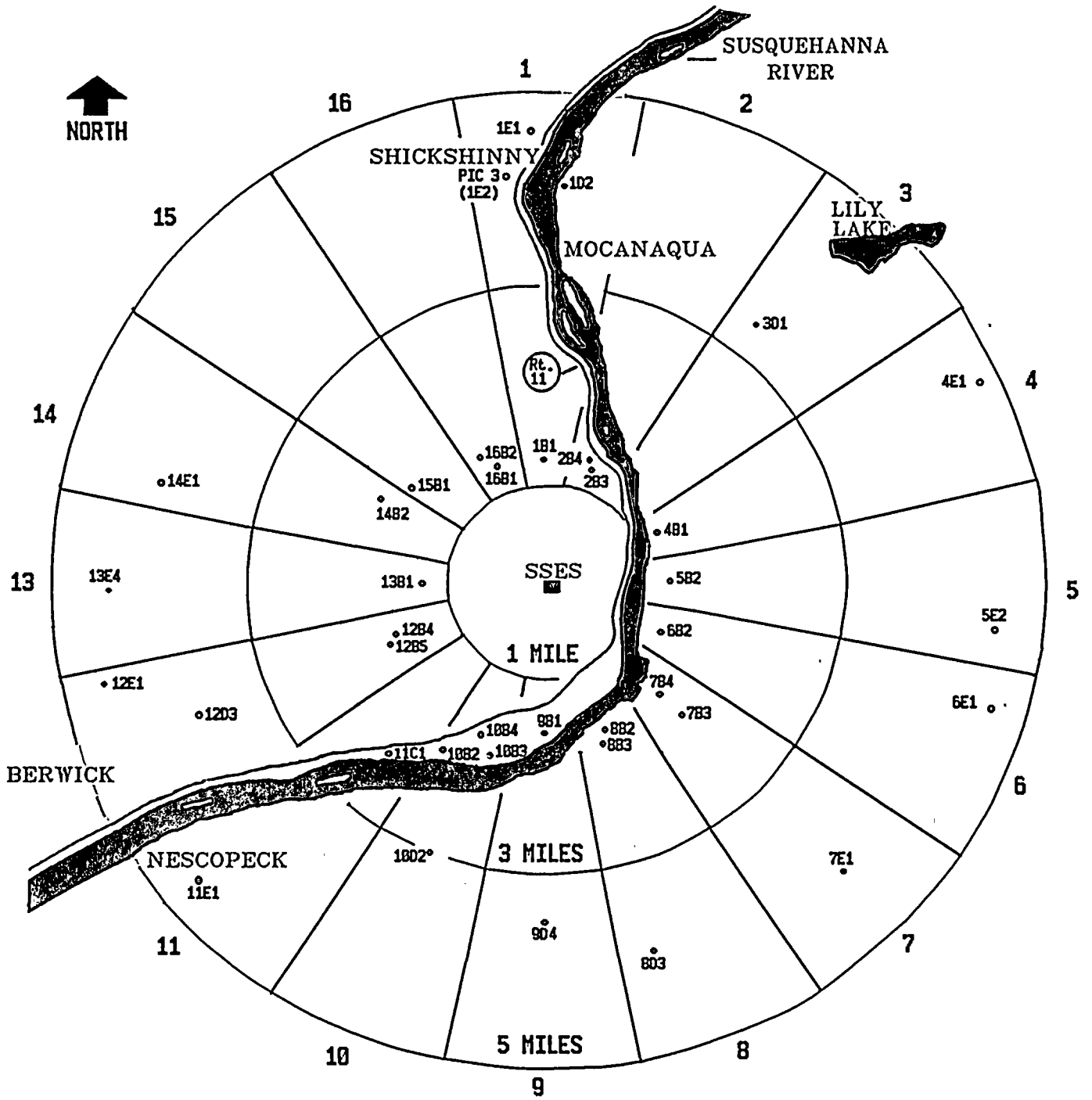


FIGURE 4
1991 TLD MONITORING LOCATIONS
GREATER THAN FIVE MILES FROM THE SSES

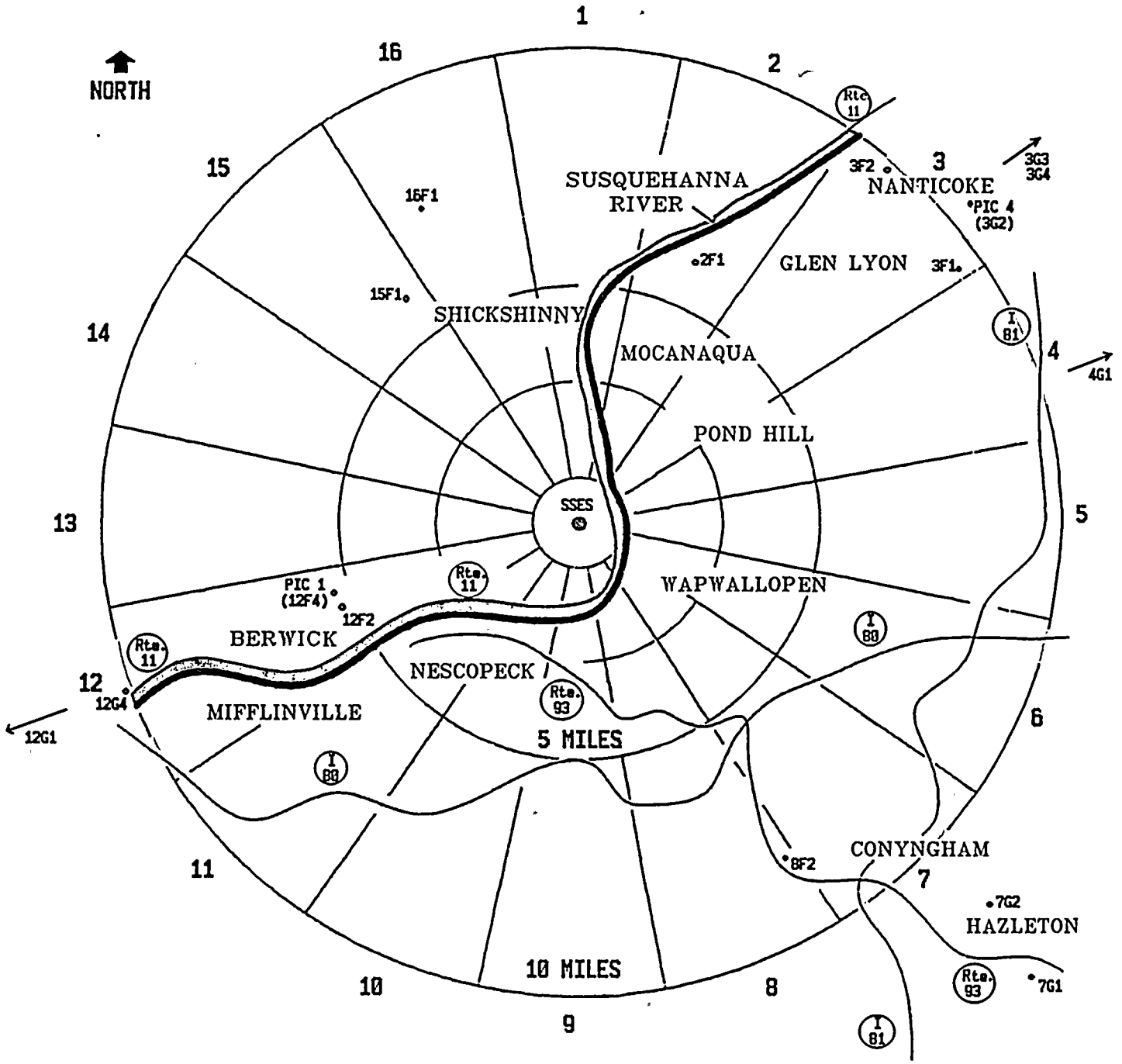


TABLE 3

Sampling Locations for the SSES Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		Less Than One Mile from the SSES[a] (See Figure 5)	
		SURFACE WATER	
5S8	0.8	E	Area under power line
6S5	0.9	ESE	Outfall Area
6S6	0.8	ESE	River water intake line
6S7	0.4	ESE	Cooling tower blowdown line
LTAW		NE - ESE	Lake Took-A-While (on site)
		ALGAE	
AG3	0.8	E	Above the river water intake - surface
AG4	0.9	ESE	Below the discharge diffuser - surface
		SEDIMENT[c]	
LTAW		NE - ESE	Lake Took-A-While (on site)
		GROUND WATER	
2S6	0.9	NNE	Energy Information Center
3S5	0.9	NE	Riverlands Security Office
4S2	0.5	NE	Peach Stand
4S4	0.5	ENE	Training Center
4S5	0.5	ENE	White House
12S1	0.5	SW	EOF Building
		AIR/PRECIPITATION	
2S2	0.9	NNE	Energy Information Center
3S2	0.5	NE	SSES Backup Met Tower
5S4	0.8	E	West of Environmental Laboratory
12S2	0.4	WSW	EOF Building

TABLE 3

Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 5)	
		AIR/PRECIPITATION (continued)	
15S4	0.6	NW	Transmission Line
		SOIL/VEGETATION	
3S7	0.5	NE	Backup Met Tower
5S5	0.8	E	West of Biological Consultants
12S4	0.4	WSW	EOF Building
15S4	0.6	NW	Transmission Line
		FISH	
LTAW		NE-ESE	Lake Took-A-While
		GAME[c]	
5S		E	SSES (on site)
10S		SSW	SSES (on site)
		<u>From One to Five Miles From the SSES</u> (See Figure 6)	
		SURFACE WATER	
1D3	3.9	N	Mocanaqua Bridge
		FISH[b]	
IND	0.9 - 1.4	ESE	At or below the discharge structure

TABLE 3

Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 6)	
		SEDIMENT[c]	
2B	1.6	NNE	Gould Island
7B	1.2	SE	Bell Bend
11C	2.6	SW	Hess Island
		FLOCCULATED SEDIMENT[c]	
2B	1.6	NNE	Gould Island
7B	1.2	SE	Bell Bend
		GROUND WATER	
12E4	4.7	WSW	Berwick Hospital
		AIR/PRECIPITATION	
9B1	1.3	S	Transmission Line east of Rte. 11
1D2	4.0	N	Near Mocanaqua Substation
3D1	3.4	NE	Pond Hill
12E1	4.7	WSW	Berwick Hospital
		MILK	
12B3	2.0	WSW	Young Farm
14B1	1.8	WNW	Stola Farm
6C1	2.7	ESE	Moyer Farm
9D3	3.8	S	Broyan Farm
10D1	3.0	SSW	Ross Ryman Farm
10D3	3.5	SSW	Drasher Farm
10D4	3.8	SSW	Kishbaugh Farm

TABLE 3
Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 6)	
		MILK (continued)	
12D2	3.7	WSW	Dagostin Farm
13E3	5.0	W	Dent Farm
		SOIL/VEGETATION	
9B2	1.3	S	Transmission Line east of Rte. 11
1D4	4.0	N	Near Mocanaqua Substation
3D2	3.4	NE	Pond Hill
12E2	4.7	WSW	Berwick Hospital
		FOOD	
7B2	1.5	SE	Heller's Orchard Store
10B5	1.2	SSW	Bodnar Residence
12B1	1.3	WSW	Kisner Farm
9D2	3.2	S	Ryman's Farm Product
11D1	3.3	SW	Zehner Farm
		MEAT, POULTRY, EGGS	
12B1	1.3	WSW	Kisner Farm
10D1	3.0	SSW	Ross Ryman Farm
		GAME[c]	
2B	1.6	NNE	Gould Island
3B	1-2	NE	Off-site
8B	1-2	SSE	Off-site
9B	1-2	S	Off-site

TABLE 3
Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
			Greater Than Five Miles from the Site[a] (See Figure 7)
			SURFACE WATER
12F1	5.3	WSW	Berwick Bridge
12G2	17	WSW	US Radium Site, Bloomsburg
12H1	26	WSW	Merck Co.
			DRINKING WATER
12H2R	26	WSW	Danville Water Co. (raw)
12H2T	26	WSW	Danville Water Co. (treated)
			FISH[b]
2H	30	NNE	Near Falls, Pa.
			SEDIMENT[c]
2F	6.4	NNE	Between Shickshinny and Retreat State Correctional Institution
12F	6.9	WSW	Old Berwick Test Track
			GROUND WATER
12F3	5.2	WSW	Berwick Water Co.
			AIR/PRECIPITATION
7G1	14	SE	Hazleton Chem Lab
12G1	15	WSW	PP&L Service Center, Bloomsburg

TABLE 3
Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

Location Code	Distance (miles)	Direction	Description
		(See Figure 7)	
		MILK	
10G1	14	SSW	Davis Farm
		SOIL/VEGETATION	
7G1	14	SE	Hazleton Chem Lab
12G3	15	WSW	PP&L Service Center, Bloomsburg
		FOOD	
7F1	6.7	SE	Burger Farm
10F1	5.7	SSW	Miller Farm
10F2	6.0	SSW	Karchner Farm
11F1	5.6	SW	Mangan Residence
12F5	7.5	WSW	Seesholtz Farm
12F6	5.8	WSW	Montgomery Residence
16F2	7.8	NNW	Hidlay Residence
16F3	8.5	NNW	Soya Residence
13G1	13	W	Jacobsen Residence
2H1	21	NNE	Yalicks Residence
		GAME	
15F	5-10	NW	Off-site
16F	5-10	NNW	Off-site

a) All distances from the SSES to monitoring locations are measured from the standby gas treatment vent at 44200/N34117 (Pa. Grid System. The location codes are based on both distance and direction from the SSES. The letters in the location codes indicate if the monitoring locations are on site (within the site boundary) or, if they are not on site, the approximate distances of the locations from the SSES as described below:

TABLE 3
Sampling Locations for the SSES
Radiological Environmental Monitoring Program - 1991

S - on site	E - 4-5 miles
A - <1 mile	F - 5-10 miles
B - 1-2 miles	G - 10-20 miles
C - 2-3 miles	H - >20 miles
D - 3-4 miles	

The numbers preceding the letters in the location codes provide the directions of the monitoring locations from the SSES by indicating the sectors in which they are located. A total of 16 sectors (numbered 1 through 16) equally divide an imaginary circle on a map of the SSES and its vicinity, with the SSES at the center of the circle. The middle of sector 1 is directed due north (N). Moving clockwise from sector 1, the sector immediately adjacent to sector 1 is sector 2, the middle of which is directed due north, northeast (NNE). Continuing to move clockwise, the sector numbers increase to 16, which is the north, northwest sector.

The numbers following the letters in the location codes are used to differentiate sampling locations found in the same sectors at approximately the same distances from the SSES.

b) No actual location is indicated since fish are sampled over an area which extends through 3 sectors (5, 6, 7) near the outfall area.

c) No permanent locations exist; samples are taken based on availability. Consequently, it is not necessary to assign a number following the letter in the location code.

FIGURE 5
1991 ENVIRONMENTAL SAMPLING LOCATIONS
WITHIN ONE MILE OF THE SSES

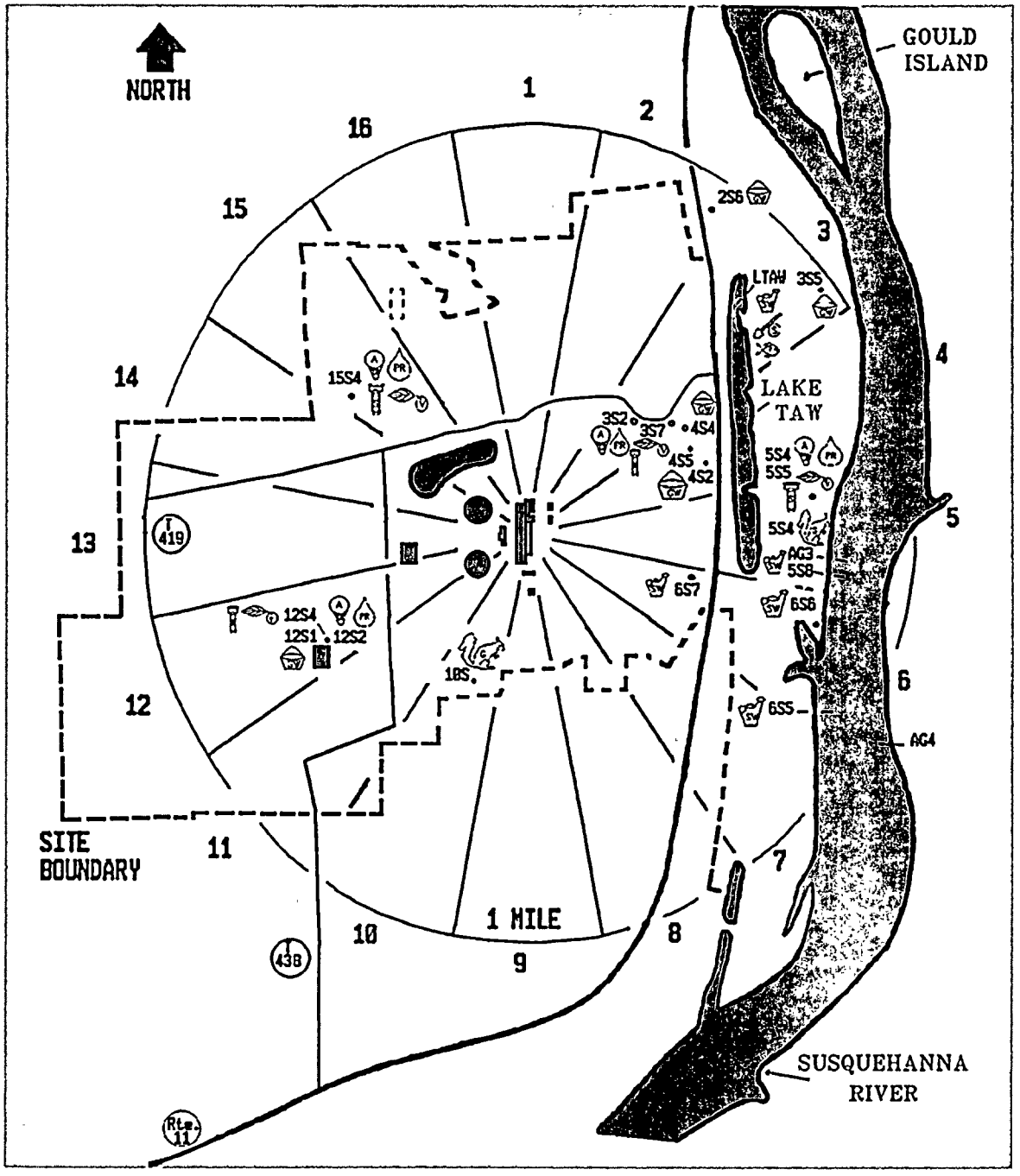


FIGURE 6
1991 ENVIRONMENTAL SAMPLING LOCATIONS
FROM ONE TO FIVE MILES OF THE SSES

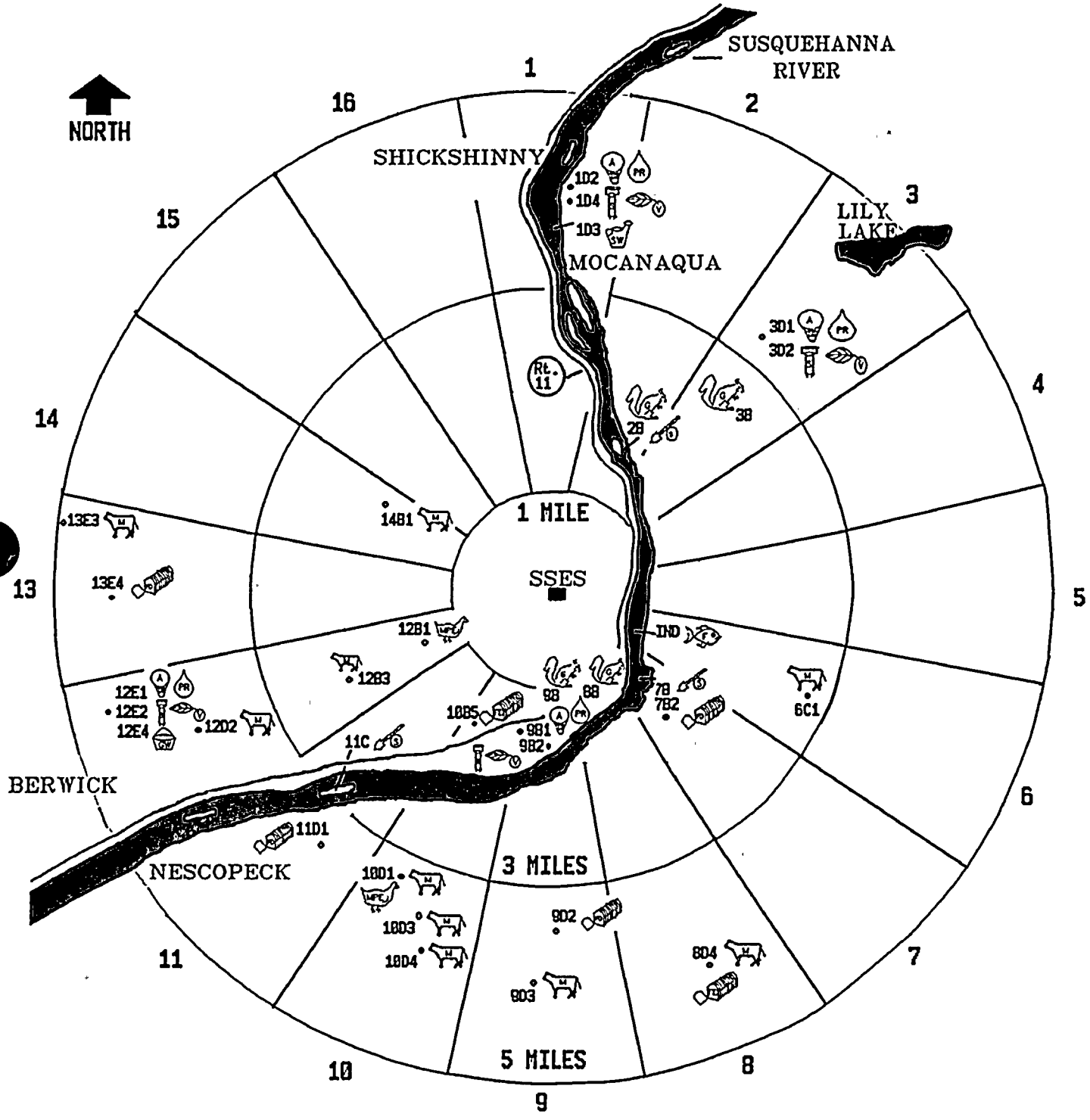
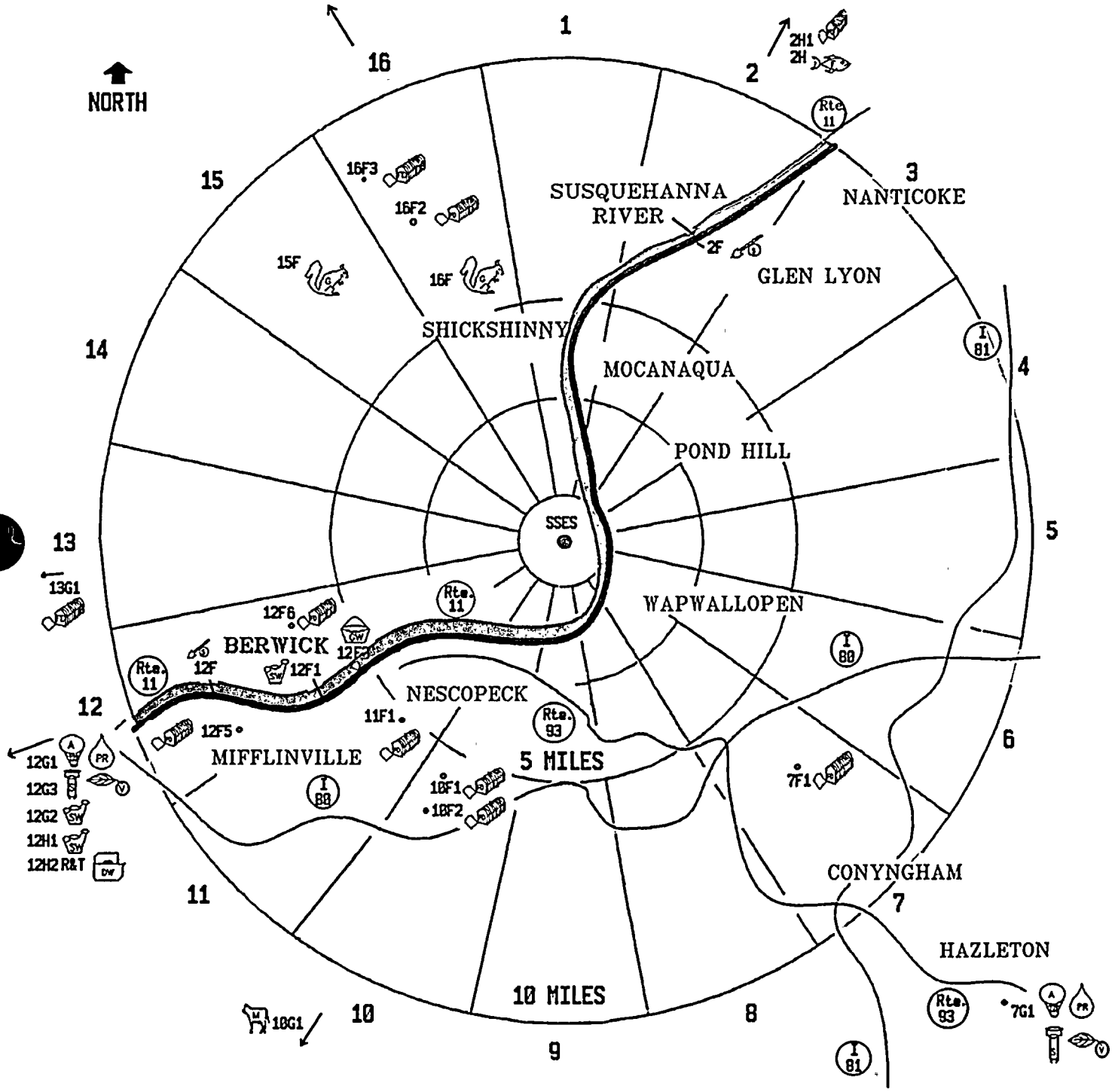


FIGURE 7
1991 ENVIRONMENTAL SAMPLING LOCATIONS
GREATER THAN FIVE MILES FROM THE SSES



IV. MONITORING METHODS

A. Ambient Radiation

Thermoluminescent dosimeters (TLDs) were used to determine the ambient radiation levels at ninety-three monitoring points as described in Tables 1 and 2. TLDs were retrieved quarterly and processed.

The area around the station was divided into sixteen radial sectors of 22.5 degrees each. TLDs were placed in all sectors. Monitoring locations were chosen according to the criteria given in the USNRC Branch Technical Position on Radiological Monitoring (Revision 1, November 1979).[17] The TLDs were placed at locations selected by considering local meteorological and topographical characteristics and population distribution characteristics. The control locations were 3G2, 3G3, 3G4, 4G1, 7G1, 7G2, 12G1, and 12G4.

In 1991, direct radiation measurements were made using Panasonic UD-801 TLDs containing crystals of calcium sulfate activated with thulium.

B. Surface Water

Surface water was sampled from the Susquehanna River at five indicator locations (6S7, 6S5, 12F1, 12G2, and 12H1) and three control locations (1D3, 5S8, and 6S6) during 1991. Sampling of surface water was also performed at Lake-Took-a-While (LTAW) adjacent to the River.

Control location 6S6, the SSES River Water Intake structure, and indicator location 6S7, the SSES cooling tower blowdown discharge line, were sampled by time proportional automatic composite samplers. Weekly, the water obtained by these samplers was retrieved for either biweekly or monthly compositing. (Biweekly compositing was begun in April.) Composite sampling was also performed at location 12H1, the Merck Chemical Company. Samples at this location were picked up biweekly for most of 1991.

Weekly grab sampling was performed at the control location 5S8 and the indicator location 6S5. Weekly grab samples were composited monthly at both locations. At the beginning of April, sampling was discontinued at the control location 5S8 upstream of the SSES discharge to the Susquehanna River. Compositing of weekly grabs was performed both monthly and biweekly (beginning in September) at location 6S5. Locations 5S8 and 6S5 were considered as backups for locations 6S6 and 6S7, respectively, in the event that water could not be obtained from the automatic samplers at those locations. Nevertheless, locations 5S8 and 6S5 were sampled routinely.

Monthly grab sampling was performed at the control location 1D3, at the indicator locations 12F1 and 12G2, and at LTAW.

Surface water samples were analyzed monthly for gross alpha and beta activities, the activities of gamma-emitting radionuclides, and

tritium activities. Iodine-131 was analyzed biweekly for composite samples and monthly for the grab samples. Biweekly compositing was begun in April at locations 6S6, 6S7, and 12H1 and in September at location 6S5.

C. Drinking Water

Drinking water (RAW) samples were collected at location 12H2 by means of a time proportional automatic composite sampler and picked up weekly in 1991 from the Danville Municipal Water Authority facility on the Susquehanna River. Daily grab samples (TREATED) were also taken by Danville Municipal Water Authority personnel, composited, and picked up weekly. RAW water is taken directly from the Susquehanna River intake structure while TREATED water is drawn from the supply line after processing. The Danville Municipal Water Authority facility is the closest drinking water facility on the Susquehanna River downstream of the SSES which could be affected by plant discharges.

RAW and TREATED composite samples were each analyzed monthly for gross alpha and beta activities, the activities of gamma-emitting radionuclides and tritium activities. RAW and TREATED composite samples also were analyzed bi-weekly for iodine-131 activities.

D. Algae

In 1991, algae samples were collected monthly from control location AG3 and indicator location AG4. Algae is collected passively by allowing the flow of Susquehanna River water to deposit it on a plexiglass collector. During those months when river conditions may cause samples to be lost or otherwise make sampling impractical, sampling is not performed. This is typically about five months of the year.

E. Fish

Fish sampling on the Susquehanna River was conducted in the spring and the fall of 1991 at two locations. An indicator location IND downstream of the SSES and a control location 2H upstream of the SSES were selected. Fish samples were also taken by electrofishing from the indicator location LTAW.

The fish were filleted and the edible portions were analyzed for gross beta activity and the activity of gamma-emitting radionuclides.

F. Shoreline and Flocculated Sediment

Shoreline sediment (0 to 4 ft. of water) samples were collected in April and November of 1991 at locations 2B, 7B, 11C, 2F, and 12F on the Susquehanna River and at the LTAW location. Locations 2B and 2F are the control locations for sediment.

Flocculated sediment was also collected at locations 2B and 7B in November 1991. Flocculated sediment is the top, loose layer of sediment in the river, that is easily moved and shifted by the water.

Flocculated sediment is composed of finer particles than the shoreline sediment.

All sediment samples are analyzed for gross alpha and beta activities and the activities of gamma-emitting radionuclides.

G. Ground (Well) Water

Ground water was sampled at seven indicator locations (2S6, 3S5, 4S2, 4S4, 4S5, 12E4, and 12S1) and one control location (12F3) during 1991. Location 4S2, the Peach Stand, was replaced with location 4S5, the White House, in March, and location 12E4, the Berwick Hospital, was discontinued in April. The change from location 4S2 to 4S5 was made because the availability of samples from 4S2 could no longer be depended upon for routine sample collection due to changes in the usage of the facility at 4S2. Discontinuing 12E4 as a sample location was effected because this is simply treated water from the Berwick Water Company which is the control sampling location 12F3. Location 3S5 was only sampled monthly from May through October due to the seasonal availability (warm weather) of water from this location.

With the exception of locations 4S4 and 12E4, untreated ground water was sampled. Untreated means that the water has not undergone any processing such as filtration, chlorination, or softening. Location 4S4, the SSES Training Center, is actually well water obtained on-site and piped to the Training Center after treatment. This sampling is performed as a check to ensure that this water has not been radioactively contaminated. Sampling is performed at the Training Center to facilitate the sample collection process.

Ground water samples were analyzed for gross alpha and beta activities, the activities of gamma-emitting radionuclides, and tritium activity.

H. Airborne Particulates and Air Iodine/Precipitation

Airborne pathways to man were examined by analyzing air particulates, air iodine, and precipitation.

Airborne Particulates and Air Iodine

Air samples were collected in 1991 at locations 3S2, 5S4, 12S2, 15S4, 9B1, 1D2, 3D1, 12E1, 7G1, and 12G1. Locations 7G1 and 12G1 were the control locations.

Air particulates were collected on Gelman type-A/E, glass fiber filters with low-volume air samplers. Air iodine samples were collected with one-inch deep Science Applications, Inc. charcoal cartridges in series with the air particulate filters at all locations.

The air samplers were run continuously and the filters and charcoal cartridges exchanged weekly. The elapsed time of sampling was recorded on an elapsed-time meter. Air sample volumes were measured with temperature-compensated dry-gas meters.

Air filters were analyzed weekly for gross beta activity, then composited quarterly and analyzed for gross alpha activity and the activities of gamma-emitting radionuclides. The charcoal cartridges were analyzed weekly for iodine-131.

Precipitation

Precipitation samples were collected at least monthly in 1991 from the same locations as airborne samples were obtained and were composited quarterly.

Precipitation was analyzed for gross alpha and beta activities, the activities of gamma-emitting radionuclides, and tritium activity.

I. Milk

Cow milk samples were collected at nine indicator locations (6C1, 9D3, 10D1, 10D3, 10D4, 12B3, 12D2, 13E3, and 14B1) and one control location (10G1) in 1991. Samples were collected semi-monthly from April through October at four locations (10G1, 12B3, 12D2, and 14B1); otherwise, samples were collected monthly. In April, location 13E3 was replaced with 6C1 and location 9D3 was discontinued. These were the two lowest dose potential locations being sampled.

Milk samples were analyzed for the activities of strontium-89, strontium-90, iodine-131, and gamma-emitting radionuclides.

J. Soil (top and bottom) and Vegetation

Soil (top and bottom) and vegetation samples were collected in September 1991 at locations 3S7, 5S5, 12S4, 15S4, 9B2, 1D4, 3D2, 12E2, 7G1, and 12G3. Locations 7G1 and 12G3 were control locations.

These samples were taken by compositing twelve plugs at each location. The top soil consists of the first two inches of soil, and the bottom soil is from a depth of two to six inches. These samples were analyzed for the activities of gamma-emitting radionuclides.

K. Food Products

Various types of fruits and vegetables were collected in 1991 from fifteen locations within the vicinity of the SSES. These locations are 7B2, 10B5, 12B1, 9D2, 11D1, 7F1, 10F1, 10F2, 11F1, 12F5, 12F6, 16F2, 16F3, 13G1, and 2H1. Location 2H1 was a control location.

All fruit and vegetable samples were analyzed for the activities of gamma-emitting radionuclides.

Poultry and Eggs

Duck, chicken, and egg samples were collected in 1991 from locations 10D1 and 12B1 respectively. The edible portions were analyzed for the activities of gamma-emitting radionuclides.

Game

Deer, rabbit, and squirrel samples were collected in January and November of 1991 at locations 5S, 10S, 2B, 3B, 8B, 9B, 15F, and 16F. The flesh was analyzed for the activities of gamma-emitting radionuclides.

V. SUMMARY AND DISCUSSION OF 1991 ANALYTICAL RESULTS

The analytical methods used by Teledyne Isotopes and Controls for Environmental Pollution are capable of meeting the lower limit of detection (LLD) requirements set forth in the Susquehanna Steam Electric Station Technical Specifications. The procedures and an explanation of the analytical calculation methods used in the laboratory for these analyses are summarized in Appendix B. Data from the radiological analyses of environmental media are tabulated and discussed below.

Radioactivity levels in environmental media are usually so low that their measurements, even with state-of-the-art measurement methods, typically have significant degrees of uncertainty associated with them.[18] As a result, expressions are often used when referring to these measurements that convey information about the levels being measured relative to the measurement sensitivities. Terms such as "minimum detectable concentration" (MDC) and "critical level" (CL) are used for this purpose. When the value of the MDC or CL for a specific measurement is compared to the value of the actual measurement, the comparison provides information about the difficulty in differentiating the activity being measured from background activity. The formulas used to calculate MDCs may be found in Appendix B. CLs are equivalent to one-half the so-called MDCs.

Measured values for the activities of specific radionuclides, such as man-made gamma-emitting radionuclides, only appear in the individual data tables (Tables 7 - 20) for each specific medium when the levels that are measured exceed the critical level (CL) values for those measurements. Measured values for the activities of naturally-occurring gamma-emitting radionuclides, such as beryllium-7, potassium-40, radium-226, and thorium-228, as well as analyses that are not radionuclide specific, such as gross alpha and beta analyses, are presented in the individual data tables (Tables 7 - 20) for specific media when the levels that are measured exceed the actual MDCs.

When measured values do not exceed either the CL or the MDC, whichever is appropriate, those values are not presented in Tables 7 - 20. In these instances, for measurements that are not radionuclide specific, the symbol < followed by the values for the appropriate MDCs appear in the tables. However, it is important to note that all measured values, whether or not they are shown in Tables 7 - 20, are taken into account in the calculation of the reported annual averages for indicators and controls, which are summarized in Table 4, for all analysis results except gamma spectroscopic results.

A. AMBIENT RADIATION

Thermoluminescent dosimeters (TLDs) included in the Radiological Environmental Monitoring Program (REMP) in 1991 were placed at 85 indicator locations and 8 control locations. Sixteen of these locations were co-located with TLDs belonging to the Nuclear Regulatory Commission. A description of PP&L's TLD system may be found in Appendix B.

Totals of 323 indicator TLD readings and 32 control TLD readings were obtained from quarterly processings during 1991. The detailed results of these TLD readings can be found in Table 6. The means of quarterly TLD readings for 1991 are compared to the ranges and means of the yearly average TLD readings at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990, respectively, in the Table below.

AMBIENT RADIATION LEVELS AS MEASURED BY TLDS (mR/STD QTR)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	18.5-19.2	17.3-19.2	--	15.0-17.9	17.3-19.2	--
Mean	18.9	18.2	18.1	16.3	17.8	18.0

Refer to Figure 8 which trends both indicator and control quarterly data from 1973 through 1991.

Oakley[19] calculates an ionizing radiation dose equivalent of 82 mrem/year from natural sources other than radon for the Wilkes-Barre area. Since Oakley's values represent averages covering wide geographical areas, the measured ambient radiation averages of approximately 72 mrem/year for both indicator and control locations in the vicinity of the SSES are consistent with Oakley's observations. Significant variations occur between geographical areas as a result of geological composition and altitude differences. Variations with time result from changes in cosmic radiation intensity and factors such as ground cover and soil moisture.

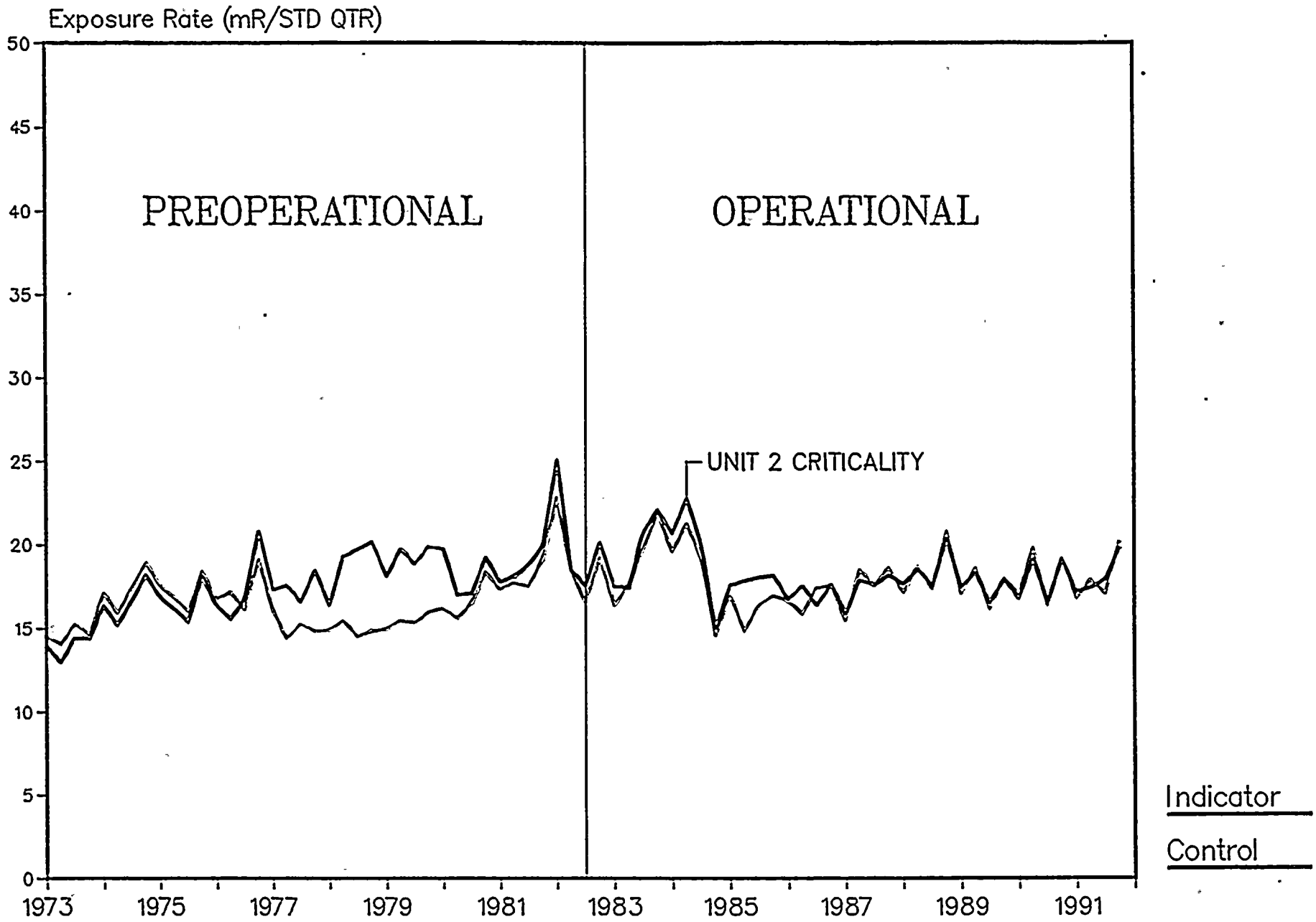
Pressurized Ion Chambers

In 1991, pressurized ion chamber (PIC) data were collected continuously at locations in Berwick (12F4/PIC 1), Nanticoke (3G2/PIC 4), Shickshinny (1E2/PIC 3), and at the Susquehanna Energy Information Center (2S5/PIC 2). TLD data was also obtained at these locations.

PIC measurements at all locations are currently recorded on paper strip charts that are periodically reviewed and then archived. An improved collection method for this data began in December, 1988. A datalogger was connected to the output of PIC 2 at the Energy Information Center to allow for the digital storage of PIC data. Near the end of July, 1990, dataloggers were also connected to the outputs of PICs 1, 3, and 4 at the Berwick Town Hall, the Shickshinny Municipal Building, and the Nanticoke Municipal

FIGUR

AMBIENT RADIATION LEVELS BASED ON TLD DATA



Building, respectively. Data collected and stored by the dataloggers for periods of approximately one month each have been retrieved during 1991 and analyzed. The dataloggers have been programmed to provide hourly results for each monitoring period. From this information, overall hourly averages have been obtained for each monitoring period, as well as the maximum and minimum hourly levels within each period.

The table below summarizes the overall average radiation levels in units of milliRoentgen per standard quarter for each quarter, as converted from hourly data, of 1991 that the respective dataloggers were recording PIC measurements at PIC locations 1, 2, 3, and 4.

AMBIENT RADIATION LEVELS AS MEASURED BY PIC (mR/std. qtr.)

Calendar Quarter	PIC			
	Berwick 1	EIC 2	Shickshinny 3	Nanticoke 4
1	17.9	16.8	18.2	18.7
2	17.3	16.2	17.9	18.0
3	17.3	16.4	18.3	18.0
4	19.1	17.0	19.1	18.0

Figures 9, 10, and 11 compare the quarterly average radiation levels as determined from TLD readings with the levels determined by PICs 1, 2, and 4 at locations 12F4, 2S5, and 3G2, respectively. (No figure is included for PIC 3 at the Shickshinny Municipal Building because TLD data for comparison with the PIC data only exists for the third quarter.) Either a positive or negative bias of PIC data relative to TLD data is consistently observed at each location; PICs 2 and 4 display positive biases while PIC 1 displays a negative bias.

FIGURE 9
PIC/TLD QTRLY DATA COMPARISON
Berwick City Hall

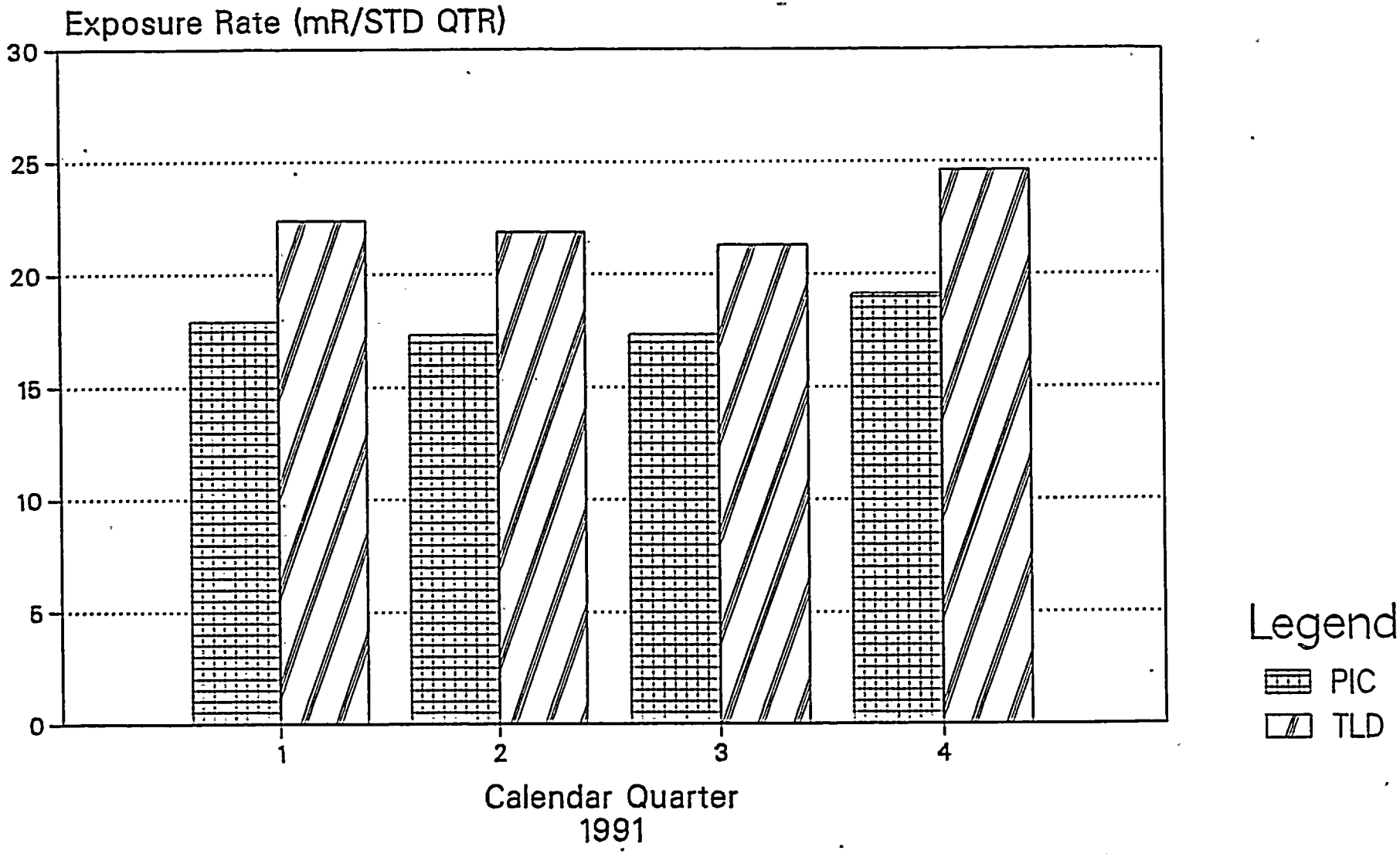


FIGURE 10
PIC/TLD QTRLY DATA COMPARISON
Energy Information Center

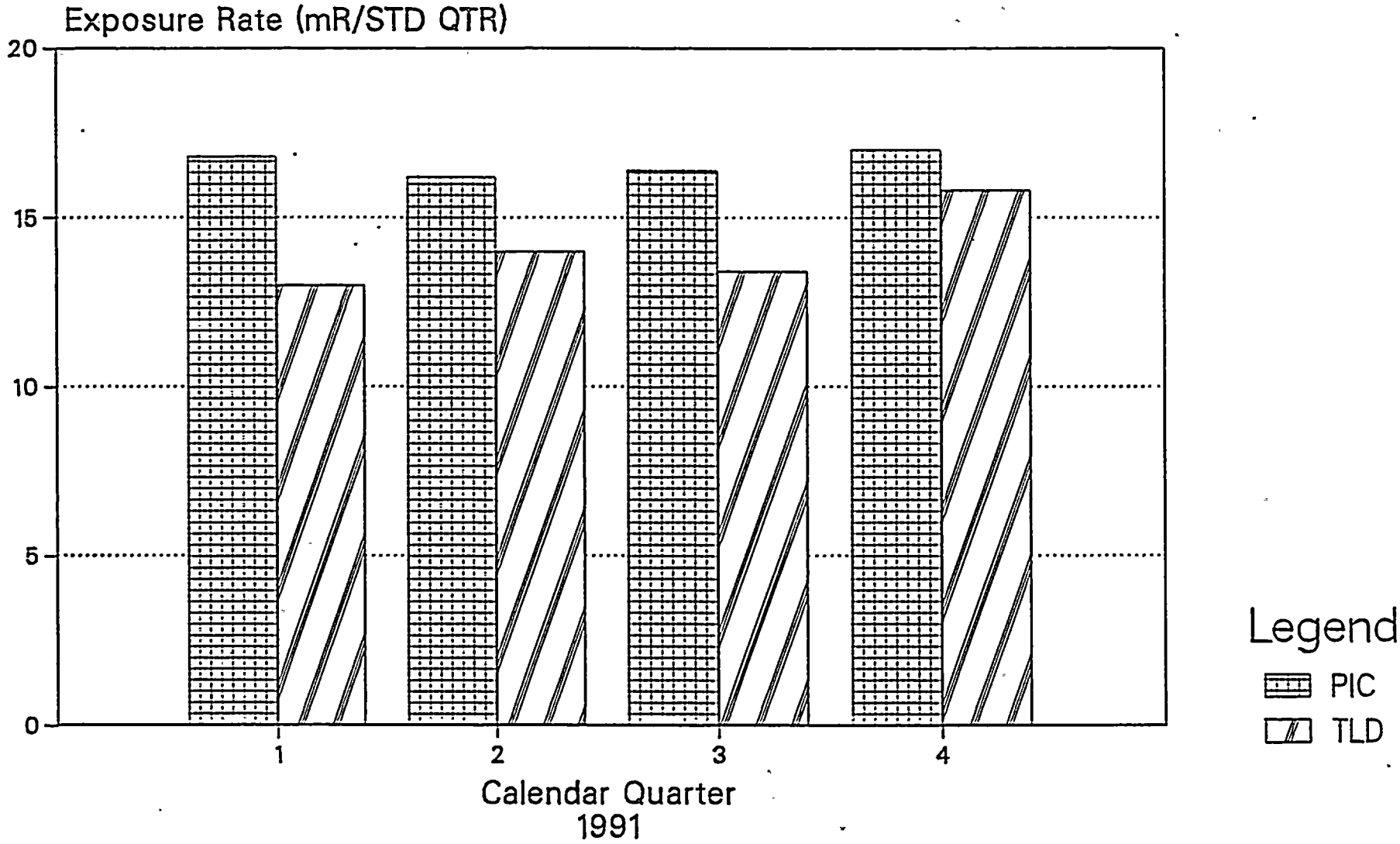
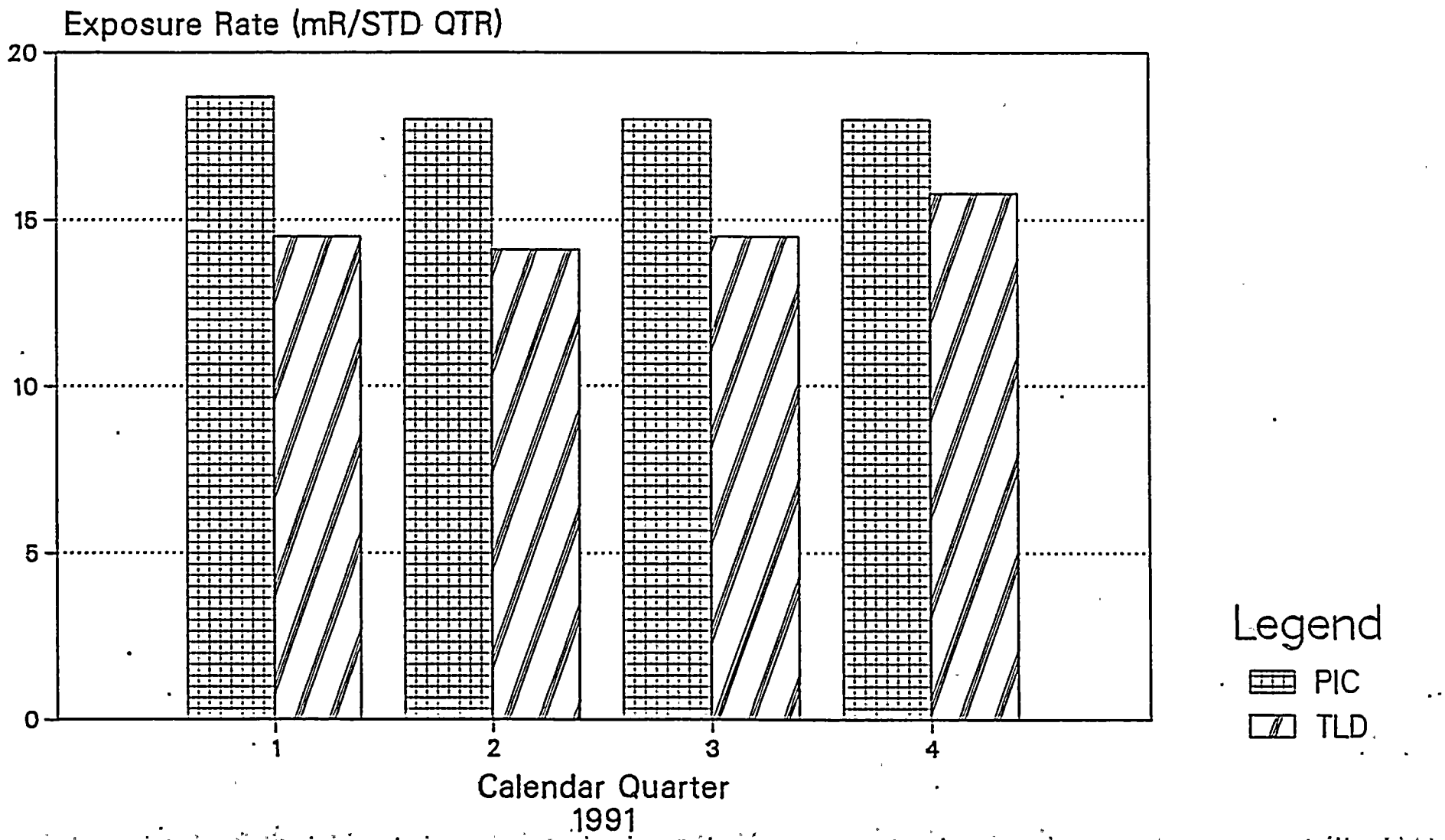


FIGURE 11
PIC/TLD QTRLY DATA COMPARISON
Nanticoke Municipal Building



The table below compares the annual average radiation levels separately for indicator and control locations as determined by TLD data from all 93 monitored locations and PIC data from the four monitored locations.

ANNUAL AVERAGE AMBIENT RADIATION LEVELS (mR/std.qtr.)		
LOCATION	TLD	PIC
Indicator	18.1	17.5
Control	18.0	18.2*

*PIC 4 at the Nanticoke Municipal Building is considered to be the control.

Figure 12 compares PIC data from all four locations for all quarters for which such information is available. The range of radiation levels measured by all PICs in any quarter is less than two milliRoentgen per standard quarter.

B. SURFACE WATER

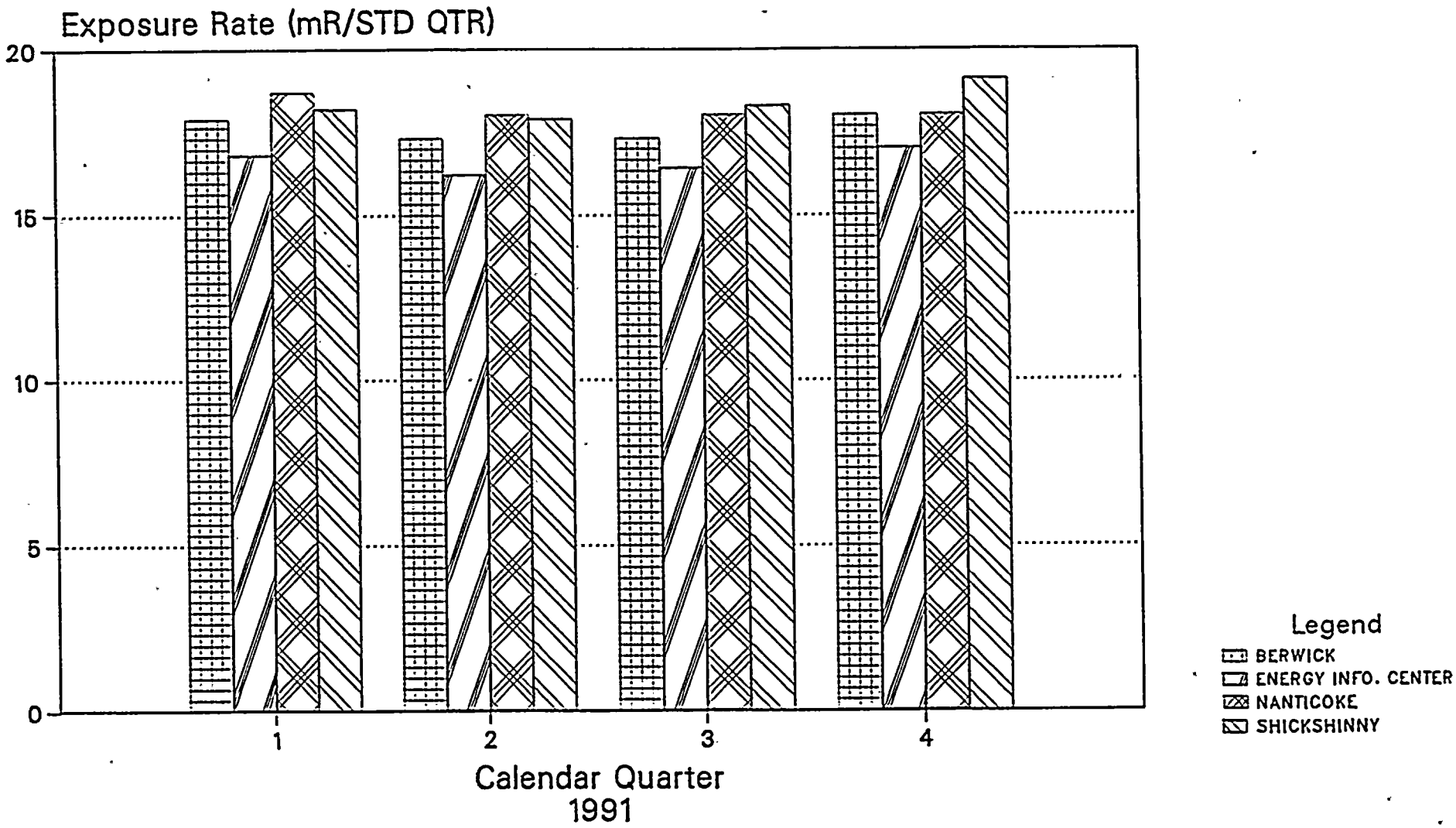
Surface water was sampled monthly at four locations. In addition, it was composited monthly at five locations for the first three months of the year and four locations for the remainder of the year. Samples were analyzed for gross alpha, gross beta, iodine-131, tritium, and gamma-emitting radionuclides. A total of 164 routine (excluding non-routine grab samples, duplicates, and splits) surface water samples were analyzed. One hundred eighteen of these were indicator samples and 46 were control samples. The detailed results of these analyses can be found in Table 7.

The average 1991 indicator and control gross alpha activities may be compared to the ranges and means of yearly average gross alpha activities at surface water indicator and control locations during the period 1984 through 1990 in the table below.

SURFACE WATER GROSS ALPHA ACTIVITIES (pCi/l)				
Location	Indicator		Control	
Period	1984-90	1991	1984-90	1991
Range	1.0 - 4.3	--	1.2 - 3.1	--
Mean	2.4	0.8	2.0	0.6

Note that the 1991 mean alpha activities in the table above are lower than previous years primarily because of the averaging method used. Unlike previous years, means were determined using all measured values, not just those results exceeding the MDCs. Refer to Appendix C for additional explanation. Surface water gross alpha activity is not attributed to the SSES operation.

FIGURE 12
PIC QUARTERLY COMPARISON
All Sites



The means of gross beta activities in surface water for 1991 are compared to the ranges and means of yearly average gross beta activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990 respectively in the table below.

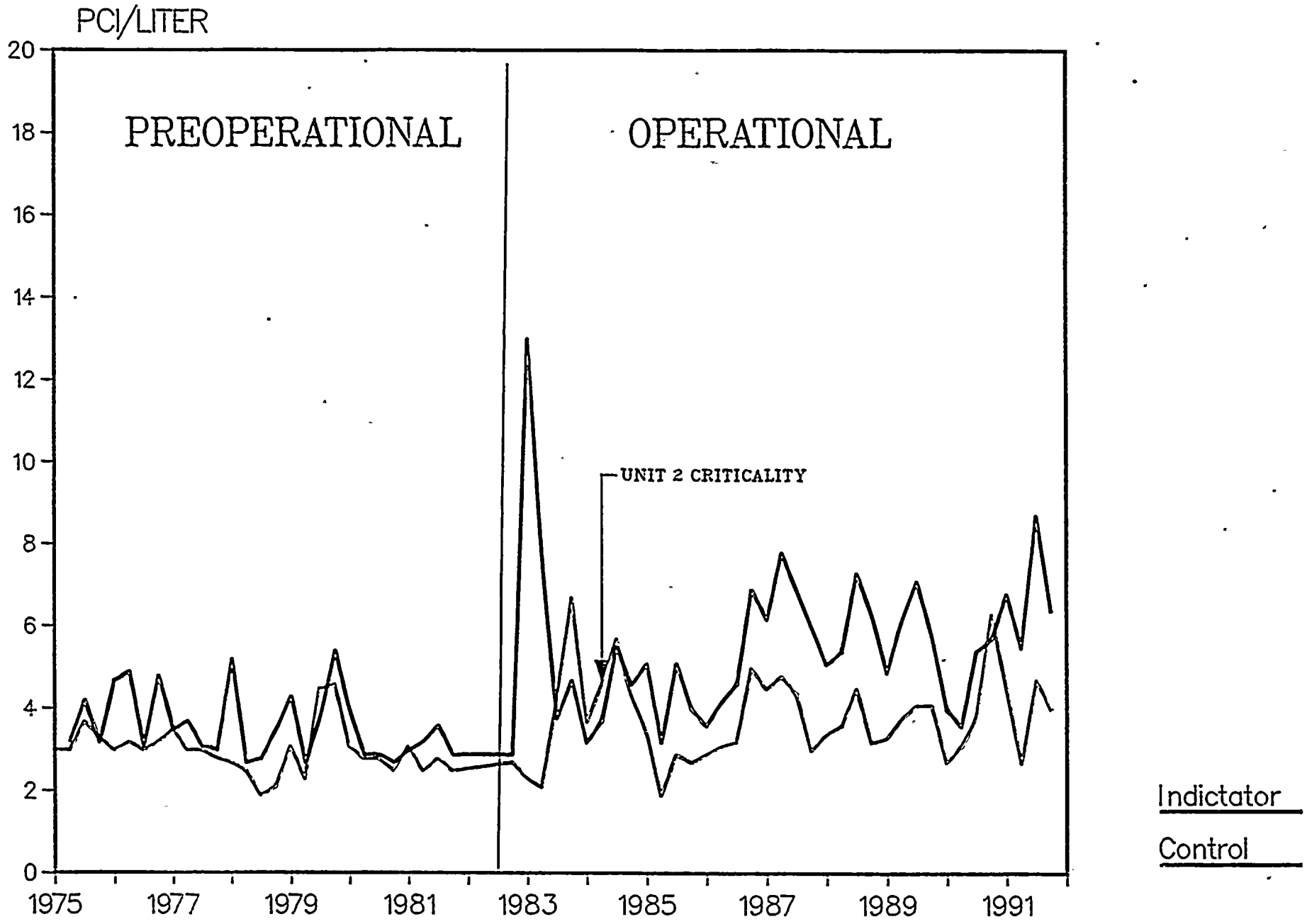
SURFACE WATER GROSS BETA ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	3.2-4.9	3.0-7.7	--	2.9-5.2	2.9-4.8	--
Mean	3.8	5.3	7.1	4.0	3.7	4.5

The average beta activity for indicator locations in 1991 is within the range of activities for the previous operational and preoperational periods at the SSES. Refer to Figure 13 which trends gross beta activities separately for surface water indicator and control locations from 1975 through 1991.

Results from indicator location 6S7, the cooling tower blowdown discharge line sample point, are an indicator of the concentration of the activity of the water that is periodically discharged to the river. Since the activity at this sample location is not likely to be representative of the activity in the river water more than a few feet from the discharge pipe, it is of interest to compare the mean activity of indicator locations excluding that of 6S7 in 1991 with the mean gross beta activities at control locations during the preoperational period 1978-81. The mean gross beta activity of the indicator locations for 1991 in the table above becomes 5.3 when 6S7 is excluded. This mean would be lower, itself, if it were not for three surface water sample results (one of which was for a control location) from March with unusually high gross beta activities. This was due to high levels of sediment in the water resulting from an eight-foot rise in the river during a three-day period.

Iodine-131 was analyzed in monthly samples from all locations for the first three months of the year. Beginning in April, Iodine-131 was analyzed in biweekly samples from three locations and a fourth location was added to this schedule in September. Analyses of Iodine-131 continued to be monthly at all other locations. The ranges and means of yearly average iodine-131 activities at indicator and control locations during the preoperational and operational periods 1979-1981 and 1982-1990, respectively, are presented in the table below.

FIGURE
GROSS BETA ACTIVITY IN SURFACE WATER



SURFACE WATER IODINE-131 ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1979-81	1982-90	1991	1979-81	1982-90	1991
Range	0.24-0.37	0.17-0.60	--	0.29-0.43	0.18-1.0	--
Mean	0.29	0.4	0.10	0.36	0.4	0.06

Note that the 1991 mean iodine-131 activities in the table above are lower than previous years because of the averaging method used. Refer to Appendix C for an explanation. The surface water iodine-131 activity is not attributed to the SSES operation. It appears to result from medical waste discharges.

The means of tritium activities in surface water for 1991 are compared to the ranges and means (medians) of yearly average tritium activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1989*, respectively, in the table below.

SURFACE WATER TRITIUM ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-89	1991	1978-81	1982-89	1991
Range	101-122	126-366	--	119-319	90-212	--
Mean (median)**	109	290 (308)	581	171 (123)	136 (124)	48

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

**The medians are presented in Section V tables only when there is a significant difference between means and medians.

Note that the 1991 mean tritium activity for control locations in the table above is lower than previous years primarily because of the averaging method used. Refer to Appendix C for an explanation.

The tritium activities reported throughout 1991 at location 6S7, the cooling tower blowdown discharge line, tend to inflate the mean activity reported for all indicator locations, just as the 6S7 gross beta activities inflated the mean indicator gross beta activity. If the tritium activities from location 6S7 are

excluded from the data used to calculate the mean indicator tritium activity, the mean indicator tritium activity becomes 110 pCi/liter. This mean would be lower if it weren't for an unusually high result reported in September for an indicator sample location 17 miles distance from the SSES, near the former U.S. Radium Site. This is not believed to be due to the SSES operation or discharges because samples from other indicator locations closer to the SSES showed no elevated activities. Refer to Figure 14 which trends tritium activities separately for surface water indicator and control locations from 1972 through 1991.

In spite of the fact that the tritium activities reported for 6S7 are from the discharge line prior to dilution in the river, the highest tritium activity reported at 6S7 during 1991 is well below the NRC non-routine reporting levels of 20,000 pCi/liter when a drinking water pathway exists or 30,000 pCi/liter when no drinking water pathway exists. The calculated dose to the maximally exposed individual due to tritium released to the Susquehanna River by way of the discharge line is presented in Section V-L.

No anthropogenic gamma-emitting radionuclides were positively detected in surface water in 1991 that are attributable to the SSES operation.

In 1983, 1984, 1990, and 1991, cesium-137 was not measured at levels in excess of the MDC in any indicator or control samples. Since 1983, cesium-137 has been reported in 11 indicator samples and 15 control samples. The ranges and means of yearly average cesium-137 activities at indicator and control locations during the operational period 1983-1990 are presented in the table below.

SURFACE WATER CESIUM-137 ACTIVITIES (pCi/l)		
Location	Indicator	Control
Period	1983-90	1983-90
Range	2.1 - 4.6	2.8 - 4.0
Mean	3.6	3.5

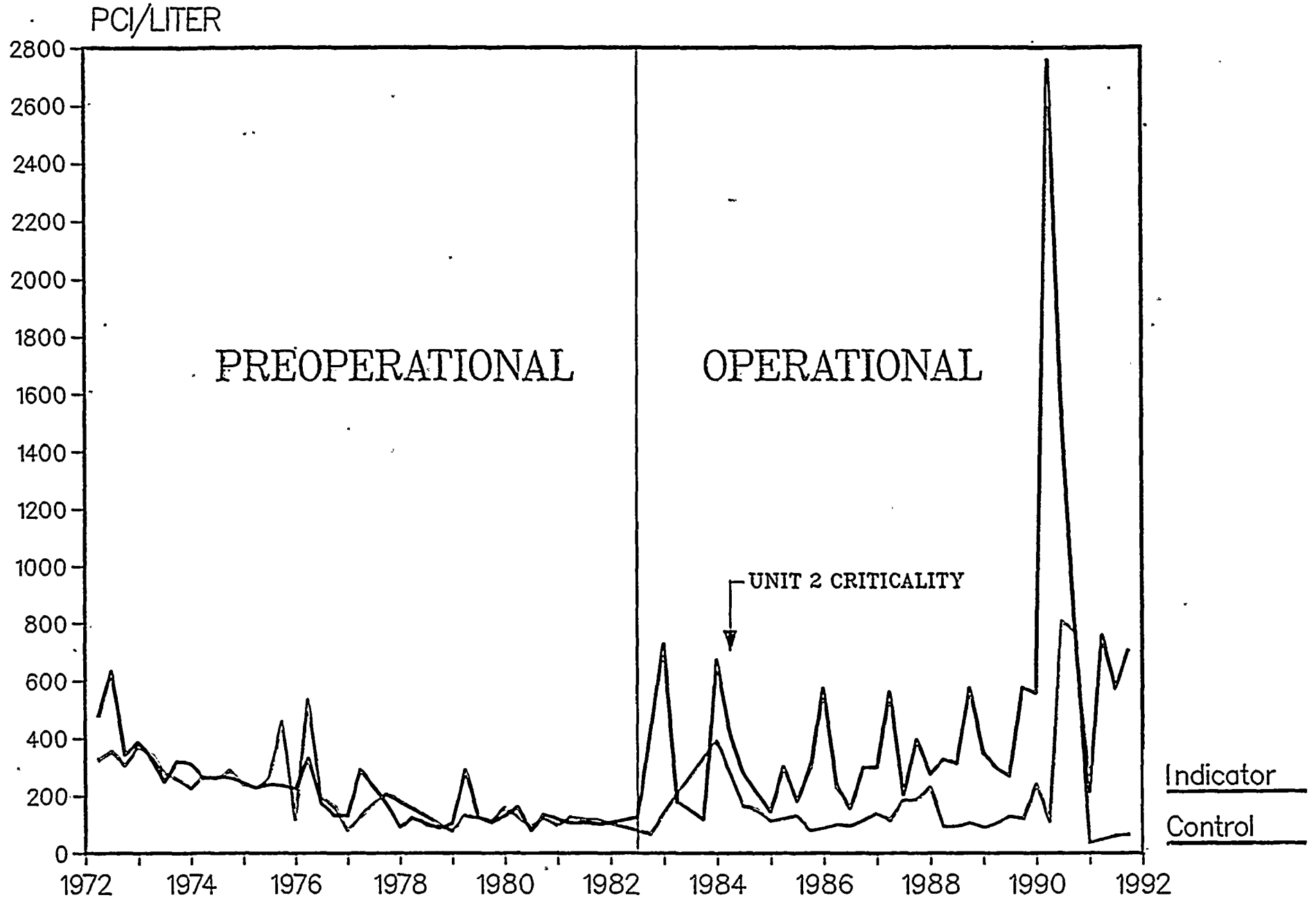
Cesium-137 is attributed to fallout from previous atmospheric nuclear weapons testing and the Chernobyl incident.

C. DRINKING WATER

Composite drinking water samples were analyzed during 1991 from the Danville Water Company's facility 26 miles WSW of SSES on the Susquehanna River. The detailed results of the analyses of the samples can be found in Table 8.

FIGURE 14

TRITIUM ACTIVITY IN SURFACE WATER



Half of the composited drinking water samples are normally taken prior to treatment of the water. These are referred to as the raw water samples. The remainder of the samples are normally taken after treatment and are referred to as the treated water samples.

From 1977 (when drinking water samples were first collected) through 1984, drinking water samples were also obtained from the Berwick Water Company at location 12F2 (12F3), 5.2 miles WSW of SSES. The drinking water supply for the Berwick Water Company is not, however, water from the Susquehanna River; it is actually well water.

Since there are no drinking water supplies on the Susquehanna River upstream of the SSES that would be appropriate to serve as a control location, the Danville drinking water samples may be compared to surface water control samples.

Gross alpha activity has been monitored in drinking water since 1980. Since 1980, alpha activity has been observed at levels above the minimum detectable concentrations in a small minority of these samples during most years. In 1981, 1987, 1989, and 1990, no composite samples yielded any alpha activity above the MDCs for the analyses. The yearly average gross alpha activities during the preoperational and operational periods 1980-1981 and 1982-1990, respectively, are compared with the mean gross alpha activity in drinking water for 1991 in the table below.

DRINKING WATER GROSS ALPHA ACTIVITIES (pCi/l)

Period	Preoperational	Operational	
	1980 - 81	1982 - 90	1991
Range	--	1.2 - 10.0	--
Mean (median)	1.3	3.7 (2.1)	0.2

Note that the mean gross alpha activity is lower than previous years because of the new averaging method. Former averages were determined by only the few results which normally exceeded their MDCs. The 1991 average was determined from all measured values, most of which are below their respective MDCs. Refer to Appendix C for an explanation. Drinking water gross alpha activity is not attributed to the SSES operation.

The mean of gross beta activity in drinking water for 1991 is compared to the ranges and means of yearly average gross beta activities during the preoperational and operational periods 1977-1981 and 1982-1990 respectively in the table below.

DRINKING WATER GROSS BETA ACTIVITIES (pCi/l)			
Period	Preoperational	Operational	
	1977 - 81	1982 - 90	1991
Range	2.2 - 3.2	2.4 - 5.4	--
Mean	2.7	3.4	3.2

It should be noted that the average drinking water gross beta activity in 1991 is less than the mean gross beta activities of surface water control locations during the preoperational period of the SSES. Therefore, the gross beta activities in drinking water samples for 1991 are not attributable to the operation of the SSES. Refer to Figure 15 which trends gross beta activities in drinking water samples from 1977 through 1991.

Iodine-131 was measured in excess of the MDC in one drinking water sample for 1991. Since 1980, iodine-131 has only been detected in drinking water five years out of 11 years.

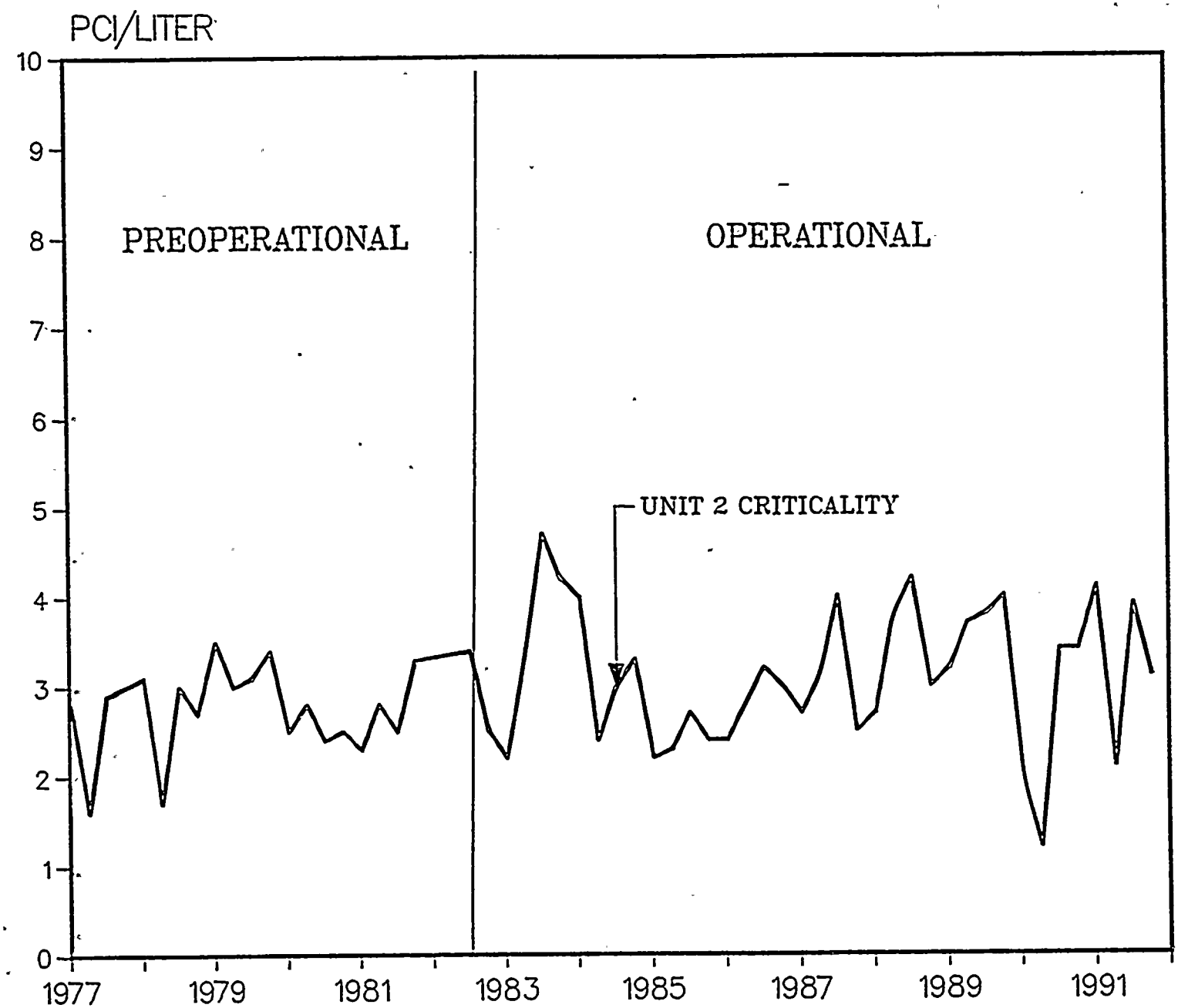
The mean of tritium activity in drinking water for 1991 is compared to the ranges and means (medians) of yearly average tritium activities during the preoperational and operational periods 1977-1981 and 1982-1990 respectively in the table below.

DRINKING WATER TRITIUM ACTIVITIES (pCi/l)			
Period	Preoperational	Operational	
	1977 - 81	1982 - 90	1991
Range	101 - 194	83 - 220	--
Mean (median)	132 (120)	126	84

D. ALGAE

A total of 12 algae samples were collected from May through October of 1991 at two locations on the Susquehanna River. Half of the samples were collected at the indicator location AG4 below the SSES discharge diffuser, and the other half of the samples were obtained at the control location AG3 above the SSES river water intake structure. The algae samples were analyzed by gamma spectrometry. The detailed results of the analyses of these samples can be found in Table 8.

FIGURE 3
GROSS BETA ACTIVITY IN DRINKING WATER



The naturally-occurring radionuclides beryllium-7, potassium-40, radium-226 and thorium-228, were measured at levels in excess of the MDCs in algae samples in 1991. With the exception of beryllium-7, which is cosmogenic in origin (produced by the interaction of cosmic radiation in the atmosphere), these radionuclides are terrestrial in origin (found in the earth's crust).

The means of beryllium-7 activities in algae for 1991 are compared to the ranges and means of yearly average beryllium-7 activities at indicator and control locations during the period 1984 through 1990 in the table below.

ALGAE BERYLLIUM-7 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 90	1991
Range	4.1 - 20.7	--	4.3 - 18.9	--
Mean	8.2	6.2	7.7	5.9

The means of potassium-40 activities in algae for 1991 are compared to the ranges and means (medians) of yearly average potassium-40 activities at indicator and control locations during the period 1984 through 1989* in the table below.

ALGAE POTASSIUM-40 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 89	1991	1984 - 89	1991
Range	12.0 - 89.7	--	10.6 - 80.8	--
Mean (median)	29.1 (13.8)	12.6	27.2 (15.1)	11.6

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

The means of yearly average radium-226 and thorium-228 activities at indicator and control locations during the period 1985-1990 are compared with the means of radium-226 and thorium-228 activities in algae for 1991 in the tables below.

ALGAE RADIUM-226 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1985 - 90	1991	1985 - 90	1991
Range	3.1 - 7.1	--	3.1 - 6.3	--
Mean	4.4	<MDC	4.6	5.6

It should be noted that radium-226 was only reported in excess of the MDC at one control location in June.

ALGAE THORIUM-228 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1985 - 90	1991	1985 - 90	1991
Range	0.9 - 1.4	--	1.0 - 1.3	--
Mean	1.1	1.5	1.1	1.4

None of the activity of the naturally-occurring radionuclides is attributable to the SSES operation.

The fission-product radionuclides cesium-137 and iodine-131 were positively detected in algae in 1991. Iodine-131 has been measured at levels above the MDCs in less than half of both indicator and control samples each year from 1984 through 1991. The iodine-131 activities in algae for 1991 are compared to the ranges and means (medians) of yearly average iodine-131 activities at indicator and control locations during the period 1984 through 1989* in the table below.

ALGAE IODINE-131 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 89	1991	1984 - 89	1991
Range	0.55 - 1.32	--	0.70 - 1.10	--
Mean (median)	0.94	3.2	0.97 (0.89)	3.1

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

Iodine-131 was reported in only one indicator and one control sample in September of 1991. However, the levels reported were higher than seen in past years. As in past years, the presence of

iodine-131 in algae does not appear to be from the SSES operation, but from medical sources upstream of the SSES. Iodine-131 has been found more times in control algae samples each year than it has been found in indicator algae samples since algae began to be monitored in 1984.

The means of cesium-137 activities in algae for 1991 are compared to the ranges and means (medians) of yearly average cesium-137 activities at algae indicator and control locations during the period 1984 through 1990 in the table below.

ALGAE CESIUM-137 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 90	1991
Range	0.15 - 0.48	--	0.15 - 0.82	--
Mean (median)	0.28	<CL	0.31 (0.22)	0.52

Cesium-137 in the environment comes from fallout resulting from past atmospheric nuclear weapons tests. As algae data continues to be accumulated, assuming that atmospheric nuclear testing is not resumed, a decline in cesium-137 activity would be expected to be observed eventually. In 1989, cesium-137 was measured at levels exceeding the CLs in the majority of the algae sample analyses. In 1990, cesium-137 exceeding the CLs was measured in only 2 out of 12 sample analyses, and, in 1991, it was only measured above the CL in 1 out of 12 sample analyses. This might indicate the beginning of a long-term reduction in the levels of cesium-137 to be observed.

E. FISH

Four different species of fish were collected at three different locations during May and October 1991. The species included small mouth bass, large mouth bass, channel catfish, and white sucker. The large mouth bass was obtained from Lake Took-a-While (LTAW) located on PP&L property on the opposite side of Route 11 from the station. LTAW is considered an indicator location even though it does not receive flow from the Susquehanna River below the SSES cooling tower blowdown line to the river. The small mouth bass, channel catfish and white sucker were all obtained from the Susquehanna River at a control location 30 miles NNE near Falls, Pennsylvania and at an indicator location between 0.9 and 1.4 miles ESE of the site, at or below the discharge structure. The detailed results of these analyses can be found in Table 10.

As in every fish sample taken since the Spring of 1984, when gross beta analyses first began to be performed on fish flesh, all 9 indicator samples and all 6 control samples showed gross beta activities above the MDCs.

The means of gross beta activities in fish for 1991 are compared to the ranges and means of yearly average gross beta activities at indicator and control locations during the period 1984-1990 in the table below.

FISH GROSS BETA ACTIVITIES (pCi/g wet)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 89	1991
Range	3.7 - 5.6	--	2.2 - 6.8	--
Mean	4.9	5.8	4.8	4.5

Although the indicator mean for 1991 is greater than the 1991 control mean, it is within the range of the control means for the period 1984 through 1989. The gross beta activities in fish for 1991 are not attributable to the SSES operation.

Gamma spectrometry of fish in 1991 did not positively detect any gamma-emitting radionuclide except for potassium-40. Naturally-occurring potassium-40 was positively detected in all indicator and control samples.

The means of potassium-40 activities in fish for 1991 are compared to the ranges and means of yearly average potassium-40 activities at indicator and control locations during the preoperational and operational periods 1977-1981 and 1982-1990, respectively, in the table below.

FISH POTASSIUM-40 ACTIVITIES (pCi/g wet)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1977-81	1982-90	1991	1977-81	1982-90	1991
Range	2.7 - 3.5	3.1 - 5.3	--	2.8 - 3.6	3.1 - 4.1	--
Mean	3.2	3.9	3.6	3.2	3.6	3.6

Note that the means of the potassium-40 activities for the indicator and control locations in 1991 and in prior years are in very good agreement. The naturally-occurring potassium-40 is not attributable to the SSES operation.

By comparison to the potassium-40 activities, cesium-137 activities in any given year appear very small. Cesium-137 was not measured in any indicator or control samples in 1991 at levels in excess of the critical levels (CLs). This is the second year in a row that levels have been this low. The decrease in cesium-137 levels observed in fish for the 1990-91 period is similar to that observed for algae.

The ranges and means (medians) of yearly average cesium-137 activities at indicator and control locations during the preoperational and operational periods 1977-1981 and 1982-1990, respectively, are presented in the table below.

FISH CESIUM-137 ACTIVITIES (pCi/g wet)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1977-81	1982-90	1991	1977-81	1982-90	1991
Range	0.10-.042	.009-.020	--	.012-.016	.006-.015	--
Mean (median)	0.21 (.016)	.013	<CL	.013	.010	<CL

Note that the highest mean of cesium-137 activities in the table above is from the preoperational period at the indicator locations. As in all other environmental media monitored, the source of the cesium-137 activity detected since 1977 has been attributed to the residual fallout from previous atmospheric nuclear weapons tests.

F. SHORELINE AND FLOCCULATED SEDIMENT

Shoreline sediment was sampled in July and November 1991 at four indicator locations and two control locations. The sediment was analyzed for gross alpha activity, gross beta activity, and the activity of gamma-emitting radionuclides. The detailed results of these analyses can be found in Table 11.

Gross alpha activities in sediment have been determined every year since 1982. The means of gross alpha activities in sediment for 1991 are compared to the ranges and means of yearly average gross alpha activities at indicator and control locations during the period 1982 through 1989* in the table below.

SEDIMENT GROSS ALPHA ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1982 - 89	1991	1982 - 89	1991
Range	6.0 - 17.0	--	5.7 - 13.0	--
Mean	11.3	10.0	11.4	9.1

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

Sediment gross alpha activity is not attributed to the SSES operation.

Gross beta analyses have been performed on sediment every year since 1984. Gross beta activity has been measured at levels exceeding the MDCs in all indicator and control sediment samples since 1984. The means of gross beta activities in sediment for 1991 are compared to the ranges and means of yearly average gross beta activities at indicator and control locations during the period 1984 through 1989* in the table below.

SEDIMENT GROSS BETA ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 90	1991
Range	19.7 - 35.5	--	20.5 - 33.0	--
Mean	27.7	28.5	27.4	27.8

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

Gamma spectrometry in 1991 measured the naturally-occurring radionuclides potassium-40, radium-226, and thorium-228 in sediment at levels exceeding the MDCs. The means of the activities of potassium-40 and radium-226 in sediment for 1991 are compared to the corresponding ranges and means (medians) of the yearly average activities of these radionuclides at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990, respectively, in the tables below.

SEDIMENT POTASSIUM-40 ACTIVITIES (pCi/g dry)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	8.6-10.4	7.4-13.2	--	7.5-11.0	6.2-12.5	--
Mean	9.3	10.0	9.1	9.4	10.1	9.4

SEDIMENT RADIUM-226 ACTIVITIES (pCi/g dry)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	0.5-0.7	0.5-1.9	--	0.6-1.9	0.4-2.1	--
Mean	0.6	1.3	1.5	0.7	1.4	1.6

From 1984 through 1991, with the exception of 1990, thorium-228 was reported in sediment samples. Thorium-228 is part of the same naturally-occurring decay chain as thorium-228. The means of thorium-228 activities in sediment for 1991 are compared to the ranges and means of yearly average thorium-228 activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1989, respectively, in the table below.

SEDIMENT THORIUM-228 ACTIVITIES (pCi/g dry)				
Location	Indicator		Control	
Period	1984 - 89	1991	1984 - 89	1991
Range	1.1 - 1.3	--	1.0 - 1.4	--
Mean	1.2	0.9	1.2	0.9

The means of cesium-137 activities in sediment for 1991 are compared to the ranges and means of yearly average cesium-137 activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990, respectively, in the table below.

SEDIMENT CESIUM-137 ACTIVITIES (pCi/g dry)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	0.08-0.15	0.04-0.17	--	0.08-0.21	0.06-0.21	--
Mean	0.10	0.11	0.09	0.13	0.13	0.11

The cesium-137 activities in sediment are the result of fallout from previous atmospheric nuclear weapons tests. The cesium-137 activity in sediment is not attributed to the SSES operations.

Flocculated sediment (floc) samples have been collected on a trial basis since 1986 at one control location and one indicator location on the Susquehanna River. Floc is the top, loose layer of sediment in the river that is easily moved and shifted by the water. It is thought that perhaps material carried by the water might be transferred most readily to this floc. The data collected to date do not point to the appearance of radionuclides in the floc that haven't also been identified in the underlying sediment.

G. GROUND WATER

Ground water was sampled monthly at eight locations in 1991, including one control location. A total of 64 indicator samples and 12 control samples were collected. The detailed results of the analyses of these samples can be observed in Table 12.

Gross alpha activity has been analyzed in ground water since 1980. It is usually positively detected in a small number of samples annually. The means of yearly average gross alpha activities in ground water for 1991 are compared to the ranges and means at indicator and control locations during the preoperational and operational periods 1980-1981 and 1982-1990, respectively, in the table below.

GROUND WATER GROSS ALPHA ACTIVITIES (pCi/l)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-90	1991	1980-81	1982-90	1991
Range	--	1.3 - 4.5	--	<MDC	1.2 - 2.7	--
Mean	2.7	2.5	0.3	<MDC	1.7	0.7

Note that the 1991 mean alpha activities in the table above are lower than previous years because of the averaging method used. Refer to Appendix C for an explanation. Ground water gross alpha activity is not attributed to the SSES operation.

Gross beta activity has been analyzed in ground water since 1977. It is measured at levels in excess of the MDCs in a majority of samples every year. The means of gross beta activities in ground water for 1991 are compared to the ranges and means of yearly average gross beta activities at indicator and control locations during the preoperational and operational periods 1980-1981 and 1982-1990, respectively, in the table below.

GROUND WATER GROSS BETA ACTIVITIES (pCi/l)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-90	1991	1980-81	1982-90	1991
Range	3.2 - 3.4	2.1 - 3.7	--	1.9 - 3.0	1.8 - 2.5	--
Mean	3.3	2.5	1.2	2.5	1.7	2.6

The gross beta activity in ground water is not attributed to the SSES operation.

The means of tritium activities in ground water for 1991 are compared to the ranges and means of yearly average tritium activities at indicator and control locations during the preoperational and operational periods 1980-1981 and 1982-1990, respectively, in the table below.

GROUND WATER TRITIUM ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-90	1991	1980-81	1982-90	1991
Range	93-109	98 - 180	--	117 - 119	105 - 260	--
Mean	101	124	64	118	147	72

The 1991 mean tritium activities in the table above are lower than previous years because of the averaging method used. Refer to Appendix C for an explanation. Note that for both preoperational and operational periods the means of tritium activities at the control locations exceed those at the indicator locations, although the difference does not appear to be significant.

Gamma spectrometry of ground water has yielded few positively detected radionuclides since it was begun in 1979. The naturally occurring radionuclides potassium-40 and thorium-228 have been detected occasionally in ground water samples. Potassium-40 was found in 1979, 1981, 1985, and 1991. Thorium-228 was observed in 1985 and 1986.

Cesium-137 was not measured above the critical level in any indicator or control samples in 1991. The ranges and means of yearly average tritium activities at indicator and control locations during the operational period 1982-1990 are presented in the table below.

GROUND WATER CESIUM-137 ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-90	1991	1980-81	1982-90	1991
Range	<MDC	3.0 - 4.6	--	<MDC	2.4	--
Mean	<MDC	3.8	<CL	<MDC	2.9	<CL

Cesium-137 activity is attributed to the fallout from previous atmospheric nuclear weapons tests.

H. AIR PARTICULATE

The results of a total of 510 routine air samples collected at 10 locations during 1991 are included in this report. Four hundred eight samples were collected at 8 indicator locations and 102 samples

were collected at 2 control locations. The detailed results of these analyses can be found in Tables 13 and 14.

Air particulate filters were collected weekly and analyzed individually for gross beta activity. Quarterly, the particulate filters were composited and analyzed for gross alpha activity and the activity of specific radionuclides identified by gamma spectrometry.

Gross beta activity was positively detected in all 510 weekly samples, which includes both indicators and controls. The mean of gross beta activities in air samples in 1991 is compared to the range and mean of yearly average gross beta activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990, respectively, in the table below.

AIR PARTICULATE GROSS BETA ACTIVITIES (E-3 pCi/m^3)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	24 - 97	13 - 29	--	24 - 102	12 - 28	--
Mean	61	18	17	62	17	17

The yearly average of 97 E-3 pCi/m^3 was obtained twice for the indicator locations in the preoperational years 1978 and 1981. Since 1981, the highest gross beta activity occurred in 1986 due to the Chernobyl incident. Prior to this, the unusually high gross beta activities may generally be attributed to fallout from atmospheric nuclear weapons tests. Refer to Figure 16 which trends gross beta activity in air particulates separately for indicators and controls from 1974 through 1990.

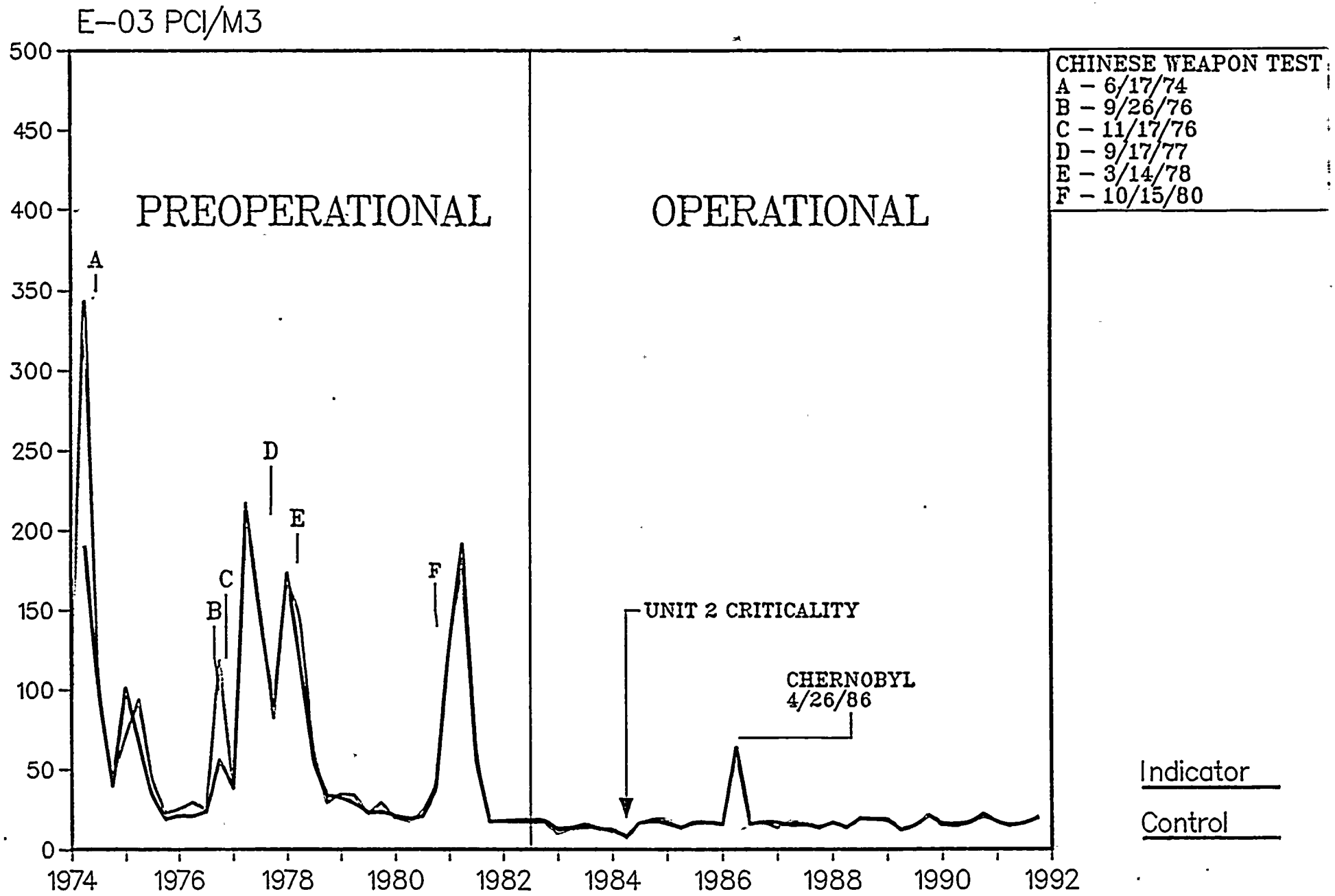
Gross alpha activity was positively detected in all quarterly indicator and control analyses in 1991. The ranges and means of gross alpha activities at both indicator and control locations in 1991 are compared to the range and mean (median) of yearly average gross alpha activities at indicator and control locations during the preoperational and operational periods 1980-1981 and 1982-1989*, respectively, in the table below.

AIR PARTICULATE GROSS ALPHA ACTIVITIES (E-3 pCi/m^3)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-89	1991	1980-81	1982-89	1991
Range	2.8 - 3.1	2.4 - 6.8	--	2.2 - 3.5	2.5 - 9.0	--
Mean (median)	3.0	4.0	4.5	2.9	4.1 (3.3)	4.5

FIGURE

GROSS BETA ACTIVITY IN AIR PARTICULATES



*1990 results were not averaged with 1982-89 data because the validity of the values is questionable in some instances. Laboratory analysis error is suspected.

Air particulate gross alpha activities are not attributed to the SSES operation. Refer to Figure 17 trending gross alpha activity in air particulates separately for indicators and controls from 1980 through 1991.

Gamma-emitting radionuclides are monitored in quarterly composite samples. Gamma spectrometry measured the naturally-occurring radionuclides beryllium-7 and potassium-40 in air samples in 1991 at levels exceeding the MDCs for the analyses.

The means of activities for indicator and control locations in 1991 are compared to the ranges and means of beryllium-7 yearly average activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1989*, respectively, in the table below.

BERYLLIUM-7 ACTIVITIES (E-3 pCi/m^3)

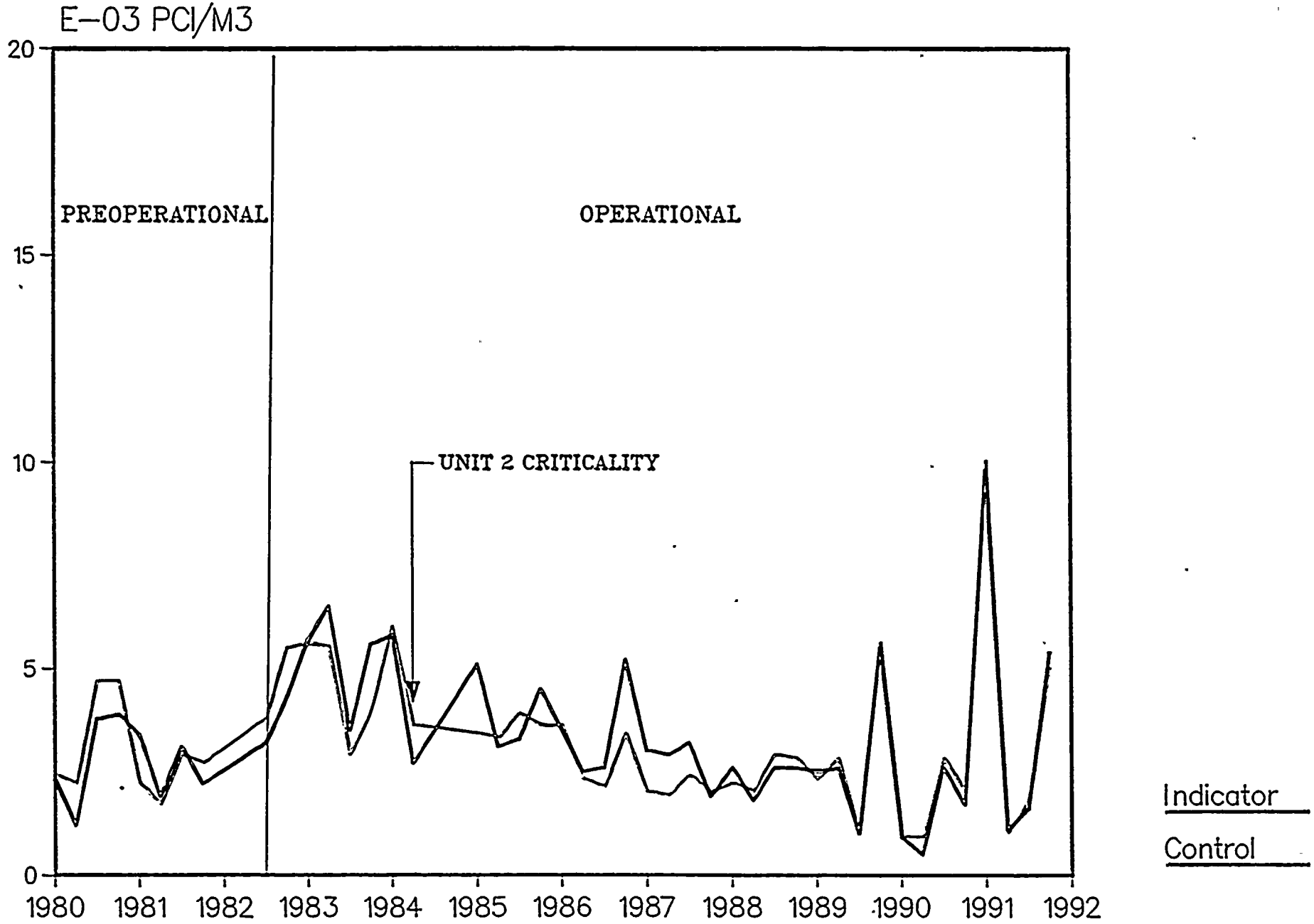
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-89	1991	1978-81	1982-89	1991
Range	69 - 81	62 - 76	--	59 - 85	53 - 68	--
Mean	76	66	95	72	61	96

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

The annual average beryllium-7 activity levels for 1991 are high when compared with the years prior to 1990. Beryllium-7 is cosmogenic in origin. Because 1991 was at the peak of an 11-year cycle for solar activity, levels of cosmic radiation were particularly intense. This may account for the higher beryllium-7 levels observed in 1991. Results during the last two quarters of the year were within the expected ranges.

Potassium-40 was measured at levels exceeding the MDCs for the analyses of three indicator samples during 1991. The means of potassium-40 activities for indicator and control locations in 1991 are compared to the ranges and means (medians) of potassium-40 yearly average activities at indicator and control locations from 1983 through 1989* in the table below.

FIGURE
GROSS ALPHA ACTIVITY IN AIR PARTICULATES



POTASSIUM-40 ACTIVITIES (E-3 pCi/m^3)				
Location	Indicator		Control	
Period	1983 - 89	1991	1983 - 89	1991
Range	4.0 - 12.0	--	3.2 - 5.8	--
Mean (median)	6.0 (5.0)	11.9	4.6 (4.9)	<MDC

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

AIR IODINE

Routine iodine-131 analyses by gamma spectrometry of 510 charcoal cartridges did not positively detect iodine-131 in any air samples in 1991. Iodine-131 was detected infrequently from 1976, when it was first monitored, through 1990. Since operation of the SSES began in 1982, iodine-131 has only been positively detected in air sampling in 1986 due to the Chernobyl incident.

PRECIPITATION

Precipitation samples from eight indicator locations and two control locations were analyzed quarterly in 1991 for gross alpha activity, gross beta activity, tritium activity, and the activity of gamma-emitting radionuclides identified by gamma spectrometry. The detailed results of these analyses can be found in Table 15.

The means of gross alpha activities in precipitation for 1991 at both indicator and control locations are compared to the corresponding ranges and means from 1984 through 1990 in the table below.

PRECIPITATION GROSS ALPHA ACTIVITY (pCi/l)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 90	1991
Range	0.6 - 1.3	--	0.6 - 1.1	--
Mean	1.0	0.6	0.9	0.6

The data above do not indicate any gross alpha activity attributable to the operation of the SSES.

The means of gross beta activities in precipitation for 1991 at both indicator and control locations are compared to the corresponding ranges and means (medians) from 1984 through 1990 in the table below.

PRECIPITATION GROSS BETA ACTIVITY (pCi/l)				
Location	Indicator		Control	
Period	1984 - 90	1991	1984 - 90	1991
Range	2.5 - 4.3	--	3.4 - 5.8	--
Mean	3.7	4.2	3.9	3.8

The data in the table above do not indicate any gross beta activity attributable to the operation of the SSES. Although the indicator mean activity is higher than the control mean activity for 1991, it is still within the range of previous annual mean activities for control locations.

The means of tritium activities in precipitation for 1991 at both indicator and control locations are compared to the corresponding ranges and means (medians) during the preoperational and operational periods 1980-1981 and 1983-1989* respectively, in the table below.

PRECIPITATION TRITIUM ACTIVITIES (pCi/l)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1983-89	1991	1980-81	1983-89	1991
Range	119 - 213	94 - 200	--	99 - 135	92 - 530	--
Mean	166	136(128)	49	117	196 (137)	32

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

The 1991 mean tritium activities above are lower than previous years primarily because of the averaging method used. Refer to Appendix C for an explanation. The data in the table above do not indicate any tritium activity attributable to the operation of the SSES.

Gamma spectrometry was first performed on precipitation samples in 1980. The only gamma-emitting radionuclides in precipitation in 1991 were the naturally-occurring beryllium-7 and potassium-40. These radionuclides were observed in one sample.

Cesium-137 was not measured at levels exceeding the CLs in any indicator precipitation samples or control samples in 1991. Cesium-137 has been in precipitation samples from indicator and/or control locations previously in 1981, 1985, 1986, 1987 1988, and 1989. The cesium-137 activity during the years it has been reported is attributable to previous atmospheric nuclear weapons tests.

I. MILK

Milk was sampled at a total of nine indicator locations and one control location in 1991. The frequency of sampling was monthly,

except for four locations where sampling was semi-monthly from April through October. In 1991, a total of 108 indicator milk samples and 19 control milk samples from cows were routinely analyzed for iodine-131 activity, strontium-89/90 activity, and the activity of gamma-emitting radionuclides by gamma spectrometry. The detailed results of these analyses can be found in Table 16.

Iodine-131 has been chemically separated in the milk samples and counted routinely since 1977. (Refer to Figure 18 trending iodine-131 activity in milk separately for indicators and controls from 1977 through 1988.) Typically, iodine-131 is not positively detected in any milk samples during a monitored year. The 1991 monitoring year was no exception; no iodine-131 above the lower limit of detection was observed in either indicator or control samples. The preoperational years 1976, 1978, and 1980 were exceptional years in the sense that activity was positively detected due to fallout. Iodine-131 activity was also detected in milk samples in 1986 in the vicinity of SSES as a result of the Chernobyl incident.

Strontium-89 was not reported in any milk sample during 1991. No strontium-89 has been reported in SSES gaseous effluents since the end of 1989. Strontium-89 has a relatively short half-life (~ 50 days) and would not be expected to be detected in the environment in 1991 as a result of fallout from atmospheric nuclear weapons testing in 1980 or before, unlike other fission products such as strontium-90 and cesium-137. Interestingly, strontium-89 was not detected following Chernobyl, even when elevated levels of such radionuclides as iodine-131 were observed. Typically, the presence of strontium-89 above the lower limit of detection would suggest the SSES as the origin.

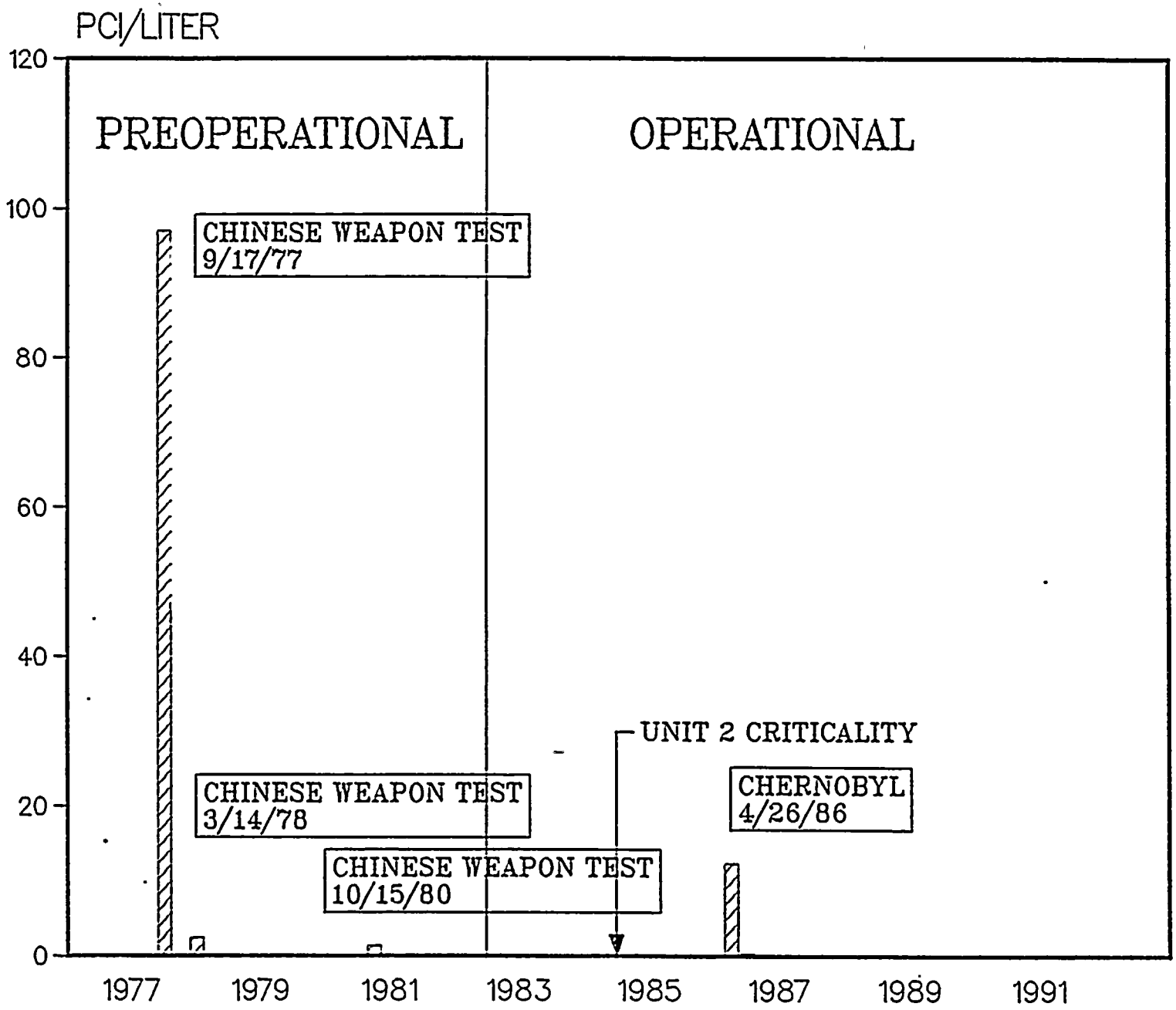
The mean of strontium-90 activities in milk for 1991 are compared to the ranges and means (medians) of yearly average strontium-90 activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1986-1989* respectively, in the table below.

MILK STRONTIUM-90 ACTIVITIES (pCi/l)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-89	1991	1978-81	1982-89	1991
Range	4.3 - 5.3	5.2 - 6.8	--	1.7 - 7.5	5.7 - 6.9	--
Mean	4.9 (4.5)	5.9	1.5	5.0 (5.4)	6.3	1.7

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

FIGURE 8
IODINE–131 ACTIVITY IN MILK



Note that the 1991 mean strontium-90 activities in the table above are lower than previous years because of the averaging method used. Refer to Appendix C for an explanation. The source of the strontium-90 before SSES operation and since criticality appears to be the Chinese atmospheric nuclear weapons tests, referred to in previous REMP annual reports, that took place in 1972, 1974, 1976, 1977, 1978, and 1980.

Gamma spectrometry of milk samples in 1991 measured naturally-occurring potassium-40 in all samples. The means of potassium-40 activities in milk for 1991 are compared to the ranges and means of yearly average potassium-40 activities at indicator and control locations during the preoperational and operational periods 1978-1981 and 1985-1990, respectively, in the table below.

MILK POTASSIUM-40 ACTIVITIES (pCi/l)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1985-90	1991	1978-81	1985-90	1991
Range	1222-1500	1241-1350	--	1273-1500	1273-1356	--
Mean	1353	1322	1266	1390	1343	1247

The cesium-137 activity measured in one indicator milk sample in 1991 is compared to the ranges and means of yearly average cesium-137 activity at indicator and control locations during the preoperational and operational periods 1978-1981 and 1982-1990, respectively, in the table below.

MILK CESIUM-137 ACTIVITIES (pCi/l)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1978-81	1982-90	1991	1978-81	1982-90	1991
Range	2.3 - 5.2	1.6 - 9.6	--	3.3-4.9	1.9-7.4	--
Mean	3.4	4.6	4.7	3.9	4.3	<CL

Cesium-137 in milk is the result of the fallout from previous years' atmospheric nuclear weapons tests and Chernobyl fallout. The only years during the Radiological Environmental Monitoring Program that cesium-137 was not reported in milk were in 1973 and 1984. Cesium-137 remains in the environment following fallout for a relatively long time because of its 30 year half-life.

J. SOIL (TOP AND BOTTOM) AND VEGETATION

Soil (top and bottom) was sampled once at each of eight REMP indicator locations and two REMP control locations during 1991. Vegetation, usually grass, was sampled at all of the locations from which soil was obtained except one. Vegetation could not be collected at one control location because there was not enough growing there. The locations for sampling soil and vegetation are the same as those for sampling air. The soil and vegetation samples were analyzed by gamma spectrometry. The detailed results of these analyses can be found in Tables 16 and 17.

Sixteen indicator soil samples and four control soil samples were collected in 1991. Half of the soil samples were "top" samples taken from the top two inches of soil The other half of the soil samples were gathered from a depth of two to six inches and are called "bottom" samples.

Naturally-occurring potassium-40, radium-226, and thorium-228 were measured at levels exceeding the MDCs in all indicator and control soil samples in 1991 except one. Radium-226 was not measured above the MDC in one indicator sample. The means of the activities of potassium-40, radium-226 and thorium-228 in soil for 1991 are compared to the corresponding ranges and means of the yearly average activities of these radionuclides at indicator and control locations during the preoperational and operational periods 1979 & 1981 and 1982-1990 respectively, in the tables below.

SOIL POTASSIUM-40 ACTIVITIES (pCi/g dry)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1979&81	1984-90	1991	1979&81	1984-90	1991
Range	9.2 - 9.7	9.4-14.3	--	9.1-11.0	7.4-14.1	--
Mean	9.5	11.2	11.2	10.1	10.7	10.1

SOIL RADIUM-226 ACTIVITIES (pCi/g dry)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1979&81	1984-90	1991	1979&81	1984-90	1991
Range	0.8 - 1.3	0.8 - 2.5	--	0.8 - 1.2	1.0 - 2.0	--
Mean	1.1	1.7	1.4	1.0	1.7	1.7

SOIL THORIUM-228 ACTIVITIES (pCi/g dry)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1979&81	1982-89	1991	1979&81	1982-89	1991
Range	0.9 - 1.3	0.9-1.3	--	--	1.0 - 1.2	--
Mean	1.1	1.0	0.9	1.0	1.1	1.1

Cesium-137 activity has been identified in all indicator and control soil samples in 1991 except for a bottom sample from indicator location 1D4. The means of cesium-137 activities in soil for 1991 are compared to the ranges and means of yearly average cesium-137 activities at indicator and control locations during preoperational and operational periods 1979 & 1981 and 1982-1990 respectively, in the table below.

SOIL CESIUM-137 ACTIVITIES (pCi/g dry)						
Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1979&81	1982-90	1991	1979&81	1982-90	1991
Range	0.5 - 0.7	0.3-0.5	--	0.2 - 1.2	0.2 - 1.2	--
Mean	0.6	0.3	0.2	0.7	0.6	0.5

Due to the relatively small activities of cesium-137 in soil and the relatively large variability associated with cesium-137 activities and their means, it is difficult to attempt to draw any conclusions about possible changes of the activities with time or about possible differences between indicator and control locations. The cesium-137 activity in soil is the result of fallout from previous atmospheric nuclear weapons tests. No other anthropogenic radionuclides were identified in soil in 1991.

Soil samples were also obtained in 1991 for the purpose of monitoring the site of disposal of SSES sewage sludge. This site is the Mowery farm in Lycoming County, Pennsylvania. Since the fall of 1987, the SSES sewage sludge has been disposed of there to permit its utilization for agricultural purposes. Monitoring on an annual basis is expected to continue indefinitely to verify that there is no increase in the presence of radionuclides at the site or in the levels of radionuclides already found to exist at that location. The results of the 1991 monitoring in three areas at the Mowery farm may be found in Table 16 identified as Areas 1, 2 and 3.

The only gamma-emitting radionuclides measured at levels in excess of the MDCs or CLs in samples from the Mowery farm in 1991 were potassium-40, thorium-228, radium-226, and cesium-137. The activity levels of the gamma-emitting radionuclides identified in the Mowery farm soil samples in 1991 were at essentially the same magnitudes as those reported in soil samples from the vicinity of the SSES.

Naturally-occurring potassium-40 was positively detected in all vegetation indicator and control samples in 1991. Naturally-occurring beryllium-7 was detected in all but two vegetation samples. The means of the activities of beryllium-7 and potassium-40 in vegetation for 1991 are compared to the corresponding ranges and means (medians) of the yearly average activities of these radionuclides at indicator and control locations during the period 1986-1989/90 in the tables below.

VEGETATION BERYLLIUM-7 ACTIVITIES (pCi/g wet)				
Location	Indicator		Control	
Period	1986 - 90	1991	1986 - 90	1991
Range	0.6 - 2.6	--	0.6 - 2.2	--
Mean (median)	1.2 (0.8)	0.7	1.4	0.4

VEGETATION POTASSIUM-40 ACTIVITIES (pCi/g wet)				
Location	Indicator		Control	
Period	1986 - 89	1991	1986 - 89	1991
Range	6.2 - 6.3	--	4.9 - 7.2	--
Mean (median)	5.9 (6.2)	6.0	5.7 (5.4)	4.3

*1990 results were not averaged with 1981-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

The activity of Cs-137 measured in one vegetation indicator sample in 1991 is compared to the corresponding ranges and means of yearly average cesium-137 activities at indicator and control locations during the period 1986-90 in the table below.

VEGETATION CESIUM-137 ACTIVITIES (pCi/g wet)				
Location	Indicator		Control	
Period	1986 - 90	1991	1986 - 90	1991
Range	01. - .06	--	.01 - .04	--
Mean	.03	.03	.02	<CL

The cesium-137 in the table above is attributable to fallout from previous atmospheric nuclear weapons tests. No other gamma-emitting radionuclides were positively detected in vegetation in 1991.

K. FOOD PRODUCTS

Ninety-four fruit and vegetable samples and 15 game/poultry/egg samples were analyzed by gamma spectrometry during 1991. Twenty-nine types of fruits and vegetables were sampled in 1991 from 15 different locations and 8 different sectors.

Three types of game animals were sampled in 1991. In addition, samples were obtained of duck, chicken and eggs. Together 10 locations in nine different sectors were sampled.

FRUITS AND VEGETABLES

Sample collection began in June and ended in November. Collection took place at one control location and 14 indicator locations. The naturally-occurring and gamma-emitting radionuclides measured at levels above their MDCs in 1991 were naturally-occurring beryllium-7 and potassium-40. The fallout radionuclide cesium-137 was only reported in one sample (honey) in 1991.

The means of the activities of potassium-40 in fruits and vegetables for 1991 are compared to the ranges and means of the yearly average activities of those radionuclides at indicator and control locations during the preoperational and operational periods 1980-1981 and 1982-1989*, respectively, in the table below.

FRUITS/VEGETABLES POTASSIUM-40 ACTIVITIES (pCi/g wet)

Location	Indicator			Control		
Period	Pre-Op	Operational		Pre-Op	Operational	
	1980-81	1982-89	1991	1980-81	1982-89	1991
Range	2.5 - 3.0	2.0-4.2	--	3.0 - 3.1	2.2 - 2.8	--
Mean	2.8	3.2	2.5	3.1	2.5	2.5

*1990 results were not average with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

Potassium-40 levels in the samples routinely vary considerably over a range of more than an order of magnitude.

GAME, POULTRY AND EGGS

Rabbit, squirrel, and deer were sampled in January and November and analyzed for the activities of gamma-emitting radionuclides in 1991. Naturally-occurring potassium-40 and the fallout radionuclide cesium-137 were reported in game samples in 1991. No other gamma-emitting radionuclides were reported in game samples in 1991.

The mean of naturally-occurring potassium-40 activities in game for 1991 is compared to the ranges and means of the yearly average activities of potassium-40 in samples from the preoperational and operational periods 1972-1981 and 1982-1989*, respectively, in the table below.

GAME POTASSIUM-40 ACTIVITIES (pCi/g wet)			
Period	Preoperational	Operational	
	1972 - 81	1982 - 89	1991
Range	1.8 - 4.8	2.7 - 3.7	--
Mean	2.8	3.0	2.9

*1990 results were not averaged with 1982-89 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

Note that there are no control locations designated for game as there are for the other environmental media sampled. The reasons for this have been, not only that specific locations for game (especially game such as deer - the range of one individual may span a significant distance) is usually impossible to specify, but also that most game samples in the past have been obtained in relatively close proximity to the SSES due to the means (such as "road" kills) with which many deer samples are collected.

The mean cesium-137 sample activity in game in 1991 is compared with the ranges and means (medians) of the yearly average activities of cesium-137 in samples from the preoperational and operational periods 1972-1981 and 1982-1990, respectively, in the table below.

GAME CESIUM-137 ACTIVITIES (pCi/g wet)			
Period	Preoperational	Operational	
	1972 - 81	1982 - 90	1991
Range	0.0 - 8.8	0.5 - 1.6	--
Mean (median)	1.9 (1.1)	0.8	0.2

Since 1986, there appears to be a general downward trend in the cesium-137 levels in game. The cesium-137 in the table above is attributed to fallout from previous atmospheric nuclear weapons tests.

A duck from a farm at location 10D1 and a chicken and eggs from location 12B1 were also sampled in 1991. As in 1988, 1989, and 1990, no anthropogenic radionuclides were reported in 1991.

L. CALCULATED DOSE TO THE HYPOTHETICAL MAXIMALLY EXPOSED INDIVIDUAL

Tritium is the only radionuclide that is attributable to the operation of the Susquehanna Steam Electric Station (SSES) to be detected in the vicinity of the SSES by the 1991 Radiological Environmental Monitoring Program (REMP). Tritium was observed in the surface water portion of the aquatic pathway. As previously described, tritium was frequently identified in the cooling tower

blowdown line in 1991 at levels exceeding those found at the control locations on the Susquehanna River.

The doses to hypothetical maximally exposed individuals in four age groups (adult, teenager, child, and infant) were determined according to the methodology of the Offsite Dose Calculation Manual using the LADTAP II code and the levels of tritium contributed by the SSES to the aquatic pathway of the environment. For the purpose of performing the dose calculation, tritium was assumed to be present continuously in the cooling tower blowdown line throughout 1991 at an activity level equivalent to the difference between the blowdown line's 1991 average level and the 1991 average tritium activity level for surface water control locations. Using conservative discharge volume estimates, doses were calculated at the nearest downriver municipal water supplier via the drinking water, shoreline, and fish pathways.

The maximally exposed age group from the aquatic pathway in 1991 was determined to be the child. The calculated whole body dose was less than 0.001 millirem. This dose is less than 0.01 percent of the 6 millirem limit (as expressed in 10 CFR 50, Appendix I) for two-unit reactor operation. This value can also be compared to the average annual value of approximately 300 millirem effective dose-equivalent received by the U.S. population from exposure to natural background radioactivity.

VI. DEVIATIONS FROM THE TECHNICAL SPECIFICATIONS SAMPLE SCHEDULE AND LLDs-1991

The analysis sensitivities required by the Technical Specifications were met throughout 1991.

Deviations from routine occurred in the monitoring of surface water, drinking water, and food products. These deviations are discussed below and specifically documented in Tables 7, 8, and 12.

Surface Water

Problems with automatic composite samplers (ACSs) at two surface water locations (6S6 and 6S7) led to relatively brief intervals when no water was being collected and intervals when too much water was collected. These instances resulted in samples that were not as proportionally representative of their entire sampling periods as desirable. However, samples were collected and analyzed when possible for scheduled sample periods. In certain instances, grab samples were obtained during weeks that automatic composite samplers were malfunctioning.

Early in 1991, the ACS at 6S7, the cooling tower blowdown discharge sampling location, had a problem which had occurred frequently in 1990. This problem resulted in overflowing of sample from the ACS sample collection jug. Replacement of a deteriorating plastic hose inside the ACS cabinet in late February seemed to drastically reduce the frequency of occurrences during the remainder of 1991 in comparison to those that had occurred during 1990. In fact, there was only one additional occurrence of this overflow problem in September.

With the exception of the intentional down time in February for hose replacement, the ACS at 6S7 was only intentionally shut down one other time in 1991. In June, divers cleaned out the blowdown line over a period of a little more than one week. Because there was no blowdown line flow during this period, the ACS pump had to be shut down.

The ACS at location 6S6, the SSES river water intake structure, was shutdown five times for maintenance during 1991. Each time, the durations of the shutdowns were for periods of less than five hours. In a couple of instances, the 6S6 ACS was only shutdown for periods of about one-half an hour.

Drinking Water

Problems also were experienced with the ACS located at the drinking water sampling location 12H2, the Danville Municipal Water Authority. Both raw (untreated) and treated water are sampled at this facility. However, an ACS is only used for the sampling of the raw water which is designated as 12H2R.

The sampling of 12H2R by the ACS was interrupted inadvertently or intentionally on more than one occasion during 1991. At the beginning of January, the ACS was not sampling water for a little more than a week before being restored to operation. At the end of May, as a result of an electrical storm, the pump supplying water to the ACS shut down and

was not restored to operation until the third of June. Beginning about the middle of September, a pump problem rendered the 12H2R ACS inoperable until a new pump was installed in the latter half of October. During this period grab sampling was performed. The pump was also down for a relatively brief period during the first half of December.

The ACS at 12H2R also was shutdown intentionally once in July for equipment installation and once in December for maintenance. The down time in July was drawn out to a little more than two days because those installing the equipment forgot to restart the pump. The shutdown period in December was for less than 2 hours.

On several other occasions, although the ACS continued to operate, either too little or too much sample was obtained. For a period of about 5 days in October, following the installation of a new pump to supply water to the ACS, insufficient water was collected because the ACS was set to sample too infrequently and because the water that was collected drained from the collection jug through a spigot that was left partially open. Once in January and again in November the collection jugs overflowed, resulting in brief periods when, effectively, the water was not being sampled although the ACS continued to function.

Food Products

The 1990 Land Use Census identified the Lupini farm, 8.3 miles WSW of the SSES, as one of two locations within 10 miles of the SSES that was using water from the Susquehanna River downstream of the SSES discharge for irrigation purposes. The SSES Technical Specifications require that food product samples be obtained from any area which is irrigated by water into which waterborne effluents from the SSES have been discharged. Although sample collection personnel were directed to investigate the possibility of collecting samples there, food product samples were not obtained from this location. The other location using Susquehanna River water from downstream of the SSES discharge for irrigation was sampled as required. That was the Zehner farm, 3.3 SW of the SSES, designated as location 11D1.

The importance of obtaining samples from the Lupini farm in 1992 and for as long as it continues to irrigate with Susquehanna River water has been stressed with the personnel responsible for sample collection. Sample collectors will be informed that this sampling is required by SSES Technical Specifications. Specific reference to the requirement to sample the Lupini farm will be included in 1992 monthly sample schedules throughout the harvest season.

VII. PROGRAM CHANGES - 1991

Sample Analysis

PP&L obtained a new contract with another radioanalytical laboratory to analyze REMP samples during 1991. Samples were sent to one laboratory for the first two months of the year and another laboratory for the remainder of the year. This was done because of concerns about the frequency with which the original laboratory was not meeting some of the required analysis sensitivities. Another concern was the unusually long times that transpired in many cases between the laboratory's receipt of samples and the transmission of analysis results to PP&L.

Sampling Locations and Frequencies

Milk Sampling

The total number of milk sampling locations decreased by one, from nine to eight, during 1991. One of the least sensitive (lowest dose potential) locations (9D3), the Broyan farm, for sampling milk was eliminated in April 1991 following a review of 1990 meteorological data and the available sampling locations as indicated by the 1990 Land Use Census. This change was prompted by an effort to control the overall costs of the monitoring program, which were raised by increases in the frequency of sampling and analyses of surface water during 1991.

Other changes also took place in milk sampling during 1991. Two milk sampling locations were replaced. Location 8D4, the Chapin farm, was lost because the farmer went out of business in January 1991. It was replaced with the Kishbaugh farm, designated as location 10D4. Location 13E3, the Dent farm, also was replaced by the Durwood Moyer farm, designated 6C1, in April. This change was initiated because of the greater monitoring sensitivity provided by location 6C1.

In addition, a review of the locations that were sampled semi-monthly for milk in 1990 indicated that some changes should be made. When semi-monthly milk sampling began again in April (semi-monthly sampling takes place from April through October each year), locations 10G1, 12B3, 12D2, and 14B1 were selected.

Location 12B3, the Young farm, replaced 12B2 as a semi-monthly location because the Schultz farm went out of business in October 1990. Location 12D2 was added to the list of semi-monthlies because of its relatively high dose potential. Overall there was a net reduction in the semi-monthlies from six locations in 1990 to four in 1991. Four locations (9D3, 10D1, 10D3, and 13E3) that were sampled semi-monthly in 1990 were not sampled semi-monthly in 1991.

As noted before, locations 9D3 and 13E3 were no longer sampled at all by April 1991. With the exception of location 10G1, the Davis farm

(the control milk sampling location), the other three locations sampled semi-monthly for milk in 1991 were the most sensitive indicator locations available.

Ground Water Sampling

Ground water sampling at location 12E4, the Berwick Hospital, was discontinued in April 1991. This change occurred because sampling at this location was essentially redundant at best. The ground water sampled at the Berwick Hospital was actually treated water supplied to the Hospital by the Berwick Water Company. Untreated ground water has been and continues to be sampled at the Berwick Water Company. It is used as a control for comparing with ground water sampled from locations near the SSES that have a potential for being affected by unplanned liquid releases to the environment from the SSES.

As a continuation of the transition from the collection of treated samples to the collection of untreated samples at ground water monitoring locations that began in 1990, both types of samples were simultaneously collected at two locations in 1991. Simultaneous collection of both types of samples at location 2S6, which was begun in 1990, continued for the first six months of 1991. In addition, both types of samples were collected simultaneously at location 12S1 for two months in 1991. For the remainder of 1991, only untreated samples were obtained at these locations.

Location 4S5, the White House, replaced location 4S2, the Peach Stand, as a ground water sampling location. Changes in the usage of the Peach Stand made routine sample availability questionable.

Surface Water Sampling

The surface water control sampling location on the Susquehanna River designated as 5S8 was discontinued in April 1991. Because two other control locations upstream of the SSES discharge to the Susquehanna River, the bridge at Mocanaqua designated as 1D3 and the automatic composited sampler at the SSES river water intake structure designated as 6S6, are also sampled, it was decided that this degree of redundancy for control sampling was unnecessary. Sufficient information is provided by the other two control locations that were sampled throughout 1991.

Bi-weekly compositing of water samples for I-131 analysis was initiated at sampling locations 6S6, 6S7, 12H1, 12H2R, and 12H2T in April. Bi-weekly compositing was extended to location 6S5 in September. Monthly compositing continues at these locations for gross alpha and beta, tritium, and gamma spectroscopic analyses.

Fruit/Vegetable Sampling

As usual, changes took place from 1990 to 1991 in fruit and vegetable sampling locations. New gardens that were sampled in 1991, but not

in 1990, were the Bodnar (10B5), Soya (16F3), and Jacobsen (13G1) gardens. Gardens that had been sampled in 1990, but not in 1991, were the Moskaluk (14B), Gibbons (15B), Chapin (8D4), and Kessler 13E4) gardens. Overall, one less garden was sampled in 1991 than in 1990.

The availability of fruits and vegetables from gardens often varies from one year to the next as gardeners may grow different plants or even choose not to plant gardens. An attempt is made each year to obtain samples from the most sensitive locations. This may lead to the intentional substitution of one garden for another based on consideration of meteorological data and Land Use Census data from the previous year.

Game Sampling

The sampling method for small game is hunting, and for deer, it is typically recovery of the flesh from road-killed animals. While picking up road kills is not particularly time intensive, hunting small game frequently is time intensive. Factors that determine the opportunities for sampling are complex and, for the most part, beyond the sampler's control. As a result, it is difficult to be able to ensure that the same numbers and types of game samples are collected each year. While two more locations were sampled in 1991 than in 1990, one less type of game was monitored. Although groundhog samples were obtained in 1990, none were collected in 1991. However, squirrel, rabbit, and deer continued to be sampled in 1991.

Data Reporting

Concurrent with PP&L's change to Teledyne Isotopes as the REMP Analysis Laboratory, PP&L decided to make a change in its statistical approach to data handling. In prior Annual Reports (before the 1991 REMP Annual Report), the reported annual averages were obtained by considering only those measured values that exceeded a decision limit corresponding to either the lower limit of detection or, in the case, of man-made gamma-emitting radionuclides, the critical level for the analysis. Beginning with this report, all measured values (positive, negative, or zero) will be included in the calculations of averages for all analysis results except those from gamma spectroscropic analyses. Averages determined for gamma spectroscopic analysis results are expected to be determined in the same way as those for other analyses in future reports once programming changes are accomplished.

Because the former method for determining averages excluded positive values below the lower limit of detection (or critical level), as well as zeroes, and negative values, the averages reported in the past would have tended to be positively biased by this censoring process. Negative values for activity levels of specific radionuclides in the environment have no physical reality. However, the statistical nature of radioactive decay and the measurement

process for levels of radioactivity very close to background levels argues for the inclusion of data below decision limits in the averaging process. The decision limits, consequently, become useful only as indications of the sensitivities of the measurement processes and not as tools for the censoring of data.

VIII. CONCLUSION

In 1991, REMP detected the naturally-occurring radionuclides beryllium-7, potassium-40, radium-226, and thorium-228 in the environment. Beryllium-7 was observed in algae, air, precipitation, vegetation, and fruits and vegetables. Potassium-40 was reported for all media except drinking water. Radium-226 was reported routinely in sediment and soil samples as expected, and, in addition, it was reported in one algae sample. Thorium-228 was routinely reported in sediment and soil as expected. Thorium-228 was also reported in some algae samples.

The 1991 REMP also reported the following four man-made radionuclides in the environment: tritium, strontium-90, iodine-131, and cesium-137. The fission products strontium-90, iodine-131, and cesium-137 are typically observed in certain media in any given year and are attributed to sources (previous atmospheric nuclear weapons tests and medical procedures) other than the SSES. While tritium also appears in the environment from sources other than the SSES, levels of tritium are typically observed in the aquatic pathway that indicate a contribution from the SSES.

Strontium-90 was reported in most 1991 milk samples and in one surface water sample. Strontium-90 (like cesium-137) is a long-lived radionuclide present in the environment as a result of the fallout from atmospheric nuclear weapons tests. Average levels of strontium-90 reported in 1991 were within the range of averages reported in previous years, with no indication of any addition to environmental levels resulting from the SSES operation.

Iodine-131 was found in surface water samples from the Susquehanna River, both upstream and downstream of the SSES, more frequently from August through the end of the year than it is usually observed. It was also found in one drinking water sample and two algae samples. Iodine-131 is believed to be present as the result of medical usage.

Cesium-137, from the fallout of previous atmospheric nuclear weapons testing, was reported in algae, sediment, soil, vegetation, milk, honey, and game. In general, there appears to have been a reduction in the reporting frequency of cesium-137 in various media in 1991 compared to the years prior to 1990.

Tritium, as usual, was observed in all four types of water samples (surface water, drinking water, ground water, and precipitation) that were collected in 1991. However, tritium was used to estimate the offsite dose impact from the aquatic pathway, via surface water only, because the levels observed in the other waters do not indicate a contribution from SSES operation distinguishable from non-SSES sources. The resulting conservatively calculated radiation dose to a hypothetically exposed individual was less than 0.001 millirem to the whole body. This confirms the negligible impact of the SSES operation presented in the Semiannual Effluent and Waste Disposal report for the SSES in 1991 (41).

Monitoring the ambient radiation levels in the vicinity of the SSES by thermoluminescent dosimetry has similarly demonstrated no significant impact on the health and safety of the public living around the SSES. The annual dose-equivalent of about 72 millirem indicated by REMP TLD monitoring can not be determined to be different from the exposure due to natural background radiation.

TABLE 4
SUMMARY OF DATA FOR THE SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1991
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
REPORTING PERIOD: DECEMBER 31, 1990 to JANUARY 6, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED(1)		LOWER LIMIT OF DETECTION (LLD) (2)	ALL INDICATOR LOCATIONS MEAN(f)(3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(f)(3) RANGE	CONTROL LOCATION MEAN(f)(3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Ambient Radiation (mR/std. qtr.)	TLD	368		18.1(336/336) (14.1-24.3)	9S2 0.2 miles S	24.3(4/4) (23.1-27.4)	18.0(32/32) (14.7-20.4)	0
Surface Water (pCi/l)	Gross Alpha	99		0.8(62/72) (-1.1-9.4)	6S7 Discharge	1.3(11/12) (-0.5-9.4)	0.6(23/27) (-0.7-7.8)	0
	Gross Beta	99	4	7.1(66/71) (1.8-20)	6S7 Discharge	15.4(12/12) (8.8-20)	4.5(24/27) (1.8-25)	0
	Tritium	94	2000	581(68/70) (-21-7700)	6S7 Discharge	2858(12/12) (128-7700)	48(21/24) (-45-130)	0
	Iodine-131	136	1	0.10(89/98) (-0.18-1.2)	6S7 Discharge	0.24(22/23) (-0.07-1.2)	0.06(34/38) (-0.15-0.46)	0
	Gamma Spec							0
	K-40	99		523(4/72) (25-1770)	12H1 26 miles WSW	898(2/12) (25-1770)	< MDC	0
Potable Water (pCi/l)	Gross Alpha	24		0.2(22/24) (-0.83-0.85)	12H2R 26 miles WSW	0.4(11/12) (-0.63-0.85)	Only Indicator Stations Sampled for this Medium	0
	Gross Beta	24	4	3.2(22/24) (1.4-8.9)	12H2R 26 miles WSW	3.6(11/12) (1.4-8.9)		0
	Iodine-131	44	1	0.032(42/44) (-0.056-0.15)	12H2R 26 miles WSW	0.050(20/21) (-0.056-0.15)		0
	Tritium	24	2000	84(24/24) (-33-250)	12H2T 26 miles WSW	89(12/12) (32-210)		0

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Algae (pCi/g dry)	Gamma Spec						
	Be-7	12	6.2(4/6) (3.9-8.4)	AG-4 0.9 miles ESE	6.2(4/6) (3.9-8.4)	5.9(5/6) (3.2-7.3)	0
	Cs-137	12	< MDC	AG-3 0.8 miles E	0.5(1/6) (0.5-0.5)	0.5(1/6) (0.5-0.5)	0
	K-40	12	12.6(6/6) (5.1-15.1)	AG-4 0.9 miles ESE	12.6(6/6) (5.1-15.1)	11.6(6/6) (9.5-15.4)	0
	Ra-226	12	< MDC	AG-3 0.8 miles E	5.6(1/6) (5.6-5.6)	5.6(1/6) (5.6-5.6)	0
	Th-228	12	1.5(3/6) (1.4-1.5)	AG-4 0.9 miles ESE	1.5(3/6) (1.4-1.5)	1.4(2/6) (0.9-1.8)	0
Fish (pCi/g wet)	Gross Beta	15	5.8(9/9) (4.1-7.5)	IND 0.9-1.4 miles ESE	5.9(6/6) (4.2-7.5)	4.5(6/6) (2.4-6.6)	0
	Gamma Spec						
	K-40	15	3.6(9/9) (2.3-4.4)	LTAW On site NE-ESE	3.8(3/3) (3.7-3.9)	3.6(6/6) (2.9-4.7)	0

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Sediment (pCi/g dry)	Gross Alpha	12	10(8/8) (7-12)	LTAW On site NE-ESE	11(2/2) (11-11)	9.1(4/4) (7-12)	0
	Gross Beta	12	29(8/8) (24-36)	LTAW On site NE-ESE	34(2/2) (32-36)	28(4/4) (26-31)	0
	Cs-137	12	0.09(4/8) (0.05-0.11)	2B 1.6 miles NNE	0.13(2/2) (0.12-0.14)	0.11(3/4) (0.06-0.15)	0
	K-40	12	9.1(8/8) (4.2-12.1)	2B 1.6 miles NNE	10.6(2/2) (9.4-11.8)	9.4(4/4) (7.4-12)	0
	Ra-226	12	1.5(6/8) (0.9-1.8)	2B 1.6 miles NNE	1.8(2/2) (1.6-2.0)	1.6(4/4) (1.2-2.0)	0
	Th-228	12	0.9(8/8) (0.5-1.2)	12F 6.9 miles WSW	1.1(2/2) (1.0-1.2)	0.9(4/4) (0.7-1.0)	0
Floc (pCi/g dry)	Gross Alpha	2	20(1/1) (20-20)	7B 1.2 miles SE	20(1/1) (20-20)	19(1/1) (19-19)	0
	Gross Beta	2	35(1/1) (35-35)	2B 1.6 miles NNE	40(1/1) (40-40)	40(1/1) (40-40)	0
	Cs-137	2	< MDC	2B 1.6 miles NNE	0.6(1/1) (0.6-0.6)	0.6(1/1) (0.6-0.6)	0
	K-40	2	13(1/1) (13-13)	7B 1.2 miles SE	13(1/1) (13-13)	12.5(1/1) (12.5-12.5)	0

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Ground Water (pCi/l)	Gross Alpha	76		0.3(64/64) (-0.1-2.9)	3S5 0.9 miles NE	0.4(6/6) (-0.1-1.5)	0.7(12/12) (-0.5-2.3)	0
	Gross Beta	76		1.2(64/64) (-0.50-5.8)	12F3 5.2 miles WSW	2.6(12/12) (1.2-4.3)	2.6(12/12) (1.2-4.3)	0
	K-40	76		70.5(2/64) (59.8-81.2)	3S5 0.9 miles NE	81.2(1/6) (81.2-81.2)	< MDC	0
	Tritium	76	2000	64(64/64) (-33-180)	12E4 4.7 miles WSW	126(3/3) (77-180)	72(12/12) (14-150)	0
Air Particulates (E-03 pCi/m^3)	Gross Beta	510	10	17(408/408) (16.3-18.2)	12G1 15 miles WSW	18(51/51) (6.5-36)	17(51/102) (5.1-32)	0
Air Iodine (E-03 pCi/m^3)	Gamma Spec	510	70	< MDC			< MDC	
Air Particulates Quarterly Composite (E-03 pCi/m3)	Gross Alpha	40		4.5(32/32) (3.6-5.4)	12E1 4.7 miles WSW	5.4(4/4) (1.1-9.8)	4.5(8/8) (1.0-10.0)	0
	Gamma Spec							
	Be-7	40		95(32/32) (88-104)	15S4 0.6 miles NW	104(4/4) (92.1-129)	96(8/8) (72-110)	0
	K-40	40		11.9(3/32) (5.0-16.8)	9B1 1.3 miles S	16.8(1/4) (16.8-16.8)	< MDC	0

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LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
REPORTING PERIOD: DECEMBER 31, 1990 to JANUARY 6, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED(1)		LOWER LIMIT OF DETECTION (LLD) (2)	ALL INDICATOR LOCATIONS MEAN(f)(3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(f)(3) RANGE	CONTROL LOCATION MEAN(f)(3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Precipitation (pCi/l)	Gross Alpha	40		0.6(32/32) (0.27-1.0)	12G1 15 miles WSW	0.67(4/4) (0.41-0.78)	0.6(8/8) (0.15-0.81)	0
	Gross Beta	40		4.2(32/32) (1.4-16)	12E1 4.7 miles WSW	7.4(4/4) (2.7-160)	3.8(8/8) (1.8-5.2)	0
	Be-7	40		27.3(7/32) (19.9-36.9)	3D1 3.4 miles NE	36.9(1/4) (36.9-36.9)	25.4(2/8) (22.9-27.9)	0
	K-40	40		39.5(3/32) (9.5-64.6)	1D2 4.0 miles N	64.6(1/4) (64.6-64.6)	< MDC	0
	Tritium	40		49(32/32) (-28-140)	3S2 0.5 miles NE	64(4/4) (23-100)	32(8/8) (27-63)	0
Milk (pCi/l)	I-131	126	1	< MDC			< MDC	
	Sr-90	126		1.5(107/107) (0.6-17)	13E3 5.0 miles W	17(1/3) (17-17)	1.7(19/19) (-0.1-3.5)	0
	Gamma Spec							
	K-40	126		1266(107/107) (203-1342)	10D4 3.8 miles SSW	1342(12/12) (1220-1550)	1247(19/19) (775-1410)	0
	Cs-137	126	18	4.7(1/107) (4.7-4.7)	6C1 2.7 miles ESE	4.7(1/12) (4.7-4.7)	< MDC	0

TABLE 4
SUMMARY OF DATA FOR THE SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1991
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
REPORTING PERIOD: DECEMBER 31, 1990 to JANUARY 6, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED(1)	LOWER LIMIT OF DETECTION (LLD) (2)	ALL INDICATOR LOCATIONS MEAN(f)(3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(f)(3) RANGE	CONTROL LOCATION MEAN(f)(3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Soil (pCi/g dry)	Cs-137	20	0.2(15/16) (0.07-0.44)	9B2 1.3 miles S	0.4(2/2) (0.30-0.44)	0.5(4/4) (0.12-0.97)	0
	K-40	20	11.2(16-16) (8.1-14.8)	3S7 0.5 miles NE	14.5(2/2) (14.2-14.8)	10.1(4/4) (8.5-11.8)	0
	Ra-226	20	1.4(15/16) (0.9-2.0)	12G3 15 miles WSW	1.8(2/2) (1.8-1.8)	1.7(4/4) (1.3-2.0)	0
	Th-228	20	0.9(16/16) (0.6-1.4)	3D2 3.4 miles NE	1.4(2/2) (1.2-1.5)	1.1(4/4) (1.1-1.1)	0
Vegetation (pCi/g wet)	Gamma Spec						
	Be-7	9	0.7(7/9) (0.15-1.23)	15S4 0.6 miles NW	1.23(1/1) (1.23-1.23)	0.4(1/1) (0.4-0.4)	0
	K-40	9	6.0(9/9) (3.8-7.0)	12E2 4.7 miles WSW	7.0(1/1) (7.0-7.0)	4.3(1/1) (4.3-4.3)	0
Food/Garden Crops (pCi/g wet)	Gamma Spec						
	Be-7	79	0.18(3/79) (0.10-0.28)	11F 5.6 miles SW	0.28(1/1) (0.28-0.28)	< MDC	0
	Cs-137	79	0.01(1/79) (0.01-0.01)	7F1 6.7 miles SE	0.01(1/12) (0.01-0.01)	< MDC	0
	K-40	79	2.5(79/79) (1.1-11.4)	11F1 5.6 miles SW	11.4(1/1) (11.4-11.4)	2.5(3/3) (1.6-3.4)	0

TABLE 4
SUMMARY OF DATA FOR THE SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1991
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
REPORTING PERIOD: DECEMBER 31, 1990 to JANUARY 6, 1992

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED(1)	LOWER LIMIT OF DETECTION (LLD) (2)	ALL INDICATOR LOCATIONS MEAN(f)(3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN(f)(3) RANGE	CONTROL LOCATION MEAN(f)(3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Animals (pCi/g wet)	Cs-137	15	0.2(3/15) (0.02-0.6)	16F 5-10 miles NNW	0.6(1/3) (0.6-0.6)	Only Indicator Stations Sample for this Medium	0
	K-40	15	2.9(15/15) (1.0-4.7)	16F 5-10 miles NNW	3.7(3/3) (2.6-4.7)		0

1. The total number of analyses does not include duplicates or splits or repeated analyses.
2. The technical Specifications LLD is given when applicable.
3. Means and ranges are based upon detectable activities for gamma emitters only. (f) is the ratio of positive results for the number of samples analyzed. For other analyses, means are based on all analysis results.
4. USNRC reporting levels are specified in the Technical Specifications.

X. LAND USE CENSUS

The USNRC Branch Technical Position on "An Acceptable Radiological Environmental Monitoring Program" (November 1979, Revision 1), states that "a census shall be conducted annually during the growing season to determine the location of the nearest milk animal and nearest garden greater than 50 square meters (500 sq. ft.) producing broad leaf vegetation in each of the 16 meteorological sectors within a distance of 8 km (5 miles)." To comply with this requirement, a land-use survey was conducted for the Susquehanna SES during 1991. The closest garden (greater than 50 square meters, producing broad leaf vegetation) and residence in each radial sector was determined and all dairy animals within five (5) miles were identified.

Table 5 lists the nearest dairy animals, the nearest garden, and nearest residence in each sector identified during the survey. These land-use parameters are used in the assessment of potential radiological doses to individuals and populations of the stated regions.

TABLE 5

Nearest residence, garden, and dairy animal in each of the 16 meteorological sectors within a 5-mile radius of the Susquehanna Steam Electric Station, 1991.

Sector	Direction	Nearest Residence	Nearest Garden	Nearest Dairy Animal
1	N	1.3 mi	3.2 mi	>5.0 mi
2	NNE	0.9 mi	1.3 mi	>5.0 mi
3	NE	2.3 mi	2.3 mi[a]	>5.0 mi
4	ENE	2.1 mi	2.2 mi	3.7 mi
5	E	1.4 mi	1.4 mi	4.5 mi[b]
6	ESE	0.5 mi	2.3 mi	2.7 mi[b]
7	SE	0.4 mi	0.6 mi	2.6 mi[b]
8	SSE	0.6 mi	0.9 mi	>5.0 mi
9	S	1.0 mi	1.1 mi	3.9 mi
10	SSW	1.0 mi	1.2 mi	3.0 mi[b]
11	SW	1.5 mi	1.8 mi	>5.0 mi
12	WSW	1.1 mi[c]	1.1 mi[c]	2.0 mi
13	W	1.2 mi	1.5 mi	5.0 mi
14	WNW	0.7 mi	0.7 mi	1.8 mi
15	NW	0.8 mi	1.8 mi	>5.0 mi
16	NNW	0.6 mi	4.0 mi	4.2 mi

[a]Chickens raised for consumption at this location.

[b]Fruits/vegetables grown for consumption at this location.

[c]Eggs consumed from chickens raised at this location.

XI. REFERENCES

1. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, Report #1 (April - December 1972)" RMC-TR-73-14, July 1973.

2. Radiation Management Corporation, "Susquehanna Steam Electric Station, Pre-operational Radiological Environmental Monitoring Program 1973," RMC-TR-74-07, May 1974.

3. Radiation Management Corporation, "Susquehanna Steam Electric Station, Preoperational Radiological Environmental Monitoring Program, 1974 Annual Report," RMC-TR-75-07, April 1975.

4. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1975 Annual Report," RMC-TR-76-05, May 1976.

5. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1976 Annual Report," RMC-TR-77-04, March 1977.

6. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1977 Annual Report," RMC-TR-78-01, May 1978.

7. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1978 Annual Report," RMC-TR-79-01, April 1979.

8. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1979 Annual Report," RMC-TR-80-01, March 1980.

9. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1980 Annual Report," RMC-TR-81-02, July 1981.

10. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1981 Annual Report," RMC-TR-82-03, July 1982.

11. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1982 Preoperational Report," RMC-TR-83-01, April 1983.

12. Radiation Management Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1982 Operational Report." RMC-TR-83-02, April 1983.

13. NUS Corporation, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1983 Annual Report," NUS-4516 March 1984.

14. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Environmental Report, Operating License Stage," May 1978.

15. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Final Safety Analysis Report".

16. United States Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, "Final Environmental Statement Related to the Operation of Susquehanna Steam Electric Station, Units 1 and 2," Docket Nos. 50-387 and 50-388, June 1981.

17. United States Nuclear Regulatory Commission, "An Acceptable Radiological Environmental Monitoring Program," Radiological Assessment Branch Technical Position, November 1979, Revision 1.

18. National Council on Radiation Protection and Measurements, "Environmental Radiation Measurement," NCRP Report No. 50, Washington, D.C., December 27, 1976.

19. Oakley, D.C., "Natural Radiation Exposure in the United States," ORP/SID 72-1 Office of Radiation Programs, U.S. Environmental Protection Agency, Washington, D.C., June 1972.

20. Denham, D.H., Roberts, M.C., Novitsky, W.M., Testa, E.D., "Investigation of Elevated Cesium-137 Concentrations in Small Game in Luzerne County, Pennsylvania." Proceedings of Papers presented at Health Physics Society Tenth Midyear Topical Symposium, October 11-13, 1976, pgs 271-279.

21. Teledyne Isotopes, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1984 Annual Report," April 1985.

22. Currie L.A., "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements," NUREG/CR-4007, September 1984.

23. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: January - June 1986", August 1986.

24. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: July - December 1986," February 1987.

25. Pennsylvania Power and Light Company Technical Specifications Susquehanna Steam Electric Station, Units no. 1 and 2; Docket no. 50-387 and 50-388 Appendix A to License no. NPF-14, April 91 and NPF-22, April 91.

26. Teledyne Isotopes, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1985 Annual Report", April 1986.

27. Teledyne Isotopes, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1986 Annual Report," April 1987.

28. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: January - June 1987, August 1987.

29. Pennsylvania Power and Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: July - December 1987, February 1988.

30. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1987 Annual Report," April 1988.

31. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: January-June 1988," August 1988.

32. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: July-December 1988," February 1989.

33. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1988 Annual Report," April 1989.

34. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: January-June 1989," August 1989.

35. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: July-December 1989," February 1990.

36. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1989 Annual Report," April 1990.

37. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: January-June 1990," August 1990.

38. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-annual Effluent Waste Disposal Report, Data Period: July-December, 1990," February 1991.

39. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1990 Annual Report," April 1991.

40. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-Annual Effluent Waste Disposal Report, Data Period: January - June 1991," August 1991.

41. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-Annual Effluent Waste Disposal Report, Data Period: July 1 - December, 1991," February 1992.

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
TLDs WITHIN PP&L PROPERTY BOUNDARY				
+ 1S2	17.7±1.4	18.3±1.5	18.6±1.9	21.4±1.0
2S2	17.6±0.5	17.8±1.2	18.4±1.1	19.6±1.0
+ 2S3	17.5±0.7	17.1±0.7	18.2±1.0	19.7±0.7
2S5(EIC)	13.0±0.8	14.0±1.5	13.4±0.4	15.8±0.8
3S2	17.5±2.1	17.8±1.4	18.2±1.2	18.4±1.7
3S3	14.5±1.0	16.2±2.1	15.3±0.4	17.9±1.7
+ 3S4	16.4±0.8	16.2±0.8	16.7±0.3	18.5±0.8
4S1	13.0±1.0	13.9±0.7	14.7±1.1	15.8±1.6
+ 4S3	19.4±1.3	20.2±1.0	19.4±0.6	23.4±1.1
5S1	13.6±1.2	14.2±1.0	14.7±0.8	16.4±1.3
5S4	14.7±1.4	16.1±0.8	16.8±0.7	17.8±0.4
+ 5S7	15.8±1.1	16.3±0.2	15.8±1.1	18.3±1.0
+ 6S4	20.7±0.8	20.9±0.8	20.9±1.4	24.2±1.0
6S8	15.1±0.3	15.7±0.6	15.1±0.2	17.9±1.7
+ 6S9	19.2±0.9	18.2±1.3	19.5±1.1	21.5±0.8
+ 7S6	18.8±0.9	18.9±1.2	18.6±1.0	21.7±0.8
+ 8S2	20.1±1.8	18.7±1.3	19.6±1.1	22.1±0.4
+ 9S2	23.5±2.2	23.1±2.4	23.2±1.5	27.4±1.1

See footnotes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
+ 10S1	16.3±1.3	15.9±1.1	16.5±1.0	16.9±1.3
10S2	22.3±0.7	21.3±1.1	21.2±1.3	24.2±1.1
11S2	14.5±1.8	14.7±0.5	14.9±0.4	17.4±0.9
+ 11S3	23.5±0.7	22.8±1.1	22.7±1.1	25.2±1.8
11S6	14.8±0.4	15.1±0.3	15.4±0.8	17.5±1.8
+ 12S3	22.0±1.7	22.1±2.4	22.5±1.4	24.5±1.6
+ 13S2	18.7±1.1	20.1±1.3	20.3±1.7	21.8±1.4
13S4	23.1±0.7	23.8±2.3	23.5±1.1	26.4±2.1
13S5	22.0±0.4	21.7±2.3	22.1±1.4	24.8±1.4
+ 14S5	19.1±1.5	19.7±1.1	19.7±1.4	21.6±1.6
14S6	18.5±1.5	18.8±0.9	19.3±0.9	21.1±1.4
15S4	13.8±1.0	15.1±0.9	15.1±1.2	16.6±0.2
+ 15S5	18.3±1.3	18.1±1.6	18.3±1.4	20.5±1.2
+ 16S1	18.3±0.6	18.2±1.2	19.0±0.9	20.6±0.8
+ 16S2	19.5±1.2	20.3±0.9	20.3±0.5	22.7±1.1

See [illegible]otes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
0-1 MILE OFFSITE				
+ 6A4	17.2±0.2	18.9±1.5	17.8±0.6	21.0±1.1
7A1	15.5±1.3	16.4±2.1	16.2±1.1	18.2±0.7
7A2	16.6±1.6	17.6±1.8	17.0±0.7	19.8±0.3
8A3	17.3±1.4	17.6±0.3	17.5±1.2	19.4±0.8
15A3	16.4±1.4	18.4±1.3	17.7±1.2	20.8±1.5
16A2	13.3±0.9	15.2±1.1	15.5±1.6	17.5±1.1
1-2 MILES OFFSITE				
*1B1	17.5±0.8	17.0±0.5	17.9±1.4	19.2±0.6
+ 2B3	16.8±1.5	16.2±0.6	16.7±0.6	18.6±1.5
*2B4	16.0±1.7	17.5±2.5	16.9±1.2	19.5±2.3
*4B1	16.0±1.4	16.0±1.6	16.7±0.9	18.5±1.7
*5B2	17.5±1.0	17.9±0.8	18.2±1.0	21.0±0.4
*6B2	17.6±0.6	16.5±0.6	18.2±1.6	19.4±1.7
*7B2	17.5±1.2	17.2±2.4	17.9±0.9	19.1±1.1
7B3	16.0±1.8	16.1±0.4	17.1±1.4	18.8±1.5

See footnotes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
+ 8B2	16.1±2.2	16.8±0.6	17.1±1.1	19.7±1.5
*8B3	17.3±1.4	17.2±1.2	17.6±0.8	19.8±0.9
9B1	15.5±1.0	15.2±1.5	16.9±1.0	17.5±0.8
10B2	13.3±1.2	13.6±1.7	15.0±1.3	16.2±1.9
10B3	14.0±0.7	14.3±2.0	15.5±0.9	16.4±1.8
*10B4	17.1±1.0	16.8±0.7	18.6±2.7	19.4±1.5
12B4	15.9±0.4	15.6±1.0	17.2±0.8	18.7±0.9
*12B5	16.4±0.7	16.1±0.5	16.4±0.8	18.1±1.3
*13B1	15.3±1.0	15.8±1.2	16.6±1.0	18.3±0.5
*14B2	16.3±0.7	16.5±2.2	17.3±1.2	19.2±1.4
*15B1	15.7±1.1	15.6±0.4	17.4±1.2	18.0±1.1
16B1	14.4±1.9	14.9±1.0	15.6±1.5	16.4±1.1
*16B2	15.2±1.2	16.6±2.2	16.6±1.2	18.1±2.5
2-3 MILES OFFSITE				
*11C1	19.3±1.3	19.0±1.3	20.2±1.1	21.6±0.9

See notes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
3-4 MILES OFFSITE				
+ 1D2	17.6±1.9	17.9±1.5	18.3±1.4	20.3±1.5
+ 3D1	17.3±1.2	18.6±0.3	19.4±1.6	21.3±0.9
+ 8D3	17.0±2.3	17.2±1.0	18.0±1.6	19.5±0.4
+ 9D4	17.7±1.2	18.3±2.6	19.2±0.5	19.5±1.8
+ 10D2	17.3±2.7	17.3±0.8	17.8±1.8	19.8±0.3
12D2	18.4±1.1	19.1±0.1	19.8±1.6	21.3±1.6
4-5 MILES OFFSITE				
1E1	14.7±.7	14.9±1.1	15.9±0.6	16.7±0.5
1E2	N/A	13.9±1.3	N/A	N/A
+ 4E1	17.2±1.9	17.4±1.9	18.4±1.6	20.7±0.7
+ 5E2	17.4±2.2	17.4±1.8	19.1±1.6	20.3±0.3
+ 6E1	19.4±0.4	19.5±1.4	21.0±0.7	22.4±1.2
+ 7E1	18.3±0.7	18.4±1.7	19.2±1.0	21.0±1.8
+ 11E1	14.0±1.3	14.0±1.2	14.0±0.8	17.0±1.2
+ 12E1	16.4±1.0	17.0±1.8	17.4±0.5	18.3±1.2

See footnotes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
+ 13E4	16.4±1.4	16.4±1.7	17.1±0.6	19.0±1.5
+ 14E1*	17.6±0.7	19.1±1.0	19.2±1.5	21.4±1.6
5-10 MILES OFFSITE				
+ 2F1	15.8±0.5	17.1±1.5	16.8±0.4	18.1±1.3
+ 3F1	15.5±1.2	15.5±0.2	16.0±1.4	17.5±1.2
*3F2	18.5±1.0	17.7±1.0	(2)	19.4±2.2
8F2	16.6±1.7	15.1±0.9	16.5±1.2	18.0±1.7
12F2	17.8±1.6	17.2±1.9	17.7±1.8	19.2±1.4
12F4 (BER)	22.4±0.9	21.9±3.2	21.3±1.5	24.6±3.2
+ 15F1	17.5±1.1	17.8±1.4	17.3±0.3	19.2±1.2
+ 16F1	18.2±0.6	19.1±1.8	18.8±1.6	19.9±1.2

See notes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

Location	First Quarter 1/10/91 to 3/22/91	Second Quarter 3/20/91 to 6/25/91	Third Quarter 6/25/91 to 10/2/91	Fourth Quarter 9/30/91 to 1/13/92
10-20 MILES OFFSITE				
3G2 (NAN)	14.5±0.4	14.1±1.1	14.5±1.0	15.8±0.7
3G4	16.6±1.1	18.4±0.3	17.3±1.6	20.6±1.1
+ 3G3	17.5±1.1	19.5±2.2	17.9±1.0	20.8±0.8
+ 4G1	18.6±1.2	20.5±0.8	19.3±0.8	23.3±1.6
+ 7G1	18.5±1.8	18.1±0.2	17.4±0.4	21.9±0.9
*7G2	17.4±1.5	17.8±0.6	17.4±1.7	20.8±1.0
+ 12G1	15.3±0.4	17.1±0.8	15.8±1.1	18.8±1.8
12G4	16.3±0.6	18.0±0.6	17.7±0.7	19.2±1.5
Indicator Average(3)	17.2±4.8	17.4±4.5	17.9±4.2	19.8±2.5
Control Average(3)	16.8±2.9	17.9±3.8	17.1±2.9	20.2±0.8

See footnotes at end of table

TABLE 6

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS (1)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

Results are in mR/std. qtr. +/-2s

NOTES

(1) Uncertainties for individual measurements are two standard deviations of the average of four readings per station.
(2) TLD Missing.
(3) Uncertainties of column averages are two standard deviations calculated from the mean of each.
(4) Mean is average of 3 TLD elements.
(5) Mean is average of 2 TLD elements.

(+) Tech Spec Locations
(*) NRC Co-Located Stations: 2B4 (1), 1B1(2), 16B2(3), 15B1(4), 14B1(5), 13B1(6), 12B5(7), 11C1(8), 10B4(9), 3F2(19), 4B1(23), 5B2(24) 6B2(25), 7B4(26), 8B3(27), 7G2(35).

wah/chd152i(25)

TABLE 7

ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY		COMMENTS
1D3	01/07/91	<2	<3.1	92+-75			
5S8	01/07/91 TO 02/04/91	<0.9	<2.6	<135			2
6S6	01/07/91 TO 02/04/91	<0.9	<2.6	<133			
6S5	01/07/91 TO 02/04/91	<0.9	<2.6	<127			2
6S7	01/07/91 TO 02/04/91	<1.8	8.8+-2.2	128+-86			1
LTAW	01/07/91	<1.6	2.3+-1.8	83+-77			
12F1	01/07/91	<2	3.8+-2.0	91+-75			
12G2	01/07/91	1.9+-1.3	9.3+-2.2	134+-81			
12H1	01/07/91 TO 02/04/91	<0.9	<2.6	<132			
1D3	02/04/91	<0.9	2.6+-1.7	<137			
5S8	02/11/91 TO 03/04/91	<1	4.4+-0.9	<90			
6S6	02/04/91 TO 03/04/91	<1	2.4+-0.8	<100			
6S5	02/11/91 TO 03/04/91	<1	3.8+-0.9	<100			
6S7	02/04/91 TO 03/04/91	<2	20+-2.	130+-60			3
LTAW	02/04/91	<1	<2.6	236+-94			
12F1	02/04/91	<0.9	<2.6	105+-83			
12G2	02/04/91	<0.9	<2.6	357+-99			
12H1	02/04/91 TO 03/04/91	<1	2.7+-0.8	<80			
1D3	03/05/91	7.8+-2.1	25+-1.0	<100			
5S8	03/11/91 TO 04/08/91	<0.9	3.1+-0.9	<60			
6S6	03/04/91 TO 04/08/91	<0.8	1.8+-0.8	<50			
6S5	03/11/91 TO 04/08/91	<0.9	2.1+-0.8	<60	K-40	142+-34	
6S7	03/04/91 TO 04/08/91	<2	13+-2.	2500+- 100			
LTAW	03/05/91	<1	4.9+-0.5	<70			
12F1	03/05/91	6.9+-1.6	17+-1.	<80			
12G2	03/05/91	5.4+-1.7	18+-1.	<100			
12H1	03/04/91 TO 04/08/91	<0.8	2.3+-0.8	<50			

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY		COMMENTS
1D3	04/08/91	<0.9	2.3+-0.8	<60			
6S6	04/08/91 TO 05/06/91	<1	2.0+-0.7	53+-31			4
6S5	04/15/91 TO 05/06/91	<1	2.9+-0.8	<90			
6S7	04/08/91 TO 05/06/91	<2	12+-2.	6200+- 100			
LTAW	04/08/91	<1	5.6+-1.2	<80			
12F1	04/08/91	<0.9	2.3+-0.8	<60			
12G2	04/08/91	<0.9	1.8+-0.8	<60			
12H1	04/08/91 TO 05/06/91	<2	3.3+-1.9	<100	K-40	1770+- 180	
1D3	05/06/91	<1	1.8+-0.9	<120			
6S6	05/06/91 TO 06/03/91	<2	3.7+-1.0	120+-70			
6S5	05/13/91 TO 06/03/91	<2	4+-1	<90			
6S7	05/06/91 TO 06/03/91	<4	16+-2.	5700+- 100	SR-90	0.92+-0.24	
LTAW	05/06/91	<2	5.4+-1.3	<100			
12F1	05/06/91	<1	2.5+-0.9	70+-28			
12G2	05/06/91	<1	3.7+-1.0	90+-27			
12H1	05/06/91 TO 06/03/91	<4	<4	<120			
1D3	06/03/91	<2	3.5+-1.3	61+-34			
6S6	06/03/91 TO 07/08/91	<2	2.6+-1.0	<90			5
6S5	06/10/91 TO 07/08/91	<2	3.7+-1.1	<100			
6S7	06/03/91 TO 07/08/91	<1	17+-3.	980+-70			6
LTAW	06/03/91	<1	6.2+-1.5	110+-60			
12F1	06/03/91	<2	2.4+-1.2	64+-37			
12G2	06/03/91	<2	3.9+-1.3	120+-40			
12H1	06/03/91 TO 07/08/91	<2	3.2+-1.1	86+-50			

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY		COMMENTS
1D3	07/08/91	<2	3.9+-1.2	<60			
6S6	07/08/91 TO 08/05/91	<2	3.7+-1.1	<90			
6S5	07/15/91 TO 08/05/91	1.6+-1.5	3.5+-1.1	<80			
6S7	07/08/91 TO 08/05/91	<2	20+-3.	3200+- 100			
LTAW	07/08/91	<3	11+-2.	140+-60			
12F1	07/08/91	<2	3.6+-1.1	140+-60			
12G2	07/08/91			290+-50			
12H1	07/08/91 TO 08/05/91	<2	3.6+-1.3	<90			7
1D3	08/05/91	<2	4.3+-1.7	<90			
6S6	08/05/91 TO 09/03/91	<2	4.2+-1.1	<90			
6S5	08/12/91 TO 09/03/91	<2	6.1+-1.3	<90			
6S7	08/05/91 TO 09/03/91	<2	16+-2.	3600+- 100			
LTAW	08/05/91	<3	8.7+-1.6	99+-53			
12F1	08/05/91	<2	3.7+-1.3	<100			
12G2	08/05/91	<2	4.7+-1.4	180+-50			
12H1	08/12/91 TO 09/03/91	<2	5.6+-1.2	200+-70			8, 9
1D3	09/03/91	<2	7.8+-1.4	<100			
6S6	09/03/91 TO 10/07/91	<2	4.0+-1.1	130+-50			10
6S5	09/09/91 TO 10/07/91	<2	4.4+-1.1	<100			
6S7	09/03/91 TO 10/07/91	<3	20+-2.	760+-70			11
LTAW	09/03/91	2.7+-2.3	13+-2.	120+-50			
12F1	09/03/91	<2	7.2+-1.3	<90			
12G2	09/03/91	<2	11+-2.	1300+- 100.			
12H1	09/03/91 TO 10/07/91	<2	6.3+-1.3	<90	K-40	25+-10	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY		COMMENTS
1D3	10/07/91	<2	4.3+-1.1	<70			
6S6	10/07/91 TO 11/04/91	<1	4.7+-1.1	71+-34			12
6S5	10/14/91 TO 11/04/91	<2	5.3+-1.1	94+-48			
6S7	10/07/91 TO 11/04/91	<2	16+-2.	1800+- 100			
LTAW	10/07/91	<2	6.9+-1.3	170+-50			
12F1	10/07/91	<2	4.4+-1.1	<70			
12G2	10/07/91	<2	5.6+-1.2	240+-50			
12H1	10/07/91 TO 11/04/91	<2	4.5+-2.4	100+-50			
1D3	11/04/91	<2	4.5+-1.2	<80			
6S6	11/04/91 TO 12/02/91	<1	4.2+-1.1	57+-31			
6S5	11/11/91 TO 12/02/91	<1	4.5+-1.1	81+-33			
6S7	11/04/91 TO 12/02/91	<2	13+-2.	1600+- 100			
LTAW	11/04/91	<2	7.2+-1.3	220+-60			
12F1	11/04/91	<2	4.3+-1.2	<90			
12G2	11/04/91	<2	4.9+-1.2	170+-60	K-40	153+-33	
12H1	11/04/91 TO 12/02/91	<1	4.7+-1.1	99+-36			
1D3	12/02/91	<1	3.9+-0.7	78+-44			
6S6	12/02/91 TO 01/06/92	<1	2.4+-0.8	71+-38			13
6S5	12/09/91 TO 01/06/92	<1	1.9+-0.7	<50			
6S7	12/02/91 TO 01/06/92	<1	13+-2.	7700+- 100			
LTAW	12/02/91	<2	7.5+-0.9	150+-40			
12F1	12/02/91	<1	4.0+-0.7	86+-35			
12G2	12/02/91	<1	4.8+-0.7	74+-34			
12H1	12/02/91 TO 01/06/92	<1	2.2+-0.8	62+-33			

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

COMMENTS

(1) COLLECTION CONTAINER WAS FOUND OVERFLOWING ON 1/7, 14, 21, 28, AND 2/4/91.
(2) SAMPLE COULD NOT BE COLLECTED FROM THE NORMAL LOCATION DUE TO ICE IN THE RIVER. SAMPLE WAS COLLECTED FROM THE SSES ENVIRONMENTAL LAB'S BOAT RAMP ON 1/14/91 AND 1/28/91.
(3) SAMPLING WAS INTERRUPTED BRIEFLY ON 2/17/91 TO PERFORM REPAIR ON THE AUTOMATIC COMPOSITE SAMPLER (ACS).
(4) THE ACS WAS NOT FUNCTIONING FOR ABOUT ONE-HALF HOUR ON 4/8/91 TO ALLOW FOR MAINTENANCE.
(5) SAMPLING WAS INTERRUPTED FROM 1030 TO 1510 ON 6/17/91 TO PERMIT PREVENTIVE MAINTENANCE TO BE PERFORMED ON THE ACS.
(6) SAMPLING WAS INTERRUPTED FROM 0910 TO 1600 ON 6/10/91 AND FROM 0800 TO 1600 FOR THE PERIOD 6/12/91 TO 6/19/91 BECAUSE BLOWDOWN FLOW FROM THE COOLING TOWERS TO THE RIVER WAS SUSPENDED TO PERMIT CLEANING OF THE DIFFUSER BY DIVERS.
(7) THE NORMAL AMOUNT OF WATER WAS NOT COLLECTED BY MERCK COMPANY PERSONNEL.
(8) THE SAMPLE COLLECTOR INADVERTENTLY DISCARDED SAMPLE FOR THE PERIOD 8/5/91 TO 8/12/91.
(9) SOME SAMPLE WAS LOST FOR THE PERIOD 8/12/91 TO 8/26/91 BECAUSE A SPIGOT ON THE COLLECTION CONTAINER WAS LEFT OPEN.
(10) SAMPLING WAS INTERRUPTED FROM 0940 TO 1125 ON 10/1/91 FOR MAINTENANCE ON THE ACS.
(11) THE COLLECTION CONTAINER WAS OVERFLOWING FROM 9/6/91 TO 9/9/91.
( ) SAMPLING WAS INTERRUPTED FOR PREVENTIVE MAINTENANCE OF TH[redacted]S FOR ONE-HALF HOUR ON 10/30/91.
( ) SAMPLING WAS INTERRUPTED FOR PREVENTIVE MAINTENANCE OF T[redacted] FROM 1310 TO 1445 ON 12/3/91.

TABLE 7A

IODINE-131 ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
1D3	01/07/91	<0.3	
5S8	01/07/91	<0.3	
6S6	01/07/91	<0.3	
6S5	01/07/91 TO 02/04/91	<0.2	
6S7	01/07/91 TO 02/04/91	<0.2	
LTAW	01/07/91	<0.2	
12F1	01/07/91	<0.2	
12G2	01/07/91	<0.2	
12H1	01/07/91 TO 02/04/91	<0.2	
1D3	02/04/91	<0.3	
5S8	02/11/91 TO 03/04/91	<0.07	
6S6	02/04/91 TO 03/04/91	<0.06	
6S5	02/11/91 TO 03/04/91	<0.09	
6S7	02/04/91 TO 03/04/91	<0.08	
LTAW	02/04/91	<0.3	
12F1	02/04/91	<0.3	
12G2	02/04/91	<0.3	
12H1	02/04/91 TO 03/04/91	<0.07	
1D3	03/05/91	<0.07	
5S8	03/11/91 TO 04/08/91	<0.09	
6S6	03/04/91 TO 04/08/91	<0.1	
6S5	03/11/91 TO 04/08/91	<0.09	
6S7	03/04/91 TO 04/08/91	<0.1	
LTAW	03/05/91	<0.07	
12F1	03/05/91	<0.09	
12G2	03/05/91	<0.2	
12H1	03/04/91 TO 04/08/91	<0.08	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 7A

IODINE-131 ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
1D3	04/08/91	<0.1	
6S6	04/08/91 TO 04/22/91	<0.1	
6S6	04/22/91 TO 05/06/91	<0.1	
6S5	04/15/91 TO 05/06/91	<0.07	
6S7	04/08/91 TO 04/22/91	<0.1	
6S7	04/22/91 TO 05/06/91	<0.1	
LTAW	04/08/91	<0.1	
12F1	04/08/91	<0.1	
12G2	04/08/91	<0.09	
12H1	04/08/91 TO 04/22/91	<0.1	
12H1	04/08/91 TO 05/06/91	<0.05	1
1D3	05/06/91	<0.07	
6S6	05/06/91 TO 05/20/91	<0.2	
6S6	05/20/91 TO 06/03/91	<0.1	
6S5	05/13/91 TO 06/03/91	<0.08	
6S7	05/06/91 TO 05/20/91	<0.2	
6S7	05/20/91 TO 06/03/91	<0.5	
LTAW	05/06/91	<0.08	
12F1	05/06/91	<0.1	
12G2	05/06/91	<0.09	
12H1	05/06/91 TO 05/20/91	<0.1	
12H1	05/20/91 TO 06/03/91	<0.1	
1D3	06/03/91	<0.08	
6S6	06/03/91 TO 06/17/91	<0.07	
6S6	06/17/91 TO 07/01/91	<0.2	
6S5	06/10/91 TO 07/08/91		3
6S7	06/17/91 TO 07/01/91	<0.2	
LTAW	06/03/91	<0.06	
12F1	06/03/91	<0.09	
12G2	06/03/91	<0.1	
12H1	06/03/91 TO 06/17/91	<0.06	
12H1	06/17/91 TO 07/01/91	<0.2	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED: TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

IODINE-131 ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
1D3	07/08/91	<0.09	
6S6	07/01/91 TO 07/15/91	<0.1	
6S6	07/15/91 TO 07/29/91	<0.1	
6S6	07/29/91 TO 08/12/91	<0.1	
6S5	07/15/91 TO 08/05/91	<0.1	
6S7	07/01/91 TO 07/15/91	<0.1	
6S7	07/15/91 TO 07/29/91	<0.1	
6S7	07/29/91 TO 08/12/91	<0.1	
LTAW	07/08/91	<0.06	
12F1	07/08/91	<0.08	
12G2	07/08/91	<0.2	
12H1	07/01/91 TO 07/15/91	<0.1	
12H1	07/15/91 TO 07/29/91	<0.2	
12H1	07/29/91 TO 08/12/91	<0.1	
1D3	08/05/91	<0.09	
6S6	08/12/91 TO 08/26/91	<0.1	
6S6	08/26/91 TO 09/09/91	0.32+-0.06	
6S5	08/12/91 TO 09/03/91		3
6S7	08/12/91 TO 08/26/91	<0.1	
6S7	08/26/91 TO 09/09/91	0.90+-0.11	
LTAW	08/05/91	<0.06	
12F1	08/05/91	<0.1	
12G2	08/05/91	<0.06	
12H1	08/12/91 TO 08/26/91		2
12H1	08/26/91 TO 09/09/91	<0.07	
1D3	09/03/91	<0.1	
6S6	09/09/91 TO 09/23/91	<0.1	
6S6	09/23/91 TO 10/07/91	0.46+-0.13	
6S5	09/09/91 TO 09/23/91	<0.1	
6S5	09/30/91 TO 10/07/91	0.52+-0.10	
6S7	09/09/91 TO 09/23/91	0.91+-0.18	
6S7	09/23/91 TO 10/07/91	1.2+-0.2	
LTAW	09/03/91	<0.09	
12F1	09/03/91	<0.08	
12G2	09/03/91	<0.1	
12H1	09/09/91 TO 09/23/91	<0.2	
12H1	09/23/91 TO 10/07/91	0.39+-0.14	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 7A

IODINE-131 ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
1D3	10/07/91	0.35+-0.06	
6S6	10/07/91 TO 10/21/91	<0.1	
6S6	10/21/91 TO 11/04/91	<0.08	
6S5	10/14/91 TO 10/21/91	<0.1	
6S5	10/28/91 TO 11/04/91	<0.1	
6S7	10/07/91 TO 10/21/91	0.54+-0.12	
6S7	10/21/91 TO 11/04/91	0.26+-0.12	
LTAW	10/07/91	<0.08	
12F1	10/07/91	0.36+-0.06	
12G2	10/07/91	0.34+-0.06	
12H1	10/07/91 TO 10/21/91	<0.08	
12H1	10/21/91 TO 11/04/91	0.20+-0.09	
1D3	11/04/91	<0.07	
6S6	11/04/91 TO 11/18/91	<0.2	
6S6	11/18/91 TO 12/02/91	<0.1	
6S5	11/11/91 TO 11/18/91	<0.1	
6S5	11/25/91 TO 12/02/91	<0.1	
6S7	11/04/91 TO 11/18/91	<0.1	
6S7	11/18/91 TO 12/02/91	0.31+-0.11	
LTAW	11/04/91	<0.06	
12F1	11/04/91	0.06+-0.04	
12G2	11/04/91	0.10+-0.04	
12H1	11/04/91 TO 11/18/91	<0.1	
12H1	11/18/91 TO 12/02/91	<0.1	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 7A

IODINE-131 ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
1D3	12/02/91	0.20+-0.05	
6S6	12/02/91 TO 12/16/91	<0.09	
6S6	12/16/91 TO 12/30/91	<0.1	
6S6	12/30/91 TO 01/13/92	<0.08	
6S5	12/09/91 TO 12/16/91	<0.07	
6S5	12/23/91 TO 12/30/91	<0.1	
6S7	12/02/91 TO 12/16/91	0.13+-0.07	
6S7	12/16/91 TO 12/30/91	<0.1	
6S7	12/30/91 TO 01/13/92	0.35+-0.08	
LTAW	12/02/91	<0.07	
12F1	12/02/91	0.24+-0.05	
12G2	12/02/91	<0.1	
12H1	12/02/91 TO 12/16/91	<0.09	
12H1	12/16/91 TO 12/30/91	<0.1	
12H1	12/30/91 TO 01/13/92	<0.1	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

COMMENTS

(1) WATER FROM THE SAMPLING PERIOD 4/22/91 TO 5/6/91 WAS INCORRECTLY MIXED WITH WATER FROM THE SAMPLING PERIOD 4/8/91 TO 4/22/91 BY MERCK COMPANY PERSONNEL.
(2) INSUFFICIENT WATER WAS COLLECTED FOR BOTH BIWEEKLY AND MONTHLY SAMPLE ANALYSIS. CONSEQUENTLY NO SAMPLE WAS SENT FOR IODINE-131 ANALYSIS FOR THE PERIOD 8/12/91 TO 8/26/91.
(3) ANALYSIS MISSED DUE TO LABORATORY ANALYSIS ERROR.

TABLE 8

GROSS ALPHA, GROSS BETA, TRITIUM, IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF DRINKING WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	COMMENTS
12H2 R	12/31/90 TO 02/04/91	<0.5	<2.7	90+-88		1
12H2 T	12/31/90 TO 02/04/91	<0.6	<2.7	210+-83		
12H2 R (G)	01/07/91	<1.3	<2.8	174+-74		
12H2 R	02/04/91 TO 03/04/91	<1	2.2+-0.8	<90		
12H2 R (G)	02/25/91	<1	3.9+-1.0	80+-42		
12H2 T	02/04/91 TO 03/04/91	<1	2.3+-0.9	<100		
12H2 R	03/04/91 TO 04/08/91	<0.8	8.9+-1.2	<90		
12H2 T	03/04/91 TO 04/08/91	<0.9	2.8+-0.9	<90		
12H2 R	04/08/91 TO 05/06/91	<1	1.4+-0.8	<100		
12H2 T	04/08/91 TO 05/06/91	<1	1.7+-0.9	<100		
12H2 R	05/06/91 TO 05/30/91	<1	2.3+-0.8	86+-42		2
12H2 T	05/06/91 TO 06/03/91	<2	1.6+-1.0	98+-55		
12H2 R (G)	06/03/91	<1	<2	<100		
12H2 R	06/03/91 TO 07/08/91	<2	3.5+-1.1	<90		3
12H2 T	06/03/91 TO 07/08/91	<2	1.8+-1.0	<90		
12H2 R	07/08/91 TO 08/05/91	2.0+-1.6	4.1+-1.1	85+-28		
12H2 T	07/08/91 TO 08/05/91	<1	3.4+-1.1	65+-31		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA, GROSS BETA, TRITIUM, IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF DRINKING WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	COMMENTS
12H2 R	08/05/91 TO 09/03/91	<2	4.5+-1.1	250+-60		
12H2 T	08/05/91 TO 09/03/91	<2	4.3+-1.1	170+-60		
12H2 R	09/03/91 TO 09/18/91	<1	3.3+-1.1	89+-51		4
12H2 R (G)	09/30/91	<1	3.7+-1.1	<90		
12H2 R (G)	09/23/91	<1	4.4+-1.2	<90		
12H2 T	09/03/91 TO 10/07/91	<1	4.0+-1.2	<80		
12H2 R (G)	10/07/91	<1	4.4+-1.2	<100		
12H2 R	10/28/91 TO 11/04/91	<2	5.0+-1.2	96+-51		5
12H2 R (G)	10/21/91	<2	5.5+-1.1	120+-50		
12H2 R (G)	10/14/91	<2	6.3+-1.3	<80		
12H2 R (G)	10/28/91	<2	4.3+-1.1	<70		
12H2 T	10/07/91 TO 11/04/91	<2	4.0+-1.1	<100		
12H2 R	11/04/91 TO 12/02/91	<2	2.9+-0.8	120+-40		6
12H2 T	11/04/91 TO 12/02/91	<2	2.3+-0.8	67+-25		
12H2 R	12/09/91 TO 01/06/92	<1	1.9+-0.7	73+-31		7
12H2 R (G)	12/02/91	<1	3.8+-1.0	81+-31		
12H2 R	12/30/91 TO 01/13/92				I-131 0.15+-0.06	
12H2 T	12/02/91 TO 01/06/92	<1	2.7+-0.8	70+-21		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

COMMENTS

(1) THER WAS NO FLOW THROUGH THE AUTOMATIC COMPOSITE SAMPLER (ACS) UNTIL 1/9/91. SAMPLING WAS INTERRUPTED BRIEFLY ON 1/14/91 FOR REPLACEMENT OF A LEAKING HOSE IN THE ACS. THE COLLECTION CONTAINER WAS FOUND OVERFLOWING ON 1/28/91.
(2) THE SAMPLING PUMP WAS DISABLED BY AN ELECTRICAL STORM ON 5/30/91. THE PUMP WAS NOT RESTARTED UNTIL 113/ ON 6/3/91.
(3) THE SAMPLING PUMP WAS TURNED OFF FOR EQUIPMENT INSTALLATION FROM 0900 ON 7/2/91 TO 7/4/91 AT 1700.
(4) NO SAMPLE WAS COLLECTED BY THE ACS FROM 9/18/91 TO 10/07/91 DUE TO A PROBLEM WITH THE SAMPLING PUMP.
(5) NO SAMPLE WAS COLLECTED BY THE ACS FROM 10/7/91 TO 10/23/91 DUE TO A PROBLEM WITH THE SAMPLING PUMP. A NEW SAMPLING PUMP WAS INSTALLED. INSUFFICIENT SAMPLE WAS COLLECTED FROM 10/23/91 TO 10/28/91 BECAUSE THE SAMPLING FREQUENCY WAS INCORRECTLY SET AND A SPIGOT ON THE COLLECTION CONTAINER WAS LEFT PARTIALLY OPEN.
(6) THE COLLECTION CONTAINER WAS FOUND OVERFLOWING BY DANVILLE PERSONNEL ON 11/26/91. A SECOND CONTAINER WAS USED TO REPLACE THE FULL ONE.
(7) A SAMPLING PUMP WAS FOUND NOT OPERATING ON 12/9/91. THEFIRST WEEK"S SAMPLE WAS SENT AS A GRAB. SAMPLING WAS INTERRUPTED FOR 1.5 HOURS ON 12/13/91 FOR PUMP MAINTENANCE.

TABLE 9

GAMMA* SPECTROSCOPIC ANALYSES OF ALGAE

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM DRY +- 2S

LOCATION	COLLECTION DATE	BE-7	K-40	I-131	CS-137	TH-228	RA-226
AG-3	05/04/91 TO 06/03/91	<6	12.4+-4.7				
AG-4	05/04/91 TO 06/03/91	<3	13.7+-3.6				
AG-3	06/03/91 TO 07/08/91	5.75+-1.91	9.54+-2.19			1.81+-0.34	5.55+-3.04
AG-4	06/03/91 TO 07/08/91	6.09+-1.99	14.5+-3.2			1.37+-0.35	
AG-3	07/08/91 TO 08/05/91	6.48+-2.26	10.2+-3.0				
AG-4	07/08/91 TO 08/05/91	<2	5.07+-1.94				
AG-3	08/05/91 TO 09/03/91	3.17+-1.67	10.6+-2.3			0.90+-0.18	
AG-4	08/05/91 TO 09/03/91	3.89+-1.24	14.7+-2.4				
AG-3	09/03/91 TO 10/07/91	6.78+-1.87	15.4+-2.2	3.13+-0.53			
AG-4	09/03/91 TO 10/07/91	8.41+-1.40	15.1+-2.0	3.21+-0.35		1.53+-0.22	
AG-3	10/07/91 TO 11/04/91	7.25+-2.35	11.3+-2.8		0.52+-0.27		
AG-4	10/07/91 TO 11/04/91	6.40+-1.65	12.7+-2.5			1.51+-0.30	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 10

GROSS BETA AND GAMMA* SPECTROSCOPIC ANALYSES OF FISH

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	GR-BETA	K-40
2H	SMALLMOUTH BASS	05/02/91	6.6+-0.1	3.60+-0.37
2H	WHITE SUCKER	05/02/91	2.4+-0.1	3.23+-0.44
2H	CHANNEL CATFISH	05/02/91	4.3+-0.1	2.89+-0.54
IND	SMALLMOUTH BASS	05/09/91	5.9+-0.1	4.35+-0.46
IND	WHITE SUCKER	05/09/91	6.0+-0.1	3.73+-0.43
IND	CHANNEL CATFISH	05/09/91	4.2+-0.1	2.26+-0.34
LTAW	LARGEMOUTH BASS	05/13/91	7.3+-0.2	3.92+-0.46
LTAW	CHANNEL CATFISH	05/13/91	4.1+-0.1	3.88+-0.39
2H	SMALLMOUTH BASS	10/15/91	2.6+-0.1	3.94+-0.58
2H	WHITE SUCKER	10/15/91	4.8+-0.1	4.68+-0.47
2H	CHANNEL CATFISH	10/15/91	6.0+-0.1	2.99+-0.45
IND	SMALLMOUTH BASS	10/22/91	7.5+-0.2	3.79+-0.56
IND	WHITE SUCKER	10/22/91	6.3+-0.1	3.62+-0.55
IND	CHANNEL CATFISH	10/23/91	5.6+-0.1	3.23+-0.36
LTAW	LARGEMOUTH BASS	10/24/91	5.5+-0.1	3.66+-0.46

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 11

GROSS ALPHA, GROSS BETA, AND GAMMA* SPECTROSCOPIC ANALYSES OF SHORELINE AND FLOCCULATED SEDIMENT

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM DRY +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	K-40	CS-137	RA-226	TH-228
2B	07/01/91	9.9+-5.0	26+-3	9.38+-0.94	0.13+-0.04	1.58+-0.54	0.97+-0.10
2F	07/01/91	7.3+-4.4	28+-3	9.05+-0.91	0.06+-0.03	1.15+-0.50	0.81+-0.08
7B	07/01/91	9.4+-4.9	24+-3	8.86+-0.89	0.11+-0.05	1.54+-0.77	0.80+-0.08
11C	07/01/91	9.4+-4.9	24+-3	9.06+-0.91	0.05+-0.03	0.90+-0.48	0.72+-0.07
12F	07/01/91	12+-5	25+-3	8.67+-0.91	0.09+-0.05	1.72+-0.79	1.16+-0.12
LTAW	07/01/91	11+-5	32+-3	4.20+-0.45			0.48+-0.05
2B FLOC	11/19/91	19+-7	40+-3	12.5+-3.0	0.60+-0.33		
7B FLOC	11/19/91	20+-7	35+-3	13.1+-2.2			
2B	11/19/91	12+-6	31+-3	11.8+-1.2	0.15+-0.04	2.01+-0.53	1.0+-0.1
2F	11/20/91	7+-5	26+-3	7.44+-0.74		1.67+-0.44	0.70+-0.07
7B	11/19/91	11+-6	31+-3	12.1+-1.2	0.11+-0.05	1.69+-0.72	1.23+-0.12
11C	11/20/91	8.8+-5.4	27+-3	8.27+-0.83		1.52+-0.48	0.81+-0.08
12F	11/20/91	7+-5	29+-3	9.64+-0.96			1.0+-0.1
LTAW	11/19/91	11+-6	36+-3	11.8+-1.2		1.75+-0.56	1.01+-0.10

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND (WELL) WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY
12F3	01/07/91	1.7+-1.6	4.3+-2.0	130+-85	
2S6 TREAT	01/07/91	<2	<3	130+-78	
2S6	01/07/91	<0.7	3.8+-1.5	117+-80	
4S4 TREAT	01/07/91	<2	5.8+-2.0	103+-79	
4S5	01/07/91	<0.8	2.8+-1.5	83+-78	
12E4 TREAT	01/07/91	<1.5	<2.8	180+-82	
12S1 TREAT	01/07/91	<1.6	<2.8	93+-80	
12F3	02/04/91	1.3+-0.6	2.2+-1.7	<136	
2S6 TREAT	02/04/91	<0.5	<2.7	<135	
2S6	02/04/91	<0.5	<2.7	<133	
4S2	02/05/91	<0.7	<2.7	<135	
4S4 TREAT	02/05/91	<0.5	<2.7	<132	
12E4 TREAT	02/04/91	1.2+-1.0	<3	121+-86	
12S1 TREAT	02/05/91	<1.6	<3	<137	
12F3	03/05/91	<3	3.2+-1.1	<90	
2S6 TREAT	03/05/91	<1	<1	<100	
2S6	03/05/91	<1	<1	<80	
4S4 TREAT	03/05/91	<1	1.9+-0.8	<90	
4S5	03/05/91	<2	<1	<80	
12E4 TREAT	03/05/91	<2	1.7+-1.0	<90	
12S1 TREAT	03/05/91	<2	<1	<90	
12F3	04/08/91	<2	<1	<90	
2S6 TREAT	04/08/91	<1	<1	<90	
4S4 TREAT	04/05/91	<0.7	1.2+-0.7	<80	
4S5	04/05/91	<1	<1	<80	
12S1 TREAT	04/09/91	<1	<1	120+-50	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND (WELL) WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	
12F3	05/06/91	<2	2.7+-1.2	81+-42		
2S6 TREAT	05/06/91	<1	<1	<60		
2S6	05/06/91	<1	<1	83+-35		
3S5	05/06/91	<0.7	2.6+-0.8	170+-40		
4S4 TREAT	05/06/91	<1	<1	<90		
4S5	05/06/91	<1	<1	<90		
12S1 TREAT	05/06/91	<2	<1	170+-50		
12S1	05/06/91	<2	<2	<90		
12F3	06/03/91	<2	<1	<70		
2S6 TREAT	06/03/91	<1	<1	<60		
2S6	06/03/91	<1	<1	<70		
3S5	06/03/91	<1	1.2+-0.7	84+-38		
4S4 TREAT	06/03/91	<1	<1	<60		
4S5	06/03/91	<2	<1	<60		
12S1 TREAT	06/03/91	<2	<1	<100		
12S1	06/03/91	<2	<1	<90		
12F3	07/08/91	<2	1.7+-1.1	<100		
2S6	07/08/91	<2	<1	<90		
3S5	07/08/91	<1	<1	<70		
4S4 TREAT	07/08/91	<1	<1	100+-60		
4S5	07/08/91	<2	<1	<100		
12S1	07/08/91	<2	<1	<90		
12F3	08/05/91	<2	2.1+-1.0	<90		
2S6	08/05/91	<1	<1	<90		
3S5	08/05/91	<0.9	1.8+-0.8	<70	K-40	81.2+-36.0
4S4 TREAT	08/05/91	<1	1.1+-0.8	96+-54		
4S5	08/05/91	<2	<1	<90		
12S1	08/06/91	<2	<1	<90		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED: TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND (WELL) WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	
12F3	09/03/91	<2	4.1+-1.1	150+-60		
2S6	09/03/91	<1	1.8+-0.8	180+-60		
3S5	09/03/91	0.79+-0.75	1.9+-0.7	96+-57		
4S4 TREAT	09/03/91	<0.9	1.9+-0.8	93+-52		
4S5	09/03/91	<1	1.7+-0.8	<90		
12S1	09/03/91	<1	<1	79+-45		
12F3	10/07/91	2.3+-1.6	3.8+-1.2	<90		
2S6	10/07/91	2.9+-1.4	2.7+-0.9	<90		
3S5	10/07/91	1.5+-1.1	2.9+-0.9	<70		
4S4 TREAT	10/07/91	<1	4+-1	120+-50		
4S5	10/07/91	<2	2.0+-0.9	<90		
12S1	10/07/91	<2	2+-1	<100		
12F3	11/04/91	<2	3.2+-1.2	<90		
2S6	11/04/91	<2	1.2+-0.8	<70		
4S4 TREAT	11/04/91	<2	2.8+-0.9	100+-60		
4S5	11/04/91	<2	<1	<80		
12S1	11/04/91	<2	<1	<80		
12F3	12/03/91	<2	<1	110+-30		
2S6	12/02/91	<1	<1	66+-34		
4S4 TREAT	12/03/91	<1	<1	110+-30		
4S5	12/03/91	<1	<1	<50		
12S1	12/02/91	<2	1.4+-0.9	66+-31	K-40	59.8+-29.7

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 13

GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN E-03 PCI/CU. M +- 2S

MONTH	COLLECTION DATE	7G1	12G1	3S2	5S4	12S2	15S4	9B1	1D2	3D1	12E1
JAN	01/08/91 TO 01/15/91	15+-1	17+-1	18+-1	17+-1	17+-1	16+-1	16+-1	17+-1.	18+-1	18+-1
	01/15/91 TO 01/22/91	22+-1	24+-1	24+-2 (1)	21+-1	23+-1	23+-1	22+-1	24+-1	23+-1	24+-1
	01/22/91 TO 01/29/91	15+-1	23+-1	20+-1(2)	22+-1	24+-1	20+-1	21+-1	23+-1	21+-1	22+-1
	01/29/91 TO 02/05/91	23+-1	31+-2	33+-2	34+-2	36+-2	26+-1	31+-2	33+-2	32+-2	31+-2
FEB	02/05/91 TO 02/12/91	14+-1	18+-1	18+-1	17+-1	18+-1	20+-1	16+-1	15+-1	17+-1	18+-1
	02/12/91 TO 02/20/91	27+-2	32+-2	12+-1	14+-1	13+-1	12+-1	14+-1	14+-1	16+-1	30+-1
	02/20/91 TO 02/26/91	16+-1	22+-2	17+-1	18+-2 (3)	19+-1	20+-1	18+-1	20+-1	20+-1	20+-2
	02/26/91 TO 03/05/91	10+-2	12+-2	12+-2	12+-2	12+-2	9.9+-1.5	9.5+-1.5	12+-2	11+-1	11+-2
MAR	03/05/91 TO 03/12/91	16+-2	19+-2	18+-2	17+-2	17+-2	16+-2	17+-2	17+-2	16+-2	15+-2
	03/12/91 TO 03/19/91	5.1+-1.3(4,5)	6.5+-1.3	4.9+-1.3(4)	6.2+-1.3	4.4+-1.2	5.1+-1.2	6.1+-1.3	6.2+-1.2	5.6+-1.2	6.1+-1.4
	03/19/91 TO 03/26/91	9+-1.6	10+-2	9.9+-1.7	11+-2	9.2+-1.6	8.3+-1.6	9.1+-1.6	7.7+-1.5	7.7+-1.5	9.6+-1.8
	03/26/91 TO 04/02/91	12+-1	13+-2	14+-2	11+-2	13+-2	12+-2	15+-2	13+-2	11+-2	13+-2
APR	04/02/91 TO 04/09/91	17+-2	19+-2	18+-2	19+-2	17+-2	17+-2	17+-2	16+-2	16+-2	17+-2
	04/09/91 TO 04/16/91	9.9+-1.6	10+-1	11+-2	9+-1.4	10+-1	7.7+-1.3	11+-2	11+-1	9.9+-1.6	9.9+-1.5
	04/16/91 TO 04/23/91	8.9+-1.5	10+-1	11+-2	11+-2	11+-1	9.7+-1.4	12+-2	11+-2	9.5+-1.5	9.2+-1.5
	04/23/91 TO 04/30/91	13+-2	15+-2	15+-2	16+-2	14+-2	14+-2	15+-2	14+-2	14+-2	15+-2
	04/30/91 TO 05/07/91	8.3+-1.7(6)	11+-1	12+-2	10+-1	10+-1	10+-1	12+-2	11+-1	11+-2	10+-2
MAY	05/07/91 TO 05/14/91	32+-4	36+-4	35+-4	35+-4	37+-4	38+-4	41+-5	41+-4	38+-5	37+-5
	05/14/91 TO 05/21/91	12+-1	13+-2	14+-2	14+-2	14+-2	13+-2	13+-2	13+-2	12+-2	14+-2
	05/21/91 TO 05/28/91	16+-2	19+-2	17+-2	17+-2	17+-2	18+-2	19+-2	17+-2	16+-2	18+-2
	05/28/91 TO 06/04/91	14+-2	15+-2	16+-2	16+-2	15+-2	15+-2	15+-2	15+-2	14+-1	15+-2

GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN E-03 PCI/CU. M +- 2S

MONTH	COLLECTION DATE	7G1	12G1	3S2	5S4	12S2	15S4	9B1	1D2	3D1	12E1
JUN	06/04/91 TO 06/11/91	8.3+-1.4	11+-2	9.7+-1.4	10+-2	9.9+-1.5	8.2+-1.4	10+-2	10+-2	11+-2(7)	11+-1
	06/11/91 TO 06/18/91	12+-2	14+-2	13+-2	15+-2	13+-2	13+-2	13+-2	13+-2	12+-2	13+-2
	06/18/91 TO 06/25/91	12+-2	12+-2	10+-1	11+-1	12+-2	11+-1	13+-2	13+-2	11+-1	11+-2
	06/25/91 TO 07/02/91	14+-2	13+-1	15+-2	15+-2	16+-2	16+-2	15+-2	15+-2	16+-2	16+-2
JUL	07/02/91 TO 07/09/91	16+-2	16+-2	14+-2	15+-2	15+-2	13+-2	15+-2	15+-2	14+-2	14+-2
	07/09/91 TO 07/16/91	10+-2	13+-2	10+-2	10+-2	10+-2	9.5+-1.6	9.8+-1.6	11+-2	12+-2	9.9+-1.9
	07/16/91 TO 07/23/91	24+-2	27+-2	26+-2	26+-2	24+-2	26+-2	25+-2	27+-2	25+-2	28+-2
	07/23/91 TO 07/30/91	15+-2	14+-2	15+-2	14+-2	13+-1	17+-2	12+-1	12+-2	15+-2	16+-2
	07/30/91 TO 08/06/91	16+-2	19+-2	18+-2	19+-2	16+-2	14+-2	18+-2	19+-2	16+-2	17+-2
AUG	08/06/91 TO 08/13/91	10+-2	13+-2	12+-2	10+-2	10+-1	10+-2	11+-2	12+-2	11+-2	12+-2
	08/13/91 TO 08/20/91	18+-2	20+-2	17+-2	19+-2	18+-2	19+-2	17+-2	20+-2	20+-2	19+-2
	08/20/91 TO 08/27/91	17+-2	18+-2	18+-2	17+-2	18+-2	17+-2	18+-2	19+-2	17+-2	15+-2
	08/27/91 TO 09/04/91	17+-2	21+-2	19+-2	19+-2	20+-2	19+-2	18+-2	20+-2	19+-2	22+-2
SEP	09/04/91 TO 09/11/91	21+-2	23+-2	19+-2	21+-2	18+-2	18+-2	20+-2	20+-2	19+-2	20+-2
	09/11/91 TO 09/17/91	20+-2	20+-2	18+-2	19+-2	18+-2	19+-2	17+-2	19+-2	19+-2	17+-2
	09/17/91 TO 09/24/91	9.9+-1.5	13+-2	13+-2	13+-2	12+-1	13+-2	12+-1	12+-2	11+-2	10+-2
	09/24/91 TO 10/01/91	12+-2	13+-2	11+-1(8)	12+-2(8)	11+-1	13+-2	10+-1(8)	11+-2	11+-2	9.5+-1.6
OCT	10/01/91 TO 10/08/91	18+-2	25+-2	21+-2	21+-2	20+-2	22+-2	21+-2	22+-2(9)	21+-2	20+-2
	10/08/91 TO 10/16/91	15+-2	19+-2	17+-2	18+-2	17+-2	15+-2	16+-2	8.1+-1.3(9)	17+-2	17+-2
	10/16/91 TO 10/22/91	17+-2	17+-2	14+-2	17+-2	17+-2	18+-2	16+-2	18+-2(9)	14+-2	16+-2
	10/22/91 TO 10/29/91	28+-2	33+-2	34+-2	33+-2	29+-2	30+-2	32+-2	34+-2(10)	35+-3	34+-2
	10/29/91 TO 11/05/91	20+-2	21+-2	20+-2	20+-2	17+-2	20+-2	20+-2	23+-2	18+-2	21+-2

TABLE 13

GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN E-03 PCI/CU. M +- 2S

MONTH	COLLECTION DATE	7G1	12G1	3S2	5S4	12S2	15S4	9B1	1D2	3D1	12E1
NOV	11/05/91 TO 11/12/91	25+-3	24+-2	24+-2	21+-2	23+-2	22+-2	21+-2	22+-2	22+-2	22+-2
	11/12/91 TO 11/19/91	24+-4(11)	24+-2	25+-2	24+-2	22+-2	21+-2	20+-2	23+-2	20+-2	23+-2
	11/19/91 TO 11/26/91	6.8+-1.5(12)	13+-2	12+-2	12+-2	11+-2	11+-1	12+-1	12+-2	9+-1.5	11+-2
	11/26/91 TO 12/03/91	14+-2	19+-2	16+-2	17+-2	18+-2	17+-2	17+-2	18+-2	15+-2	17+-2
DEC	12/03/91 TO 12/10/91	18+-2	20+-2	22+-2	23+-2	22+-2	20+-2	24+-2	24+-2	20+-2	22+-2
	12/10/91 TO 12/17/91	18+-2	23+-2	21+-2	21+-2	22+-2	40+-4	22+-2	20+-2	17+-2	19+-2
	12/17/91 TO 12/23/91	11+-2	18+-2	19+-2	20+-2	16+-2	16+-5(11)	17+-2	16+-2	15+-2	19+-2
	12/23/91 TO 12/31/91	13+-2	17+-2	18+-2	18+-2	18+-2	17+-2	16+-2	17+-2	14+-2	18+-2

COMMENTS

(1) ELECTRICITY WAS OUT OF SERVICE FROM 1/18/91 TO 1/22/91.
(2) ELECTRICITY WAS OUT OF SERVICE FROM 1/22/91 TO 1130 ON 1/23/91.
(3) WHITE SPECS WERE OBSERVED ON THE FILTER AT THE END OF THE COLLECTION PERIOD.
(4) ELECTRICITY WAS OUT OF SERVICE FOR ABOUT 15 TO 20 MINUTES WHILE AN AIR TRITIUM SAMPLER WAS INSTALLED.
(5) A HOLE WAS OBSERVED IN THE FILTER AT THE END OF THE COLLECTION PERIOD.
(6) ELECTRICITY WAS OUT OF SERVICE FROM 4/30/91 TO 1100 ON 5/2/91.
(7) EXCAVATION WAS OBSERVED WITHIN 25 FEET OF THE SAMPLE STATION DURING THE COLLECTION PERIOD.
(8) ELECTRICITY WAS OUT OF SERVICE FOR ABOUT 2 HOURS ON 9/30/91.
(9) EXCAVATION WAS BEING PERFORMED IN CLOSE PROXIMITY TO THE SAMPLE STATION DURING THIS COLLECTION PERIOD.
(10) HEAVY EQUIPMENT WAS IN MOTION ON A DIRT ROAD NEAR THE SAMPLE STATION DURING THIS COLLECTION PERIOD.
(11) ELECTRICITY WAS OUT OF SERVICE AT SOME TIME DURING THIS COLLECTION PERIOD.
(12) ELECTRICITY WAS OUT OF SERVICE FROM 11/19/91 TO 1130 ON 11/20/91.

TABLE 14

GROSS ALPHA AND GAMMA* SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN E-03 PCI/CU. M +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	BE-7	K-40
7G1	01/08/91 TO 04/02/91	10+-1	110+-32	
12G1	01/08/91 TO 04/02/91	9.4+-0.8	112+-31	
1D2	01/08/91 TO 04/02/91	11+-1	89.5+-31.2	
3D1	01/08/91 TO 04/02/91	11+-1	91.8+-24.4	
3S2	01/08/91 TO 04/02/91	9.8+-0.8	92.4+-28.2	
5S4	01/08/91 TO 04/02/91	8.2+-0.7	147+-32	
9B1	01/08/91 TO 04/02/91	10+-1	106+-34	
12F1	01/08/91 TO 04/02/91	9.8+-0.7	92.1+-36.6	
12S2	01/08/91 TO 04/02/91	9.2+-0.7	112+-31	
15S4	01/08/91 TO 04/02/91	9.6+-0.8	129+-32	
7G1	04/02/91 TO 07/02/91	1.0+-0.2	100+-10	
12G1	04/02/91 TO 07/02/91	1.2+-0.2	92+-9.2	
1D2	04/02/91 TO 07/02/91	0.7+-0.1	121+-12	
3D1	04/02/91 TO 07/02/91	1.0+-0.2	96.8+-9.7	
3S2	04/02/91 TO 07/02/91	1.3+-0.2	100+-10	
5S4	04/02/91 TO 07/02/91	1.2+-0.2	102+-10	
9B1	04/02/91 TO 07/02/91	0.9+-0.1	104+-10	
12F1	04/02/91 TO 07/02/91	1.1+-0.2	115+-12	
12S2	04/02/91 TO 07/02/91	1.2+-0.2	90.8+-9.1	13.9+-3.7
15S4	04/02/91 TO 07/02/91	1.2+-0.2	92.1+-9.2	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA AND GAMMA* SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN E-03 PCI/CU. M +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	BE-7	K-40
7G1	07/02/91 TO 10/01/91	1.8+-0.2	103+-10	
12G1	07/02/91 TO 10/01/91	2.0+-0.2	79.9+-8	
1D2	07/02/91 TO 10/01/91	2.0+-0.2	93+-9.3	
3D1	07/02/91 TO 10/01/91	1.4+-0.2	97.8+-9.8	
3S2	07/02/91 TO 10/01/91	1.7+-0.2	93.5+-9.4	
5S4	07/02/91 TO 10/01/91	1.7+-0.2	88.6+-8.9	
9B1	07/02/91 TO 10/01/91	1.3+-0.2	94.6+-9.5	
12E1	07/02/91 TO 10/01/91	1.6+-0.2	106+-11	
12S2	07/02/91 TO 10/01/91	1.5+-0.2	98.9+-9.9	
15S4	07/02/91 TO 10/01/91	1.6+-0.2	97.3+-9.7	
7G1	10/01/91 TO 12/31/91	5.0+-0.6	71.7+-7.2	
12G1	10/01/91 TO 12/31/91	5.6+-0.6	69.9+-7	
1D2	10/01/91 TO 12/30/91	5.1+-0.6	75.4+-7.5	5.0+-2.3
3D1	10/01/91 TO 12/31/91	5.4+-0.6	75.2+-7.5	
3S2	10/01/91 TO 12/31/91	5.6+-0.6	76.1+-7.6	
5S4	10/01/91 TO 12/31/91	5.5+-0.5	69.7+-7	
9B1	10/01/91 TO 12/31/91	3.3+-0.4	73.5+-7.4	16.8+-3.2
12E1	10/01/91 TO 12/31/91	5.7+-0.5	83+-8.3	
12S2	10/01/91 TO 12/31/91	6.7+-0.6	78.5+-7.9	
15S4	10/01/91 TO 12/31/91	6.1+-0.6	98.7+-9.9	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GROSS ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF PRECIPITATION

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	BE-7	K-40	COMMENTS
7G1	01/02/91 TO 04/02/91	0.81+-0.56	5.2+-0.9	<80			
12G1	01/02/91 TO 04/02/91	0.73+-0.46	4.8+-0.8	<90			
1D2	01/02/91 TO 04/02/91	0.70+-0.52	7.7+-1.0	<130			
3D1	01/02/91 TO 04/02/91	0.61+-0.45	5.1+-0.8	<80			
3S2	01/02/91 TO 04/02/91	0.58+-0.48	6.2+-0.9	95+-54			
5S4	01/02/91 TO 04/02/91	0.69+-0.46	5.1+-0.8	<80			
9B1	01/02/91 TO 04/02/91	0.78+-0.48	4.7+-0.8	<90			
12E1	01/02/91 TO 04/02/91	<0.8	16+-1.	<90			
12S2	01/02/91 TO 04/02/91	0.52+-0.44	4.6+-0.8	<100			
15S4	01/02/91 TO 04/02/91	0.52+-0.43	4.1+-0.8	<100			
7G1	04/02/91 TO 07/02/91	0.41+-0.38	3.8+-0.8	<80	22.9+-9.5		
12G1	04/02/91 TO 07/02/91	0.78+-0.43	4.8+-0.8	<70	27.9+-13.2		
1D2	04/02/91 TO 07/02/91	<0.5	3.3+-0.7	<100	29.4+-7.9		
3D1	04/02/91 TO 07/02/91	<0.8	4.2+-0.9	<80	36.9+-11.4		
3S2	04/02/91 TO 07/02/91	0.66+-0.40	4.3+-0.8	<70	22.5+-8.5		
5S4	04/02/91 TO 07/02/91	0.80+-0.43	4.2+-0.8	<100			
9B1	04/02/91 TO 07/02/91	0.66+-0.48	4.3+-0.8	<100	32.4+-10.2		
12E1	04/02/91 TO 07/02/91	<0.6	6.6+-0.9	<80	25.9+-9.6	44.5+-9.8	
12S2	04/02/91 TO 07/02/91	0.66+-0.48	4.6+-0.8	72+-37	24.3+-8.0	9.48+-5.4	
15S4	04/02/91 TO 07/02/91	0.95+-0.47	4.0+-0.8	<100	19.9+-11.1		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 15

GROSS ALPHA, GROSS BETA, TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF PRECIPITATION

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	BE-7	K-40	COMMENTS
7G1	07/02/91 TO 10/01/91	0.34+-0.29	3.4+-0.8	<80			
12G1	07/02/91 TO 10/01/91	0.77+-0.40	4.1+-0.8	<100			
1D2	07/02/91 TO 10/01/91	0.27+-0.26	3.1+-0.7	<80			
3D1	07/02/91 TO 10/01/91	0.28+-0.26	4.4+-0.8	140+-50			
3S2	07/02/91 TO 10/01/91	0.95+-0.44	4.2+-0.8	<70			
5S4	07/02/91 TO 10/01/91	0.79+-0.41	3.9+-0.8	<60			
9B1	07/02/91 TO 10/01/91	0.96+-0.44	3.9+-0.8	<80			
12E1	07/02/91 TO 10/01/91	1.0+-0.5	4.4+-0.8	<90			
12S2	07/02/91 TO 10/01/91	0.97+-0.44	4.0+-0.8	<80			
15S4	07/02/91 TO 10/01/91	0.81+-0.41	3.9+-0.8	<80			
7G1	10/01/91 TO 12/31/91	<0.5	1.8+-0.7	<30			1
12G1	10/01/91 TO 12/30/91	<0.4	2.2+-0.7	63+-23			1
1D2	10/01/91 TO 12/31/91	<0.4	1.4+-0.6	58+-24		64.6+-31.8	1
3D1	10/01/91 TO 12/31/91	0.61+-0.43	2.5+-0.7	<50			1
3S2	10/01/91 TO 12/31/91	<0.4	1.6+-0.6	100+-30			1
5S4	10/01/91 TO 12/31/91	<0.4	2.5+-0.7	70+-22			1
9B1	10/01/91 TO 12/31/91	<0.4	1.8+-0.6	<50			1
12E1	10/01/91 TO 12/31/91	<0.4	2.7+-0.7	<40			1
12S2	10/01/91 TO 12/31/91	<0.4	2.9+-0.7	94+-21			1
15S4	10/01/91 TO 12/31/91	<0.4	2.1+-0.7	<50			1

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

COMMENTS

(1) THE COLLECTION CONTAINER WAS FOUND OVERFLOWING ON 11/26/91.

IODINE-131 AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	K-40	SR-90	OTHER ACTIVITY
10G1	01/07/91	856+- 370	1.8+-0.6	
9D3	01/07/91	1570+- 360	<0.8	
10D1	01/07/91	1440+- 370	1.6+-0.6	
10D3	01/07/91	401+- 408	1.8+-0.6	
10D4	01/07/91	1230+- 350	2.7+-0.7	
12B3	01/07/91	1450+- 370	<0.9	
12D2	01/07/91	685+- 385	1.5+-0.6	
13E3	01/07/91	981+- 412	<0.9	
14B1	01/07/91	1140+- 350	2.1+-0.6	
10G1	02/04/91	775+- 391	3.5+-0.7	
9D3	02/04/91	788+- 394	<0.9	
10D1	02/04/91	548+- 431	2.3+-0.7	
10D3	02/04/91	1310+- 390	<0.9	
10D4	02/04/91	1550+- 360	<0.9	
12B3	02/04/91	1030+- 360	<1	
12D2	02/04/91	1360+- 330	<0.9	
13E3	02/04/91	1320+- 350	<1	
14B1	02/04/91	893+- 362	<0.9	
10G1	03/04/91	1320+- 130	1.2+-0.5	
9D3	03/04/91	1280+- 130	1.9+-0.2	
10D1	03/04/91	1510+- 150	2.2+-0.5	
10D3	03/04/91	1330+- 130	<0.2	
10D4	03/04/91	1230+- 120	2.0+-0.3	
12B3	03/04/91	1410+- 140	1.1+-0.5	
12D2	03/04/91	1260+- 130	<0.2	
13E3	03/04/91	1500+- 150	17+-7.0	
14B1	03/04/91	1110+- 110	<0.4	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 16

IODINE-131 AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	K-40	SR-90	OTHER ACTIVITY	
10G1	04/08/91	1310+- 130	1.6+-0.2		
6C1	04/08/91	1370+- 140	1.7+-0.2		
10D1	04/08/91	1140+- 110	3.1+-0.4		
10D3	04/08/91	1250+- 120	1.5+-0.2		
10D4	04/08/91	1270+- 130	1.2+-0.2		
12B3	04/08/91	1390+- 140	1.7+-0.2		
12D2	04/08/91	1320+- 130	0.86+-0.17		
14B1	04/08/91	1130+- 110	1.7+-0.2		
10G1	04/22/91	1270+- 130	3.1+-0.3		
12B3	04/22/91	1300+- 130	0.45+-0.16		
12D2	04/22/91	1320+- 130	0.78+-0.33		
14B1	04/22/91	1140+- 110	1.0+-0.3		
10G1	05/06/91	1340+- 130	1.2+-0.2		
6C1	05/06/91	1310+- 130	0.58+-0.23		
10D1	05/06/91	1190+- 120	5.6+-1.1		
10D3	05/06/91	1290+- 130	2.7+-0.5		
10D4	05/06/91	1220+- 120	<0.6		
12B3	05/06/91	1220+- 120	2.6+-0.3		
12D2	05/06/91	1300+- 130	1.6+-0.6		
14B1	05/06/91	1290+- 130	<0.4		
10G1	05/20/91	1350+- 140	<0.4		
12B3	05/20/91	1170+- 120	<0.3		
12D2	05/20/91	1300+- 130	<0.3		
14B1	05/20/91	1270+- 130	<0.2		
10G1	06/03/91	1360+- 140	0.47+-0.19		
6C1	06/03/91	1240+- 120	0.47+-0.16	CS-137	4.66+-2.60
10D1	06/03/91	1410+- 140	1.8+-0.3		
10D3	06/03/91	1240+- 120	0.64+-0.16		
10D4	06/03/91	1360+- 140	0.27+-0.14		
12B3	06/03/91	1190+- 120	1.2+-0.2		
12D2	06/03/91	1320+- 130	<0.4		
14B1	06/03/91	1280+- 130	1.4+-0.2		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

IODINE-131 AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	K-40	SR-90	OTHER ACTIVITY
10G1	06/17/91	1240+- 120	1.1+-0.4	
12B3	06/17/91	1310+- 130	2.8+-0.4	
12D2	06/17/91	1410+- 140	0.52+-0.33	
14B1	06/17/91	1240+- 120	2.9+-0.4	
10G1	07/08/91	1410+- 140	2.1+-0.2	
6C1	07/08/91	1430+- 140	2.2+-0.7	
10D1	07/08/91	1260+- 130	1.1+-0.2	
10D3	07/08/91	1420+- 140	1.2+-0.2	
10D4	07/08/91	1410+- 140	0.92+-0.19	
12B3	07/08/91	1270+- 130	1.8+-0.2	
12D2	07/08/91	1340+- 130	0.95+-0.24	
14B1	07/08/91	1360+- 140	4.2+-0.3	
10G1	07/22/91	1400+- 140	0.88+-0.26	
12B3	07/22/91	1420+- 140	1.2+-0.2	
12D2	07/22/91	1360+- 140	<0.5	
14B1	07/22/91	1160+- 120	<0.3	
10G1	08/05/91	1130+- 110	1.9+-0.2	
6C1	08/05/91	1240+- 120	2.0+-0.5	
10D1	08/05/91	1310+- 130	1.2+-0.2	
10D3	08/05/91	1270+- 130	1.3+-0.2	
10D4	08/05/91	1430+- 140	2.1+-0.3	
12B3	08/05/91	1210+- 120	3.3+-0.3	
12D2	08/05/91	1290+- 130	<0.3	
14B1	08/05/91	1260+- 130	<0.2	
10G1	08/19/91	1360+- 140	2.3+-0.2	
12B3	08/19/91	1390+- 140	2.9+-0.2	
12D2	08/19/91	1450+- 140	1.2+-0.2	
14B1	08/19/91	1190+- 120	0.53+-0.13	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 16

IODINE-131 AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	K-40	SR-90	OTHER ACTIVITY
10G1	09/03/91	1230+- 120	3.1+-0.3	
6C1	09/03/91	1370+- 140	<0.2	
10D1	09/03/91	1310+- 130	<0.2	
10D3	09/03/91	1280+- 130	<0.1	
10D4	09/03/91	1370+- 140	1.1+-0.2	
12B3	09/03/91	1330+- 130	1.7+-0.2	
12D2	09/03/91	1280+- 130	1.1+-0.2	
14B1	09/03/91	1220+- 120	2.6+-0.4	
10G1	09/19/91	1310+- 130	0.51+-0.12	
12B3	09/19/91	1300+- 130	2.7+-0.3	
12D2	09/19/91	1290+- 130	0.64+-0.11	
14B1	09/19/91	1320+- 130	2.9+-0.2	
10G1	10/07/91	1250+- 130	2.5+-0.2	
6C1	10/07/91	1280+- 130	1.9+-0.2	
10D1	10/07/91	1340+- 130	2.4+-0.3	
10D3	10/07/91	1240+- 120	2.7+-0.2	
10D4	10/07/91	1300+- 130	1.4+-0.2	
12B3	10/07/91	1270+- 130	3.2+-0.2	
12D2	10/07/91	1270+- 130	0.95+-0.21	
14B1	10/07/91	1280+- 130	3.5+-0.3	
10G1	10/21/91	1290+- 130	1.3+-0.1	
12B3	10/21/91	1250+- 120	2.6+-0.3	
12D2	10/21/91	1310+- 130	0.95+-0.26.	
14B1	10/21/91	1160+- 120	1.7+-0.2	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

IODINE-131 AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/LITER +- 2S

LOCATION	COLLECTION DATE	K-40	SR-90	OTHER ACTIVITY
10G1	11/04/91	1310+- 130	2.4+-0.3	
6C1	11/04/91	1290+- 130	<0.2	
10D1	11/04/91	1350+- 130	2.0+-0.2	
10D3	11/04/91	1440+- 140	0.94+-0.18	
10D4	11/04/91	1380+- 140	<0.2	
12B3	11/04/91	1370+- 140	1.3+-0.3	
12D2	11/04/91	1400+- 140	<0.8	
14B1	11/04/91	1160+- 120	2.2+-0.3	
10G1	12/09/91	1180+- 120	2.2+-1.0	
6C1	12/09/91	1250+- 120	<0.4	
10D1	12/09/91	1340+- 130	0.67+-0.20	
10D3	12/09/91	1060+- 110	<0.2	
10D4	12/09/91	1360+- 140	1.3+-0.2	
12B3	12/09/91	1050+- 100	<0.1	
12D2	12/09/91	1250+- 130	<0.3	
14B1	12/09/91	1250+- 120	<0.3	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TAPLE 17

GAMMA* SPECTROSCOPIC ANALYSES OF SOIL

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM DRY +- 2S

LOCATION	COLLECTION DATE	K-40	CS-137	RA-226	TH-228
7G1 BOT	09/18/91	8.49+-0.85	0.97+-0.10	1.98+-0.65	1.14+-0.11
7G1 TOP	09/18/91	9.47+-0.95	0.89+-0.09	1.33+-0.67	1.14+-0.11
12G3 BOT	09/18/91	11.8+-1.2	0.12+-0.04	1.79+-0.68	1.08+-0.11
12G3 TOP	09/18/91	10.6+-1.1	0.14+-0.05	1.76+-0.55	1.05+-0.11
1D4 BOT	09/17/91	10.3+-1.0	<0.06	1.57+-0.71	1.06+-0.11
1D4 TOP	09/17/91	8.05+-0.81	0.14+-0.04	1.58+-0.64	1.09+-0.11
3D2 BOT	09/17/91	13.5+-1.4	0.12+-0.03	1.34+-0.70	1.51+-0.15
3D2 TOP	09/17/91	13.8+-1.4	0.24+-0.04	1.58+-0.65	1.23+-0.12
3S7 BOT	09/17/91	14.8+-1.5	0.07+-0.03	1.39+-0.60	0.93+-0.09
3S7 TOP	09/17/91	14.2+-1.4	0.12+-0.03	1.64+-0.66	0.91+-0.09
5S5 BOT	09/17/91	10.2+-1.0	0.19+-0.04	1.41+-0.47	0.96+-0.10
5S5 TOP	09/17/91	10.6+-1.1	0.25+-0.05	1.31+-0.62	0.94+-0.09
9B2 BOT	09/18/91	8.43+-0.84	0.44+-0.04	0.89+-0.43	0.62+-0.06
9B2 TOP	09/18/91	9.24+-0.92	0.30+-0.05	1.18+-0.52	0.55+-0.06
12E2 BOT	09/18/91	11.4+-1.1	0.28+-0.04	2.00+-0.55	0.82+-0.08
12E2 TOP	09/18/91	10.6+-1.1	0.30+-0.04	1.26+-0.59	0.81+-0.08
12S4 BOT	09/18/91	12.2+-1.2	0.10+-0.05	<0.7	1.03+-0.10
12S4 TOP	09/18/91	11.2+-1.1	0.11+-0.05	1.26+-0.61	0.79+-0.08
15S4 BOT	09/18/91	10.5+-1.0	0.27+-0.05.	1.22+-0.64	0.91+-0.09
15S4 TOP	09/18/91	9.67+-0.97	0.28+-0.06	1.77+-0.82	0.88+-0.09
FLD1 BOT	05/24/91	9.06+-0.91	0.29+-0.05	2.12+-0.68	1.01+-0.10
FLD1 TOP	05/24/91	8.76+-0.88	0.31+-0.04	1.93+-0.68	1.04+-0.10
FLD2 BOT	05/24/91	9.82+-0.98	0.28+-0.04	1.68+-0.52	0.94+-0.09
FLD2 TOP	05/24/91	9.71+-0.97	0.27+-0.04	1.82+-0.65	1.01+-0.10
FLD3 BOT	05/24/91	9.48+-0.95	0.31+-0.06	2.49+-0.91	1.06+-0.11
FLD3 TOP	05/24/91	10.1+-1.0	0.29+-0.03	2.61+-0.66	1.38+-0.14

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 18

GAMMA* SPECTROSCOPIC ANALYSES OF VEGETATION

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	COLLECTION DATE	BE-7	K-40	CS-137	COMMENTS
7G1					1
12G3	09/18/91	0.38+-0.14	4.30+-0.43		
1D4	09/17/91	0.27+-0.13	4.63+-0.46		
3D2	09/17/91	<0.3	6.71+-0.67		
3S7	09/17/91	0.16+-0.08	5.07+-0.51		
5S5	09/17/91	0.51+-0.22	6.57+-0.66		
9B2	09/18/91	<0.3	3.76+-0.38		
12E2	09/18/91	0.34+-0.20	7.03+-0.70		
12S4	09/18/91	1.08+-0.20	6.26+-0.63		
15S4	09/18/91	1.23+-0.18	6.93+-0.69	0.03+-0.01	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

COMMENTS

(1) VEGETATION WAS NOT AVAILABLE FOR SAMPLING DUE TO POOR GROWING CONDITIONS (INADEQUATE RAINFALL).

TABLE 19

GAMMA* SPECTROSCOPIC ANALYSES OF FOOD PRODUCTS (FRUITS, VEGETABLES, AND HONEY)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	K-40	OTHER	ACTIVITY
10F2	BAKING APPLE	07/23/91	1.50+-0.15		
10F1	APPLES	08/22/91	0.59+-0.09		
12B1	APPLES	09/04/91	0.66+-0.08		
7B2	RED DELICIOUS AP	09/17/91	0.99+-0.1		
7B2	CORTLAND APPLE	09/17/91	1.13+-0.11		
7B2	MCINTOSH APPLE	09/17/91	0.78+-0.08		
11D1	GREEN BEAN	07/23/91	4.46+-0.45		
9D2	GREEN BEAN	08/07/91	1.06+-0.11		
10F1	YELLOW BEAN	08/22/91	2.03+-0.2		
10F1	LIMA BEAN	08/22/91	5.21+-0.52		
10F1	RED BEET	08/22/91	3.74+-0.37		
12F6	RED BEET	08/22/91	4.44+-0.44		
12B1	RED BEET	09/04/91	3.97+-0.4		
7F1	RED BEET	09/10/91	4.80+-0.48		
10B5	RED BEET	10/08/91	4.40+-0.44	BE-7	0.10+-0.05
7F1	BROCCOLI	09/10/91	4.26+-0.43		
16F3	CABBAGE	07/01/91	3.10+-0.31		
10F2	CABBAGE	07/23/91	1.57+-0.16		
9D2	CABBAGE	08/07/91	2.62+-0.26		
10F1	CABBAGE	08/22/91	1.58+-0.16		
12B1	CABBAGE	09/04/91	2.57+-0.26		
7F1	CABBAGE	09/10/91	1.85+-0.18		
10B5	CABBAGE	10/08/91	1.64+-0.16		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GAMMA* SPECTROSCOPIC ANALYSES OF FOOD PRODUCTS (FRUITS, VEGETABLES, AND HONEY)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	K-40	OTHER	ACTIVITY
12B1	CANTALOUPE	09/04/91	2.81+-0.28		
10B5	CARROT	10/08/91	4.21+-0.42		
10F2	SWEET CHERRIES	07/02/91	1.99+-0.2		
10B5	SWISS CHARD	10/08/91	4.54+-0.45		
2H1	SWEET CORN ONCOB	08/13/91	3.35+-0.33		
10F2	SWEET CORN (COB)	07/23/91	2.19+-0.22		
11D1	SWEET CORN (COB)	07/23/91	3.62+-0.36		
10F1	SWEET CORN	08/22/91	1.93+-0.19		
12B1	SWEET CORN	09/04/91	2.89+-0.29		
7F1	SWEET CORN ON COB	09/10/91	1.59+-0.16		
2H1	CUCUMBER	08/13/91	1.61+-0.16		
11D1	CUCUMBER	07/23/91	1.84+-0.18		
10F1	CUCUMBER	08/22/91	2.17+-0.22		
7F1	CUCUMBER	09/10/91	1.88+-0.19		
16F3	NIAGRA GRAPES	09/10/91	2.15+-0.21		
7F1	HONEY	09/10/91	0.63+-0.08	CS-137	0.01+-0.01
9D2	KOHLRABI	08/07/91	3.76+-0.38		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GAMMA* SPECTROSCOPIC ANALYSES OF FOOD PRODUCTS (FRUITS, VEGETABLES, AND HONEY)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	K-40	OTHER	ACTIVITY
16F3	LETTUCE	06/25/91	3.60+-0.36	BE-7	0.17+-0.06
11F1	LETTUCE	07/01/91	11.4+-1.1	BE-7	0.28+-0.15
10F1	ONION	08/22/91	0.7+-0.1		
7F1	ONION	09/10/91	1.09+-0.11		
9D2	PEACHE	08/07/91	1.65+-0.17		
10F1	PEACHE	08/22/91	2.03+-0.2		
9D2	PEAR	08/07/91	2.12+-0.21		
10F1	PEAR	08/22/91	1.08+-0.11		
7B2	ASIAN PEAR	09/17/91	1.0+-0.1		
11D1	SWEET PEPPER	07/23/91	1.56+-0.16		
9D2	SWEET PEPPER	08/07/91	1.92+-0.19		
12B1	SWEET PEPPER	09/04/91	1.29+-0.13		
7F1	SWEET PEPPER	09/10/91	2.44+-0.24		
10F2	PLUM	07/23/91	2.23+-0.22		
10F1	PLUM	08/22/91	2.07+-0.21		
7B2	PLUM	09/17/91	1.51+-0.15		
9D2	POTATO	08/07/91	4.08+-0.41		
10F1	POTATO	08/22/91	3.58+-0.36		
11D1	POTATO	09/17/91	3.81+-0.38		
10B5	SWEET POTATO	10/08/91	2.59+-0.35		
10B5	POTATO	10/08/91	4.19+-0.42		
10B5	RED POTATO	10/08/91	4.43+-0.44		

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

GAMMA* SPECTROSCOPIC ANALYSES OF FOOD PRODUCTS (FRUITS, VEGETABLES, AND HONEY)

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	K-40	OTHER ACTIVITY
2H1	YELLOW SQUASH	08/13/91	2.39+-0.24	
7F1	BUTTERNUT SQUASH	09/10/91	4.59+-0.46	
10B5	BUTTERNUT SQUASH	10/08/91	<0.5	
12F5	STRAWBERRIES	06/03/91	1.08+-0.11	
13G1	STRAWBERRIES	06/05/91	1.95+-0.2	
11D1	TOMATO	07/23/91	2.12+-0.21	
9D2	TOMATO	08/07/91	3.22+-0.32	
10F1	TOMATO	08/22/91	2.23+-0.22	
16F2	TOMATO	09/08/91	2.45+-0.25	
7F1	TOMATO	09/10/91	2.41+-0.24	
10B5	TOMATO	10/08/91	3.14+-0.31	
9D2	WATERMELON	08/07/91	1.32+-0.13	
12B1	WATERMELON	09/04/91	1.30+-0.13	
7F1	WATERMELON	09/10/91	0.93+-0.09	
11D1	WATERMELON	09/17/91	0.95+-0.1	
16F3	ZUCCHINI	07/01/91	1.54+-0.15	
16F2	ZUCCHINI	07/09/91	2.48+-0.25	
10F2	ZUCCHINI	07/23/91	1.75+-0.18	
11D1	ZUCCHINI	07/23/91	1.88+-0.19	
7F1	ZUCCHINI	09/10/91	2.24+-0.22	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 20

GAMMA* SPECTROSCOPIC ANALYSES OF GAME, POULTRY, AND EGGS

SUSQUEHANNA STEAM ELECTRIC STATION - 1991

RESULTS IN PCI/GM WET +- 2S

LOCATION	SAMPLE TYPE	COLL.DATE	K-40	CS-137
16F	DEER	01/01/91	4.73+-0.71	
2B	DEER	01/03/91	1.02+-1.01	0.02+-0.02
9B	DEER	01/03/91	2.46+-1.22	
10S	DEER	01/12/91	3.52+-0.7	0.10+-0.03
8B	DEER	01/15/91	3.56+-0.79	
3B	RABBIT	11/07/91	3.24+-0.49	
15F	RABBIT	11/09/91	2.41+-0.65	
16F	RABBIT	11/09/91	2.60+-0.53	
5S	RABBIT	11/13/91	2.84+-0.55	
2B	SQUIRREL	11/07/91	3.40+-0.88	
3B	SQUIRREL	11/07/91	4.01+-0.95	
16F	SQUIRREL	11/14/91	3.82+-0.65	0.60+-0.07
10D1	DUCK	12/09/91	2.05+-0.22	
12B1	CHICKEN	12/09/91	2.03+-0.2	
12B1	EGGS	12/10/91	1.08+-0.11	

* ONLY DETECTED GAMMA EMITTERS ARE REPORTED; TYPICAL MDC VALUES ARE FOUND IN TABLE 21.

TABLE 21

TYPICAL * MINIMUM DETECTABLE CONCENTRATIONS OF NUCLIDES SEARCHED FOR BUT NOT FOUND BY GAMMA SPECTROMETRY IN THE VICINITY OF SUSQUEHANNA STEAM ELECTRIC STATION, 1991

Nuclide	Fish (pCi/g wet)	Sediment (pCi/g dry)	Surface Water (pCi/l)	Ground Water (pCi/l)	Potable Water (pCi/l)	Rain Water (pCi/l)
Mn54	0.012	0.11	5.9	4.8	5.4	3.6
Co-58	0.014	0.22	4.9	4.8	5.6	5.0
Fe-59	0.048	0.65	12	11	10	11
Co-60	0.013	0.11	6.4	5.7	5.6	4.5
Zn-65	0.032	0.21	12	9.7	11	8.6
Zr-95	0.041	0.38	14	11	11	9.8
Nb-95	0.18	0.18	7.6	5.4	5.5	9.2
Ru-103	0.028	0.31	6.4	6.5	6.2	6.4
I-131**	0.98	66	0.28	6.3	0.13	17
Cs-134	0.012	0.13	6.4	6.2	5.9	4.5
Cs-137	0.012	0.11	5.9	5.6	5.6	5.2
Ba-140	0.48	9	30	30	35	36
La-140	0.23	9.6	11	12	16	14
Ce-141	0.061	0.70	14	14	12	12

Nuclide	Air Particulate (10-3 pCi/m3)	Milk (pCi/l)	Fruits/Veg. (pCi/g wet)	Algae (pCi/g dry)	Game, Poultry & Eggs (pCi/g wet)	Soil (pCi/g dry)
Mn-54	0.31	5.4	0.018	0.42	0.012	0.01
Co-58	0.31	5.6	0.020	0.41	0.025	0.054
Fe-59	0.95	12	0.040	0.96	0.076	0.166
Co-60	0.37	6.2	0.021	0.46	0.010	0.050
Zn-65	0.92	12	0.046	0.89	0.046	0.11
Zr-95	0.68	8.8	0.040	0.86	0.046	0.12
Nb-95	0.36	5.4	0.19	0.41	0.032	0.076
Ru-103	0.44	6.8	0.021	0.43	0.046	0.10
I-131**	2.9	0.14	0.024	0.86	48	0.21
Cs-134	0.42	5.8	0.022	0.41	0.016	0.056
Cs-137	0.36	4.7	0.022	0.50	0.012	0.036
Ba-140	3.8	29	0.066	0.19	14	0.89
La-140	1.1	9.6	0.038	0.84	8.0	0.54
Ce-141	0.66	11	0.030	0.61	0.14	0.14

* Typical refers to mean plus two standard deviations.

** Iodine-131 in surface water, potable water and milk is determined by radiochemical methods. See appendix B-5.

TABLE A-1

INTER-LABORATORY COMPARISONS - 1991

TELEDYNE ISOTOPES

Collection Date	Sequence No.	Media	Nuclide	EPA Results(a)	Teledyne Isotopes Results(b)	Normalized Deviation Grand Avg.	Normalized Deviation Known	All Participants Mean ± 2 s.d.
01/11/91	561	Water	Sr-89	5.00 ± 8.66	5.00 ± 0.00	-0.08	0.00	5.0 ± 3.58
			Sr-90	5.00 ± 8.66	5.00 ± 0.00	0.05	0.00	5.0 ± 3.02
02/08/91	565	Water	Co-60	40.0 ± 8.66	39.33 ± 9.18	-0.24	-0.23	40.04 ± 5.74
			Zn-65	149.0 ± 25.98	147.00 ± 3.00	-0.31	-0.23	149.71 ± 21.36
			Ru-106	186.00± 32.91	176.67 ± 52.68	-1.38	-0.85	191.83 ± 39.86
			Cs-134	8.0 ± 8.66	7.33 ± 1.74	-0.26	-0.23	8.09 ± 3.96
			Cs-137	8.0 ± 8.66	7.67 ± 9.63	-0.48	-0.12	9.06 ± 3.18
			Ba-133	75.0 ± 13.86	75.67 ± 16.53	0.33	0.14	74.14± 11.72
02/15/91	563	Water	I-131	75.0 ± 13.86	80.00 ± 15.87	0.65	1.08	77.00 ± 11.78
02/22/91	564	Water	H-3	4418.0 ± 765.6	4500.0 ± 519.63	0.24	0.32	4437.54 ±665.58
03/29/91	568	Air Filter	Gross Alpha	25.0 ± 10.39	42.67 ± 1.74 (c)	3.73	5.10	29.73 ± 11.86
			Gross Beta	124.0 ± 10.39	126.67 ± 11.54	-0.99	0.77	130.11 ± 27.20
			Sr-90	40.0 ± 8.66	37.00 ± 3.00	-0.80	-1.04	39.30 ± 10.42
			Cs-137	40.0 ± 8.66	43.00 ± 15.87	-0.56	1.04	44.61 ± 15.24
04/16/91	570	Water Lab Perf.	Gross Alpha	54.0 ± 24.25	59.67 ± 12.12	1.23	0.70	49.71 ± 22.86
			Gross Beta	115.0 ± 29.44	110.00 ± 0.00	0.14	-0.51	108.60 ± 27.74
			Sr-89	28.0 ± 8.66	31.00 ± 3.00	1.82	1.04	25.74 ± 12.90
			Sr-90	26.0 ± 8.66	21.00 ± 0.00	0.90	1.73	23.61 ± 6.54
			Cs-134	24.0 ± 8.66	25.00 ± 3.00	0.71	0.35	22.96 ± 4.12
			Cs-137	25.0 ± 8.66	24.00 ± 5.19	-0.52	-0.35	25.49 ± 4.28
04/26/91	571	Milk	Sr-89	32.0 ± 8.66	24.00 ± 9.00 (d)	-1.06	-2.77	27.07 ± 15.06
			Sr-90	32.0 ± 8.66	26.33 ± 6.24	-0.59	-1.96	28.02 ± 10.28
			I-131	60.0 ± 10.39	53.33 ± 6.93	-2.26	-1.92	61.17 ± 11.58
			Cs-137	49.0 ± 8.66	52.67 ± 4.59	0.46	1.27	51.35 ± 7.46
			K	1650.0 ± 143.76	1590.00± 245.55	-1.32	-1.25	1653.09 ±324.44

TABLE A-1

INTER-LABORATORY COMPARISONS - 1991

TELEDYNE ISOTOPES

Collection Date	Sequence No.	Media	Nuclide	EPA Results(a)	Teledyne Isotopes Results(b)	Normalized Deviation Grand Avg.	Normalized Deviation Known	All Participants Mean ± 2 s.d.
05/10/91	572	Water	Sr-89	39.0 ± 8.66	38.67 ± 13.53	0.43	-0.12	37.43 ± 16.54
			Sr-90	24.0 ± 8.66	22.00 ± 5.19	-0.64	-0.69	23.85 ± 6.04
05/17/91	569	Water	Gross Alpha	24.0 ± 10.39	24.33 ± 7.56	0.98	0.10	20.94 ± 13.26
			Gross Beta	46.0 ± 8.66	50.33 ± 3.06	1.94	1.50	44.73 ± 15.46
06/07/91	573	Water	Co-60	10.0 ± 8.66	10.33 ± 1.74	-0.12	0.12	10.69 ± 4.64
			Zn-65	108.0 ± 19.05	106.00 ± 7.95	-0.56	-0.31	109.54 ± 16.26
			Ru-106	149.0 ± 25.98	136.67 ± 11.37	-0.56	-1.42	141.48 ± 28.16
			Cs-134	15.0 ± 8.66	13.67 ± 4.59	-0.19	-0.46	14.20 ± 4.04
			Cs-137	14.0 ± 8.66	13.67 ± 4.59	-0.59	-0.12	15.37 ± 3.92
			Ba-133	62.0 ± 10.39	56.33 ± 4.59	-1.45	-1.64	61.37 ± 10.96
06/21/91	574	Water	H-3	12480 ±2161.60	12833.33 ± 346.50	0.55	0.49	12434.92 ±1881.62
08/09/91	576	Water	I-131	20.0 ± 10.39	19.33 ± 1.74	-0.47	-0.19	20.96 ± 6.04
08/30/91	580	Air Filter	Gross Alpha	25.0 ± 10.39	27.00 ± 6.00	-0.38	0.58	28.33 ± 10.06
			Gross Beta	92.0 ± 17.32	100.00 ± 0.00	0.77	1.39	95.54 ± 18.08
			Sr-90	30.0 ± 8.66	27.67 ± 8.67	-0.50	-0.81	29.11 ± 7.84
			Cs-137	30.0 ± 8.66	33.33 ± 9.63	0.30	1.15	32.48 ± 10.76
09/13/91	581	Water	Sr-89	49.0 ± 8.66	50.67 ± 8.67	0.38	0.58	49.57 ± 18.16
			Sr-90	25.0 ± 8.66	26.00 ± 3.00	0.44	0.35	24.72 ± 5.82
09/20/91	579	Water	Gross Alpha	10.0 ± 8.66	11.67 ± 1.74	0.45	0.58	10.36 ± 6.30
			Gross Beta	20.0 ± 8.66	21.00 ± 0.00	0.24	0.35	20.30 ± 7.36
09/27/91	584	Milk	Sr-89	25.0 ± 8.66	21.00 ± 7.95	0.02	-1.39	20.95 ± 10.36
			Sr-90	25.0 ± 8.66	19.00 ± 0.00 (d)	-0.72	-2.08	21.09 ± 8.40
			I-131	108.0 ± 19.05	113.33 ± 17.31	0.75	0.84	108.56 ± 16.68
			Cs-137	30.0 ± 8.66	29.00 ± 10.83	-0.81	-0.35	31.35 ± 4.68
			K	1740.0 ± 150.69	1503.33 ± 225.18 (e)	-3.27	-4.71	1667.46 ±241.58

TABLE A-1

INTER-LABORATORY COMPARISONS - 1991

TELEDYNE ISOTOPES

Collection Date	Sequence No.	Media	Nuclide	EPA Results(a)	Teledyne Isotopes Results(b)		Normalized Deviation Grand Avg.	Normalized Deviation Known	All Participants Mean ± 2 s.d.
10/04/91	582	Water Lab Perf.	Co-60	29.0 ± 8.66	30.33 ± 6.24		0.18	0.46	29.83 ± 6.00
			Zn-65	73.0 ± 12.12	72.67 ± 21.27		-0.47	-0.08	74.57 ± 13.28
			Ru-106	199.0 ± 34.64	197.67 ± 22.53		0.30	-0.12	194.21 ± 41.84
			Cs-134	10.0 ± 8.66	10.33 ± 1.74		0.14	0.12	9.93 ± 3.64
			Cs-137	10.0 ± 8.66	11.33 ± 1.74		0.16	0.46	10.86 ± 3.62
			Ba-133	98.0 ± 17.32	97.00 ± 26.16		0.25	-0.17	95.56 ± 14.88
10/18/91	583	Water	H-3	2454.0 ± 611.41	2333.33 ± 173.22		-0.98	-0.59	2531.91 ±677.04
10/22/91	586	Water Lab Perf.	Gross Alpha	82.00 ± 36.37	55.00 ± 13.08	(f)	-1.70	-2.23	60.64 ± 32.10
			Gross Beta	65.0 ± 17.32	56.00 ± 3.00		0.08	-1.56	50.78 ± 12.64
			Sr-89	10.0 ± 8.66	10.67 ± 9.24		0.30	0.23	18.84 ± 10.24
			Sr-90	10.0 ± 8.66	9.33 ± 1.74		-0.26	-0.23	14.44 ± 4.04
			Co-60	20.0 ± 8.66	19.67 ± 1.74		-0.19	-0.12	20.22 ± 4.26
			Cs-134	10.0 ± 8.66	10.33 ± 9.24		0.26	-0.12	7.49 ± 2.88
			Cs-137	11.0 ± 8.66	13.67 ± 1.74		0.42	0.92	5.94 ± 3.10
01/31/92	588	Water	Gross Alpha	30.00 ± 13.86	25.00 ± 12.00		0.21	-1.08	24.04 ± 15.58
			Gross Beta	30.00 ± 8.66	31.67 ± 1.74		0.62	0.58	29.88 ± 10.84

Footnotes:

(a) EPA Results - Expected laboratory precision (3 sigma). Units are pCi/l for water and milk except K is in mg/l.

(b) Teledyne Results - Average ± 3 sigma. Units are pCi/l for water and milk except K is in mg/l. Units are total pCi for air particulate filters.

(c) The sample presents a different counting geometry. The EPA deposits activity in a 3/4 inch diameter circle, on a plastic disk approximately 3/32 inch thick. A special calibration for EPA filters will be performed. The laboratory has obtained blank filters from the Las Vegas facility, and will simulate their deposits.

(d) The cause for the deviation is believed to be erroneously high strontium yields, probably caused by incomplete separation of calcium. The laboratory has investigated carrier concentrations and pipeting techniques and have found them to be correct. Further aspects of analysts' techniques are being tested. The laboratory has received a new strontium extraction material developed at Argonne National Laboratory. Experiments with this method to achieve better separation of calcium were completed and procedure PRO-032-105 was implemented on 2/1/92.

(e) There is no apparent cause for the low K-40 results. Two other isotopes spiked in the sample were in good agreement with EPA values. Unit conversions were reviewed and found to be correctly applied. Possible background errors in geometry were investigated and found to have an insignificant effect.

(f) Probable failure to transfer all sample residue to the counting planchet. Analysts are being testing using in-house and other EPA spikes.

APPENDIX B

SUMMARY OF ANALYTICAL METHODS

The following section contains brief descriptions of the analytical laboratory procedures and the calculational methods used by Teledyne Isotopes and Controls for Environmental Pollution for sample analyses. These are considered proprietary and are published for informational purposes only.

A further discussion on data reporting conventions can be found in Appendix C.

TLD MEASUREMENTS

During the four quarters of 1986, a PP&L dosimetry system was used which consists of a Panasonic UD-710 reader and UD-801 badges. The UD-801 badges have two elements of lithium borate (Cu) and two elements of calcium sulfate (Tm). Only the calcium sulfate (Tm) elements are used for environmental measurements. This phosphor was chosen for its characteristic high light output, minimal thermally induced signal loss (fading) and negligible self-dosing.

In handling, the badges are kept clean, and the element phosphors are not touched. The badges are stored and transported in plastic bags or other containers.

Before going to the field, the dosimeters are read twice (separated by one hour) in which the second reading is used as an inherent (background) reading for each element. After the inherent read, the badges are placed in sealed plastic bags, to aid in preventing moisture contacting the TLDs, labeled with the sampling location and taken immediately out to the field. Upon removal from the field, the TLDs are inspected for any damage and read out immediately. In-transit TLDs are not used because of the short time period between the inherent reading and field placement.

An element correction factor has been calculated for each element, and the reader is calibrated using TLDs exposed to a cesium-137 source.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA ACTIVITY
TELEDYNE ISOTOPES

One liter aliquots of water samples are treated with about one milliliter of concentrated nitric acid and evaporated to near dryness in beakers. The remaining volumes (approximately five milliliters or less) are transferred to stainless steel planchets and evaporated to dryness.

Two hundred or more grams of each fish sample are dried and then ashed in a muffle furnace. One gram of each ashed sample is then transferred to a stainless steel planchet.

Approximately 50 grams of each soil or sediment sample is dried by heat lamp over a period of a couple days. One gram of each dried sample is then transferred to a stainless steel planchet.

All planchets are counted in low background gas-flow proportional counters. Calculations of both gross alpha and beta activities include the use of empirical self-absorption correction curves to account for changes in effective counting efficiency occurring as a result of changes in the masses of residue being counted.

Weekly air particulate filters are placed into planchets as received and counted in low background gas-flow proportional counters. No corrections are made for beta self-absorption when calculating the gross beta activities of the air particulate filters because of the impracticality of weighing the deposit and because the penetration depth of the deposit into the filter is unknown.

CONTROLS FOR ENVIRONMENTAL POLLUTION

The wet ash method is used in the determination of gross alpha and beta activities, without the identification of specific nuclides, for all samples except air particulate filters.

One liter aliquots of water samples are treated with about ten milliliters of concentrated nitric acid and are then evaporated to dryness. The residues are then wet ashed with hydrogen peroxide and nitric acid. After wet ashing, the residues are transferred by washing to stainless steel planchets. The planchets are flamed until red hot.

Approximately 200 gram aliquots of soil, sediment, and fish samples are dried, ground, and muffled to remove organic material. The samples are then leached with hydrochloric acid, and filtered. After the leachates are evaporated to dryness, the residues are wet ashed using nitric acid and hydrogen peroxide and transferred to stainless steel planchets. The planchets are flamed until red hot.

All planchets are counted in low background gas-flow proportional counters. Calculation of gross alpha activities includes the use of an empirical self-absorption correction curve. No corrections are made for self-absorption in the calculation of gross beta activities. It is assumed that the beta self-absorption is negligible with the masses of residue involved.

Quarterly composites of the weekly air particulate filters are counted for gross alpha activities. Preparation for counting involves the dissolution of the filters and the eventual transfer of the residue from filter deposits onto stainless steel planchets. As with the calculation of other gross alpha activities, corrections are made for sample self-absorption of alpha particles during counting.

CALCULATION OF THE SAMPLE ACTIVITY

$$\frac{pCi}{unit\ volume\ or\ mass} = \frac{\left[\frac{C}{t} - R_b\right]}{2.22(V)(E)} \pm \frac{2\sqrt{\frac{\frac{C}{t} + R_b}{t}}}{2.22(V)(E)}$$

net activity random uncertainty

where:
- C = total counts for sample
- t = count time for sample/background (minutes)
- R_b = background count rate of counter (cpm)
- 2.22 = $\frac{dpm}{pCi}$
- V(M) = volume or mass of sample analyzed
- E = efficiency of the counter (cpm/dpm)

Calculation of the Minimum Detectable Concentration (MDC) Value

$$MDC = \frac{4.66\sqrt{\frac{R_b}{t}}}{2.22(V)(E)}$$

RADIOCHEMICAL DETERMINATION OF I-131 IN MILK AND WATER SAMPLES

TELEYDYNE ISOTOPES

A four liter aliquot of sample is first equilibrated with stable iodide carrier. Following a period of time sufficient for equilibration, anion exchange resin is added to the aliquot to capture the iodide ions present. The iodide ion is subsequently removed from the resin using sodium hypochlorite. Hydroylamine hydrochloride is then used to produce free iodine. The resulting free iodine is then extracted from the aqueous phase by dissolution in carbon tetrachloride. This is followed by a reduction back to the iodide form using sodium bisulfite and back-extraction to the aqueous phase. Once in the aqueous phase again, the iodide is precipitated as palladium iodide following the addition of palladium chloride.

Another aliquot of the sample is used to determine the stable iodide content of the milk by the use of a specific-ion electrode. This information is then used to correct the chemical yield determined from the mass of the dried precipitate obtained.

The dried precipitate is beta counted on a low-level counter.

CONTROLS FOR ENVIRONMENTAL POLLUTION

Different methods are used for the analyses of water and milk samples by Controls for Environmental Pollution (CEP).

Stable iodide carrier is added to four liter aliquots of each water sample together with sodium nitrite and carbon tetrachloride. Free iodide is produced that then preferentially dissolves in the carbon tetrachloride portion of the mixture. Hydrazine solution is then added to the portion containing the free iodine and carbon tetrachloride, effectively pulling the iodine out of solution in the carbon tetrachloride and back to the aqueous phase. From the aqueous phase, the iodine is precipitated as silver iodide.

Stable iodide carrier is added to four liter aliquots of each milk sample together with anion exchange resin which captures the iodide ions that are present. The iodide ions are subsequently removed from the resin with sodium perchlorate. The iodine is then precipitated as silver iodide.

The dried precipitates resulting from the procedures for both water and milk analyses described above are beta counted on low-level counters.

CALCULATION OF THE SAMPLE ACTIVITY

$$\frac{pCi}{\ell} = \frac{\left[\frac{C}{t} - R_B\right]}{2.22\,(V)\,(y)\,(DF)\,(E)} \pm \frac{2\sqrt{\frac{\frac{C}{t} + R_b}{t}}}{2.22\,(V)\,(y)\,(DF)\,(E)}$$

net activity | random uncertainty

where: C = total counts from sample

t = counting time for sample (min)

R_b = background count rate of counter (cpm)

2.22 = $\frac{dpm}{pCi}$

V = volume of sample analyzed (liters)

y = chemical yield of the mount or sample counted

DF = decay factor from the collection to the mid count time

E = efficiency of the counter for the I-131 betas.

Note: Efficiency is determined by counting an I-131 standard.

Calculation of the MDC

$$MDC = 4.66\frac{\sqrt{\frac{R_b}{t}}}{2.22\,(V)\,(y)\,(DF)\,(E)}$$

DETERMINATION OF TRITIUM BY GAS COUNTING

TELEDYNE ISOTOPES

A 2 ml aliquot is reduced into hydrogen gas and collected in an activated charcoal trap. The hydrogen is then transferred into a previously evacuated one liter proportional counter. Non tritiated hydrogen and ultra-high purity methane is added and the mixture is counted. Backgrounds and standards are counted in the same gas mixture as the samples.

Calculation of the sample activity:

$$\frac{Net\ pCi}{unit\ vol.} = \frac{3.234 \times (TU)N \times V_N}{CPM_N \times V_s} \left[(CPM)_G - BKG \pm 2\sqrt{{}^sG^2 + {}^sB^2} \right]$$

where: $(TU)_N$ = the tritium units of the standard

V_N = volume of the standard used to calibrate the efficiency of the detector - in psia

V_S = volume of the sample loaded into the detector - in psia

$(CPM)_N$ = the cpm activity of the standard of volume V_N

$(CPM)_G$ = the gross activity of the sample of volume V_S and the detector background

BKG = the background of the detector in cpm

3.234 = conversion factor changing TU to pCi/l

t = counting time for the sample

${}^sG$ = standard deviation of the gross activity of the sample and the detector background, in cpm

${}^sB$ = standard deviation of the background, in cpm

Calculation of the MDC

$$MDC = \frac{3.3 \times 3.234 \times (TU)n \times Vn \times \sqrt{{}^{s}G^2 + {}^{s}B^2}}{(CPM)_N \times V_s}$$

where: ^{s}G = standard deviation of the gross activity of the sample and the detector background, in cpm

^{s}B = standard deviation of the background, in cpm

DETERMINATION OF TRITIUM IN WATER BY LIQUID SCINTILLATION COUNTING

TELEDYNE ISOTOPES

Teledyne Isotopes uses electrolytic enrichment of the sample prior to liquid scintillation counting to increase the sensitivity of the analysis. Approximately 55 milliters of the sample undergoes enrichment by electrolysis.. Water molecules containing only protium (hydrogen with a mass number of one) decompose electrolytically at a faster rate than those tritiated water molecules. The non-electrolyzed water which remains becomes enriched in tritium as a result. Electrolytic enrichment typically produces 3 to 5 milliliters of water in which the tritium is concentrated.

After the enriched water is distilled for purification purposes, three milliliters is mixed with liquid scintillation material and counted for typically 100 minutes to determine its activity.

CALCULATION OF THE SAMPLE ACTIVITY FOR TRITIUM

$$\frac{pCi}{\ell} = \frac{\left[\frac{C}{t} - R_b\right]}{2.22\,(V)\,(EF)\,(E)\,(\frac{V_c}{V_F})} \pm \frac{2\sqrt{\frac{\frac{C}{t} + R_b}{t}}}{2.22\,(V)\,(EF)\,(E)\,(\frac{V_c}{V_f})}$$

net activity — random uncertainty

where:
- C = total counts from sample
- t = count time for sample (minutes)
- R_b = background count rate of counter (cpm)
- 2.22 = $\frac{dpm}{pCi}$
- V = initial volume before enrichment (liters)
- EF = enrichment factor (unitless)
- E = efficiency of the counter for tritium (cpm/dpm)
- V_c = volume counted by liquid scintillation
- V_f = final volume at the end of enrichment

Calculation of the MDC

$$MDC = \frac{4.66\sqrt{\frac{R_b}{t}}}{(2.22)\,(V)\,(EF)\,(E)\,(\frac{Vc}{Vf})}$$

CONTROLS FOR ENVIRONMENTAL POLLUTION

Electrolytic enrichment is not currently available to Controls for Environmental Pollution (CEP). Consequently, larger aliquots of sample and longer counting times are employed to achieve the same sensitivities as Teledyne. CEP first filters and/or distills an aliquot of each sample, depending on the samples' appearances and the likelihood that contaminants are present that might interfere with the liquid scintillation process. Following any purification steps that may be employed, 9 milliliters of the sample is typically counted for 1,000 minutes.

CALCULATION OF THE SAMPLE ACTIVITY FOR TRITIUM

$$\frac{pCi}{\ell} = \frac{\left[\frac{R_s}{E_s} - \frac{R_b}{E_b}\right]}{2.22\,(V)\,(DF)} \pm \frac{2\sqrt{\frac{R_s+R_b}{t}}}{2.22\,(V)\,(DF)\,(E_s)}$$

net activity | random uncertainty

where: R_s = sample count rate (cpm)
R_b = background count rate (cpm)
E_s = sample counting efficiency (cpm/dpm)
E_b = background counting efficiency (cpm/dpm)
2.22 = $\frac{dpm}{pCi}$
V = volume of aliguot counted (liter)
DF = decay factor from collection to mid-count time (unitless)
T = sample/background count time (minutes)

Calculation of the MDC

$$MDC = \frac{4.66\sqrt{\frac{R_b}{t}}}{2.22\,(V)\,(E_s)\,(DF)}$$

DETERMINATION OF GAMMA EMITTING RADIOISOTOPES

TELEDYNE ISOTOPES AND CONTROLS FOR ENVIRONMENTAL POLLUTION

Gamma emitting radionuclides are determined with the use of a lithium-drifted germanium (Ge(Li)) and high purity germanium detectors with high resolution spectrometry in specific media, such as, air particulate filters, charcoal filters, milk, water, vegetation, soil/sediments, biological media, etc. Each sample is prepared and counted in standard geometries such as one liter or four liter wrap-around Marinelli containers, 300 ml or 150 ml bottles, two-inch filter paper source geometries, etc.

Samples are counted on large (55 cc volume) germanium detectors connected to Nuclear Data 6620 data acquisition and computation systems. All resultant spectra are stored on magnetic tape.

The analysis of each sample consists of calculating the specific activities of all detected* radionuclides as well as the minimum detectable concentration for a standard list of nuclides. The germanium detection systems are calibrated for each standard geometry using certified radionuclide standards traceable to the National Bureau of Standards.

CALCULATION OF THE SAMPLE ACTIVITY

$$\text{Net pCi/vol or mass} = \frac{[C-B]}{2.22\,(V)\,(E)\,(GA)\,(DF)\,(t)} \pm \frac{2\sqrt{C+B}}{2.22\,(V)\,(E)\,(GA)\,(DF)\,(t)}$$

net activity — random uncertainty

where:

C = area, in counts, of a spectral region containing a gamma emission of the nuclide of interest

Note: if the detector exhibits a peak in this region when counting a blank this background (BB) is subtracted from N before using the above equation. BB is the count rate of the blank in the background peak.

B = background counts in the region of interest, calculated by fitting a straight line across the region connecting the two adjacent regions.

t = counting interval of sample (minutes)

2.22 = dpm/pCi

V = volume or mass of sample analysed

E = efficiency of counter at the energy region of interest

GA = gamma abundance of the nuclide at the gamma emission energy under consideration

DF = decay factor from sample collection time to midpoint of the counting interval

Calculation Of The MDC

$$MDC\ (pCi/vol\ or\ mass) = \frac{4.66\sqrt{C}}{2.22\,(V)\,(E)\,(GA)\,(DF)\,(t)}$$

The width of the region around the energy where an emission is expected is calculated differently for MDCs than it is for the width of a peak that is actually identified. Consequently, the value of C used in the two equations may differ.

* The analyst's judgement is exercised in the decision to report an activity. The agreement between various spectral lines of the same nuclide, and possible interference from other nuclides, are considered in this decision.

DETERMINATION OF GROSS BETA MINUS K-40 ACTIVITY IN MILK SAMPLES

TELEDYNE ISOTOPES

This procedure describes a radiochemical method for measuring the gross beta activity of milk after removing natural K-40.

One fourth liter of milk sample is curdled by adding trichloroacetic acid (TCA) solution. The curd is removed by vacuum filtration. Radioactive species are co-precipitated with natural calcium as oxalates by addition of oxalic acid and ammonia (leaving potassium in solution). The precipitate is collected by vacuum filtration on a polycarbonate (Millipore) filter, then is ashed in a muffle furnace to remove organic material. The ash is dissolved in hydrochloric acid and solids are removed by filtration. Oxalates are again precipitated and collected on a polycarbonate filter. After drying, the precipitate is removed from the filter and crushed to a powder, the placed in a 2-inch stainless steel counting planchet.

Precipitate mass is determined by weighing the planchet before and after mounting the sample. The planchet is counted for beta activity on an automatic proportional counter. Results are calculated using an empirical self-absorption curve which allows for the change in effective counting efficiency caused by the residue mass.

CALCULATION OF THE SAMPLE ACTIVITY

TELEDYNE ISOTOPES

$$\frac{pCi}{\ell} = \frac{\left[\frac{C}{t} - R_b\right]}{2.22\,(V)\,(E)} \pm \frac{2\sqrt{\frac{C}{t} + R_b}}{2.22\,(V)\,(E)}$$

net activity random uncertainty

where:
- C = total counts from sample (counts)
- t = counting time for sample (min)
- R_b = background count rate of counter (cpm)
- 2.22 = $\frac{dpm}{pCi}$
- V = volume of sample analyzed (liters)
- E = efficiency of the counter (cpm/dpm)

Establishing and reporting activities that are equal to or less than the detection limit:

Calculation of the MDC

$$MDC = \frac{4.66\sqrt{\frac{R_b}{t}}}{2.22\,(V)\,(E)}$$

RADIOCHEMICAL DETERMINATION OF STRONTIUM-90 IN MILK
CONTROLS FOR ENVIRONMENTAL POLLUTION

Cation exchange resin is added to one liter aliquots of the milk samples to remove strontium. The strontium is subsequently stripped from the resin with nitric acid, the resulting solution is evaporated, and the residue is wet ashed with hydrogen peroxide and concentrated nitrate acid. Following the wet ashing, the residue is redissolved with hydrochloric acid and stripped of yttrium-90 with di-2-ethylhexyl-phosphoric acid. Subsequently, yttrium carrier is added and yttrium-90 is allowed to build up for approximately two weeks. Following the buildup period, yttrium, including any yttrium-90 that is present, is once again stripped from the sample. Yttrium is then precipitated as yttrium oxalate and counted in a low background beta counter for 100 minutes.

CALCULATION OF SAMPLE ACTIVITY

$$\frac{pCi}{\ell} = \underbrace{\frac{(C-B)}{2.22\,(t)\,(V)\,(E)\,(I)\,(DF)\,(Y_p)\,(Y_d)}}_{\text{net activity}} \pm \underbrace{\frac{2\sqrt{\frac{(C+B)}{t^2}}}{2.22\,(V)\,(E)\,(I)\,(DF)\,(Y_p)\,(Y_d)}}_{\text{random uncertainty}}$$

where: C = total counts for the sample
B = background counts
2.22 = $\frac{dpm}{pCi}$
t = count time for sample/background (minutes)
V = volume of sample aliquot analyzed (liters)
E = counter efficiency (cpm/dpm)
I = yttrium-90 ingrowth factor (unitless)
D_f = decay factor from collection to midpoint of count (unitless)
Y_p = yield (recovery) of strontium (unitless)
Y_d = yield (recovery) of yttrium (unitless)

Calculation of the MDC

$$MDC = \frac{4.66\sqrt{\frac{B}{t^2}}}{2.22\,(V)\,(E)\,(I)\,(DF)\,(Y_p)\,(Y_d)}$$

RADIOCHEMICAL DETERMINATION OF STRONTIUM-89 IN MILK

CONTROLS FOR ENVIRONMENTAL POLLUTION

Solution saved from the strontium-90 procedure is evaporated and the residue is wet ashed with nitric acid and hydrogen peroxide to remove organics. The strontium is precipitated as a nitrate, redissolved, and precipitated once again. After redisolving again, the strontium is finally precipitated as an oxalate. The precipitate is counted in a low background beta counter for total strontium. Strontium-89 activity is determined from the difference between the count of the total strontium and the strontium-90 count.

CALCULATION OF SAMPLE ACTIVITY

$$\frac{pCi}{\ell} = \frac{\{C - B - [1+(I)(E_{90})]N_{90}\}}{2.22(t)(V)(E)(DF)(Y_{Sr})} \pm \frac{2\sqrt{\frac{\{C+B+[1+(I)(E_{90})]N_{90}\}}{t^2}}}{2.22(V)(E)(DF)(Y_{Sr})}$$

where:
- C = total counts for the sample
- B = background counts
- 2.22 = $\frac{dpm}{pCi}$
- t = count time for sample/background (minutes)
- v = volume of sample aliquot analyzed (liters)
- E = counter efficiency for strontium-89 (cpm/dpm)
- DF = decay factor from collection to midpoint of count (unitless)
- Y_{Sr} = yield (recovery) of strontium (unitless)
- I = yttrium-90 ingrowth into strontium-89 portion (unitless)
- E_{90} = strontium-90 counting efficiency
- N_{90} = net strontium-90 counts

Calculation of the MDC

$$MDC = \frac{4.66\sqrt{\frac{\{B+[1+(I)(E90)]N\text{-}90\}}{t^2}}}{2.22(V)(E)(DF)(Y_{Sr})}$$