Robert G. Byram
Senior Vice President and
Chief Nuclear Officer

PPL Susquehanna, LLC
Two North Ninth Street
Allentown, PA 18101-1179
Tel. 610.774.7502 Fax 610.774.5019
rgbyram@pplweb.com

MAY 1 0 2001

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station OP1-17
Washington, D. C. 20555

SUSQUEHANNA STEAM ELECTRIC STATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL
OPERATING REPORT **Docket Nos. 50-387**
PLA-5307 **and 50-388**

The Susquehanna SES Annual Radiological Environmental Operating Report is hereby submitted for the calendar year 2000 in accordance with Technical Specification Section 5.6.2.

If you have any questions, please contact Mr. Robert D. Kichline at (610) 774-7705.

Sincerely,

R. G. Byram

Attachments

Copy: NRC Region I
Mr. S. L. Hansell, NRC Sr. Resident Inspector - SSES
Mr. R. G. Schaaf, NRC Project Manager

IE25
1/1

SUSQUEHANNA STEAM ELECTRIC STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

REPORT PERIOD: 12/28/99 – 1/17/01

Prepared by:

William A Hill

W. A. Hill
Health Physicist

Reviewed by:

Bonnie H. Carson

B. H. Carson
Health Physicist

Approved by:

David J. Morgan

D. J. Morgan
Acting Supervisor - Environmental Services - Nuclear

PPL Susquehanna, LLC
Two North Ninth Street
Allentown, Pennsylvania 18101

TABLE OF CONTENTS

SUMMARY AND CONCLUSIONS 1
INTRODUCTION 5
AMBIENT RADIATION MONITORING 18
AQUATIC PATHWAY MONITORING 22
ATMOSPHERIC PATHWAY MONITORING 36
TERRESTRIAL PATHWAY MONITORING 40
GROUND WATER MONITORING 46
REFERENCES 48

APPENDICES

A. 2000 REMP CHANGES A-1

B. 2000 REMP MONITORING SCHEDULE (SAMPLING AND ANALYSIS) B-1

C. 2000 REMP MONITORING LOCATION DESCRIPTIONS C-1

D. 2000 LAND USE CENSUS RESULTS D-1

E. SUMMARY DESCRIPTION OF SSES REMP ANALYTICAL METHODS E-1

F. 2000 EXCEPTIONS TO THE SSES TECHNICAL REQUIREMENTS SAMPLE SCHEDULE, METHODS AND ANALYSIS SENSITIVITIES F-1

G. 2000 SSES REMP SUMMARY OF DATA G-1

H. COMPARISON OF INDICATOR AND CONTROL 2000 REMP ANNUAL MEANS FOR SELECTED MEDIA ANALYSIS RESULTS WITH MEANS FROM PREOPERATIONAL AND PRIOR OPERATIONAL PERIODS H-1

I. SPECIFIC ANALYSIS RESULTS TABULATED BY MEDIA AND SAMPLING PERIOD I-1

J. PERFORMANCE SUMMARY FOR THE RADIOANALYSES OF SPIKED ENVIRONMENTAL SAMPLE MEDIA - 2000 J-1

LIST OF FIGURES

Figure Numbers	Title	Page
1.	Exposure Pathways to Humans	11
2.	2000 TLD Monitoring Locations within One Mile of the SSES	12
3.	2000 TLD Monitoring Locations from One to Five Miles of the SSES	13
4.	2000 TLD Monitoring Locations Greater than Five Miles from the SSES	14
5.	2000 Environmental Sampling Locations within One Mile of the SSES	15
6.	2000 Environmental Sampling Locations from One to Five Miles of the SSES	16
7.	2000 Environmental Sampling Locations Greater than Five Miles from the SSES	17
8.	Ambient Radiation Levels Based on TLD Data	21
9.	Gross Beta Activity in Surface Water	33
10.	Tritium Activity in Surface Water	34
11.	Gross Beta Activity in Drinking Water	35
12.	Gross Beta Activity in Air Particulates	39
13.	Iodine-131 Activity in Milk	45

SUMMARY AND CONCLUSIONS

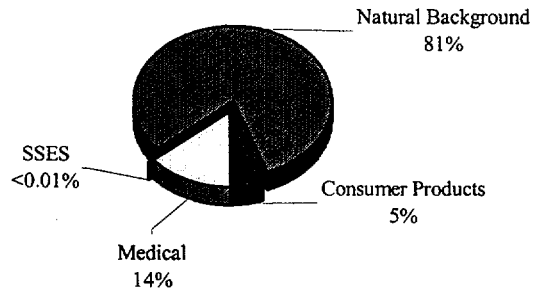
Radiological Dose Impact

The extent of the 2000 Radiological Environmental Monitoring Program (REMP) sampling met or exceeded the requirements of the Susquehanna Steam Electric Station (SSES) Technical Requirements. The types of analyses that were performed on these samples for the identification and quantification of radioactivity also met or exceeded the SSES Technical Requirements. The result of this effort was the verification of the SSES Effluent Monitoring Program data that indicate that the SSES operation has no deleterious effect on the health and safety of the public or the environment.

The amounts of the radionuclides detected in environmental samples during 2000 were very small, as in past years. Based on the radionuclide levels measured by the REMP, the maximum whole body dose or maximum organ dose to a member of the public from SSES operation is estimated to be less than one-tenth of one percent of the per unit dose limits established by the Nuclear Regulatory Commission (NRC) as stated in 10 CFR 50, Appendix I. The maximum hypothetical off-site whole body and organ doses from radionuclides detected by the REMP and attributable to the SSES operations were calculated to be approximately 0.00085 mrem/year.

By contrast, potassium-40, a very long-

COMPARISON OF PERCENT OF AVERAGE ANNUAL PUBLIC EFFECTIVE DOSE-EQUIVALENT FROM OTHER SOURCES WITH THAT FROM THE SSES



Sources for the values provided, with the exception of Susquehanna, are the following from NCRP Report #93 (1987): Tables 2.4 (Natural Background), 5.1 (Consumer Products), and 7.4 (Medical).

lived, naturally occurring radionuclide found in the human body, is estimated to deliver an average annual dose to the blood forming organs of individuals in the United States of about 27 millirem. While a small portion of the background dose from natural radiation sources, the potassium-40 dose is still more than 31,000 times the estimated maximum whole body and organ doses to a hypothetical member of the public from ingestion of radionuclides attributable to the SSES.

The maximum direct radiation dose from SSES operation to a member of the public was determined to be approximately 0.029 millirem/year. The total whole body dose from both ingested radionuclides and direct radiation is negligible compared to the public's exposure from natural background radiation, medical irradiation, and radiation from consumer products of more than 300 millirem/year effective dose-equivalent.

Identified Radionuclides and Their Dose Contributions

Naturally Occurring Radionuclides

In 2000, the SSES REMP reported the naturally occurring radionuclides beryllium-7, potassium-40, radium-226, and thorium-228 in the environment at levels exceeding the minimum detectable concentrations (MDCs) for their respective gamma spectroscopic analyses. Beryllium-7 was identified in air and one vegetable sample. Potassium-40 was observed in fish, sediment, air, milk, soil, and fruit and vegetables. Thorium-228 and radium-226 were reported in fruits and vegetables, sediment, and soil. These radionuclides are not related to the operation of the SSES. Doses from the presence of these radionuclides were not included in the estimate of the dose from SSES attributable radionuclides.

Man-made Radionuclides

Although not all due to SSES operation, the following man-made radionuclides were reported at levels in the environment in excess of the MDCs for their respective analyses: tritium, iodine-131, and cesium-137. These radionuclides, with the exception of cesium-137, were identified in surface water. Tritium was measured above minimum detectable concentrations in some surface water and drinking water analyzed. Iodine-131 was identified in surface water and drinking water. Cesium-137 was observed in fruits and vegetables, sediment, and soil.

Tritium was the only man-made radionuclide attributed to the SSES operation. Tritium in media other than Susquehanna River water downstream of the SSES was attributed to both natural production by the interaction of cosmic radiation with the upper atmosphere and previous atmospheric testing of nuclear weapons. The presence of cesium-137 was attributed to non-SSES sources. Cesium-137 was considered to be present only as residual fallout from atmospheric weapons testing. Iodine-131 was believed to be found in the aquatic pathway only as the result of the discharge of medical waste to the Susquehanna or Lackawanna Rivers through sewage treatment plants upstream of the SSES.

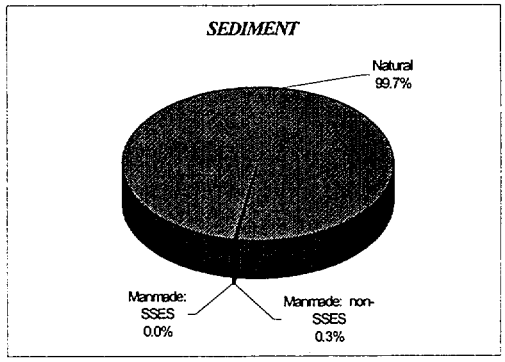
All of the man-made radionuclides mentioned above were not analyzed for in all media. For example, no analyses were performed in an effort to determine iodine-131 levels in ground water. When selecting the types of analyses that would be performed, consideration was given to the potential importance of different radionuclides in the pathways to man and the regulatory analysis requirements for various environmental media.

Relative Radionuclide Activity Levels in Selected Media

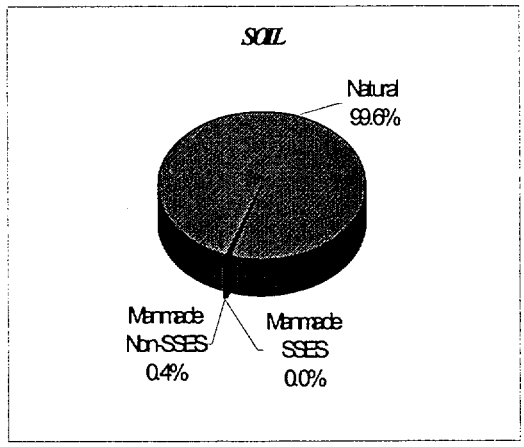
Some media monitored in the environment are significant for the numbers of gamma-emitting radionuclides routinely measured at levels exceeding analysis MDCs. Sediment in the aquatic pathway and soil in the terrestrial pathway are two such media.

The following pie graphs show the relative activity contributions for the types of gamma-emitting radionuclides reported at levels above the analysis MDCs in sediment and soil at indicator locations during 2000.

AQUATIC PATHWAY PERCENT TOTAL GAMMA ACTIVITY



TERRESTRIAL PATHWAY PERCENT TOTAL GAMMA ACTIVITY



Naturally occurring radionuclides account for 99.7% and 99.6 % of the gamma-emitting activity in sediment and in soil, respectively, in 2000. Man-made radionuclides of non-SSES origin account for most of the rest of the gamma-emitting activity in sediment and all of the rest in soil during 2000. Generally, the activity for naturally occurring radionuclides reported in sediment and soil dwarfs the activity of the man-made radionuclides also

reported, especially those originating from the SSES.

Radionuclides Contributing to Dose from SSES Operation

Of the three man-made radionuclides reported in the environment by the SSES REMP, tritium is the only radionuclide attributable to the SSES operation.

Because tritium was the only radionuclide attributable to the SSES operation, the dose to members of the public from REMP-identified radionuclides was based on the amount of tritium estimated to have been released from the SSES. Tritium was included in the dose calculation because it was identified in the REMP samples of water being discharged to the river. The concentration of tritium in the water and the volume of water discharged were used to determine the amount of tritium released. The presumed exposure pathways to the public from this radionuclide were drinking water taken from the Susquehanna River at Danville, PA, and eating fish caught near the SSES discharge to the river. Exposure from tritium was only assumed to occur through the eating of fish and the consumption of drinking water. This assumption is based on the fact that tritium does not emit gamma radiation and the beta radiation emitted by tritium is not sufficiently penetrating to reach an individual on the shore.

Radioactive Materials Releases

Radioactive Materials Generation

The SSES produces the thermal power to generate electricity using two boiling water reactors (BWRs). Radioactive materials are produced at the SSES by the fissioning of uranium and the activation of materials inside the cores of these nuclear reactors. When very small quantities of fission products escape through the cladding of the core's fuel rods, they enter the water with the activation products circulating through the reactor.

Since the mid-1980s, improvements in the following have all contributed to minimization of the escape of radioactive materials from the fuel to the reactor core's circulating water: the manufacture of nuclear fuel, PPL Susquehanna, LLC's (PPL) fuel pre-conditioning (to prevent pellet-clad interaction), reductions in the numbers of reactor scrams (rapid control rod insertions) that put stresses on the fuel, and maintenance of good water chemistry in the reactors. This has been responsible for significant reductions in the already relatively small amounts of some radioactive materials released in both gaseous and liquid effluents from the SSES.

Gaseous Effluents

In boiling water reactors (BWRs), such as the SSES Units 1 and 2, some fraction of the radioactive materials that enter the circulating water are vaporized and others are entrained in the steam, carrying over to the turbines and eventually the condensers. In turn, some fraction of the radioactive materials in the condensers are removed from them with the offgas. Offgas is eventually released to the atmosphere through turbine building vents. Other pathways also exist for the release of gases through each of five continuously monitored rooftop vents at the SSES.

The radioactive material released as gaseous effluent from the SSES may be divided into the following three categories: noble gases (xenons and kryptons), iodines and particulates, and tritium (a radioactive isotope of hydrogen). These categories are used for the purposes of tracking the amounts of radioactive material being released from the SSES and monitoring the SSES release performance. Reduction of the amounts of radioactivity otherwise destined to be released with the gaseous effluent depends on the category into which the radioactive material fits.

Short-lived noble gas activity is reduced by radioactive waste processing systems which delay the release of gases to the environment to permit them to decay prior to release. Iodine and particulate radioactivity in the gaseous effluent are reduced by adsorption in charcoal beds and capture in particulate filters, respectively. There is a total of 74 tons of charcoal distributed in five beds that the condenser offgas must pass through prior to release. A delay time of over 30 days for some of the gases is expected as a result of the charcoal

beds, providing a significant amount of decay time prior to release. This provides for a significant reduction in the radioactivity levels of the gases before release. The charcoal is typically very efficient at capturing the iodine. Similarly, the particulate filters are expected to have capture efficiencies of more than 99.7% for particles 0.3 microns or larger in size.

Unfortunately, no practical means yet exists to eliminate tritium from the gaseous effluent. Some elimination of tritium in the form of tritiated water vapor by chilling of the offgas and subsequent collection of the condensate prior to passage through the charcoal adsorbers does occur. But, the primary purpose of this chilling is to reduce the moisture entering the charcoal beds so that they will maintain their efficiency for the removal of iodine.

Liquid Effluents

Maintaining the quality of water circulating through the reactor core at acceptable levels and capturing water that leaks from reactor systems, results in the generation of waste water at the SSES. This waste water also contains radioactivity in the form of fission products and activated corrosion and wear products from structural materials. In order to minimize the release of this water to the environment, as much of it as is practical is cleaned up and recycled. Some water must be released in batches to the Susquehanna River because of excess water inventory on the site or because of chemical impurities that would be harmful to the reactor if recycled.

For the purpose of tracking radioactive releases and monitoring SSES release performance, liquid effluent radioactive materials are divided into two groups, tritium being one group, and all other radioactive materials constituting the other. Prior to releasing water to the river, a significant effort is made to reduce the level of radioactivity in waste water to levels which are as low as practicable by filtering the water and passing it through ion exchange material, similar in function to household water softeners. These methods are effective to varying degrees with all of the radioactive materials except tritium, which can't be removed from water by either method. For most radionuclides, the ion exchange media may be expected to have a removal efficiency of roughly 99%.

Controlling Radioactive Releases

NRC regulations (10 CFR 50.34 and 10 CFR 20.1101b) require that nuclear power plants be designed, constructed, and operated to keep levels of radioactive materials in effluents to areas unrestricted to the public as low as reasonably achievable (ALARA). To ensure that these criteria are met, each license authorizing reactor operation includes technical specifications (10 CFR 50.36a) that contain requirements governing radioactive effluents. Instantaneous, as well as quarterly and annual limits, have been set based on the dose that the maximally exposed individual in the public could be expected to receive. During routine operation of the SSES, doses are kept as much below these actual limits as possible.

The NRC release limits are far below the approximately 300 millirem dose received on average each year by residents of the United States from all natural background sources. On the other hand, the allowable limits are far above the doses estimated for the levels of radioactivity actually being released from the SSES. The actual doses are typically small fractions of one millirem or less per year of SSES operation. Such doses are far below the levels at which any health effects would be expected to be observed in the exposed population.

Monitoring Releases

Roof top vents from which gaseous releases take place are continuously monitored to detect any excessive rates of radioactivity release that might occur well before any release limits are reached. Also, discharge rates of radioactively contaminated water to the Susquehanna River are carefully controlled to remain as far below the discharge limits as possible. Discharges are monitored by radiation detectors so that if levels of radioactivity in the water would inadvertently approach the limits of permissible levels, the discharges could be stopped quickly.

Radiological Environmental Monitoring

In addition to the steps taken to control and to monitor radioactive effluents from the SSES, the SSES Technical Specifications also require a program for the radiological monitoring of the environment in the vicinity of the SSES. The objectives of the SSES REMP are as follows:

- Fulfillment of SSES Technical Requirements' radiological environmental surveillance obligations,
- Verification of no detrimental effects on public health and safety and the environment from SSES operations,
- Assessment of dose impacts to the public, if any,
- Verification of adequate SSES radiological effluent controls, and
- Identification, measurement, trending, and evaluation of radionuclides and their concentrations in critical environmental pathways near the SSES.

PPL has maintained a Radiological Environmental Monitoring Program (REMP) in the vicinity of the existing Susquehanna Steam Electric Station Units 1 and 2 since April, 1972, prior to construction of both units and ten years prior to the initial operation of Unit 1 in September, 1982. The SSES 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 around the site is primarily rural, consisting predominately of forest and agricultural lands. (More specific information on the demography, hydrology, meteorology, and land use characteristics of the area in the vicinity of the SSES can be found in the

Environmental Report (14), the Final Safety Analysis Report (15), and the Final Environmental Statement (16) for the SSES.) The purpose of the preoperational REMP (April, 1972 to September, 1982) was to establish a baseline for radioactivity in the local environment that could be compared with the radioactivity levels observed in various environmental media throughout the operational lifetime of the SSES. This comparison facilitates assessments to be made of the radiological impact of the SSES operation.

The SSES REMP was designed on the basis of the NRC's Radiological Assessment Branch Technical Position on radiological environmental monitoring, as described in Revision 1, November 1979.(17) However, the REMP conducted by PPL for the SSES exceeds the monitoring suggested by the NRC's branch technical position, as well as the SSES Technical Requirements in terms of the number of monitoring locations, the frequency of certain monitoring, the types of analyses required for the samples, and the achievable analysis sensitivities.

Potential Exposure Pathways

The three pathways through which radioactive material may reach the public from nuclear power plants are the atmospheric, terrestrial, and aquatic pathways. (Figure 1 depicts these pathways for the intake of radioactive materials.) Comprehensive radiological environmental monitoring must sample media from all of these pathways.

Mechanisms by which people may be exposed to radioactivity and radiation in the environment vary with the pathway. Three mechanisms by which a member of the public has the potential to be exposed to radioactivity or radiation from nuclear power plants such as the SSES are as follows:

- inhalation (breathing)
- ingestion (eating and drinking), and
- whole body irradiation directly from a plant or from immersion in the radioactive effluents.

REMP Scope

During the operational period of the SSES, it has been important to establish two different categories of monitoring locations, called control and indicator locations, to further assist in assessing the impact of the station operation. Control locations have been situated at sites where it is considered unlikely that radiation or radioactive material from normal station operation would be detected. Indicator locations are sited where it is expected that radiation and radioactive material that might originate from the station would be most readily detectable.

Control locations for the atmospheric and terrestrial pathways are more than 10 miles from the station. Preferably, the controls also are in directions from the station less likely to be exposed to wind blowing from the station than are the indicator locations. Control locations for the aquatic pathway, the Susquehanna River, are upstream of the station's discharge to the river.

Indicator locations are selected primarily on the basis of proximity to

the station, although factors such as meteorology, topography, and sampling practicality also are considered. Indicator locations for the atmospheric and terrestrial pathways are typically less than 10 miles from the station. Most often, they are within 5 miles of the station. Indicator locations in the Susquehanna River are downstream of the station's discharge. Monitoring results from indicator locations are compared with results from control locations. These comparisons are made to discern any differences in the levels and/or types of radioactive material and/or radiation that might exist between indicators and controls and that could be attributable to the station.

In 2000, the SSES REMP collected more than 850 samples at more than 40 locations and performed more than 1,600 analyses. In addition, the REMP monitors ambient radiation levels using thermoluminescent dosimeters (TLDs) at 85 indicator and control locations, making as many as 340 radiation level measurements each year. The media monitored and analyses performed are summarized in the table above.

Figures 2 through 7 display the REMP TLDs and sampling locations in the vicinity of the SSES. Appendix C provides directions, distances, and a brief description of each of the locations in Figures 2 through 7.

Regulatory agencies also participate in monitoring the SSES environment and also oversee PPL's monitoring efforts. The State of Pennsylvania's Department of Environmental Protection (PADEP) monitors air for radioactive particulates and radioactive iodine. It also monitors milk, fruits and vegetables, surface and drinking water, fish, river sediments, and ambient radiation levels. PADEP makes this data available to the NRC. Inspectors from the NRC regularly visit both PPL's Corporate Office and the SSES to review procedures and records, conduct personnel interviews, observe activities first-hand, and generally examine the programs supporting the effluent and environmental monitoring for the SSES.

SSES REMP	
Type of Monitoring	**Media Monitored**
Gross Alpha Activity	Drinking Water
Gross Beta Activity	All Waters, except Ground Water, and Air Particulates
Gamma-Emitting Radionuclide Activities	All Media
Tritium Activity	All Waters
Iodine-131 Activity	Surface Water, Drinking Water, Air & Milk
Exposure Rates (by TLD)	Ambient Radiation Levels

REMP Monitoring Sensitivity

The sensitivity of the SSES REMP was demonstrated in 1986, following the problem with the Chernobyl reactor in the former Soviet Union. When the Chernobyl incident occurred, the SSES REMP was able to detect a relatively small increase in the level of gross beta activity in air samples at both control and indicator locations, as well as the presence of some specific radioactive materials that are not normally observed.

Detection of radiation and radioactive material from the SSES in the environment is complicated by the presence of naturally occurring radiation and radioactive materials from both terrestrial and cosmic sources. Man-made radiation and radioactive material from non-SSES sources, such as nuclear fallout from previous nuclear weapons tests and medical wastes, also can make identification of SSES radiation and radioactive material difficult. Together, this radiation and radioactive material present background levels from which an attempt is made to distinguish relatively small contributions from the SSES. This effort is further complicated by the natural variations that typically occur from both monitoring location to location and with time at the same locations.

The naturally occurring radionuclides potassium-40, beryllium-7, radium-226, and thorium-228 are routinely observed in certain environmental media. Potassium-40 has been observed in all monitored media and is routinely seen at readily detectable levels in such media as milk, meat, fish, and fruits and vegetables. Seasonal variations in beryllium-7 in air samples are regularly observed. Man-made radionuclides, such as cesium-137 and strontium-90 left over from nuclear weapons testing are often observed as well. In addition, the radionuclide tritium, produced by both cosmic radiation interactions in the upper atmosphere as well as man-made (nuclear weapons), is another radionuclide typically observed.

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) are used for this purpose. The formulas used to calculate MDCs may be found in Appendix E.

The methods of measurement for sample radioactivity levels used by PPL's contracted REMP radioanalytical laboratory are capable of meeting the analysis sensitivity requirements found in the SSES Technical Requirements. Summary descriptions of the analytical procedures and the accompanying calculational methods used by the laboratory can be found in Appendix E.

Exposure Pathways to Humans

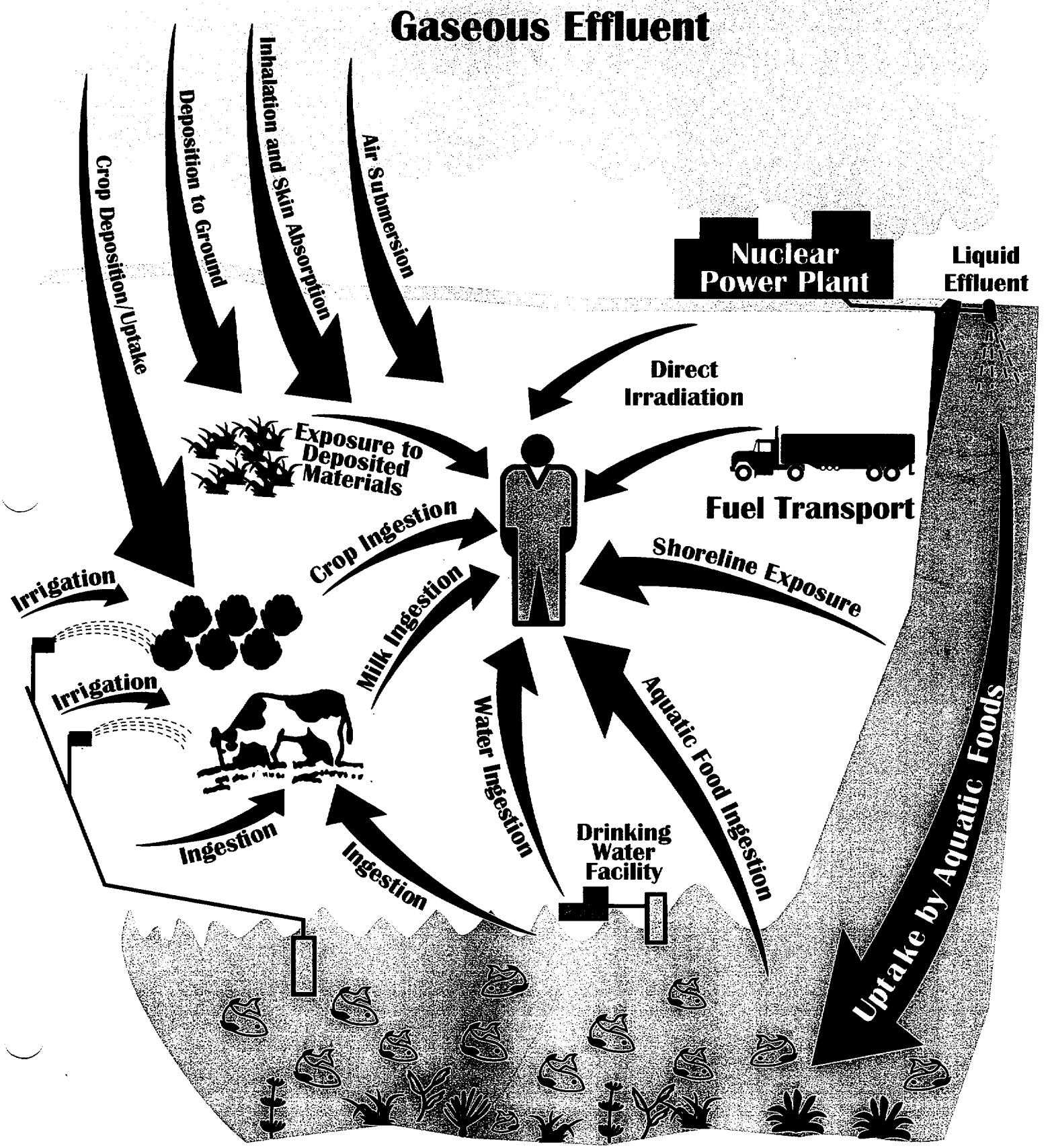


Figure 1

FIGURE 2
2000 TLD MONITORING LOCATIONS
WITHIN ONE MILE OF THE SSES

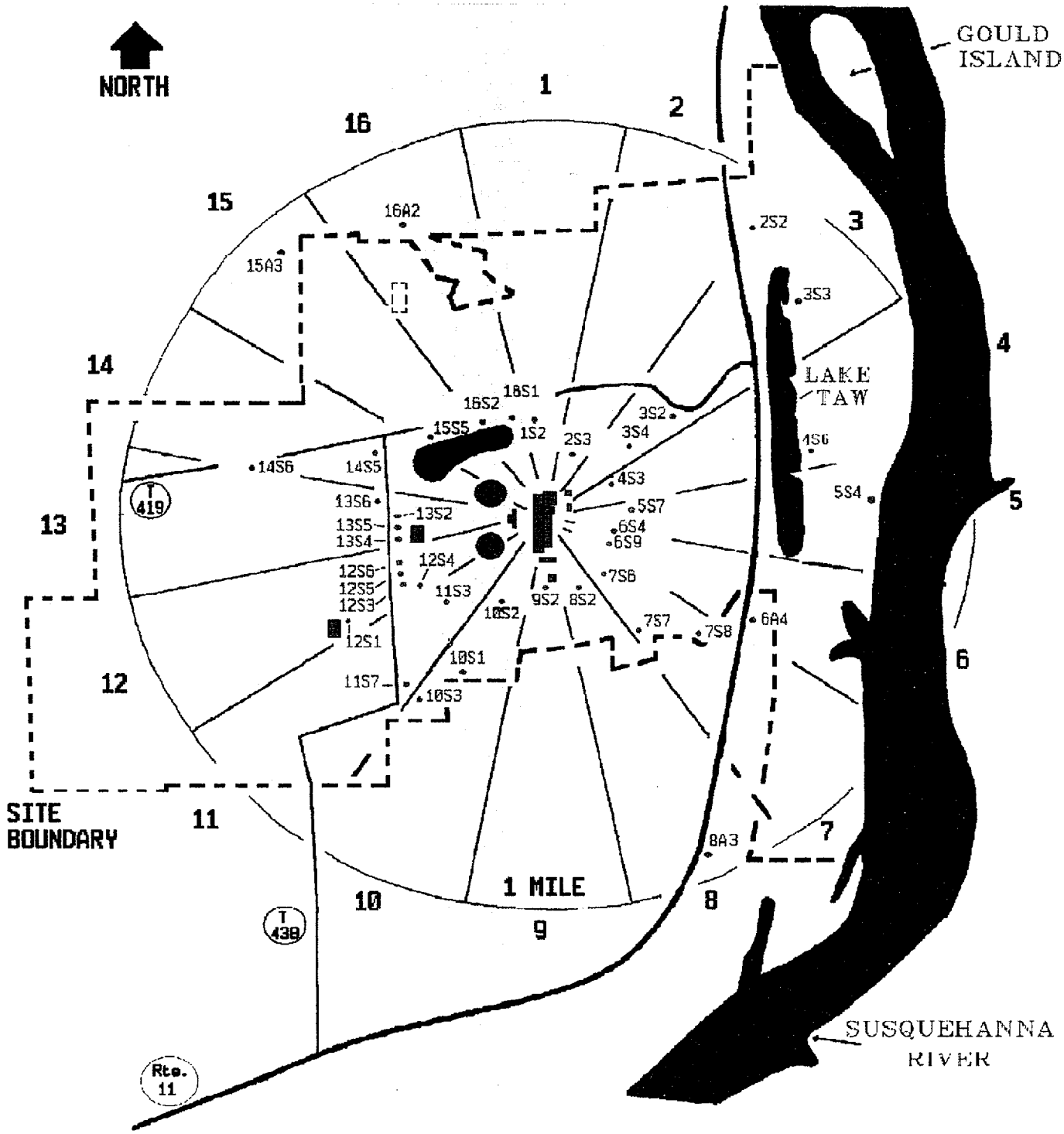


FIGURE 3
2000 TLD MONITORING LOCATIONS
FROM ONE TO FIVE MILES FROM THE SSES

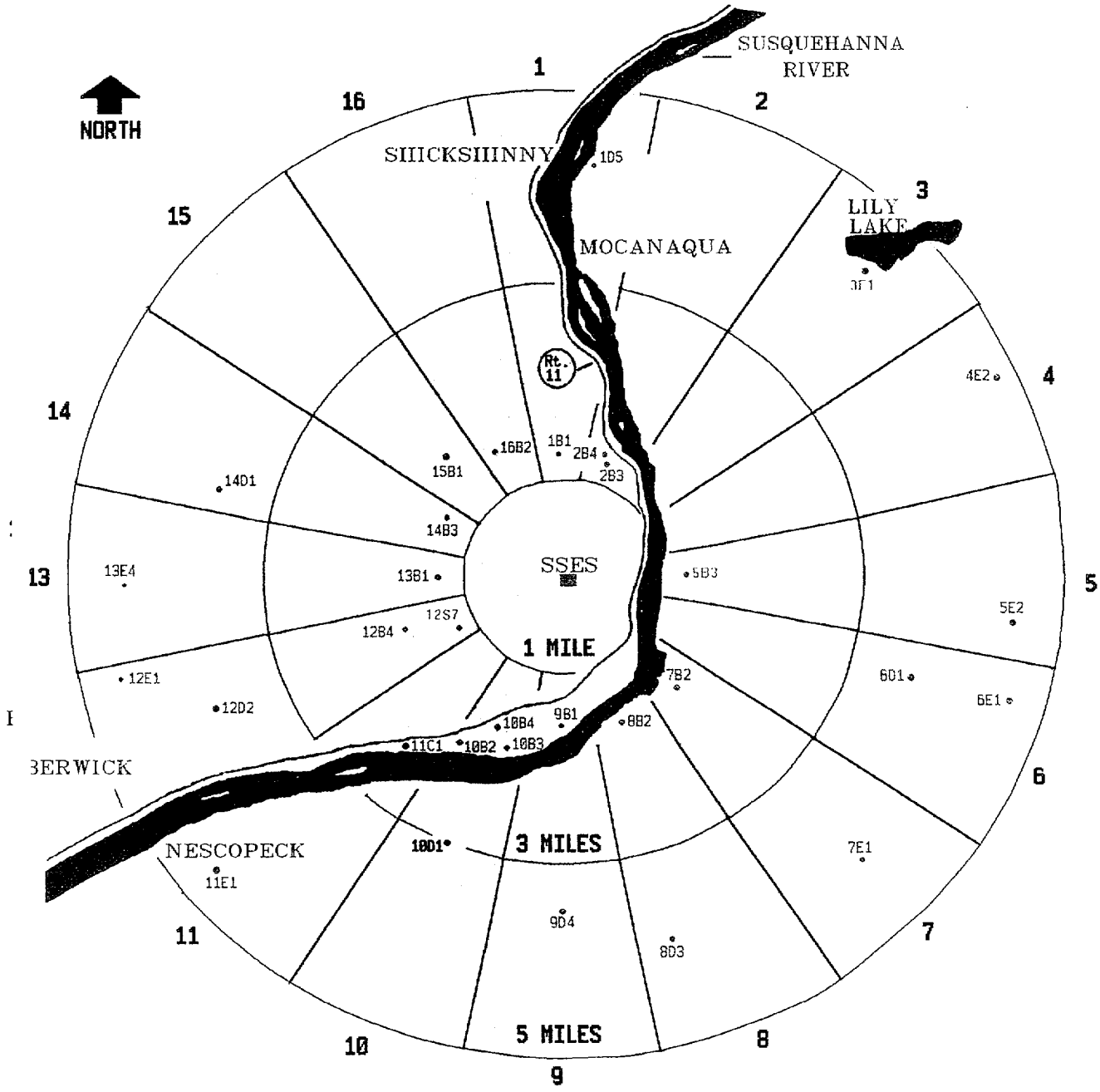


FIGURE 4
2000 TLD MONITORING LOCATIONS
GREATER THAN FIVE MILES FROM THE SSES

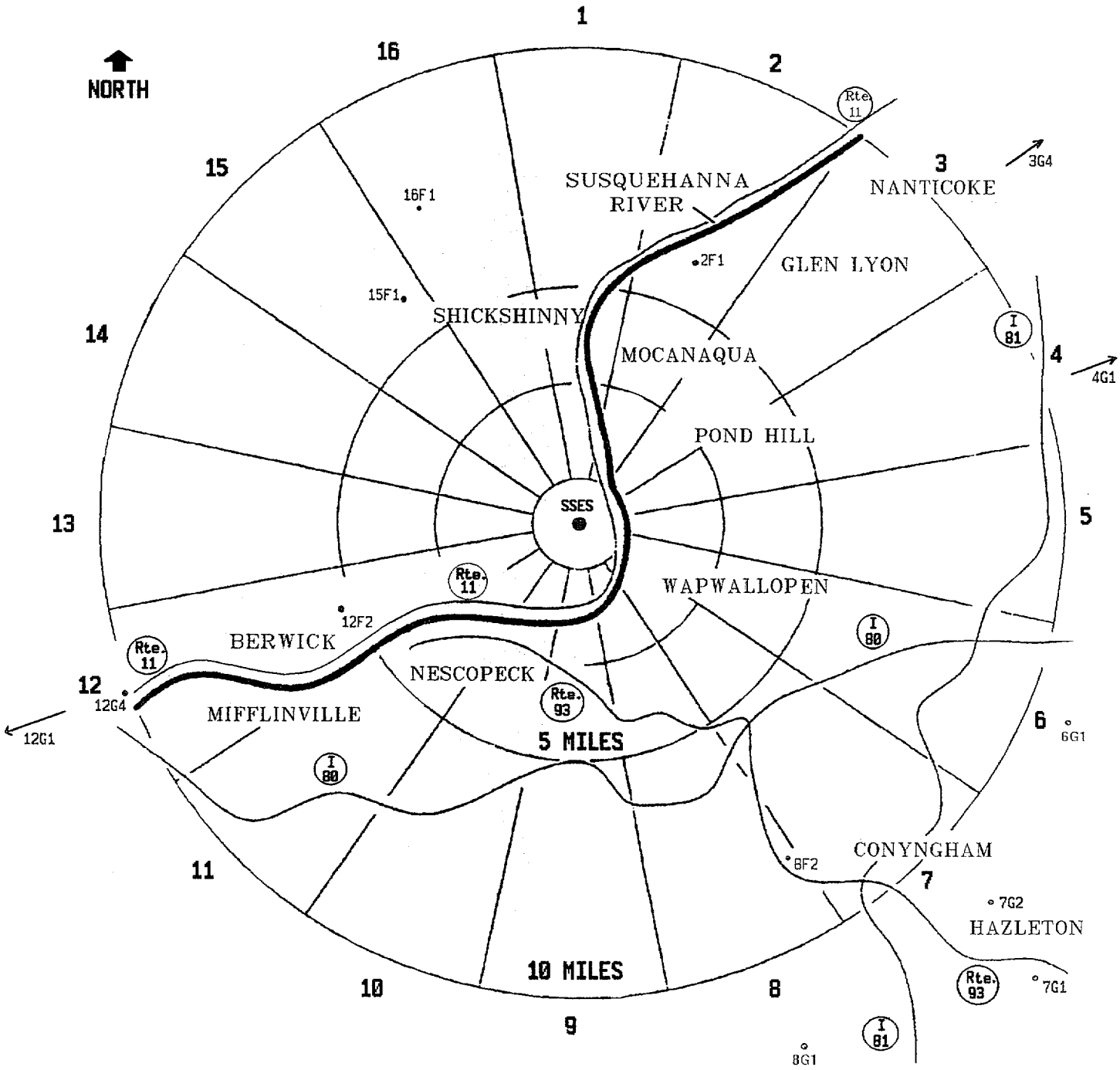


FIGURE 5
2000 ENVIRONMENTAL SAMPLING LOCATIONS
WITHIN ONE MILE OF THE SSES

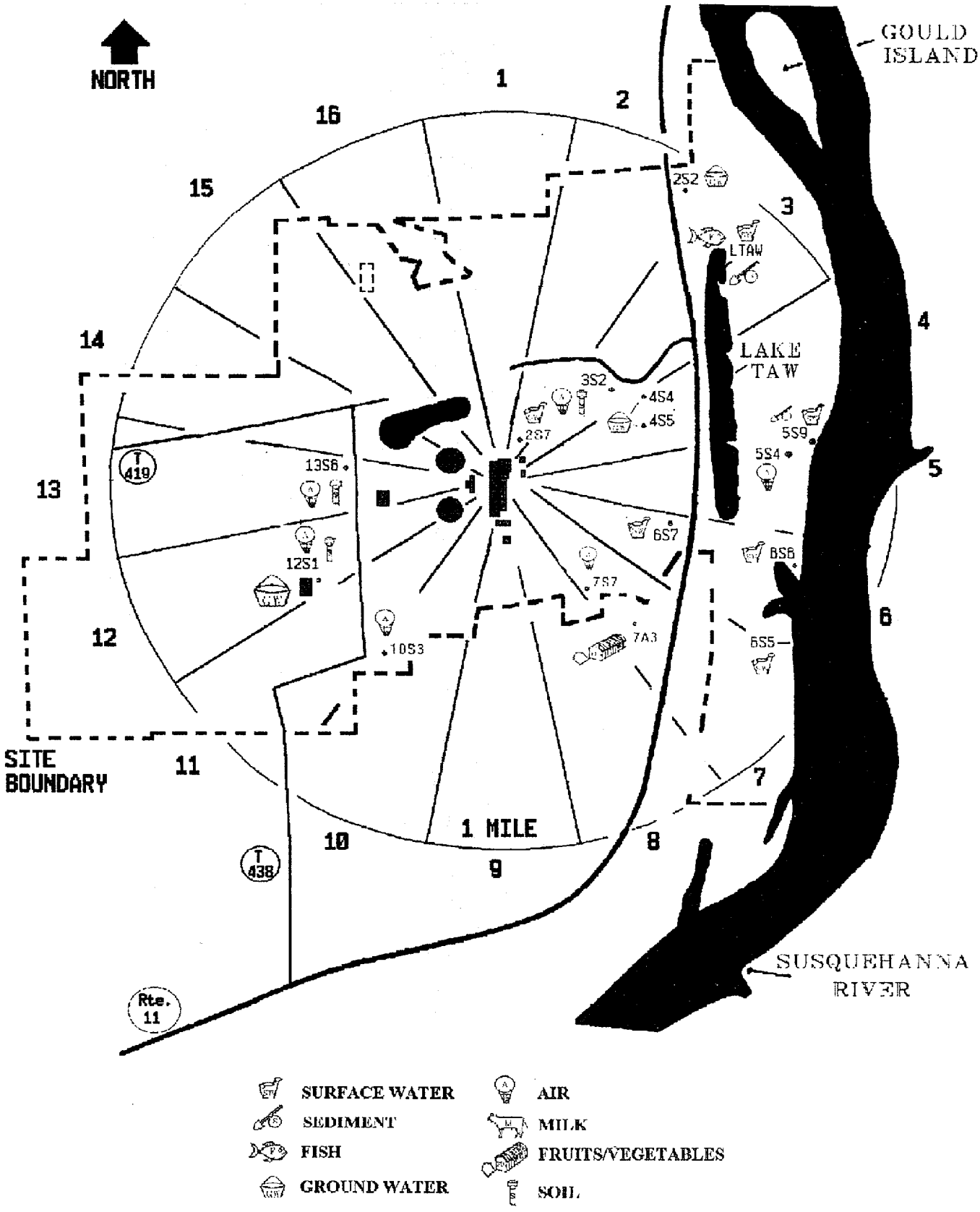


FIGURE 6
2000 ENVIRONMENTAL SAMPLING LOCATIONS
FROM ONE TO FIVE MILES FROM THE SSES

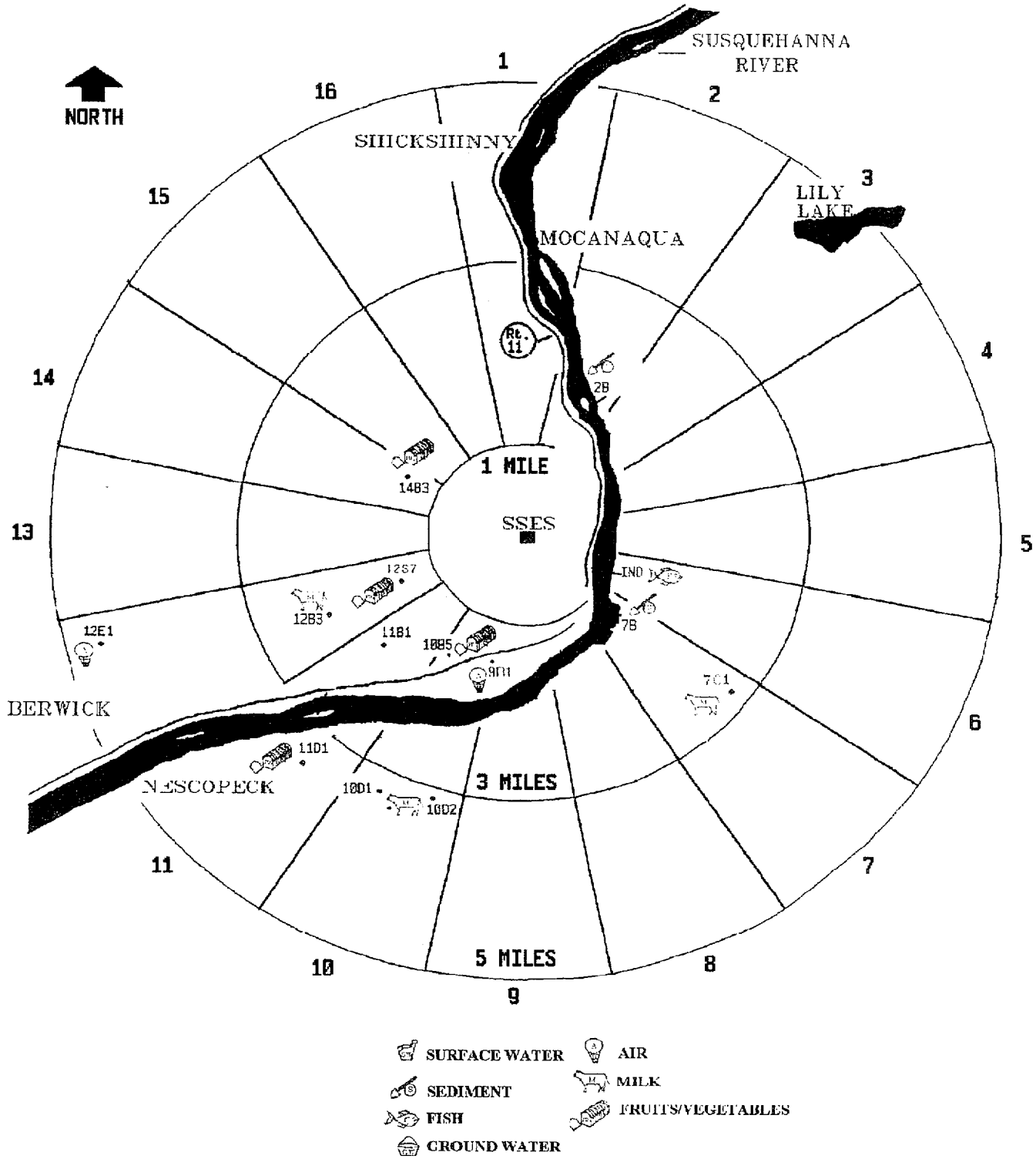
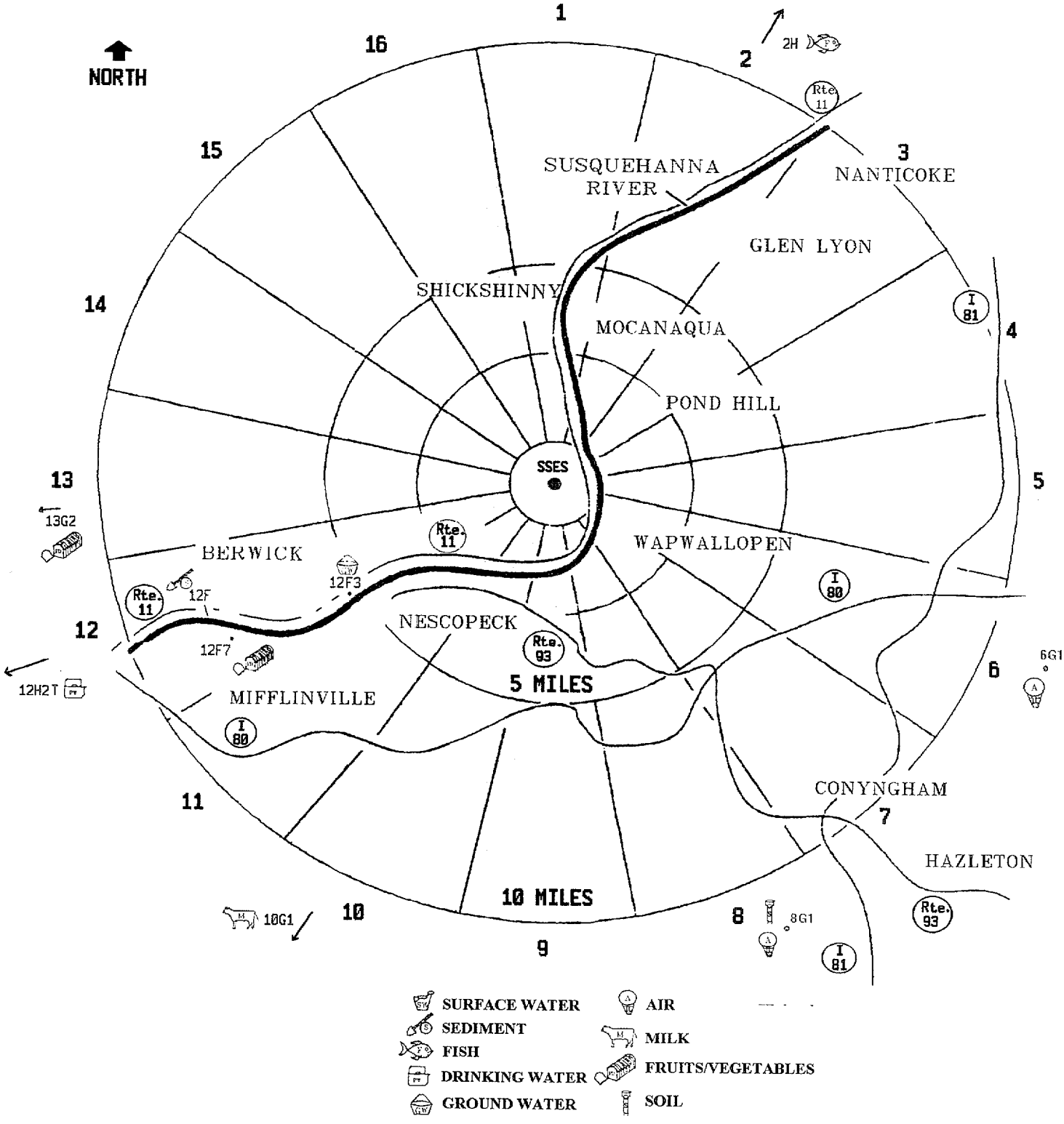


FIGURE 7
2000 ENVIRONMENTAL SAMPLING LOCATIONS
GREATER THAN FIVE MILES FROM THE SSES



AMBIENT RADIATION MONITORING

INTRODUCTION

The principal or primary method for the SSES REMP's measurement of ambient radiation levels is the use of thermoluminescent dosimeters (TLDs). The TLDs are crystals (calcium sulfate) capable of detecting and measuring low levels of radiation by absorbing a portion of the radiation's energy that is incident upon them and storing the captured energy until the TLDs are processed (read). Processing involves heating the TLDs to release their stored energy in the form of light and measuring the intensity of the light that they emit. The intensity of the emitted light is proportional to the amount of radiation to which they were exposed. Calibration of the TLD processors permits a reliable relationship to be established between the light emitted and the amount of radiation dose received by the TLDs; the result permits accurate measurements of the ambient radiation in the environment.

Environmental TLDs are continually exposed to natural radiation from the ground (terrestrial radiation) and from the sky (cosmic) radiation. In addition, they also may be exposed to man-made radiation. Most of the environmental TLD's natural radiation exposure comes from sources in the ground. These terrestrial sources vary naturally with time due to changes in soil moisture, snow cover, etc. The natural-radiation picture is complicated because these factors affecting radiation reaching the TLDs from the ground vary differently with time from one location to another due to locational differences in such factors as soil characteristics (amounts of organic matter, particle size, etc.), drainage opportunities, and exposure to sunlight. Environmental TLDs can also be affected by direct radiation (shine) from the SSES turbine buildings during operation, radwaste transfer and storage, and radioactive gaseous effluents from the SSES.

Unfortunately, TLDs do not have any inherent ability to indicate the source of the radiation to which they are exposed. The placement of numerous TLDs in the environment can facilitate decision-making about the possible radiation sources to which TLDs are exposed. However, a method for evaluating TLD data is still required. The SSES REMP relies on a statistically based approach to simultaneously compare indicator TLD data with control TLD data and operational TLD data with preoperational TLD data. This approach permits the flagging of environmental TLD doses that might have been produced by both man-made sources of radiation, as well as natural radiation sources. It also provides a means for attributing a portion of the total TLD dose to SSES operation if appropriate. Appendix E, pages E-6 through E-10, provides a description of the process for evaluating the results of TLD measurements.

Scope

TLDs

The area around the SSES was divided for monitoring purposes into sixteen sectors radiating outwards from the plant site, each encompassing an area described by an arc of 22.5 degrees. TLDs were placed in all 16 sectors at varying distances from the plant. Monitoring locations were chosen according to the criteria presented in the NRC Branch Technical Position on Radiological Monitoring (Revision 1, November, 1979).(17) The locations for the TLDs were selected by considering factors such as local meteorological, topographical, and population distribution characteristics.

At the end of 2000, the SSES REMP had 77 indicator TLD locations and eight control TLD locations. This level of monitoring exceeds that which is required by the Nuclear Regulatory Commission. The indicator TLDs nearest the SSES are positioned at the security or perimeter fences surrounding the site. This is the closest that a member of the public would be able to approach the station. The control TLDs are the most distant from the SSES, ranging from 10 to 20 miles from the site.

Monitoring Results

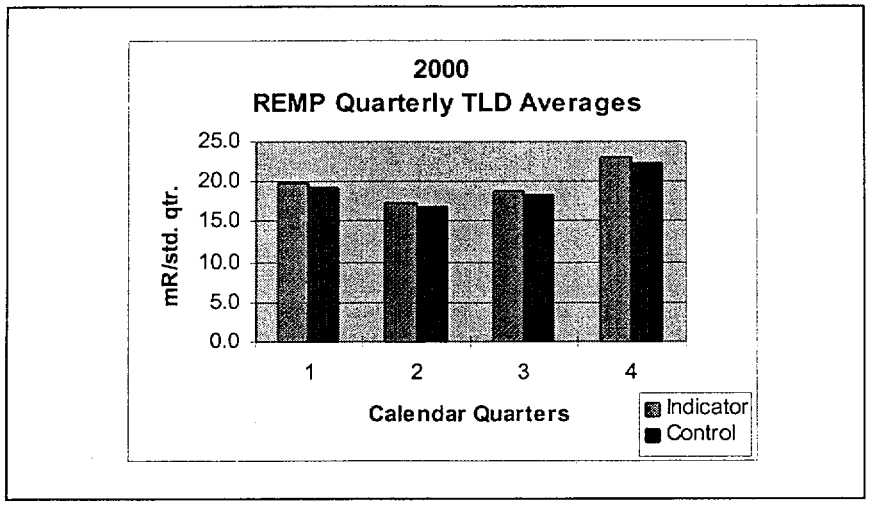
TLDs

TLDs were retrieved and processed quarterly in 2000. Average ambient radiation levels measured by environmental TLDs were lower in the second and third quarters of 2000, as shown in the bar graph on the following page than in the first and fourth quarters. This pattern is similar to that observed in 1998 and 1999. Refer to Figure 8 which trends both indicator and control data quarterly from 1973 through 2000.

The 2000 annual average exposures for indicator and control locations were 19.7 mR/std. qtr. and 19.1 mR/std. qtr., respectively. These are 1.1 mR/std. qtr. and 1.7 mR/std. qtr., respectively, below the corresponding 1999 annual averages. The 2000 exposures are within the ranges of annual averages for the prior operational periods at each type of monitoring location. The 2000 annual average exposure for control locations is also within the range for the pre-operational period. However, the 2000 annual average exposure for indicator locations exceeds the range for the pre-operational period. Refer to Figure 8 at the end of this section which trends quarterly TLD results for both preoperational and operational periods at the SSES. Refer to Appendix H, Table H 1, page H 3 for a comparison of the 2000 mean indicator and control TLD results with the means for the preoperational and prior operational periods at the SSES.

Indicator environmental TLD results for 2000 were examined quarterly on an individual location basis and compared with both current control location results and preoperational data. Very small SSES exposure contributions were suggested during 2000 at the following **onsite** locations: 6S4, 6S9, 7S6, 9S2, 10S2, 11S3, and 13S2. Thus, there were seven monitored locations in 2000 where a SSES dose contribution is considered to have been discernible. It

should be noted that the excess ratios and the exposures for the above-mentioned locations, especially at location 9S2, suggest an increase in the very small station-related exposures when compared to those for 1999. This is expected to have been the result of hydrogen water chemistry (HWC) at the SSES by both Units 1 and 2 for all of 2000, contrary to 1999. Radiation levels on site increased because of greater amounts of gamma radiation (emitted by nitrogen-16) escaping from steam-bearing equipment. Refer to Appendix E, page E-6, for a discussion of "TLD Data Interpretation." TLD results for all locations for each quarter of 2000 may be found in Appendix I, Table I-1, beginning at page I-2.



The estimated quarterly exposure contributions were summed by location for the entire year. The largest dose suggested was approximately 2.85E-2 millirem at an onsite monitoring location, 9S2, 0.2 mile south of the SSES. This dose was used for determining compliance with SSES Technical Requirement Limit 3.11.3 for annual effluent reporting purposes. This dose amounts to only 0.11% of the 25 mrem whole-body dose limit of SSES Technical Requirement 3.11.3.

AMBIENT RADIATION LEVELS
BASED ON TLD DATA

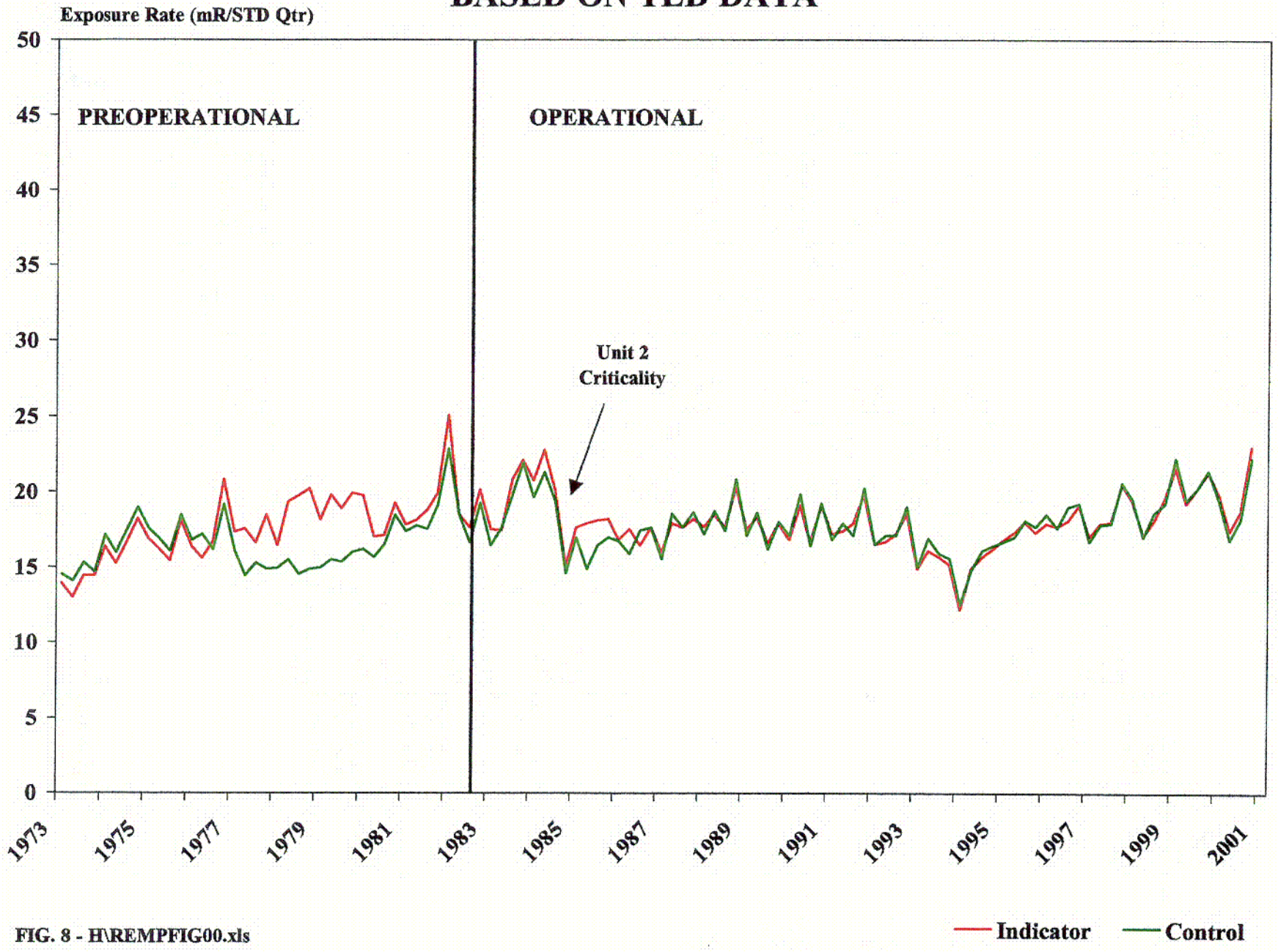


FIG. 8 - H\REMPFIG00.xls

C-1

AQUATIC PATHWAY MONITORING

INTRODUCTION

The following media were monitored in 2000 by the SSES REMP in the aquatic pathway: surface water, drinking water, fish, and sediment. Some of the media (e.g., drinking water and fish) provide information that can be especially useful to the estimation of possible dose to the public from potentially ingested radioactivity, if detected. Other media, such as sediment, can be useful for trending radioactivity levels in the aquatic pathway, primarily because of their tendency to assimilate certain materials that might enter the surface water to which they are exposed. The results from monitoring all of these media provide a picture of the aquatic pathway that is more clear than that which could be obtained if one or more were not included in the REMP.

Fruits or vegetables that are grown in fields irrigated with surface water would also be in the aquatic pathway. The land use census (Reference 61) conducted in 2000 looked at farms within 10 miles downstream of the SSES. One farm was found to have irrigated during the 2000 growing season.

The aquatic pathway in the vicinity of the SSES is the Susquehanna River. Monitoring of all of the aquatic media, except drinking water, is conducted both downstream and upstream of the location from which occasional SSES low-level radioactive discharges enter the river. The upstream monitoring locations serve as controls to provide data for comparison with downstream monitoring results. The potential exists for radioactive material that might be present in SSES airborne releases to enter the Susquehanna River upstream of the plant through either direct deposition (e.g., settling or washout) or by way of runoff from deposition on land adjacent to the river. However, direct deposition and runoff are considered to be potentially insignificant as means of entry for SSES radioactivity into the Susquehanna River when compared to liquid discharges under normal conditions.

Lake Took-a-While (LTAW), which is located in PPL's Riverlands Recreation Area adjacent to the Susquehanna River, is also considered to be part of the aquatic pathway for monitoring purposes. Although it is not in a position to receive water discharged to the river from the SSES, it can receive storm runoff from the SSES. Storm runoff from the SSES site should not normally contain any measurable radioactivity from the plant. However, the SSES REMP, consistent with other aspects of aquatic monitoring and the REMP, in general, goes beyond its requirements by monitoring LTAW.

Scope

Surface Water

Surface water was routinely sampled from the Susquehanna River at one indicator location (6S5) and one control location (6S6) at the SSES River Water Intake during 2000. Sampling also took place at the following additional indicator locations: the SSES discharge line to the river (2S7/6S7) and Lake Took-A-While (LTAW).

Drinking Water

Drinking water samples were collected at location 12H2T, the Danville Municipal Water Authority's treatment facility on the Susquehanna River, in 2000. Treated water is collected from the end of the processing flowpath, representing finished water that is suitable for drinking. This is the nearest point downstream of the SSES discharge to the River at which drinking water is obtained. No drinking water control location is sampled. For all intents and purposes, control surface water sampling locations would be suitable for comparison.

Fish

Fish were sampled from the Susquehanna River in the spring and fall of 2000 at one indicator location, IND, downstream of the SSES liquid discharge to the River and one control location, 2H, sufficiently upstream to essentially preclude the likelihood that the fish caught there would spend any time below the SSES discharge. In addition, fish were also sampled from PP&L Inc.'s Lake Took-a-While, location LTAW. This location is not downstream of the SSES discharge. It is sampled because of its potential for receiving runoff from the SSES. LTAW is considered an indicator location.

Sediment

Sediment sampling was performed in the spring and fall at indicator locations 7B and 12F and control location 2B on the Susquehanna River. In addition, sediment was also obtained from location LTAW.

Sampling

Surface Water

Weekly grab sampling was performed at the indicator location 6S5. Weekly grab samples were composited both monthly and biweekly at this location. Location 6S5 was considered a backup for locations 2S7 and 6S7 in the event that water could not be obtained from the automatic samplers at these locations. Nevertheless, 6S5 was sampled routinely throughout 2000, since it is the closest downstream sampling point to the SSES discharge.

Indicator locations 2S7 and 6S7, the SSES Cooling Tower Blowdown Discharge (CTBD) line, and control location 6S6, the SSES River Water Intake structure, were sampled time proportionally using automatic continuous samplers. The samplers were typically set to obtain 30-60 ml aliquots every 20-25 minutes. Weekly, the water obtained by these samplers was retrieved for either biweekly or monthly compositing.

The other surface water monitoring location, LTAW, was grab sampled once each month.

Drinking Water
Treated water was sampled time proportionally by an automatic sampler. The sampler was typically set to obtain 30-60 ml aliquots every twenty minutes. Weekly, the water obtained by this sampler was retrieved for either biweekly or monthly compositing.

Fish
Fish were obtained by electrofishing. Electrofishing stuns the fish and allows them to float to the surface so that those of the desired species and sufficient size can be sampled. Sampled fish include recreationally important species, such as smallmouth bass, and also channel catfish and white suckers. The fish are filleted and the edible portions are kept for analysis.

Sediment
Shoreline sediment was collected to depths of four feet of water.

Sample Preservation and Analysis

Surface and Drinking Water
Surface and drinking water samples were analyzed monthly for 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. In addition, drinking water samples were analyzed for gross alpha activity.

To optimize the accuracy of these sample analyses, preservatives were added to the samples as soon after collection as practical. Nitric acid was added to sample aliquots destined for gross alpha and beta activity analysis and the analysis of gamma-emitting radionuclide activity analysis. Sufficient acid was added to reduce the pH of these sample aliquots to nearly two in order to reduce the potential for radionuclides leaving the water and depositing on the sides of the sample containers.

Sodium bisulfite was added to sample aliquots destined for iodine-131 analysis in amounts equivalent to one gram per each gallon of water. This amount was recommended by the radioanalytical laboratory (Teledyne Brown Engineering) analyzing the samples. The purpose for sodium bisulfite addition is to reduce the potential for volatilization and loss of iodine from samples by maintaining it in a chemically reduced form.

Sediment and Fish
Fish are frozen until shipment. All samples are analyzed by gamma spectroscopy for the activities of any gamma emitting radionuclides that may be present.

Monitoring Results

Surface Water
Results from specific sample analyses of surface water may be found in Tables I-2 and I-3 of Appendix I. A summary of the 2000 surface water data may be located in Table G of Appendix G. Comparisons of 2000 monitoring results with those of past years may be found in Tables H 2 through H 4 of Appendix H.

The Nuclear Regulatory Commission (NRC) requires that averages of the activity levels for indicator environmental monitoring locations and for control environmental monitoring locations of surface water, as well as other monitored media, be reported to the NRC annually. Data from the following three surface water monitoring locations were averaged together as indicators for reporting purposes: one location (6S5) on the Susquehanna River downstream of the SSES, Lake-Took-a While (LTAW) adjacent to the river, and the SSES cooling tower blowdown discharge (CTBD) line to the river (2S7).

Technically, the CTBD line is not part of the environment. The CTBD line is a below ground pipe to which the public has no access, contrary to the other environmental monitoring locations on the Susquehanna River to which the public does have access. However, it currently is required that the water that is discharged to the Susquehanna River through the CTBD line from the SSES be included as an indicator monitoring location in the radiological environmental monitoring program.

Most of the water entering the Susquehanna River through the SSES CTBD line is simply water that was taken from the river upstream of the SSES, used for cooling purposes without being radioactively contaminated by SSES operation, and returned to the river. Nevertheless, batch discharges of relatively small volumes of slightly radioactively contaminated water are made to the river through the SSES CTBD at times throughout each year. The water is released from tanks of radioactively contaminated water on site to the CTBD and mixes with the noncontaminated water already present in the CTBD. Flow rates from the tanks containing radioactively contaminated water being discharged to the CTBD are limited to a maximum of 200 gpm. In addition, the minimum flow rate for the returning water in the CTBD is maintained at a flow rate of 5,000 gpm or higher. These requirements are in place to ensure adequate dilution of radioactively contaminated water by the returning noncontaminated water in the CTBD prior to entering the river.

At the point that CTBD water enters the river, additional, rapid dilution of the discharged water by the river is promoted by releasing it through a diffuser. The diffuser is a large pipe with numerous holes in it that is positioned near the bottom of the river. CTBD discharges exit the diffuser through the many holes, enhancing the mixing of the discharge and river waters. The concentrations of contaminants are reduced significantly as the discharged water mixes with the much larger flow of river water. The mean flow rate of the Susquehanna River in 2000 was approximately 7,896,825 gpm. This is more than 1,500 times the required minimum flow rate through the CTBD for discharges to be permitted.

The amounts of radioactively contaminated water being discharged are small. Nevertheless, sensitive analyses of the water samples can often detect the low levels of certain types of radioactivity in the CTBD water following dilution. Though the levels

of radioactivity measured in the CTBD water are generally quite low, they tend to be higher than those in the river downstream of the SSES. Most radionuclides discharged from the SSES CTBD are at such low levels in the downstream river water that, even with the sensitive analyses performed, they cannot be detected.

When the radioactivity levels from the CTBD samples throughout the year are averaged with those obtained from actual downstream monitoring locations, the result is an overall indicator location average that is too high to be representative of the actual average radioactivity levels of the downstream river water. As the following discussions are reviewed, consideration should be given to this inflation of average radioactivity levels from the inclusion of CTBD (location 2S7/6S7) results in the indicator data that is averaged.

The 2000 data for **gross beta activity** analyses of surface water are lower than those of 1999. The 2000 mean gross beta activity of 5.3 pCi/liter for indicator locations is less than the 1999 indicator mean gross beta activity of 6.6 pCi/liter. The 2000 indicator mean activity is below the average of the annual means for the previous operational period of the SSES. The 2000 mean gross beta activity of 2.8 pCi/liter for control locations is lower than the 4.7 pCi/liter for the 1999 control mean gross beta activity. The 2000 control mean activity is below the averages of the annual means for both the previous operational and preoperational periods. Refer to Figure 9 which trends gross beta activities separately for surface water indicator and control locations quarterly from 1975 through 2000.

Comparison of the 2000 indicator mean (5.3 pCi/l) to the 2000 control mean (2.8 pCi/l) suggests a contribution of beta activity from the SSES. The 2000 data is similar in this regard to the averages of annual means for indicator and control locations for the prior operational period. During the prior operational period, the average of annual indicator means exceeds the average of annual control means for gross beta activity.

The 2000 means for **iodine-131 activity** at indicator and control surface water monitoring locations were 0.35 pCi/liter and 0.39 pCi/liter, respectively. The 2000 indicator mean for iodine-131 activity is less than the 1999 indicator mean. Both the 2000 indicator and control mean activities are also greater than the averages of the annual means for both indicator and control locations for the prior operational period of the SSES.

Throughout the course of a year, iodine-131 is typically measured at levels in excess of analysis MDCs in some samples obtained from control surface water monitoring locations on the Susquehanna River upstream of the SSES as well as indicator locations downstream of the SSES. As determined by measurements of samples obtained by the SSES REMP, the mean iodine-131 activity level from the CTBD for all of 2000 was approximately 0.64 pCi/liter. This may be compared to the activity level of

0.39 pCi/liter for control surface water monitoring locations in 2000.

Iodine-131 from the discharge of medical wastes into the Susquehanna River upstream of the SSES is drawn into the SSES cooling tower basins through the SSES River Water Intake Structure. It is not unreasonable to assume that concentration of the already existing iodine-131 in the cooling tower basins occurs as it does for other substances found in the river. For example, the SSES routinely assumes concentration factors in the basin for calcium of four to five times the concentrations in the river water entering the basins, based on past measurements. This concentrating effect occurs because of the evaporation of the water in the basins, leaving behind most dissolved and suspended materials in the unevaporated water remaining in the basins. If a concentration factor of four for iodine-131 were to be applied to the 2000 mean iodine-131 activity level for the control samples from the Susquehanna River, a mean concentration of 1.56 pCi/liter for iodine-131 in the basin water and the water being discharged from the basins would be expected. The actual 2000 mean of 0.64 pCi/liter for the CTBD iodine-131 activity level was less than this.

Because iodine-131 is radioactive, unlike the calcium that has been measured, iodine-131 is removed from the water while it is in the basins through the radioactive decay process. Thus, it might be expected that the net concentration factor for iodine-131 would be somewhat less than that for calcium, considering this additional removal process. The extent to which the iodine-131 concentration factor is less than that for calcium would depend on the mean residence time for the water in the basins compared to iodine-131's radioactive half-life - the greater the ratio of the mean residence time to the half-life, the smaller the concentration factor. A mean residence time for water in the basins is expected to be about two days. This is only about one-fourth of the approximately eight-day half-life of iodine-131. Thus, radioactive decay would not be expected to reduce the concentration factor for iodine-131 by a large amount. Therefore, the difference between the 2000 mean iodine-131 activity of about 0.64 pCi/liter in the CTBD and the 2000 mean iodine-131 activity for the control location of 0.39 pCi/liter should be the result of concentration in the basins. Iodine-131 was not reported to have been discharged with water released from the SSES to the Susquehanna River during 2000.

The 2000 mean **tritium activity** for indicator locations was very similar to the corresponding 1999 mean. The 2000 means for tritium activity at indicator and control locations were 764 pCi/liter and 45 pCi/liter, respectively. The 2000 indicator and control means are within the ranges of the annual means reported for the prior operational period of the SSES. Refer to Figure 10 which trends tritium activity levels separately for surface water indicator and control locations from 1972 through 2000.

The 2000 indicator mean tritium level for all surface water locations can be misleading for those interested in the

mean tritium level in the Susquehanna River downstream of the SSES for 2000. The much higher levels of tritium observed in the CTBD line (location 2S7/6S7), when averaged with the low levels from the downstream location 6S5 sample analysis results distort the real environmental picture. The mean tritium activity from indicator location 6S5 for 2000 was 32 pCi/liter, which is less than the mean tritium activity, 45 pCi/liter, for the control location, both of which represent actual river water levels.

In spite of the fact that the tritium activity levels reported for 2S7/6S7 are from the discharge line prior to dilution in the river, the highest quarterly average tritium activity reported at 2S7/6S7 during 2000 was approximately 3,500 pCi/liter for the second quarter, well below the NRC non-routine reporting levels for quarterly average activity levels of 20,000 pCi/liter when a drinking pathway exists or 30,000 pCi/liter when no drinking water pathway exists.

The tritium activity reported in the CTBD line from location 2S7/6S7 is attributable to the SSES. Refer to the "Dose from the Aquatic Pathway" discussion at the end of this section for additional information on the projected dose to the population from tritium and other radionuclides in the aquatic pathway attributable to the SSES.

With the exception of iodine-131, no **gamma-emitting radionuclides** were measured in surface water primary samples at an activity level exceeding an analysis MDC in 2000.

Drinking Water

Drinking water was monitored during 2000 at the Danville Water Company's facility 26 miles WSW of the SSES on the Susquehanna River. From 1977 (when drinking water samples were first collected) through 1984, drinking water samples were also obtained from the Berwick Water Company at location 12F3, 5.2 miles WSW of the SSES. The drinking water supply for the Berwick Water Company is not, however, water from the Susquehanna River; it is actually well water.

There are no known drinking water supplies in Pennsylvania on the Susquehanna River upstream of the SSES and therefore no drinking water control monitoring locations. Danville drinking water analysis results may be compared to the results for surface water control monitoring locations.

Results from specific sample analyses of drinking water may be found in Table I-4 of Appendix I. A summary of the 2000 drinking water data may be located in Table G of Appendix G. Comparisons of 2000 monitoring results with those of past years may be found in Tables H 5 through H 7 of Appendix H.

Gross alpha activity has been monitored in drinking water since 1980. Gross alpha activity has been observed at levels above the analysis MDCs in a small minority of the samples during most years since 1980. In 2000, three samples were reported with gross alpha activity levels above the analysis MDCs. These three analysis results were reported by a different laboratory than those for the remainder of the year. The 2000 mean gross alpha activity

level for drinking water was 0.56 pCi/liter. The 2000 mean alpha activity is significantly below the average of the corresponding annual means for both the prior operational years as well as the preoperational period. The mean gross alpha activity is lower than the means of many of the previous years. This is primarily because of the averaging method used since 1991. But, it may also be the result of discontinuing the sampling of untreated drinking water in July, 1995. Generally, the untreated water may have contributed more naturally occurring alpha activity due to higher levels of sediment than the treated water. No gross alpha activity in drinking water during 2000 is attributed to liquid discharges from the SSES to the Susquehanna River.

Gross beta activity has been monitored in drinking water since 1977. Gross beta activity is typically measured at levels exceeding the MDCs in drinking water samples. The 2000 mean gross beta activity level for drinking water was 3.4 pCi/liter. The 2000 mean is above the 1999 mean gross beta activity level for drinking water but within the range of the corresponding annual means for the prior operational period of the SSES. Refer to Figure 11 which trends gross beta activity levels separately for drinking water indicator and control locations from 1977 through 2000.

The 2000 mean gross beta activity for drinking water is greater than the 2000 gross beta activity level for surface water control locations. However, the 2000 mean gross beta activity for drinking water is within the range of annual mean gross beta activities for both prior operational and pre-operational monitoring periods. Drinking water samples were analyzed for gross beta activity by a different laboratory than surface water samples for most of 2000. This may have contributed to differences in gross beta activity between the two media. However, an especially high gross beta activity was reported by this laboratory in November 2000. If this result weren't averaged with the others, the annual mean would have only been 2.5 pCi/l. No gross beta activity in drinking water during 2000 is attributed to liquid discharges from the SSES to the Susquehanna River.

Iodine-131 was measured in excess of analysis MDCs in eight out of 23 drinking water samples in 2000. This compares with results from 12 samples for which analysis MDCs were exceeded in 1999. The 2000 mean iodine-131 activity level in drinking water samples was 0.19 pCi/liter. This is essentially the same as the 1999 mean drinking water activity level of 0.21 pCi/liter and less than the 1999 mean of 0.39 pCi/liter for the surface water control location. No iodine-131 activity in drinking water during 2000 is attributed to liquid discharges from the SSES to the Susquehanna River.

Tritium was measured in excess of analysis MDCs once in 2000 in drinking water. The 2000 mean tritium activity level for drinking water was 54 pCi/liter. The 2000 mean is below the averages of the corresponding annual means for both the prior operational and preoperational periods of the SSES. The low 2000 mean

tritium activity level for drinking water is higher than the 2000 mean tritium activity level for the surface water control location. Tritium activity in drinking water can be attributed to liquid discharges from the SSES to the Susquehanna River.

No gamma-emitting radionuclides were measured above the analysis MDCs for gamma spectroscopic analyses of drinking water samples during 2000.

Fish

Results from specific sample analyses of fish may be found in Table I 5 of Appendix I. A summary of the 2000 fish data may be located in Table G of Appendix G. A comparison of 2000 monitoring results with those of past years may be found in Table H 8 of Appendix H.

Four species of fish were sampled at each of one indicator location and one control location on the Susquehanna River in June 2000 and again in November 2000. The species included the following: white sucker, smallmouth bass, channel catfish, and shorthead redhorse. In addition, one largemouth bass was sampled from PPL's LTAW in November 2000. A total of 13 fish were collected and analyzed.

The only gamma-emitting radionuclide reported in excess of analysis MDCs in fish during 2000 was naturally occurring potassium-40. The 2000 indicator and control means for the activity levels of potassium-40 in fish were both 3.4 pCi/gram. The 2000 indicator and control means are slightly greater than the 1999 indicator and control means. Both the 2000 indicator and control means are within the ranges of their corresponding annual means for prior operational and preoperational years. Naturally occurring potassium-40 in fish is not attributable to the liquid discharges from the SSES to the Susquehanna River.

Sediment

Shoreline sediment was sampled in May 2000 and again in December 2000. Results from specific sample analyses of sediment may be found in Table I-6 of Appendix I. A summary of the 2000 sediment data may be located in Table G of Appendix G. Comparisons of 2000 monitoring results with those of past years may be found in Tables H 9 through H 12 of Appendix H.

Naturally occurring potassium-40, radium-226, and thorium-228 were measured at activity levels above analysis MDCs in all shoreline sediment samples in 2000.

The 2000 indicator and control means for potassium-40 activity levels in shoreline sediment were 7.7 pCi/gram and 8.01 pCi/gram, respectively. The 2000 indicator and control means for potassium-40 activity are less than their corresponding 1999 means. These 2000 means were within the ranges of the corresponding annual means for all prior operational years.

The 2000 indicator and control means for radium-226 activity levels in shoreline sediment were 1.2 pCi/gram and 1.0 pCi/gram, respectively. The 2000 indicator and control mean radium-226 activities are lower than the corresponding 1999 means. These 2000

radium-226 means were within the ranges of the corresponding annual means for all prior operational years.

The 2000 indicator and control means for thorium-228 activity levels in shoreline sediment were 0.9 and 0.8 pCi/gram, respectively. These means are slightly less than the averages of the corresponding means for 1999 and for prior operational years. The naturally occurring radionuclides in sediment discussed above are not attributable to the liquid discharges from the SSES to the Susquehanna River.

Cesium-137 was measured at activity levels in shoreline sediment exceeding analysis MDCs during 2000. The 2000 indicator and control means for cesium-137 activity levels in sediment were 0.035 pCi/gram and 0.064 pCi/gram, respectively. The 2000 indicator and control means are less than the corresponding 1999 mean. The 2000 indicator and control means are less than the averages of corresponding annual means for both prior operational as well as preoperational years. This cesium-137 in the sediment is attributed to residual fallout from past atmospheric nuclear weapons tests.

Dose from the Aquatic Pathway

Tritium was the only radionuclide was identified in 2000 by the SSES REMP in the aquatic pathway that was attributable to SSES operation and also included in the pathway to man.

An estimate of the total activity (curies) of tritium in SSES discharges for the year was made, based on REMP monitoring results, for use in projecting maximum doses to the public. Based on these results for surface water, a total 37.4 curies of tritium were estimated to have been released to the Susquehanna River during 2000 due to SSES operation. (This estimate is 10.2 curies less than the amount of tritium determined by effluent monitoring to have been released to the river by the SSES in 2000.)

The total tritium activity for the year was determined by summing the activities that were calculated to have been released during each calendar quarter of the year. The tritium activity that was estimated by the REMP to have been released for each quarter was based on the following: the quarterly average tritium activity concentrations in the water entering the river, those in the water upstream of the SSES discharge, and the quarterly average release rates of water to the river. First, the difference between the quarterly average tritium activity concentration in the water released and that in the water upstream of the SSES discharge to the river was calculated for each quarter. Then, the difference in these activity concentrations was multiplied times the applicable quarterly average flow rate at which water entered the Susquehanna River to obtain the tritium added to the river from Susquehanna's operation during each quarter.

Given the total tritium activity released, the maximum whole-body and organ 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. This is in accordance with SSES Technical Requirement 3.11.4.1.3.

The dose obtained from the ingestion of tritium was estimated at the nearest downriver municipal water supplier via the drinking water pathway and near the outfall of the SSES discharge to the Susquehanna River via the fish pathway. The maximum whole body and organ doses were each estimated to be less than 0.00085 mrem.

GROSS BETA ACTIVITY IN SURFACE WATER

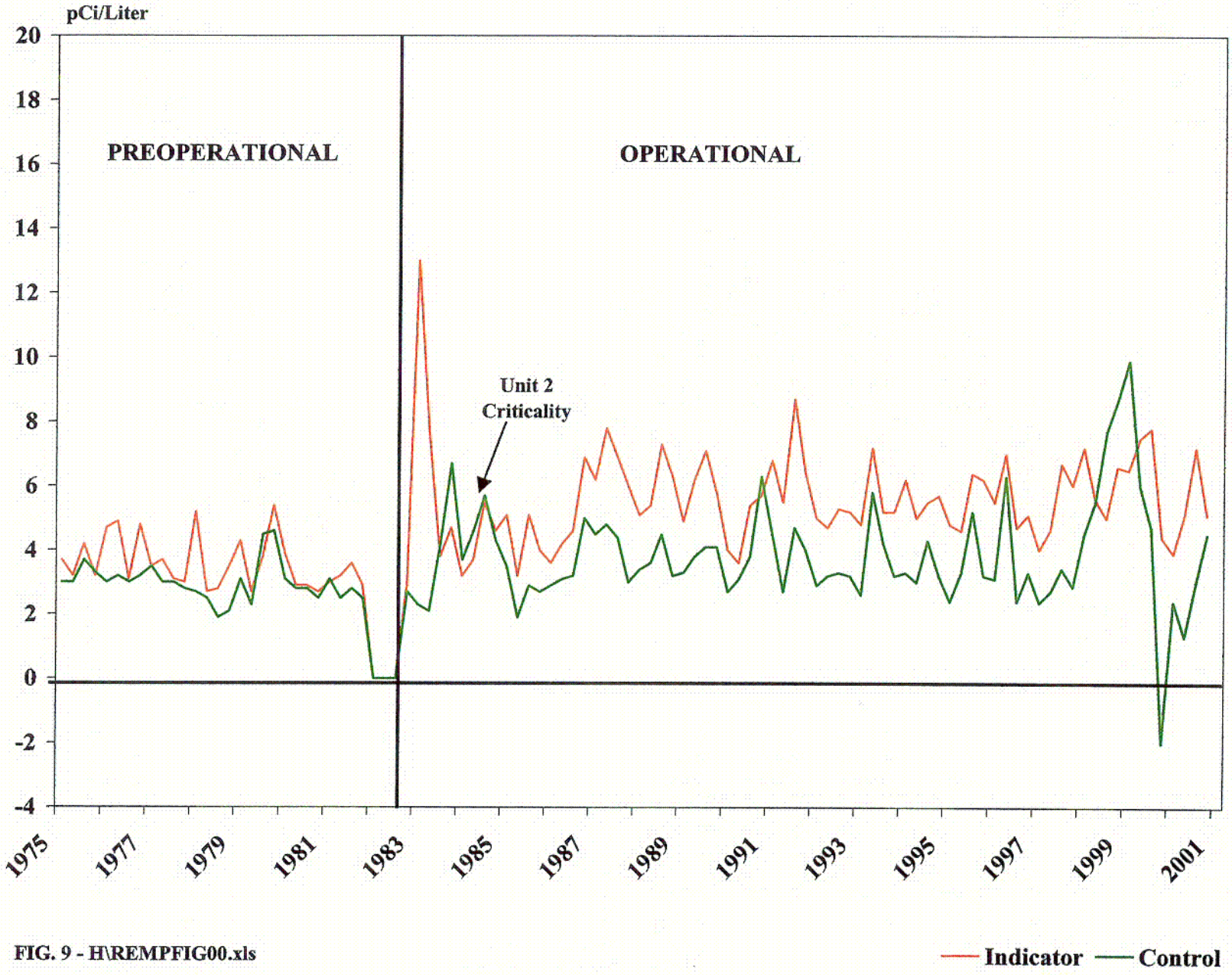


FIG. 9 - H\REMPFIG00.xls

TRITIUM ACTIVITY IN SURFACE WATER

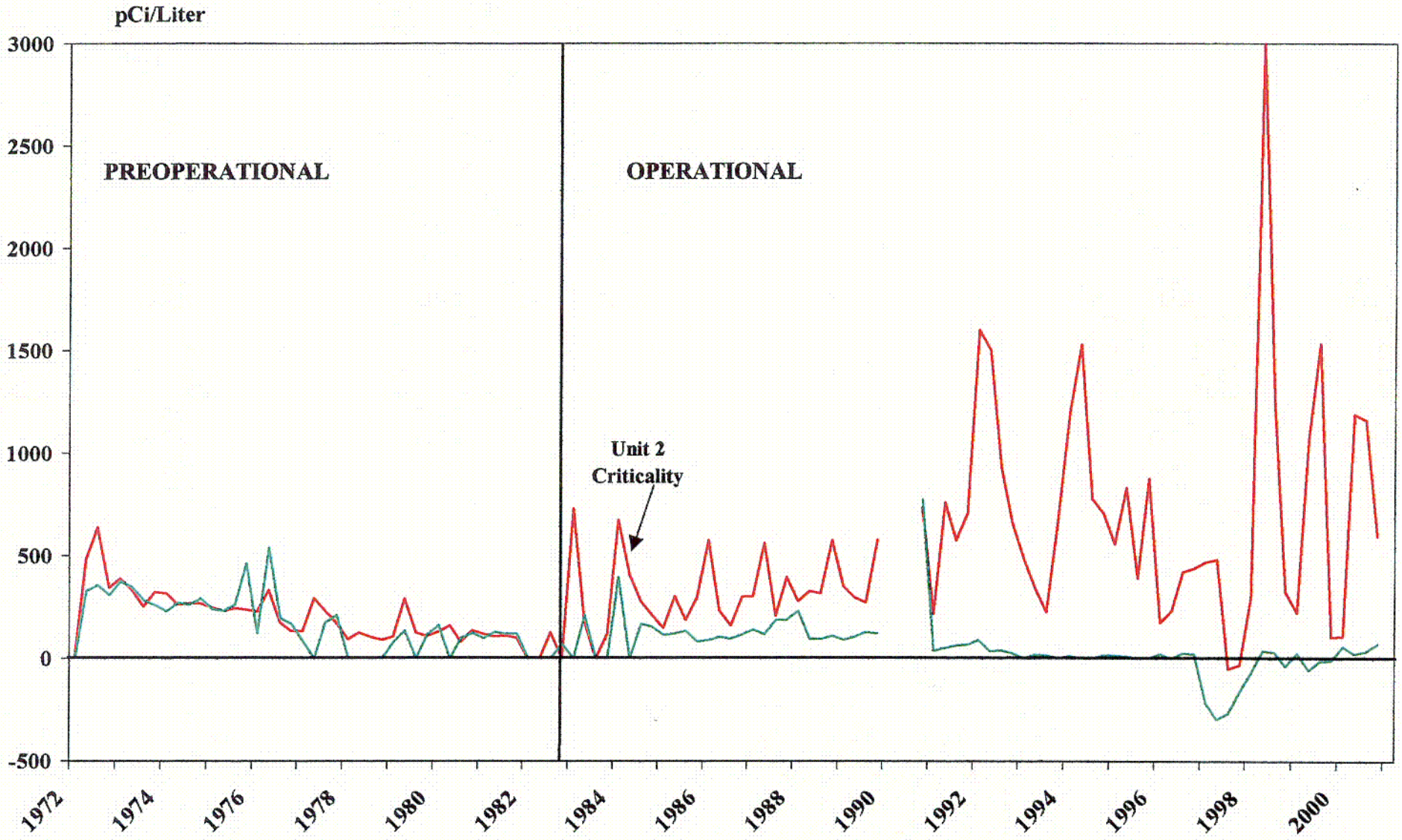


FIG. 10 - H\REMPFIG00.xls

C-3

GROSS BETA ACTIVITY IN DRINKING WATER

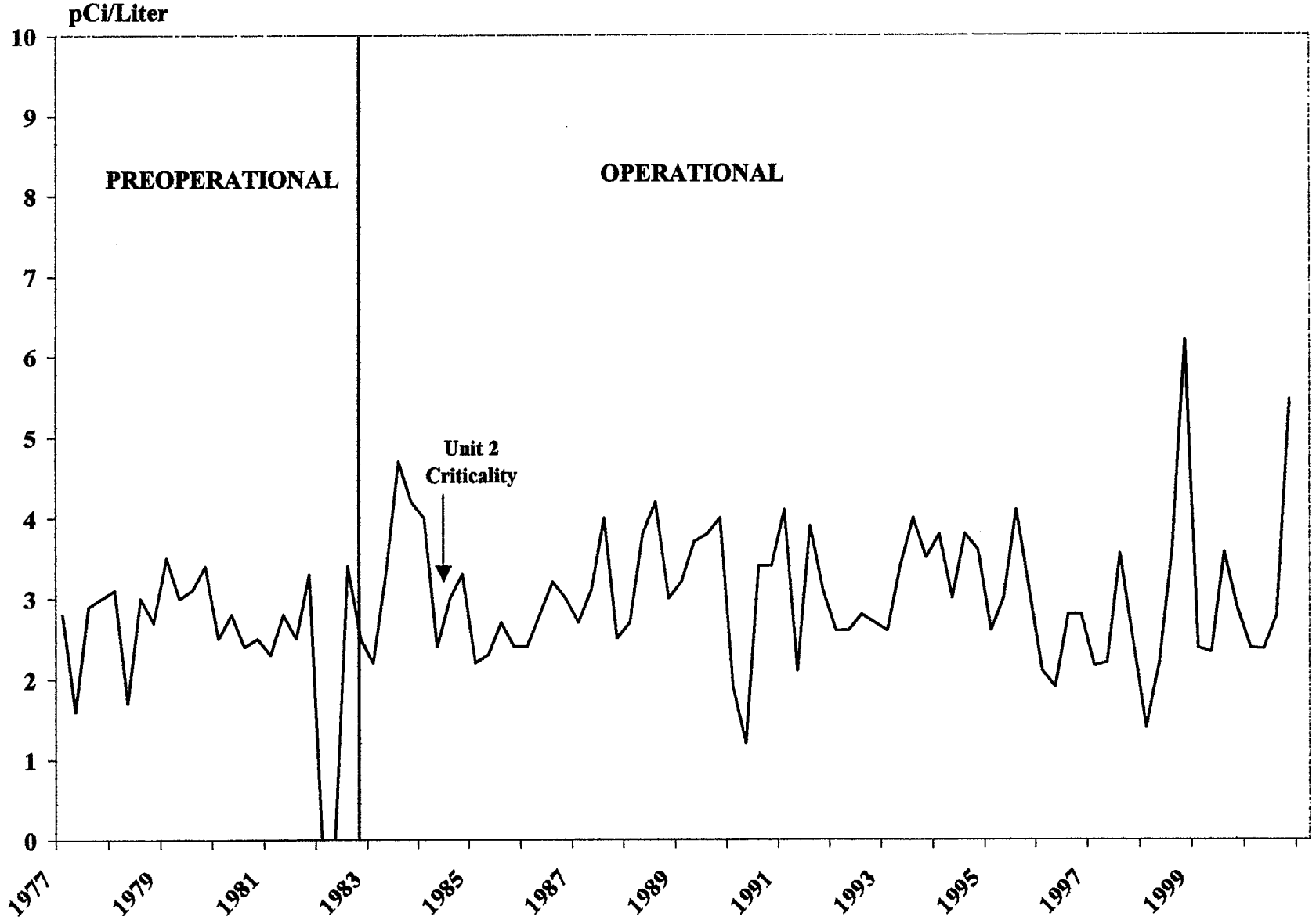


FIG . 11 - H\REMPFIG00.XLS

ATMOSPHERIC PATHWAY MONITORING

INTRODUCTION

Atmospheric monitoring by the SSES REMP involves the sampling and analysis of air. Because the air is the first medium that SSES vent releases enter in the pathway to man, it is fundamental that it be monitored. Mechanisms do exist for the transport of airborne contaminants to other media and their concentration in them. For example, airborne contaminants may move to the terrestrial environment and concentrate in milk. Concentrations of radionuclides can make the sampling and analysis of media like milk more sensitive approaches for the detection of radionuclides, such as iodine-131, in the pathway to man than the monitoring of air directly. (PPL also samples milk; refer to the Terrestrial Pathway Monitoring section of this report.) Nevertheless, the sensitivity of air monitoring can be optimized by the proper selection of sampling techniques and the choice of the proper types of analyses for the collected samples.

Scope

Air samples were collected on particulate filters and charcoal cartridges at indicator locations 3S2, 5S4, 7S7, 10S3, 12S1, 13S6, 9B1, and 12E1 and control locations 6G1 and 8G1.

Sampling and Analysis

Air

Throughout the year, the SSES REMP was monitoring the air at eight indicator locations and two control locations. The SSES Technical Requirements require monitoring at only a total of five sites. Monitoring is required at three locations at the SSES site boundary in different sectors with the greatest predicted sensitivities for the detection of SSES releases. Monitoring must be performed at the community in the vicinity of the SSES with the greatest predicted sensitivity. A control location that is expected to be unaffected by any routine SSES releases must be monitored.

Airborne particulates were collected on glass fiber filters using low volume (typically 2.0 to 2.5 cfm sampling rates) air samplers that run continuously. Air iodine samples were collected on charcoal cartridges, placed downstream of the particulate filters.

Particulate filters and charcoal cartridges were exchanged weekly at the air monitoring sites. Sampling times were recorded on elapsed-time meters. Air sample volumes for particulate filters and charcoal cartridges were measured with dry-gas meters.

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

Monitoring Results

Air Particulates

Gross beta activity is always measured at levels in excess of the analysis MDCs on the fiber filters. The highest gross beta activity levels that have been measured during the operational period of the SSES were obtained in 1986 following the Chernobyl accident in the former Soviet Union. Figure 12 trends the quarterly mean gross beta activities for the indicator and control locations separately from 1974 through 2000. Note that prior to SSES operation, before 1982, the unusually high gross beta activities were generally attributable to fallout from atmospheric nuclear weapons tests. Typical gross beta activities measured on air particulate filters are the result of naturally occurring radionuclides associated with dust particles suspended in the sampled air. They are thus terrestrial in origin.

Particulate gross beta activity levels for each monitoring location and monitoring period in 2000 are presented in Table I-8 of Appendix I. Comparisons of 2000 gross beta analysis results with those of previous years may be found in Table H 13 of Appendix H. For 2000, the annual means for the beta activities of the indicator and control locations are 14.3E-3 pCi/m^3 and 13.1E-3 pCi/m^3, respectively. These are near the low end of the corresponding ranges of previous operational yearly averages. They are significantly below the corresponding lower ends of their preoperational yearly averages. No contribution of radioactivity from the SSES is discernible from 2000 airborne gross beta data.

Quarterly gamma spectroscopic measurements of composited filters often show the naturally occurring radionuclide beryllium-7. Occasionally, other naturally occurring radionuclides, potassium-40 and radium-226, are also observed. Beryllium-7 is cosmogenic in origin, being produced by the interaction of cosmic radiation with the earth's atmosphere. The other two gamma-emitting radionuclides originate from soil and rock.

Beryllium-7 was measured above analysis MDCs for all quarterly composite samples in 2000. The 2000 indicator and control means for beryllium-7 activity were 88E-3 pCi/m^3, and 82E-3 pCi/m^3, respectively. The 2000 indicator and control means were lower than the averages of the corresponding annual means for the prior operational period but higher than those for the preoperational period. The 2000 means are lower than the corresponding 1999 means. Beryllium-7 activity levels for each 2000 calendar quarter at each monitoring location are presented in Table I-9 of Appendix I. Comparisons of 2000 beryllium-7 analysis results with previous years may be found in Table H 14 of Appendix H.

Potassium-40 was seen in excess of analysis MDCs in some quarterly composites during 2000. The 2000 indicator and control means for potassium-40 activity were 1.4E-3 and 3.8E-3 pCi/m^3, respectively. No other gamma-emitting radionuclides were reported for air in 2000. Beryllium-7

and potassium-40 are not attributable to SSES operation.

Air Iodine

Iodine-131 has been detected infrequently from 1976, when it was first monitored, through 2000. Since operation of the SSES began in 1982, iodine-131 has only been positively detected in air samples in 1986 due to the Chernobyl accident. No iodine-131 was reported for the 2000 air monitoring results.

GROSS BETA ACTIVITY IN AIR PARTICULATES

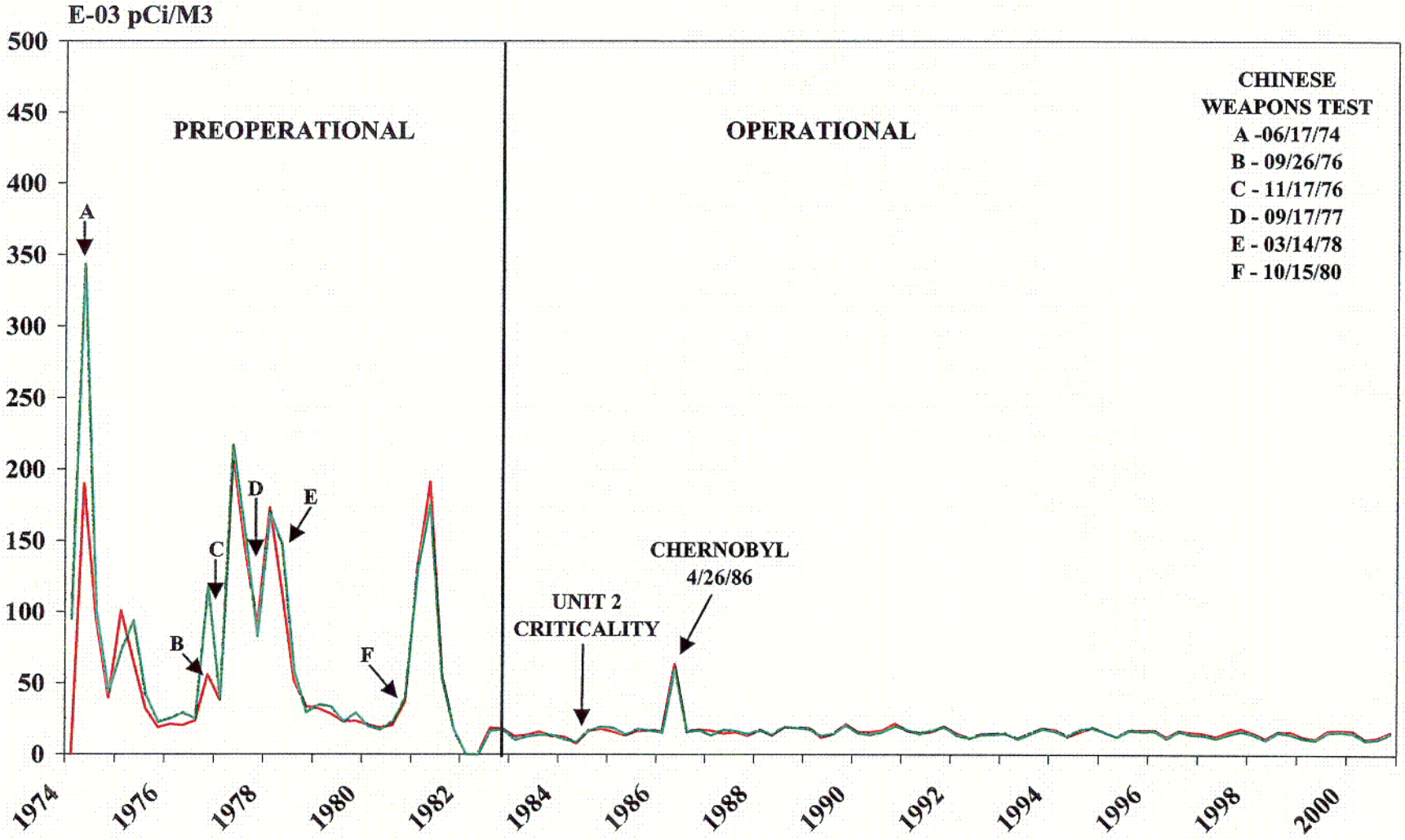


FIG. 12 - H\REMPFIG00.xls

C-9

TERRESTRIAL PATHWAY MONITORING

INTRODUCTION

The following media were monitored in the Terrestrial Pathway in 2000: soil, milk, fruits and vegetables.

Soil can be a great accumulator of man-made radionuclides that enter it. The extent of the accumulation in the soil depends of course on the amount of the radionuclides reaching it, but it also depends on the chemical nature of those radionuclides and the particular characteristics of the soil. For example, the element cesium, and, therefore, cesium-137 can be bound very tightly to clay in soils. The amount of clay in soil can vary greatly from one location to another. In highly clay soils, cesium-137 may move very slowly and also may be taken up very slowly in plants as they absorb soil moisture.

Any medium, such as soil, that tends to accumulate radioactive materials can also provide more sensitivity for radionuclide detection in the environment than those media that don't. Such a medium facilitates the early identification of radionuclides in the environment, as well as awareness of changes that subsequently may occur in the environmental levels of the identified radionuclides.

The SSES REMP samples soil near four of the ten REMP air sampling stations. The purpose for soil sampling near the air sampling sites is to make it easier to correlate air sampling results with soil sampling results if any SSES related radioactive material were found in either medium. Sampling is performed at different depths near the surface to help provide information on how recently certain radioactive materials may have entered the soil. Sampling at more than one depth also may help ensure the detection of materials that move relatively quickly through the soil. Such quick-moving materials may have already passed through the topmost layer of soil at the time of sampling.

Milk was sampled at five locations and fruit and vegetable samples were obtained at eight locations in 2000. Milk and fruit and vegetable monitoring locations exceeded the required numbers by one and six, respectively. SSES Technical Requirements require that the SSES REMP sample milk at the three most sensitive monitoring locations near the SSES and one control location distant from the SSES. SSES Technical Requirements only require that fruit and vegetables be sampled at locations irrigated by Susquehanna River from points downstream of the SSES discharge to the River. There are only three locations within 10 miles downstream of the SSES that have been known to irrigate with water from the Susquehanna River during unusually dry periods. These locations do not irrigate every year. Irrigation was only performed at the Zehner Brothers Farm (11D1) during 2000 as identified by the 2000 Land Use Census (Reference 67).

No requirement exists for the SSES REMP to monitor soil. All monitoring of the terrestrial pathway that is conducted by the SSES REMP in addition to milk and certain fruit and vegetables is voluntary and reflects PPL's willingness to exceed regulatory requirements to ensure that the public and the environment are protected.

Scope

Soil

Soil was sampled in September 2000 in accordance with its scheduled annual sampling frequency, at the following four REMP air sampling locations, 3S2, 12S1, 13S6, and 8G1. Location 8G1 was a control sampling location; the remaining sampling sites were indicator locations.

Twelve soil plugs were taken at selected spots at each monitoring location. The plugs were separated into "top" (0-2 inches) and "bottom" (2-6 inches) segments. Each set of top and bottom segments was composited to yield two soil samples from each location for analysis. Since there are four monitoring locations, a total of eight soil samples were analyzed in 2000.

Milk

Milk was sampled at least monthly at the following four locations in 2000: 10D1, 10D2, 10G1, and 7C1. In addition, milk was sampled at location 10D3 from April through December 2000.

Milk was sampled semi-monthly from April through October when cows were more likely to be in the pastures.

Locations 10D1, 10D2, and 10D3 are believed to be the most sensitive indicator sites available for the detection of radionuclides released from the SSES. Location 10G1 is the control location. A total of 95 milk samples from both indicator and control locations were analyzed in 2000.

Fruits and Vegetables

Fruits and vegetables were sampled during the harvest season at eight locations in six different sectors surrounding the SSES. Fifteen different kinds of fruits and vegetables were obtained for a total of 48 samples. Samples were obtained from the following locations: 7A3, 10B5, 11B1, 11D1, 12S7, 12F7, 13G2, and 14B3. Location 13G2 was the control location.

The availability of fruits and vegetables from growers typically varies from one year to the next. For example, gardeners may grow different plants or choose not to plant gardens. An attempt is made each year to obtain samples from the most sensitive indicator locations. This leads to the intentional substitution of some gardens for others based on consideration of annual meteorological data and available gardens as indicated in the Land Use Census from the previous year.

Two locations, 11D1 and 12F7, are required to be monitored every year. One location, 11D1, was identified as having irrigated with Susquehanna River water from downstream of the SSES during 2000. These locations are sampled each year even though there are often years with adequate rainfall when no irrigation is performed.

Sample Preservation and Analysis

The only sample medium monitored in the terrestrial pathway in which preservatives are used is milk. Sodium bisulfite is added to milk samples at the rate of 40 grams per gallon. This both helps maintain iodine in a reduced form and reduces the spoilage rate.

All media in the terrestrial pathway are analyzed for the activities of gamma-emitting radionuclides using gamma spectroscopy. The other analysis that is routinely performed is the radiochemical analysis for iodine-131 in milk.

Monitoring Results

The only man-made radionuclides normally expected at levels in excess of analysis MDCs in the terrestrial pathway are strontium-90 and cesium-137. Both of these radionuclides are present in the environment as a residual from previous atmospheric nuclear weapons testing.

Strontium-90 analyses are not now routinely performed for any media samples in the terrestrial pathway. Strontium-90 activity would be expected to be found in milk. SSES Technical Requirements do not require that milk be analyzed for strontium-90. Strontium-90 analyses may be performed at any time if the results of other milk analyses would show detectable levels of fission product activity which might suggest the SSES as the source.

Cesium-137 normally has been measured in excess of analysis MDCs in most soil samples. Although game is not currently being monitored, cesium-137 has also been seen often at levels above the MDCs in game in the past.

Certain naturally occurring radionuclides are also routinely found above analysis MDCs in terrestrial pathway media. Potassium-40, a primordial and very long-lived radionuclide, which is terrestrial in origin, is observed in all terrestrial pathway media. Other naturally occurring radionuclides often observed are thorium-228 and radium-226 in soil, and beryllium-7 in fruits and vegetables.

The results of the 2000 terrestrial pathway monitoring resemble those of the past. Results for specific sample analyses of terrestrial pathway media may be found in Tables I-10 through I-12 of Appendix I. A summary of the 2000 terrestrial monitoring data may be located in Appendix G. Comparisons of 2000 monitoring results with those of past years may be found in Tables H 15 through H 20 of Appendix H.

Soil

The following gamma-emitting radionuclides are routinely measured in soil at levels exceeding analysis MDCs: naturally occurring potassium-40, radium-226, and thorium-228 and man-made cesium-137. The 2000 analysis results were similar to those for previous years. No other gamma-emitting radionuclides were reported at levels above analysis MDCs.

The 2000 means for indicator and control location sample potassium-40

activity were 10.6 pCi/gram and 11.5 pCi/gram, respectively. Both means were within the ranges of corresponding means for prior operational years. The indicator and control means were higher than the corresponding ranges of preoperational means. This is not the result of SSES operation because the potassium-40 is naturally occurring. The 2000 indicator mean for potassium-40 was slightly above its corresponding 1999 mean.

The 2000 means for indicator and control location sample radium-226 activity were 1.7 pCi/gram and 1.2 pCi/gram, respectively. These means are within the ranges of the annual means for the previous operational period of the SSES, but they are above the corresponding ranges of annual means obtained during the preoperational period. This is not the result of SSES operation because the radium-226 is naturally occurring.

The 2000 means for indicator and control location sample thorium-228 activity were 2.0 pCi/gram and 2.4 pCi/gram, respectively. The 2000 indicator and control means for thorium-228 are significantly greater than the corresponding 1999 means. The indicator and control means are greater than the ranges of the corresponding means for both the previous operational and preoperational periods of the SSES. Thorium-228 in soil is not the result of SSES operation because it is naturally occurring.

The 2000 means for indicator and control location sample cesium-137 activity were 0.06 pCi/g and 0.11 pCi/g, respectively. The 2000 indicator mean is within the range of the corresponding annual mean for prior operational years, but below the range of such means for preoperational years. The 2000 control mean is below both the ranges of the corresponding annual means for both prior operational and preoperational years. Cesium-137 levels in soil samples typically vary widely from sample to sample. Levels of cesium-137 activity in 2000 samples varied by nearly a factor of ten over the entire range. Cesium-137 in soil, although man-made, is not from the operation of the SSES. It is residual fallout from previous atmospheric nuclear weapons testing.

Milk

Iodine-131 has been chemically separated in milk samples and counted routinely since 1977. Refer to Figure 13 which trends iodine-131 activity in milk for indicator and control locations separately from 1977 through 2000. Typically, iodine-131 is not reported at levels exceeding the MDCs for the analyses in any milk samples during a monitored year. The 2000 monitoring year was no exception; no iodine-131 above the analysis MDCs was observed in either indicator or control samples.

The preoperational years 1976, 1978, and 1980 were exceptional years in the sense that iodine-131 activity was observed in excess of MDCs due to fallout from atmospheric nuclear weapons testing. Iodine-131 activity was also measured at levels exceeding MDCs in milk samples in 1986 in the vicinity of the SSES as a result of the Chernobyl incident.

With the exception of the naturally occurring potassium-40, radium-226, and thorium-228, no gamma-emitting radionuclides were measured in excess of analysis MDCs in 2000. The 2000 means for indicator and control location sample potassium-40 activity were 1392 pCi/liter and 1365 pCi/liter, respectively. The 2000 indicator and control means are slightly greater than the 1999 mean. The 2000 indicator and control means for potassium-40 activity are above the corresponding ranges of annual means for previous operational years, but within the ranges of such means for preoperational years. The potassium-40 activity in milk is not attributable to the SSES operation because it is naturally occurring.

Fruits and Vegetables

Naturally occurring beryllium-7, potassium-40, radium-226, and thorium-228 were the only gamma-emitting radionuclides measured in fruits and vegetables at activity levels in excess of analysis MDCs during 2000.

With the exception of potassium-40, these radionuclides are not normally observed in fruits and vegetables. Beryllium-7, which is produced by cosmic radiation interactions in the atmosphere, can be found occasionally as the result of deposition from the air, usually on broad-leaf vegetation. Radium-226 and thorium-228 would normally be expected to be seen as the result of soil that is splashed on vegetation and not removed during preparation for analysis.

The 2000 means for indicator and control location sample potassium-40 activity were 2.6 pCi/gram and 2.1 pCi/gram, respectively. The 2000 indicator mean is slightly above its corresponding 1999 mean. The 2000 control mean is below its corresponding 1999 mean. The 2000 indicator mean is within the range of the corresponding annual means for pre-operational and prior operational years. The 2000 control mean is below the range of corresponding annual means for preoperational and prior operational years. Potassium-40 in fruits and vegetables is not attributable to SSES operation because it is a naturally occurring radionuclide.

Cesium-137, a gamma-emitting radionuclide, was also reported at very low activity concentrations in several fruit and vegetable samples during 2000, including both the control as well as the indicator monitoring locations. This radionuclide is man-made, but not attributable to SSES operations. It is present in the environment due to previous atmospheric nuclear weapons testing, but it is not routinely observed in this medium.

IODINE-131 ACTIVITY IN MILK

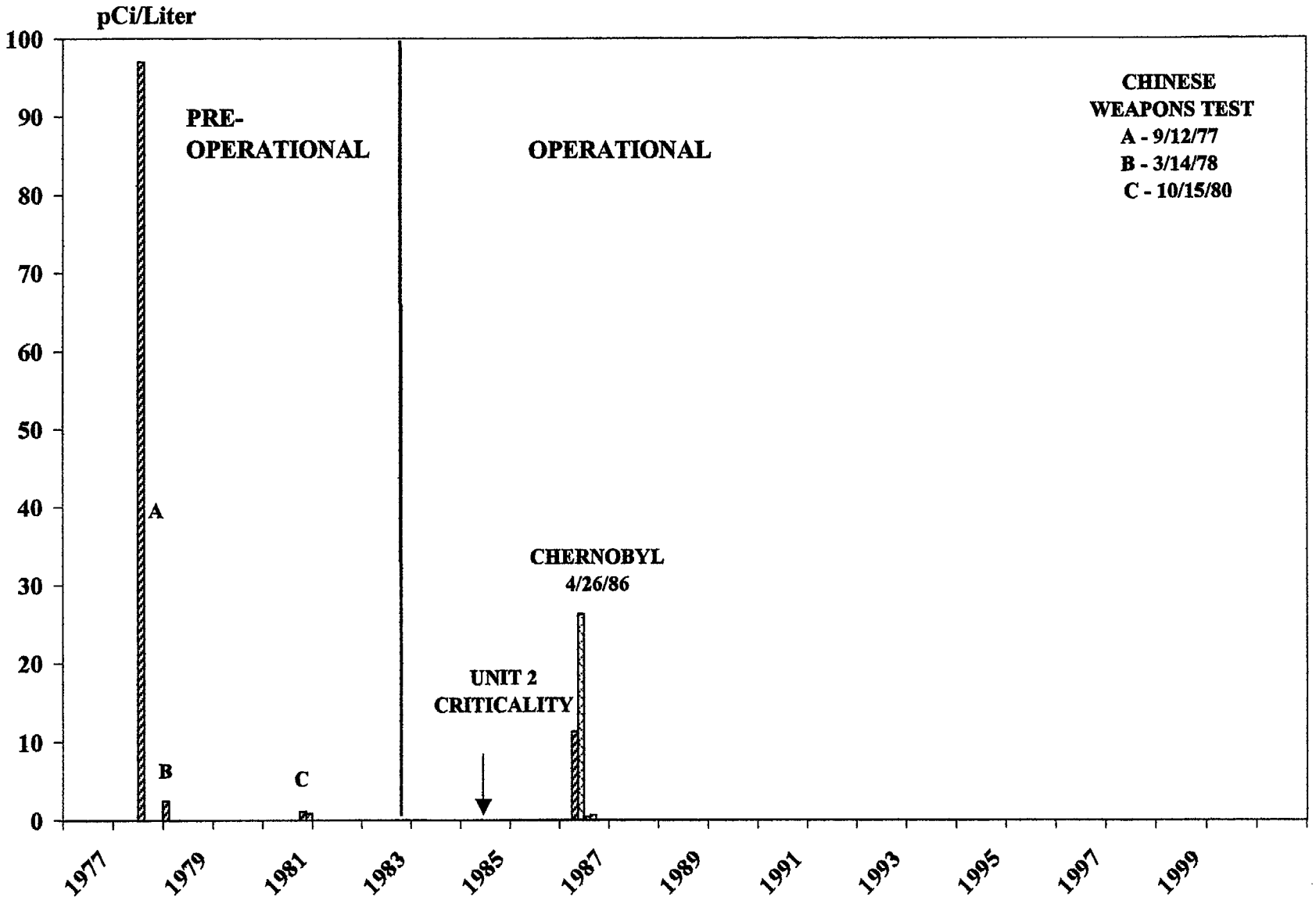


FIG. 13 - H\REMPFIG00.XLS

GROUND WATER MONITORING

INTRODUCTION

Normal operation of the SSES does not involve the release of radioactive material to ground water directly or indirectly through the ground. As a result, there are no effluent monitoring data to compare with REMP ground water monitoring results. Ground water could conceivably become contaminated by leakage or spills from the plant or by the washout or deposition of radioactive material that might be airborne. If deposited on the ground, precipitation/soil moisture could aid in the movement of radioactive materials through the ground to water that could conceivably be pumped for drinking purposes. No use of ground water for irrigation near the SSES has been identified.

Because routine SSES operation releases primarily tritium and, to a lesser extent, isotopes of xenon and krypton to the air, no radionuclides attributable to SSES operation are expected to be observed in ground water. Iodine and particulate releases to the air are negligible. Gaseous xenon and krypton tend to remain airborne; deposition or washout of these would be expected to be very minimal. Tritium would be the most likely radionuclide to reach the ground with precipitation and, if not lost to streams (surface water) by runoff, move readily through the soil to the ground water.

Scope

Ground water in the SSES vicinity was sampled monthly at four indicator locations (2S2, 4S4, 4S5, and 12S1) and one control location (12F3) during 2000.

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

Sample Preservation & Analysis

All samples (except the aliquots assigned for tritium analyses) were preserved with nitric acid, as described in Aquatic Pathway Monitoring.

Ground water samples were analyzed for the activities of gamma-emitting radionuclides and tritium activity. Gamma spectrometric analyses of ground water were begun in 1979 and tritium analyses in 1972, both prior to SSES operation.

Monitoring Results

Tritium activity levels in ground water have typically been observed to be lower than in surface water. A noticeable decline occurred between 1992 and 1993. Fewer measurements were above the analysis sensitivities in 1993 than in 1992.

Gamma-emitting radionuclides in excess of MDCs have been found in only a few samples in all the years that these analyses have been being performed. The naturally occurring radionuclides potassium-40 and thorium-228 have been measured above their MDCs occasionally in ground water. Potassium-40 was reported in 1979, 1981, 1985, 1991, 1992, 1993, and 1997. Thorium-228 was found in 1985 and 1986. The man-made radionuclide cesium-137 has been detected only occasionally since 1979. Its presence has always been attributed to residual fallout from previous atmospheric nuclear weapons tests.

The results of the 2000 REMP ground water surveillance resemble those of the past. Results for specific ground water sample analyses may be found in Table I-7 of Appendix I. A summary of the 2000 ground water monitoring data may be located in Appendix G. Comparisons of 2000 monitoring results for tritium with those of past years may be found in Table H 21 of Appendix H.

During 2000, tritium was measured in excess of analysis MDCs on five occasions. The 2000 mean tritium activity levels for indicator and control monitoring locations were 45 pCi/liter and 28 pCi/liter, respectively. Similar to those for 1999, the indicator and control means are less than the MDCs that are typically achieved. Both the 2000 indicator and control mean tritium activity levels are below the corresponding averages of annual means for prior operational and preoperational years.

Naturally occurring potassium-40 was measured in excess of analysis MDCs for some ground water samples during 2000. No man-made gamma-emitting radionuclides were determined to be at levels in excess of analysis MDCs. No radioactivity contributions to ground water from the SSES were identifiable in 2000.

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 and NPF-22.

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.

42. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1991 Annual Report," April 1992.

43. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-Annual Effluent Waste Disposal Report, Data Period: January-June 1992," August 1992.

44. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Semi-Annual Effluent Waste Disposal Report, Data Period: July 1-December 1992," February 1993.

45. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1992 Annual Report," April 1993.

46. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluent & Waste Disposal Report, Data Period: January-December 1993, March 1994.

47. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1993 Annual Report," April, 1994.

48. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluent & Waste Disposal Report," Data Period: January-December 1994, March, 1995.

49. Ecology III, Inc., "Susquehanna Steam Electric Station, 1994 Land Use Census," November, 1994.

50. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1994 Annual Report," April, 1995.

51. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluent & Waste Disposal Report," Data Period: January-December 1995, March, 1996.

52. Ecology III, Inc., "Susquehanna Steam Electric Station, 1995 Land Use Census," October, 1995.

53. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program, 1995 Annual Report," April, 1996.

54. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluents & Waste Disposal Report," Data Period: January-December 1996, March 1997.

55. Ecology III, Inc., "Susquehanna Steam Electric Station, 1996 Land Use Census," November, 1996.

56. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Radiological Environmental Monitoring Program 1996 Annual Report," April 1997.

57. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluents & Waste Disposal Report," Data Period: January-December 1997, March 1998.

58. Ecology III, Inc., "Susquehanna Steam Electric Station, 1997 Land Use Census," November 1997.

59. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, 1997 Annual Radiological Environmental Operating Report," April 1998.

60. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluents & Waste Disposal Report," Data Period: January–December 1998, April 1999.

61. Ecology III, Inc., "Susquehanna Steam Electric Station, 1998 Land Use Census," October 1998.

62. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, 1998 Annual Radiological Environmental Operating Report," May 1999.

63. Pennsylvania Power & Light Company, "Susquehanna Steam Electric Station, Annual Effluents & Waste Disposal Report," Data Period: January–December 1999, April 2000.

64. Ecology III, Inc., "Susquehanna Steam Electric Station, 1999 Land Use Census," October 1999.

65. PPL, "Susquehanna Steam Electric Station, 1999 Annual Radiological Environmental Operating Report," May 2000.

66. PPL, "Susquehanna Steam Electric Station, Annual Effluents & Waste Disposal Report," Data Period: January-December 2000, April 2001.

67. Ecology, III, "Susquehanna Steam Electric Station, 2000 Land Use Census," November 2000.

APPENDIX A

2000 REMP CHANGES

REMP Sample Analyses

From January through September 2000, Teledyne Brown Engineering's (TBE's) laboratory in Westwood, NJ was the primary laboratory for the analyses of all REMP samples, with the exception of tritium analyses of water samples and gross beta analyses of surface water samples. PPL Susquehanna, LLC's Corporate Environmental Radioactivity Measurements Laboratory (CERML) in Allentown, PA performed the primary tritium analyses for all waters and the gross beta analyses of surface water throughout the entire year. In September, TBE relocated its laboratory to Knoxville, Tennessee, and replaced most of the laboratory staff from the old Westwood facility. PPL Susquehanna performed a source verification in October that concluded that the facility was not ready to perform sample analysis activities in support of the SSES REMP. Therefore, CERML became the primary laboratory for the analyses of most REMP samples collected from October through December 2000. This change was made because of disruptions in sample processing and analysis during the relocation of TBE's Westwood laboratory to Knoxville, Tennessee, and the associated replacement of most of the laboratory staff from the old Westwood facility.

In mid-December 2000, REMP water samples began to be analyzed for I-131 activity and the activities of gamma-emitting radionuclides at Environmental Inc.'s Midwest Lab in Northbrook, Illinois. The Midwest Lab became an approved supplier for quality services following a satisfactory inspection by PPL personnel of SSES REMP sample processing and analyses. This change was made to ensure that required analysis sensitivities for I-131 and certain gamma-emitting radionuclides were met. CERML's limited number of gamma detectors and its inability to perform radiochemical separations and purifications made it very difficult to ensure that it would consistently achieve these required analysis sensitivities.

Direct Radiation Monitoring

Environmental TLD monitoring location 8B3, 1.5 miles SSE of the SSES at the Wapwallopen Post Office, was discontinued at the beginning of the 2000 monitoring year. The primary purpose for monitoring at this location was for comparison to monitoring by the NRC. The NRC has ceased co-monitoring. Equivalent monitoring is being conducted by the SSES REMP at location 8B2, which is essentially the same distance and direction from the SSES as location 8B3.

Milk Monitoring

Sampling of milk at location 10D3, the Drasher Farm located 3.5 miles SSW of the SSES, was initiated in April 2000. Sampling at this location was begun based on the results of an annual evaluation of 1999 meteorological data for potential milk sampling locations identified by the 1999 Annual Land Use Census. This evaluation looks at the relative sensitivities expected for the detection of any radionuclides that might be released

to the air from SSES operation at potential monitoring locations. The purpose of this evaluation is to determine if any of the current REMP milk monitoring locations should be replaced by locations that might more sensitive for detecting airborne radioactivity attributable to SSES operation. The results of the evaluation, performed in April 2000, indicated that location 10D3 should replace location 7C1 as a milk monitoring location. Since April 24, 2000, milk sampling has been taking place at both locations, 10D3 and 7C1. Monitoring at location 7C1 will be discontinued some time during 2001.

One potential milk sampling location, location 15B2 (1.8 miles NW of the SSES), was determined to have an even greater expected sensitivity for the detection of radionuclides in milk that might be attributable to SSES operation than location 10D3. If milk samples had been available from this location during 2000, sampling would have been performed there. However, it was determined in December 1998 that samples could not be obtained from location 15B2. A resident at this location and owner of the cows said that milk could not be spared for sampling. At that time, the residence had two cows. The results from the 1999 Land Use Census, on which decisions for 2000 milk monitoring were based, indicated that this residence had only one cow at the time the Census was being conducted. Therefore, samples were considered to be unavailable from this location.

APPENDIX B

2000 REMP MONITORING SCHEDULE (SAMPLING AND ANALYSIS)

TABLE 1
(Page 1 of 2)

Annual Analytical Schedule for the
PP&L Susquehanna Steam Electric Station
Radiological Environmental Monitoring Program - 2000

Media & Code	No. of Locations	Sample Freq.(a)	Analyses Required	Analysis Freq. (b)
Airborne Particulates	10	W	Gross Beta (c) Gamma Spectrometry	W QC
Airborne Iodine	10	W	I-131	W
Sediment	5	SA	Gamma Spectrometry	SA
Fish	2 1	SA A	Gamma Spectrometry (on edible portion)	SA
Surface Water (d)	4	MC, M, or BWC	Gross Beta I-131 Gamma Spectroscopy Tritium	M BW M M
Well (ground) Water	5	M	Gamma Spectroscopy Tritium	M M
Drinking Water (e)	1	MC, BWC	Gross Alpha Gross Beta I-131 Gamma Spectrometry Tritium	M M BW M M
Cow Milk	5	M, SM(f)	I-131 Gamma Spectrometry	SM, M SM, M
Food Products (Various Fruits and Vegetables)	8	A	Gamma Spectrometry	A
Soil	4	A	Gamma Spectrometry	A
Direct Radiation	85	Q	TLD	Q

Note: See footnotes at end of table.

(a) W = weekly, BW = biweekly, BWC = biweekly composite, 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 were greater than 10 times the yearly mean of the control sample, gamma analysis would be performed on the individual filter. Gross beta analysis was performed 24 hours or more following filter change to allow for radon and thoron daughter decay.

(d) Stations 6S6, 6S7, and 2S7 were checked at least weekly to ensure that the automatic composite samplers were operational. Time proportional sampling was performed at locations 6S6, 6S7 and 2S7 the entire year. Station 6S5 was grab sampled weekly. Individual composites of the weekly samples were made both monthly (MC) and biweekly for analysis.

(e) Water from station 12H2 TREATED was retrieved weekly. Composite samples of the weekly collections at this location were made both monthly (MC) and biweekly (BWC) for analysis. Sampling at 12H2 TREATED was performed using an automatic continuous sampler (ACS) that was operated in the time proportional mode.

(f) Stations 7C1, 10D1, 10D2, 10D3, and 10G1 were sampled semi-monthly from April through October.

APPENDIX C

2000
REMP MONITORING LOCATION DESCRIPTIONS

TABLE C 1
(Page 1 of 5)

TLD Locations for the SSES
Radiological Environmental Monitoring Program – 2000

Less Than One Mile from the SSES[a] - See Figure 2

Location Code(b)	Distance (miles)	Direction	Description
1S2	0.2	N	Perimeter Fence
2S2	0.9	NNE	Energy Information Center
2S3	0.2	NNE	Perimeter Fence
3S2	0.5	NE	SSES Backup Met Tower
3S3	0.9	NE	ANSP Riverlands Garden
3S4	0.3	NE	Perimeter Fence
4S3	0.2	ENE	Post, West of SSES APF
4S6	0.7	ENE	Riverlands
5S4	0.8	E	West of Environmental Laboratory
5S7	0.3	E	Perimeter Fence
6S4	0.2	ESE	Perimeter Fence (north)
6S9	0.2	ESE	Perimeter Fence (south)
7S6	0.2	SE	Perimeter Fence
7S7	0.4	SE	End of Kline's Road
7S8	0.4	SE	Kline Residence
8S2	0.2	SSE	Perimeter Fence
9S2	0.2	S	Security Fence
10S1	0.4	SSW	Post - south of switching station
10S2	0.2	SSW	Security Fence
10S3	0.6	SSW	Confer's Lane – east of Confer's Lane, south of Towers Club
11S3	0.3	SW	Security Fence
11S7	0.4	SW	SSES Access Road Gate #50
12S1	0.4	WSW	SSES West Building

TABLE C 1
(Page 2 of 5)

TLD Locations for the SSES
Radiological Environmental Monitoring Program – 1999

Less Than One Mile from the SSES[a] - See Figure 2

Location Code (b)	Distance (miles)	Direction	Description
12S3	0.4	WSW	Perimeter Fence
12S4	0.4	WSW	Perimeter Fence
12S5	0.4	WSW	Perimeter Fence
12S6	0.4	WSW	Perimeter Fence
13S2	0.4	W	Perimeter Fence
13S4	0.4	W	Perimeter Fence
13S5	0.4	W	Perimeter Fence
13S6	0.4	W	Former Laydown Area - west of Confer's Lane
14S5	0.5	WNW	Beach Grove Road/Confer's Lane
14S6	0.7	WNW	Beach Grove Road (pole)
15S5	0.4	NW	Perimeter Fence
16S1	0.3	NNW	Perimeter Fence (east)
16S2	0.3	NNW	Perimeter Fence (west)
6A4	0.6	ESE	Restaurant (U.S. Route 11)
8A3	0.9	SSE	PPL Wetlands Sign (U. S. Route 11)
15A3	0.9	NW	Hosler Residence
16A2	0.8	NNW	Benkinney Residence
From One to Five Miles from the SSES[a] - See Figure 3			
12S7	1.1	WSW	Kisner Residence
1B1	1.4	N	Mingle Inn Road
2B3	1.3	NNE	Durabond Corporation
2B4	1.4	NNE	U.S. Route 11/Mingle Inn Road Intersection
5B3	1.6	E	PPL Switchyard
7B2	1.5	SE	Heller's Orchard Store
8B2	1.4	SSE	Lawall Residence

TABLE C 1
(Page 3 of 5)

TLD Locations for the SSES
Radiological Environmental Monitoring Program – 2000

From One to Five Miles from the SSES[a] - See Figure 3

Location Code (b)	Distance (miles)	Direction	Description
9B1	1.3	S	Transmission Line - east of Route 11
10B2	2.0	SSW	Algatt Residence
10B3	1.7	SSW	Castek Inc.
10B4	1.4	SSW	U. S. Route 11/River Road Intersection
12B4	1.7	WSW	Shultz Farm
13B1	1.3	W	Walker Run Creek (Tele. Pole #36)
14B3	1.3	WNW	Moskaluk Residence
15B1	1.7	NW	Country Estates Trailer Park
16B2	1.7	NNW	Walton Power Line
11C1	2.0	SW	Salem Township Fire Company
1D5	4.0	N	Shickshinny/Mocanaqua Sewage Treatment Plt.
6D1	3.5	ESE	St. Peters Church – Hobbie
8D3	4.0	SSE	Mowry Residence
9D4	3.6	S	Country Folk Store
10D1	3.0	SSW	R. & C. Ryman Farm
12D2	3.7	WSW	Dagostin Residence
14D1	3.6	WNW	Moore's Hill/Mingle Inn Roads Intersection
3E1	4.7	NE	Webb Residence - Lilly Lake
4E2	4.7	ENE	Ruckles Hill/Pond Hill Roads Intersection
5E2	4.5	E	Bloss Farm
6E1	4.7	ESE	St. James Church

TABLE C1
(Page 4 of 5)

TLD Locations for the SSES
Radiological Environmental Monitoring Program – 2000

From One to Five Miles from the SSES[a] - See Figure 3

Location Code (b)	Distance (miles)	Direction	Description
7E1	4.2	SE	Harwood Transmission Line Pole #2
11E1	4.7	SW	Thomas Residence
12E1	4.7	WSW	Berwick Hospital
13E4	4.1	W	Kessler Farm

Greater than Five Miles from the SSES[a] - See Figure 4

2F1	5.9	NNE	St. Adalberts Cemetery
8F2	8.5	SSE	Huff Residence
12F2	5.2	WSW	Berwick Substation
15F1	5.4	NW	Zatwatski Farm
16F1	7.8	NNW	Hidlay Residence
3G4	17	NE	Wilkes Barre Service Center
4G1	14	ENE	Mountaintop - Crestwood Industrial Park
6G1	13.5	ESE	Freeland Substation
7G1	14	SE	Hazleton PP&L Complex
7G2	12	SE	Hazleton Cemetery - 14th Street
8G1	12	SSE	PPL SFC - Humbolt Industrial Park
12G1	15	WSW	PPL Service Center, Bloomsburg
12G4	10	WSW	Naus Residence

TABLE C 1
(Page 5 of 5)

TLD Locations for the SSES
Radiological Environmental Monitoring Program – 2000

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.

TABLE C 2
(Page 1 of 4)

Sampling Locations for the SSES Radiological Environmental Monitoring Program – 2000

Less Than One Mile from the SSES[a] - See Figure 5

Location Code	Distance (miles)	Direction	Description
SURFACE WATER			
2S7	0.1	NNE	Cooling Tower Blowdown Line
5S9	0.8	E	Environmental Lab Boat Ramp (Alternate for 6S6)
6S5	0.9	ESE	Outfall Area
6S6	0.8	ESE	River Water Intake Line
6S7	0.4	ESE	Cooling Tower Blowdown Line (alternate for 2S7)
LTAW		NE - ESE	Lake Took-A-While (on site)
FISH			
LTAW		NE - ESE	Lake Took-A-While (on site)
SEDIMENT(c)			
LTAW		NE - ESE	Lake Took-A-While (on site)
5S9	0.8	E	Environmental Lab Boat Ramp (alternate for 2B)
AIR			
3S2	0.5	NE	SSES Backup Meteorological Tower
5S4	0.8	E	West of SSES Environmental Laboratory
7S7	0.4	SE	End of Kline's Road
10S3	0.6	SSW	East of Confer's Lane, South of Towers Club
12S1	0.4	WSW	SSES West Building
13S6	0.4	W	Former Laydown Area, West of Confers Lane
SOIL			
3S2	0.5	NE	SSES Backup Meteorological Tower
12S1	0.4	WSW	SSES West Building
13S6	0.4	W	Former Laydown Area, West of Confers Lane
FRUITS/VEGETABLES			
7A3	0.6	SE	T. Scholl Residence

TABLE C2
(Page 2 of 4)

Sampling Locations for the SSES Radiological Environmental Monitoring Program – 2000

Less Than One Mile from the SSES[a] - See Figure 5

Location Code	Distance (miles)	Direction	Description
		GROUND WATER	
2S2	0.9	NNE	Energy Information Center
4S4	0.5	ENE	Training Center
4S5	0.5	ENE	White House
12S1	0.5	WSW	SSES West Building
From One to Five Miles From the SSES - See Figure 6			
		FISH[b]	
IND	0.9 - 1.4	ESE	At or Below the SSES Discharge Diffuser
		SEDIMENT[c]	
2B	1.6	NNE	Gould Island
7B	1.2	SE	Bell Bend
		AIR	
9B1	1.3	S	Transmission Line - East of Route 11
12E1	4.7	WSW	Berwick Hospital
		MILK	
10D1	3.0	SSW	R. & C. Ryman Farm
10D2	3.1	SSW	Raymond Ryman Farm
10D3	3.5	SSW	C. & K. Drasher Farm
7C1	2.6	SE	Zajac Farm
		FRUITS/VEGETABLES	
12S7	1.1	WSW	Kisner Residence
10B5	1.2	SSW	Bodnar Residence
14B3	1.3	WNW	Moskaluk Residence
11B1	1.9	SW	H. Shultz Residence
11D1	3.3	SW	Zehner Farm

TABLE C 2
(Page 3 of 4)

Sampling Locations for the SSES
Radiological Environmental Monitoring Program – 2000

Greater than Five Miles from the SSES[a] - See Figure 7

Location Code	Distance (miles)	Direction	Description
		DRINKING WATER	
12H2T	26	WSW	Danville Water Co. (treated)
		FISH[b]	
2H	30	NNE	Near Falls, Pa.
		SEDIMENT[c]	
12F	6.9	WSW	Old Berwick Test Track
		AIR	
6G1	13.5	ESE	Freeland Substation
8G1	12	SSE	PPL SFC - Humbolt Industrial Park
		SOIL	
8G1	12	SSE	PPL SFC - Humbolt Industrial Park
		MILK	
10G1	14	SSW	Davis Farm
		FRUITS/VEGETABLES	
12F7	8.3	WSW	Lupini Farm
13G2	16	W	Kile Farm
		GROUND WATER	
12F3	5.2	WSW	Berwick Water Company

TABLE C 2
(Page 4 of 4)

Sampling Locations for the SSES
Radiological Environmental Monitoring Program – 2000

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) 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.

APPENDIX D

2000 LAND USE CENSUS RESULTS

2000 LAND USE CENSUS RESULTS

The SSES Technical Requirements require that a census be conducted annually during the growing season to determine the location of the nearest milk animal, residence, and garden greater than 50 m^2 (≈500 ft^2) producing broad leaf vegetation within a distance of 8 km (≈5 miles) in each of the 16 meteorological sectors surrounding the SSES. To comply with this requirement, a land-use survey was conducted for the SSES during 2000.

Table 5 lists the results of the census. The results are used in conjunction with the most recent year's meteorological data to determine if any changes in required REMP sampling locations for milk must be made. These results have also been used to determine the optimum sampling locations for fruits and vegetables and to make changes in such sampling locations if warranted and practical. Such changes ensure that the most sensitive monitoring locations are included in the REMP. Land use census results are also used in the assessment of potential radiological doses to individuals and populations living in the vicinity of the SSES.

A comparison of the 1999 and 2000 Land Use Census results for the Susquehanna SES indicates that changes occurred in two of the nearest residences and one of the nearest dairy animal locations from 1999 to 2000. The 2000 Land Use Census identified changes in the nearest garden in Sector 4 from 1999 to 2000. This Census also identified changes in meat usage from 1999 to 2000. Refer to the summary of these changes in the tables below.

CHANGE FROM 1999 TO 2000 IN NEAREST GARDENS AS DETERMINED BY THE 2000 LAND USE CENSUS

Sector/ Direction	1999		2000	
	Name	Distance (mi.)	Name	Distance (mi.)
4/ENE	Dennis	2.4	Glova	3.6

CHANGES FROM 1999 TO 2000 IN MEAT USAGE AT THE NEAREST GARDEN & DAIRY ANIMAL LOCATIONS					
Exposure Pathway	**Sector/ Direction**	**Name**	**Distance (mi.)**	**Meat/Produce Usage**	
				1999	**2000**
Garden	2/NNE	Chapin	2.3	Ducks & Beef Cattle	Beef Cattle
Garden & Dairy Animal	15/NW	Goff	1.8	Cows & Chickens	Cows

In April 2000, the annual evaluation of current REMP milk sampling locations and available locations from which milk might be sampled, as identified by the previous (1999) Land Use Census, was performed. Considering available meteorological data from 1999, this evaluation determined that two potential milk sampling locations, which are designated as 10D3 and 10D4, were determined to have better meteorological characteristics for monitoring milk than those of an existing milk monitoring location designated as location 7C1. Of the two potential milk sampling locations, 10D3 and 10D4, location 10D3 had the best meteorological characteristics. Consequently, milk monitoring at location 10D3 was initiated on April 24, 2000. Milk sampling at monitoring location continued at location 7C1 for the remainder of 2000. Monitoring at location 7C1 will be discontinued during 2001, following the necessary changes to procedures.

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, 2000.

SECTOR	DIRECTION	NEAREST RESIDENCE	NEAREST GARDEN	NEAREST DAIRY ANIMAL
1	N	1.3 mi	3.2 mi	>5.0 mi
2	NNE	1.0 mi	2.3 mi[i]	>5.0 mi
3	NE	0.9 mi	3.6 mi	>5.0 mi
4	ENE	2.1 mi	2.4 mi	>5.0 mi
5	E	1.4 mi	1.8 mi	4.5 mi[g,i]
6	ESE	0.5 mi	2.5 mi	2.7 mi
7	SE	0.5 mi	0.6 mi	2.6 mi[g]
8	SSE	0.6 mi	1.5 mi	>5.0 mi
9	S	1.0 mi	1.1 mi	>5.0 mi
10	SSW	0.9 mi	1.2 mi	3.0 mi[a,b,c,d,e,g]
11	SW	1.5 mi	1.9 mi	>5.0 mi
12	WSW	1.1 mi	1.1 mi	>5.0 mi
13	W	1.2 mi	1.2 mi	5.0 mi[g]
14	WNW	0.8 mi	1.3 mi	>5.0 mi
15	NW	0.8 mi	1.8 mi	1.8 mi[i]
16	NNW	0.6 mi	4.0 mi	4.2 mi

[a]Chickens raised for consumption at this location.
[b]Ducks raised for consumption at this location.
[c]Eggs consumed from chickens raised at this location.
[d]Geese raised for consumption at this location.
[e]Pigs raised for consumption at this location.
[f]Turkeys raised for consumption at this location.*
[g]Fruits/vegetables grown for consumption at this location.
[h]Rabbits raised for consumption at this location*
[i]Beef cattle raised for consumption at this location.
[j]Goats raised for consumption at this location.
[k]Pheasants raised for consumption at this location.

*No locations were identified as raising turkeys, rabbits, and pheasants during 2000.

APPENDIX E

SUMMARY DESCRIPTION OF SSES REMP ANALYTICAL METHODS

TLD MEASUREMENTS

The PPL dosimetry system used for monitoring ambient radiation levels in the environment consists of Panasonic 710A readers and Panasonic UD-814 TLDs. The UD-814 TLD badges each contain four elements. Elements 2, 3, and 4 in each badge are made of calcium sulfate with 800 mg/cm^2 of filtering and element 1 is composed of lithium tetraborate with filtering of 25 mg/cm^2. Only the calcium sulfate elements are normally used for environmental measurements because of their higher light output per unit of radiation exposure relative to the lithium tetraborate and, consequently, greater sensitivity for the detection and measurement of radiation.

Note: Element 1 would be of value in the event of an unusually large release of noble gases, especially xenon, that would produce relatively low-energy X-ray or gamma emissions. This is because the lithium tetraborate does not over-respond to such low-energy emissions as does the calcium sulfate.

The TLD element manufacturers' attempt to make each element as similar as possible to each of the other elements in each batch that is produced. Nevertheless, each element ends up somewhat different in its response to radiation. In order to minimize the effect of these inherent differences when comparing actual monitoring results for different elements, Element Correction Factors (ECFs) are determined for each element. The ECFs are used to effectively normalize the readings of the field elements placed at particular monitoring locations for given monitoring periods to the average of the readings that would be expected if so-called reference elements were to be placed simultaneously at those individual locations. Reference elements are elements that have been demonstrated to display superior measurement performance.

The selection process for reference elements involves repeatedly irradiating a large set of elements, processing them, calculating the mean response for each set of elements, and evaluating the deviation of each individual element response from the mean response. After this process has been repeated at least several times, the elements with the least variability in their responses and with mean responses nearest to the mean response of the entire population of elements are chosen as reference elements.

To determine ECFs for individual field elements, the elements are first exposed to known amounts of radiation (100 mR) and processed, a minimum of three times each. Each element reading is then divided by the mean of the readings obtained from reference elements (typically 30 to 35) that were exposed to the same amounts of radiation as the elements for which the ECFs are being determined and that were processed at the same time as these elements. The mean quotient (ratio) is then calculated for each element by summing the quotients obtained for each processing and then dividing by the total number of the processings performed.

The following equation shows how ECFs are calculated:

$$ECF = \left[\frac{\sum_{i=1}^{n} \frac{E_i}{\overline{E}_{ref}}}{n} \right]$$

where

E_i an uncorrected exposure reading for the element.

$n =$ the total number of individual element exposures averaged.

$\overline{E}_{ref} =$ the mean of the ECF-corrected exposure readings of the reference elements.

Irradiated control TLDs are processed (read) with the batches of TLDs from the field to provide both processing calibration information and quality control. Field control TLDs, which accompany the field TLDs when they are being taken to their monitoring locations and subsequently retrieved from these locations, and cave control TLDs, which are stored with the field TLDs for the periods between annealing and field distribution and between retrieval from the field and processing, are also read with the field TLDs to provide checks on the exposures that the field TLDs might receive on their way to and from their monitoring locations and while in storage, respectively.

The raw data from the field TLD processings is Run Calibration Factor (RCF) corrected using the irradiated control TLD data. The irradiated control TLDs are exposed to 100 mR from a cesium-137 source at the University of Michigan. The irradiated TLDs are accompanied enroute to and from the University of Michigan by transit control TLDs. An estimate of the exposures received by the irradiated TLDs in-transit is obtained by processing the transit controls and determining the transit control mean by the following equation:

$$\overline{E}_{tc} = \frac{\sum_{i=1}^{n} \left[\frac{E_i}{ECF_i} \right]_{tc}}{n}$$

where

$\overline{E}_{tc} =$ the mean of the elementally corrected exposure readings of all the transit control elements.

$E_i =$ the uncorrected exposure reading of each individual transit control element.

ECF_i = the elemental correction factor of each individual transit control element.

n = the total number of individual element exposures averaged.

The mean of the transit control exposures is then subtracted from each of the elementally corrected exposures of the irradiated elements to obtain the net exposures for each element resulting from the irradiation. The mean of these net exposures is then divided by the known exposure (100 mR) from the irradiation to determine the RCF. The following equation describes the calculations performed:

$$RCF = \frac{\left[\dfrac{\sum_{i=1}^{n}\left(\dfrac{E_i}{ECF_i} - \overline{E}_{tc}\right)_{ic}}{n}\right]}{KE_{ic}}$$

where

RCF = the run correction factor for an individual field monitoring element.

E_i = the exposure reading of each individual irradiated control element.

ECF_i = the elemental correction factor of each individual irradiated control element.

n = the total number of individual element exposures averaged.

KE_{ic} = the known exposure for each of the irradiated control elements.

Exposure readings for individual field monitoring elements are corrected using the appropriate mean transit exposure and the elemental and run correction factors as follows:

$$CE_x = \frac{UE_x - \overline{E}_{TC}}{ECF_x \times RCF_x}$$

where

CE_x = the corrected exposure reading for field monitoring element x.

UE_x = the uncorrected exposure reading for field monitoring element x.

ECF_x = the elemental correction factor for field monitoring element x.

$\overline{E}_{TC}$ = mean transit exposure

RCF_x = the run correction factor for field monitoring element x.

NOTE: The mean transit exposure is determined from the elements of the TLDs that accompany the field TLDs during transportation to and from the field locations.

The exposure representing each environmental monitoring location and monitoring period is normally the mean of the corrected exposure readings for a total of six calcium sulfate elements, three from each of two different TLDs at each location. The following equation shows the calculation of this exposure:

$$\overline{E}_c = \frac{\sum_{i=1}^{n} CE_i}{n}$$

where

$\overline{E}_c$ = the mean of the corrected exposure readings for a given monitoring location and period.

CE_i = the corrected exposure reading of an individual element for a given monitoring location and period.

n = the total number of individual element exposures averaged.

The mean of the corrected exposure readings for a given location and period may be calculated using less than the six calcium sulfate elements if the reading from one of the elements is more than two standard deviations from the mean. In this situation, the mean would be recalculated with only five element readings, excluding the element reading that was more than two standard deviations from the originally calculated mean. The mean may be automatically calculated by the dosimetry software with as few as four element readings before the data is flagged. The following calculation is used to determine the standard deviation of the corrected elemental exposure readings:

$$S_{ce} = \sqrt{\frac{\sum_{i=1}^{n} \left(CE_i - \overline{E}_c\right)^2}{n-1}}$$

where

S_{ce} = the standard deviation of the corrected exposure readings from a given monitoring location and period for (n-1) degrees of freedom.

$\bar{E}_c$ = the mean of the corrected exposure readings for a given monitoring location and period.

CE_i = the corrected exposure reading of an individual element for a given monitoring location and period.

n = the total number of individual element exposures averaged.

The standard monitoring period for the reporting of TLD exposures is the calendar quarter. The calendar quarter is defined as a period of 91.25 days. The actual monitoring periods for TLDs in the field are often for times other than 91.25 days. The means of the corrected exposures for these nonstandard periods must be normalized to the standard calendar quarter. The following equation shows how the normalization is performed:

$$NE = \frac{\bar{E}_c \times 91.25}{MP}$$

where

NE = mean corrected exposure normalized to a standard calendar quarter of 91.25 days.

$\bar{E}_c$ = the mean of the corrected exposure readings for a given monitoring location and period.

MP = the actual TLD monitoring period (time in the field) in days.

TLD DATA INTERPRETATION

Pre-operational and operational data are compared for the purpose of determining whether or not TLD data may indicate a dose contribution from SSES operation. Between 1979 and 1994, both TLD types and TLD processing systems changed more than once. In order to avoid possible confusion in data interpretation as a result of these changes, ratios of TLD doses for specific indicator locations to the average of the TLD doses for control locations from operational periods compared to their counterparts from the preoperational period. Comparison of these ratios is performed in lieu of comparing the actual operational and preoperational doses. The following equation shows how these ratios are calculated:

$$r_i = d_i \div \bar{d}_c$$

where

r_i = the indicator-to-control-average dose ratio for a particular location and calendar quarter,

d_i = the quarterly dose for a particular indicator location, and

$\bar{d}_c$ = the average quarterly dose for certain control locations.

Note:

The r_i are the quotients of the indicator doses to the average doses of the following control locations: 3G4, 4G1, 7G1, 12G1, and 12G4. Only these control locations are used because they were the only ones existing during the preoperational period.

Operational r_i for indicator locations that do not have preoperational histories are compared with the range of preoperational control-to-control-average dose ratios (r_c) experienced at control locations. It can be safely assumed that the preoperational range of these r_c at control locations are the result of variations in the levels of background radiation at those locations. Any operational indicator r_i for an indicator location without a preoperational history that is above the uppermost range expected at control locations based on preoperational data is assumed to suggest a possible contribution from the SSES operation. The following equation shows how r_c is calculated:

$$r_c = d_c \div \bar{d}_c$$

where

r_c - is the control-to-control-average dose ratio for a particular location and calendar quarter,

d_c - is the quarterly dose for a particular control location, and

$\bar{d}_c$ - is the average quarterly dose for certain control locations.

Flagging Environmental TLD Measurements for Possible Non-Natural Dose Contributions

Confidence ranges, within which 95% of environmental TLD doses resulting from natural, background radiation are expected to be, have been derived for each location with a preoperational history by multiplying the standard deviation (S) of the r_i for the location by the appropriate t score (t) based on the applicable degrees of freedom for each location. (Degrees of freedom (df) are equal to the number of ratios that were averaged less one.) The product of the t score and the standard deviation (tS) was then subtracted from the mean ($\bar{x}$) to determine the lower end of the 95% confidence range (R) and added to the mean to obtain the upper end of the range (R) as indicated by the following equation:

$$R = \left(\bar{x} - t*S\right) to \left(\bar{x} + t*S\right)$$

The following t scores were used in the range calculations:

t SCORES	
df	**$t_{0.05}$**
1	12.706
2	4.303
3	3.182
4	2.776
5	2.571
6	2.447
7	2.365

For indicator locations with no preoperational history, TLD results are flagged for potential non-natural dose contributions to TLD measurements based on comparisons to the maximum expected variation in control-to-control-average dose ratios (r_c) for control locations. The expected ranges of r_c for each control location for each calendar quarter during the 1980-81 preoperational period have been calculated. The highest expected r_c for all the preoperational control locations is 1.22.
Ratios for indicator locations greater than 1.22 are flagged for possible SSES direct radiation dose contributions.

Calculation of SSES Attributable Direct Radiation Dose based on Onsite Indicator TLD Measurements

For TLD locations where direct radiation dose contributions from the SSES are indicated, these calendar quarter doses are estimated based on the amounts referred to as the excess ratios. Excess ratio for each location's r_i for a particular calendar quarter is the amount by which that r_i exceeds the high end of its range of preoperational r_i . The excess ratio at a specific location is multiplied times both the average dose for control locations measured during that calendar quarter and an occupancy factor based on a reasonable estimate of the portion of the calendar quarter that a MEMBER OF THE PUBLIC might spend near an onsite TLD location. The following is a table of occupancy factors that are used:

Environmental TLD Monitoring Locations	Occupancy Factors
Onsite	4.56E-4
Offsite (other than Private Residences)	3.65E-3
Private Residences	1

The following equation is used for obtaining direct radiation doses attributable to the SSES at indicator TLD locations when preoperational data exists for those locations:

$$D_{SSES}=(r_i-r_u)\times D_{CA}\times OF$$

where

D_{SSES} = the dose attributable to SSES fuel cycle operations,

r_i = the indicator-to-control average ratio for a particular location and calendar quarter,

r_u = the indicator-to-control average ratio corresponding to the upper end of the 95% confidence range for a particular location for the preoperational period, and

D_{CA} = the average quarterly dose for control locations.

OF = the occupancy factor.

The equation below is used for obtaining direct radiation doses attributable to the SSES at indicator locations when preoperational data **does not** exist for those locations:

$$D_{SSES}=(r_i-1.22)\times D_{CA}\times OF$$

where

D_{SSES} = the dose attributable to SSES fuel cycle operations,

r_i = the indicator-to-control average ratio for a particular location and calendar quarter,

1.22 = the highest expected r_c for control locations due to variations in natural radiation levels based on preoperational data. Refer to location 12G4 in Attachment 1.

D_{CA} = the average quarterly dose for control locations.

OF = the occupancy factor.

Each year, the SSES attributable doses calculated for each calendar quarter are summed for all calendar quarters at each location to obtain annual doses by location.

DETERMINATION OF GROSS ALPHA AND/OR GROSS BETA ACTIVITY

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES & PPL'S CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY

Aliquots of water samples are evaporated to near dryness in beakers. The remaining volumes (approximately five milliliters or less) are transferred to stainless steel planchets and evaporated to dryness.

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.

CALCULATION OF THE SAMPLE ACTIVITY

$$\frac{pCi}{unit\ volume\ or\ mass} = \underbrace{\frac{\left[\frac{C}{t} - R_b\right]}{2.22\,(V)(E)}}_{\textbf{net activity}} \pm \underbrace{\frac{2\sqrt{\frac{C}{t} + R_b}{t}}{2.22\,(V)\,(E)}}_{\textbf{random uncertainty}}$$

where: C = total counts for sample

t = count time for sample/background (minutes)

R_b = background count rate of counter (cpm)

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

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

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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 toluene. 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.

CALCULATION OF THE SAMPLE ACTIVITY

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

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 = $\frac{\text{dpm}}{\text{pCi}}$
- 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

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

DETERMINATION OF TRITIUM IN WATER BY LIQUID SCINTILLATION COUNTING

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES & PPL'S CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY

Ten milliliters of water is mixed with liquid scintillation material and counted for typically 200 minutes to determine its activity.

CALCULATION OF THE SAMPLE ACTIVITY FOR TRITIUM

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

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

V = initial volume before enrichment (liters)

E = efficiency of the counter for tritium (cpm/dpm)

Calculation of the MDC

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

*Note that PPL's Corporate Environmental Radioactivity Measurements Laboratory incorporates a decay factor (D) in the denominators of these expressions to account for the small amount of radioactive decay between sample collection and sample counting.

DETERMINATION OF GAMMA EMITTING RADIOISOTOPES

TELEDYNE BROWN ENGINEERING
ENVIRONMENTAL SERVICES

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.

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 Institute of Standards and Technology.

CALCULATION OF THE SAMPLE ACTIVITY

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

net activity random uncertainty

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

Note (1): If the detector exhibits a peak in this region when counting a blank , the counts from that peak are subtracted from C before using the above equation.

Note (2): If no peaks are exhibited, the counts in the channels where the predominant peaks for gammas from selected radionuclides would be expected are summed for C and used in the calculation of "net" activity.

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

Note: If no peak exists in a region from which a "net" activity is being calculated, background is represented by the average of the counts in one channel from each side of that region.

t = counting interval of sample (minutes)

2.22 = dpm/pCi

V = volume or mass of sample analyzed

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

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

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 B used in the two equations may differ.

*The analyst's judgment 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 RADIOSTRONTIUM IN MILK* AND WATER

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Strontium-89/90 analyses may be performed on water samples for PPL. The first step in the preparation of milk and water for analysis is the addition of strontium carrier. The addition of stable strontium facilitates the precipitation of any radioactive strontium that may be present and provides sufficient quantities of strontium to be able to reliably determine the amount of radioactive strontium recovered from the samples for counting.

Subsequent steps in the preparation of both the water and the milk samples for counting involves a number of physical and chemical separations to isolate any radioactive strontium that might be in the samples originally, as well as the stable strontium that is added to the sample aliquots to be analyzed. The isolation removes other metallic elements that may be present in both the water and the milk and organic materials that are present in the milk in significant quantities.

Strontium is precipitated twice, first as strontium nitrate and second as strontium sulfate, in the preparation of the water samples. This permits the removal of radium and other naturally occurring radioactive materials as the result of the first precipitation and iron by way of the second precipitation.

Milk is first evaporated and ashed to remove organic materials. The residue is then redissolved with an aqueous solution of hydrochloric acid and filtered to remove insoluble materials, after which strontium is precipitated as a phosphate to remove other unwanted materials. The phosphate precipitate then is redissolved with an aqueous solution of nitric acid and the resulting solution is passed through a chromatographic column. The strontium is retained on the column, allowing other unwanted material to pass through. The strontium is later removed from the column by passing deionized water through it.

Following all of the purification steps for both water and milk, stable yttrium carrier is added to the purified portions remaining to facilitate the precipitation of any radioactive yttrium-90 that appears in the processed sample from the radioactive decay of strontium-90. The yttrium carrier also aids in the yield determination for yttrium-90. These portions are then allowed to stand for at least five days to permit yttrium-90 ingrowth. After the yttrium-90 ingrowth period, yttrium is precipitated as an oxalate and strontium is precipitated as a carbonate. Each is then collected on separate filter discs for gravimetric yielding and beta counting.

*No milk was analyzed for strontiums 89 and 90 in 2000.

The filter discs are mounted on planchets prior to counting. Strontium-89 activity is determined by counting the strontium planchets while they are covered with 80 mg/cm^2 aluminum absorbers to eliminate interference from the strontium-90 betas. Strontium-90 activity is inferred by counting the yttrium planchets.

CALCULATION OF THE SAMPLE ACTIVITY

$$\frac{pCi}{unit\ volume\ mass} = \frac{\left[\frac{C}{t} - R_b\right] f}{2.22(V)(y_1)(y_2)(DF)(IF)(E)} \pm \frac{2\sqrt{\frac{C}{t} + \frac{R_b}{t}}}{2.22(V)(y_1)(y_2)(DF)(IF)(E)}$$

C = total counts from sample

t = counting time for sample (background)

R_b = background count rate

f = ash fraction (gm ash/gm milk)

V = volume of sample analyzed

y_1 = chemical yield of yttrium

y_2 = chemical yield of strontium

DF = decay factor of yttrium from the milking time to the mid-count time

IF = Ingrowth factor for Y-90 from scavenge time to milking time

E = efficiency of the counter for Y-90

Calculation of the Minimum Detectable Concentration Value

$$MDC = \frac{4.66f\sqrt{\frac{R_b}{t}}}{2.22(V)(y_1)(y_2)(DF)(IF)(E)}$$

CALCULATION OF THE SAMPLE SR-89 ACTIVITY

$$\frac{pCi}{unit\ volume\ (mass)} = \frac{\left[\frac{C}{t} - B_C - B_A\right] f}{2.22(V)(Y_s)(DF_{Sr-89})(E_{Sr-89})} \pm \frac{2f\sqrt{\left[\frac{C}{t} + B_C + B_A\right]/t}}{2.22(V)(Y_s)(DF_{Sr-89})(E_{Sr-89})}$$

where

C	=	total counts from sample
t	=	counting time for sample
B_C	=	background rate of counter using absorber configuration
B_A	=	background addition from Sr-90 and Y-90 ingrowth (cpm)*
f	=	ash fraction (gm ash/gm milk)
V	=	volume of sample analyzed
Y_S	=	chemical yield of strontium
DF_{Sr-89}	=	decay factor from the mid-collection date to the counting date for Sr-89
E_{Sr-89}	=	efficiency of the counter for SR-89 with the 80 mg/cm^2 aluminum absorber

*Note that B_A is a calculated value.

Calculation of the Minimum Detectable Concentration Value

$$MDC = \frac{4.66f\sqrt{\frac{[B_C + B_A]}{t}}}{2.22(V)(Y_s)(DF_{Sr-89})}$$

APPENDIX F

2000 EXCEPTIONS TO THE SSES TECHNICAL REQUIREMENTS SAMPLE SCHEDULE, METHODS AND ANALYSIS SENSITIVITIES

Exceptions to the SSES Technical Requirements occurred in the monitoring of the following media: surface water, drinking water, air, milk, fish, and ambient radiation levels. These exceptions involved sample collections that did not take place for the required periods, sampling that was performed in a manner not stated in the Technical Requirements, and sample analysis sensitivities that did not meet the Technical Requirements. Generally, they were caused by the following:

- Equipment malfunctions;
- Events taking place in the vicinity of monitoring stations that interfered in some way with the normal course of sampling;
- Facility and personnel changes at the contracted radioanalytical laboratory responsible for performing the majority of primary analyses, and
- Limitations in the rate of sample throughput at PPL Susquehanna LLC's Corporate Environmental Radioactivity Measurements Laboratory (CERML).

These exceptions are discussed in this appendix and specifically documented in the tables of Appendix I.

Surface Water

Monitoring at control location 6S6, the SSES River Water Intake Structure, and indicator location 2S7 or its alternate location 6S7, the SSES Cooling Tower Blowdown Discharge (CTBD) to the Susquehanna River, are the only environmental surveillances of surface water required by SSES Technical Specifications. The other SSES REMP routine indicator surface water monitoring location on the Susquehanna River, which is downstream from the SSES discharge to the river, and the monitoring location at LTAW are not required. They have been monitored to provide added assurance that the environment is not being compromised by radiological releases resulting from the SSES operation.

Sampling at locations 6S6 and 2S7 or 6S7 is required to be performed by the collection of aliquots at time intervals that are small compared to the compositing period. Composite samples from these locations are required to be analyzed monthly and are expected to be representative of the streams from which they are collected.

Problems occurred in 2000 with the automatic composite sampler (ACS) at sampling location 6S6 during portions of the following weekly collection periods: January 31 through February 28, February 28 through March 27, and May 30 through June 26. During the sampling intervals February 24 through February 28 and June 12 through June 19, the volumes of aliquots were found to be decreasing. These occurrences were believed to be the result of high river levels and increased amounts of debris in the river water. These conditions can lead to clogging of the line supplying water to the ACS at this location. Valve adjustments are used when practical to increase the flow rate of water to the ACS. Monthly, the ACS at location 6S6 was deliberately

removed from service for brief periods to permit performing preventative maintenance on the sampler. During this maintenance, cleaning of the line is performed to eliminate clogs. During the sampling interval from March 9 through March 13, more than the normal amount of water was collected by the ACS. The reason for the collection of extra water appeared to be dripping of water into the ACS's collection container between sample aliquots. Adjustments in valves were made, followed by the performance of maintenance on the ACS on March 16. After March 13, no extra water was observed being collected.

The ACS at monitoring location 6S6 operated routinely (as expected) for approximately 96% of 2000. No malfunctions of the ACS at monitoring location 6S6 required the collection of grab samples during 2000.

Monitoring at location 2S7 in 2000 was considered to be very good. One grab sample was collected at this location during the entire year. This sample was collected on June 19 to represent the sampling week from June 12 through June 19. The ACS collection container overflowed some time during this week. The ACS was observed to be collecting water continuously, instead of once every 25 minutes as originally programmed, on June 16. Plant staff personnel were unable to correct the condition at the time the problem was discovered. The ACS was reset on June 19 by REMP sampling personnel.

The only other instances of non-routine operation by the ACS at location 2S7 were during the monthly compositing periods from December 28, 1999 through January 31, 2000 and from May 1 through May 30, 2000. Four aliquots of sample were recorded as having been missed on January 17. One or more aliquots may have been missed on May 7. However, 404 aliquots were actually collected during the seven-day period from May 1 through May 8. Slightly more than 400 aliquots would be expected to be collected during a normal sampling week based on the ACS's programming. The loss of four aliquots during a sampling week corresponds to lost monitoring time of less than two hours. The ACS at monitoring location 2S7 operated routinely (as expected) for approximately 98% of 2000.

All required analyses were performed on surface water samples composited at the required frequencies from locations 6S6 and 2S7 during 2000. However, required analysis sensitivities were not always met. Normally, all required analysis sensitivities are achieved for these samples. Nevertheless, analysis sensitivities were missed on 16 occasions out of 288 required during 2000. Consequently, required analysis sensitivities were achieved for 94% of the required analyses.

Five of the 16 analysis sensitivities were missed for samples composited for September 2000 (8/28/00 - 9/25/00) from monitoring locations 6S6 and 2S7. These samples were shipped to Teledyne Brown Engineering's (TBE's) laboratory in Westwood, NJ for analysis near the end of September 2000. As discussed in Appendix A, at the end of September, TBE moved its laboratory from Westwood, NJ to Knoxville, TN. September's water samples were never analyzed by TBE in Knoxville. These samples were analyzed in January 2001 by Environmental Inc.'s Midwest Lab. The delay on analyzing these samples caused the MDCs to be raised above the required analysis sensitivities.

Eleven of the 16 analysis sensitivities were missed for analyses performed by PPL Susquehanna LLC's CERML. These were analyses of samples collected between October and December 2000. As discussed in Appendix A, CERML replaced TBE's facility in Westwood, NJ, as the primary laboratory for the performance of the analyses of record for these samples during the first nine months of the year. CERML's limited number of gamma detectors (2) made it very difficult to ensure that it would consistently achieve these required analysis sensitivities. The number of gamma analyses required of CERML from October through December, the long count times needed for these analyses, and the availability of only two detectors tended to produce long decay times between sample collection and analysis. These long decay times had a direct impact on the ability to achieve the analysis sensitivities required, especially for shorter-lived radionuclides.

The 16 instances of missed analysis sensitivities during 2000 are identified by monitoring location, monitoring period, and radionuclides in the table below.

Monitoring Location	Monitoring Period	Radionuclides
6S6	8/28/00 - 9/25/00	Nb-95, Ba-140, & La-140
2S7	8/28/00 - 9/25/00	Ba-140 & La-140
6S6	9/25/00 - 10/30/00	Nb-95 & La-140
2S7	9/25/00 - 10/30/00	Ba-140 & La-140
6S6	10/30/00 - 11/27/00	Ba-140 & La-140
2S7	10/30/00 - 11/27/00	La-140
6S6	11/27/00 - 12/26/00	Ba-140 & La-140
2S7	11/27/00 - 12/26/00	Ba-140 & La-140

As discussed in Appendix A, in mid-December 2000, REMP water samples began to be analyzed for I-131 activity and the activities of gamma-emitting radionuclides at Environmental Inc.'s Midwest Lab in Northbrook, Illinois. The data reported by the Midwest Lab were intended to be the primary results for the analyses of gamma-emitting radionuclides in surface water samples collected from monitoring locations 6S6 and 2S7 for the following monitoring periods: August 28 through September 25 and November 27 through December 26, 2000. However, it was determined that the gamma analyses performed by the Midwest Lab for these samples did not include niobium-95 in the library of radionuclides for which identifications and measurements were made. Consequently, CERML's analysis results for these samples were used, since the CERML library contained niobium-95. This decision was made to ensure that the reported data included the results of analyzing for niobium-95. SSES Technical Requirements for radiological environmental monitoring provide both a required monitoring sensitivity for niobium-95 as well as a Reporting Level that is based on quarterly average activity concentrations for both niobium-95 and zirconium-95. Consequently, data that include analysis results for both of these radionuclides is preferred over data which contain results for only one of these radionuclides.

Drinking Water

The flow of water to the automatic composite sampler (ACS) at monitoring location 12H2T, the Danville Municipal Drinking Water Facility, was found to have been stopped on the following days during 2000: January 24, January 27, March 20, and March 27. The valve in the supply line to the ACS was closed. On all three occasions, the ACS's collection container was full and may have overflowed prior to the valve being shut off. Danville Water Authority personnel had performed maintenance activities at the facility during the sampling weeks March 13 through March 20 and March 20 through March 27. With the exception of January 27, the ACS appeared to perform well when tested following the discovery of the non-sampling conditions. The ACS appeared to have been returned to normal operation on each occasion. However, on January 29, repairs were made to the ACS. Grab samples were collected on January 24 and 31 and composited and on March 20 and 27 and composited.

The ACS's solenoid arm malfunctioned due to a broken pin during the sampling week April 17 through April 24. Repairs were made to the ACS on April 24 and it was returned to service the same day. A grab sample was collected on April 24. These were the only instances in 2000 when the ACS was not operating as expected. The ACS operated routinely (as expected) for approximately 90% of 2000. However, because of the number of problems encountered, it was decided to replace the old ACS at this monitoring location. A new ACS was purchased in December 2000. The new ACS was installed in January 2001 and is expected to have been tested and to be fully operational by the middle of 2001.

All required analyses were performed on drinking water samples composited at the required frequencies from location 12H2T during 2000. However, required analysis sensitivities were not always met. Normally, all required analysis sensitivities are achieved for these samples in a given monitoring year. Nevertheless, analysis sensitivities were missed on nine occasions out of 156 required during 2000. Consequently, required analysis sensitivities were achieved for approximately 94% of the required analyses.

Two of the nine analysis sensitivities were missed for samples composited for September 2000 (8/28/00 - 9/25/00). These samples were shipped to Teledyne Brown Engineering's (TBE's) laboratory in Westwood, NJ for analysis near the end of September 2000. As discussed in Appendix A, at the end of September, TBE moved its laboratory from Westwood, NJ to Knoxville, TN. September's water samples were never analyzed by TBE in Knoxville. These samples were analyzed in January 2001 by Environmental Inc.'s Midwest Lab. The delay in analyzing these samples caused the MDCs to be raised above the required analysis sensitivities.

Seven of the nine analysis sensitivities were missed for analyses performed by PPL Susquehanna LLC's CERML. These were analyses of samples collected during October and November 2000. As discussed in Appendix A, CERML replaced TBE's facility in Westwood, NJ, as the primary laboratory for the performance of the analyses of record for these samples during the first nine months of the year. CERML's limited number of gamma detectors (2) made it very difficult to ensure that it would consistently achieve these required analysis sensitivities. The number of gamma analyses required of CERML during October and November, the long count times

needed for these analyses, and the availability of only two detectors tended to produce long decay times between sample collection and analysis. These long decay times had a direct impact on the ability to achieve the analysis sensitivities required, especially for shorter-lived radionuclides.

The nine instances of missed analysis sensitivities at location 12H2T during 2000 are identified by monitoring period and radionuclides in the table below.

Monitoring Period	Radionuclides
8/28/00 - 9/25/00	Ba-140 & La-140
9/25/00 - 10/30/00	Nb-95, Ba-140, & La-140
10/30/00 - 11/27/00	Ba-140 & La-140
11/27/00 - 12/26/00	Ba-140 & La-140

In December 2000, REMP water samples began to be analyzed for I-131 activity and the activities of gamma-emitting radionuclides at Environmental Inc.'s Midwest Lab in Northbrook, Illinois. The data reported by the Midwest Lab were intended to be the primary results for the analyses of gamma-emitting radionuclides in drinking water samples for the following monitoring periods: August 28 through September 25 and November 27 through December 26, 2000. However, it was determined that the gamma analyses performed by the Midwest Lab for these samples did not include niobium-95 in the library of radionuclides for which identifications and measurements were made. Consequently, CERML's analysis results for these samples were used, since the CERML library contained niobium-95. This decision was made to ensure that the reported data included the results of analyzing for niobium-95. SSES Technical Requirements for radiological environmental monitoring provide both a required monitoring sensitivity for niobium-95 as well as a Reporting Level that is based on quarterly average activity concentrations for both niobium-95 and zirconium-95. Consequently, data that include analysis results for both of these radionuclides is preferred over data which contain results for only one of these radionuclides.

Air

Reasons for exceptions to REMP air sampling and analyses during 2000 included the following: improper placement of a particulate filter on an air sampling head, malfunction of a sampling pump, loss of electrical power to air sampling stations, failure to load a charcoal cartridge into an air sampling head, and an algorithm problem with gamma spectroscopic software used in the analyses of charcoal cartridges.

During the monitoring period from December 28, 1999 through January 5, 2000 at air monitoring location 12E1, a particulate filter was mispositioned on the air sampling head. This allowed a portion of the air flowing through the sampling head to bypass the filter. Thus, some particulates would not have had the opportunity to be deposited on the filter. The gross beta activity on this filter was observed to be low, and the gamma activity of the composite sample that included this filter was also reduced. This event was reviewed with sample collection personnel to remind them to carefully check the position of the filter within the air sampling head prior to installing it in the field.

Air sampling was interrupted once in 2000 due to a problem with an air sampling pump. This occurred at air sampling location 3S2 during the scheduled monitoring period from January 5 through January 12. The problem was discovered on January 12 when personnel arrived to exchange a new sampling head for an old one. About half the normal volume of air was sampled based on the indication of the dry gas meter used to measure sample volume. Based on the observed sample volume, it is estimated that sampling stopped on January 8. Consequently, there was a period of about four days when monitoring was not being performed. The malfunctioning pump was promptly replaced and monitoring was resumed on January 12.

Electrical power to the air sampling stations at monitoring locations 3S2, 5S4, and 7S7 was interrupted for approximately 30 minutes during the scheduled monitoring period from April 25 through May 2, 2000. This apparently was the result of a local power outage that occurred on April 26. Brief interruptions in sampling normally occur during the retrieval of filters and charcoal cartridges or the normal, planned maintenance and upkeep of the sampling equipment at the beginnings and ends of sampling periods. These interruptions are unavoidable.

Iodine-131 was not monitored for from October 4 through October 11, 2000 at location 3S2. This occurred because of the unintentional omission of a charcoal cartridge from an air sampling head. Changes in the process for preparing sampling heads for installation in the field have been made to prevent future occurrences. Changes to the air sampling procedure also will be made by the end of April 2001 as the result of this occurrence.

Collectively, the air sampling equipment at the ten air monitoring locations operated routinely (as expected) for more than 99% of 2000 in spite of the exceptions noted above.

Required analysis sensitivities for gross beta analyses were met in all instances during 2000. However analysis sensitivities for iodine-131 were not met for three analyses out of 520 analyses during 2000. These analyses were performed by PPL Susquehanna LLC's CERML. They were retrieved as follows: from monitoring locations 5S4 and 10S3 for the monitoring period October 11 through October 18 and monitoring location 6G1 for the monitoring period from November 1 through November 8. These exceptions occurred because of a problem with an algorithm in the software of CERML's gamma spectrometry system that is used for determining backgrounds in different regions of the energy spectrum. New software for this gamma spectrometry system has been purchased. Implementation of this new software is expected to eliminate this problem.

Milk

All required milk samples were collected during 2000. However, all milk samples collected were not analyzed, and all required analysis sensitivities were not met. Milk samples collected from milk monitoring locations 10D1 and 10D2 on April 24, 2000 were lost during shipment to the contracted REMP radioanalytical laboratory. The loss of samples during shipment is a rare occurrence.

Required analysis sensitivities for iodine-131 were not met for eight out of 74 analyses that were performed during 2000. These analyses were performed using the gamma spectrometry system of PPL Susquehanna LLC's CERML. In addition, the required analysis sensitivities for eight out of 74 gamma analyses of Ba-140 and 10 out of 74 gamma analyses of La-140 also were not met. The actual sampling locations and sampling dates for which these analyses were performed are listed in the table below.

Monitoring Locations	Sampling Date	Radionuclides
10G1, 10D1, 10D2 & 10D3	7/25/00	Ba-140 & La-140
10G1, 10D1, 10D2 & 10D3	9/22/00	Ba-140 & La-140
10G1, 10D1, 10D2, & 10D3	11/6/00	I-131
10G1 & 10D1	12/4/00	I-131 & La-140
10D2 & 10D3	12/4/00	I-131

As discussed in Appendix A, CERML replaced TBE's facility in Westwood, NJ, as the primary laboratory for the performance of the analyses of record for these samples during the first nine months of the year. CERML's limited number of gamma detectors (2) made it very difficult to ensure that it would consistently achieve these required analysis sensitivities. The number of gamma analyses required of CERML from October through December, the long count times needed for these analyses, and the availability of only two detectors tended to produce long decay times between sample collection and analysis. These long decay times had a direct impact on the ability to achieve the analysis sensitivities required, especially for shorter-lived radionuclides.

Fish

The only exception during 2000 was that the required interval between successive semi-annual sampling events of Channel Catfish at monitoring location IND was exceeded. The interval between successive sampling events can not be greater than 224 days. The actual interval was 225 days between the sampling on June 7, 2000 and the previous sampling event on October 26, 1999. Higher river levels during April and May 2000 prevented the safe collection of fish during those months and were a factor that contributed to the occurrence of this exception. Sampling personnel were reminded of the importance of not exceeding this requirement and to exercise due diligence to prevent future occurrences.

Ambient Radiation Levels

Exceptions occurred to the monitoring of ambient radiation during the first quarterly monitoring period of 2000 at two of the 40 monitoring locations required by SSES Technical Requirements. The locations involved were 1S2 and 6S9. The first quarterly monitoring period for these locations extended from January 11 through April 11, 2000. At the end of this monitoring period the TLDs at these locations were found on the ground. The bottoms had fallen out of the containers in which the TLDs were placed. The reason for the bottoms falling out of these containers is unknown. The period of time that the TLDs were on the ground is also indeterminate. TLDs should be positioned at approximately one meter above the ground. The effect on the quarterly TLD exposures recorded at those locations for the first quarter is not

discernable. Nearly 99% of the 160 required quarterly ambient radiation level measurements were made with TLDs appropriately positioned.

APPENDIX G

2000 SSES REMP SUMMARY OF DATA

The averages for indicator and control locations reported in the Summary of Data Table, which summarizes the entire year's results for the SSES REMP, were calculated using all measured values, when available, whether or not they were reported in Appendix I tables. Values below the MDCs, even zeroes and negatives, were part of the averaging process for these analysis results. It should be noted that all measured results were not available for primary gamma analyses performed by PPL's CERML during October, November, and part of December 2000. This lab's gamma spectrometric software did not permit measured results less than the MDCs to be reported.

Preferably, the averages reported in the Summary of Data table for sample media that are normally collected continuously are determined using only results from continuously collected samples. Occasionally, grab samples are taken for these media when equipment malfunctions or other anomalies preclude or otherwise perturb routine continuous sampling. These grab samples are taken to minimize the time periods when no sampling is being performed, or, in some instances, when continuous sampling is considered to be nonrepresentative.

Because grab samples are snapshots of the media over brief periods, it is preferable not to average the analysis results of these samples with those for continuously collected composite samples. However, when equipment malfunctions are protracted, relatively large periods of time could be entirely unrepresented by averages if the results from grab sample analyses are not considered.

Allowing analysis results for grab samples to be weighted equally with those representing relatively large periods of time would tend to bias the resulting averages unjustifiably towards the conditions at the times that the grabs are obtained. Averages obtained in this way might less accurately reflect the conditions for the combined period of continuous sampling and grab sampling than if only the results from continuous sampling were used. On the other hand, using weighting factors for the analysis results of grab samples derived from the actual time it takes to collect those samples would lead to the grab sample analysis results having a negligible effect on the overall average and not justifying the effort involved.

Grab samples collected in lieu of normal continuous sampling are typically obtained at regular intervals corresponding to the intervals (weekly) at which the continuously collected samples would usually be retrieved for eventual compositing. For example, grab samples are collected once a week but may be composited monthly in place of continuously collected samples that would normally be retrieved weekly and composited monthly. Since each grab sample is used to represent an entire week, albeit imperfect, it is reasonable to weight the analysis results the same. Thus, the results of one weekly grab are given approximately one-fourth the weight of the results for a monthly composite sample collected continuously for each of the four weeks in a month. Similarly, the analysis results of a composite of four weekly grab samples would carry the same weight as the analysis results for a composite of four weeks of continuously collected sample.

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to January 17, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION			MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Ambient Radiation (mR/std. qtr.)	TLD	336		1.97E+01 (305) (1.25E+01 - 4.62E+01)	9S2 0.2	mi	S	3.90E+01 (4) (3.49E+01 - 4.62E+01)	1.91E+01 (31) (1.40E+01 - 2.52E+01)	0
Surface Water (pCi/l)	Gross Beta	50	4	5.31E+00 (38) (-1.60E+00 - 2.44E+01)	2S7 0.1	mi	NNE	9.27E+00 (14) (3.28E+00 - 2.44E+01)	2.80E+00 (12) (-4.93E-01 - 7.56E+00)	0
	Tritium	50	2000	7.64E+02 (38) (-2.97E+01 - 8.52E+03)	2S7 0.1	mi	NNE	2.17E+03 (14) (-2.97E+01 - 8.52E+03)	4.51E+01 (12) (-5.93E+01 - 1.25E+02)	0
	Iodine-131	74	1	3.50E-01 (52) (-2.00E-02 - 2.00E+00)	2S7 0.1	mi	NNE	6.40E-01 (21) (6.80E-02 - 1.90E+00)	3.90E-01 (22) (-8.10E-02 - 1.40E+00)	0
	Gamma Spec									
	K-40	33		1.93E+01 (26) (-1.70E+02 - 5.23E+02)	6S5 0.9	mi	ESE	1.03E+02 (8) (-9.50E+01 - 5.23E+02)	-3.45E+01 (7) (-7.70E+01 - -1.60E-01)	0
	Mn-54	33	15	2.26E-01 (26) (-5.30E+00 - 2.20E+00)	2S7 0.1	mi	NNE	5.55E-01 (9) (-2.10E+00 - 1.80E+00)	1.57E-01 (7) (-5.60E-01 - 9.20E-01)	0
	Co-58	33	15	2.13E-02 (26) (-1.60E+00 - 1.40E+00)	LTAW on site		NE-ESE	2.98E-01 (9) (-5.14E-01 - 1.30E+00)	-3.73E-01 (7) (-1.30E+00 - 4.90E-01)	0
	Fe-59	33	30	4.39E-01 (26) (-3.80E+00 - 4.30E+00)	LTAW on site		NE-ESE	1.76E+00 (9) (4.30E-01 - 4.30E+00)	2.77E-01 (7) (-5.00E-01 - 1.50E+00)	0
	Co-60	33	15	4.23E-01 (26) (-1.90E+00 - 2.80E+00)	2S7 0.1	mi	NNE	8.17E-01 (9) (-1.90E+00 - 2.80E+00)	7.85E-01 (7) (-2.00E-01 - 1.70E+00)	0
	Zn-65	33	30	5.80E-01 (26) (-1.23E+01 - 4.60E+00)	LTAW on site		NE-ESE	7.56E-01 (9) (-3.59E+00 - 4.50E+00)	7.35E-01 (7) (-1.40E+00 - 2.20E+00)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to January 17, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Surface Water (cont.) (pCi/l)	Zr-95	33	30	1.55E+00 (26) (-2.90E+00 - 7.60E+00)	2S7 0.1 mi NNE	1.96E+00 (9) (-2.90E+00 - 7.60E+00)	-3.38E+00 (7) (-1.30E+01 - 2.90E+00)	0
	Nb-95	33	15	1.27E+00 (26) (-2.00E+00 - 5.54E+00)	6S5 0.9 mi ESE	2.31E+00 (8) (2.20E-01 - 5.54E+00)	1.05E+00 (7) (1.90E-01 - 1.80E+00)	0
	Cs-134	33	15	2.04E-02 (26) (-1.07E+01 - 9.40E+00)	LTAW on site NE-ESE	1.34E+00 (9) (-1.20E+00 - 9.40E+00)	4.97E-01 (7) (-3.10E-01 - 1.30E+00)	0
	Cs-137	33	18	1.18E+00 (26) (-3.00E+00 - 4.30E+00)	LTAW on site NE-ESE	1.70E+00 (9) (2.00E-01 - 4.26E+00)	7.65E-01 (7) (-9.50E-01 - 2.90E+00)	0
	Ba-140	33	60	1.47E+00 (26) (-1.30E+01 - 4.96E+01)	LTAW on site NE-ESE	3.71E+00 (9) (-8.00E+00 - 4.96E+01)	-1.84E+00 (7) (-4.40E+00 - 3.20E+00)	0
	La-140	33	15	-6.56E-01 (26) (-5.20E+00 - 5.70E+00)	LTAW on site NE-ESE	6.37E-01 (9) (-2.30E+00 - 5.70E+00)	1.96E-01 (7) (-1.50E+00 - 4.10E+00)	0
	Sr-89	2		-1.26E+00 (2) (-4.80E+00 - -3.80E-01)	2S7 0.1 mi NNE	-1.26E+00 (2) (-4.80E+00 - -3.80E-01)	(0) (0.00E+00 - 0.00E+00)	0
	Sr-90	2		2.82E-01 (2) (2.20E-01 - 5.30E-01)	2S7 0.1 mi NNE	2.82E-01 (2) (2.20E-01 - 5.30E-01)	(0) (0.00E+00 - 0.00E+00)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION			MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Potable Water (pCi/l)	Gross Alpha	16		5.56E-01 (16) (-1.90E-01 - 2.03E+00)	12H2T 26	mi	WSW	5.56E-01 (16) (-1.90E-01 - 2.03E+00)	Only indicator stations sampled for this medium.	0
	Gross Beta	16	4	3.35E+00 (16) (1.30E+00 - 1.25E+01)	12H2T 26	mi	WSW	3.35E+00 (16) (1.30E+00 - 1.25E+01)		0
	Iodine-131	23	1	1.94E-01 (23) (-4.33E-01 - 7.00E-01)	12H2T 26	mi	WSW	1.94E-01 (23) (-4.33E-01 - 7.00E-01)		0
	Tritium	16	2000	5.39E+01 (16) (-3.14E+01 - 1.36E+02)	12H2T 26	mi	WSW	5.39E+01 (16) (-3.14E+01 - 1.36E+02)		0
	Gamma Spec									
	K-40	11		-2.20E+01 (11) (-6.90E+01 - 1.40E+01)	12H2T 26	mi	WSW	-2.20E+01 (11) (-6.90E+01 - 1.40E+01)		0
	Mn-54	11	15	8.45E-01 (11) (-8.70E-02 - 2.30E+00)	12H2T 26	mi	WSW	8.45E-01 (11) (-8.70E-02 - 2.30E+00)		0
	Co-58	11	15	2.87E-01 (11) (-1.10E+00 - 1.50E+00)	12H2T 26	mi	WSW	2.87E-01 (11) (-1.10E+00 - 1.50E+00)		0
	Fe-59	11	30	3.88E-02 (11) (-2.60E+00 - 2.60E+00)	12H2T 26	mi	WSW	3.88E-02 (11) (-2.60E+00 - 2.60E+00)		0
	Co-60	11	15	-4.13E-01 (11) (-1.40E+00 - 1.20E+00)	12H2T 26	mi	WSW	-4.13E-01 (11) (-1.40E+00 - 1.20E+00)		0
	Zn-65	11	30	5.96E-01 (11) (-4.20E+00 - 2.80E+00)	12H2T 26	mi	WSW	5.96E-01 (11) (-4.20E+00 - 2.80E+00)		0
	Zr-95	11	30	6.75E-01 (11) (-1.10E+01 - 4.50E+00)	12H2T 26	mi	WSW	6.75E-01 (11) (-4.20E+00 - 4.50E+00)		0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION			MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Potable Water (cont) (pCi/l)	Nb-95	11	15	1.59E+00 (11) (1.80E-01 - 2.90E+00)	12H2T 26	mi	WSW	1.59E+00 (11) (1.80E-01 - 2.90E+00)	Only indicator stations sampled for this medium.	0
	Cs-134	11	15	2.11E-01 (11) (-3.00E+00 - 1.00E+00)	12H2T 26	mi	WSW	2.11E-01 (11) (-3.00E+00 - 1.00E+00)		0
	Cs-137	11	18	9.04E-01 (11) (-1.30E+00 - 2.10E+00)	12H2T 26	mi	WSW	9.04E-01 (11) (-1.30E+00 - 2.10E+00)		0
	Ba-140	11	60	-1.43E+00 (11) (-4.20E+00 - 3.50E+00)	12H2T 26	mi	WSW	-1.43E+00 (11) (-4.20E+00 - 3.50E+00)		0
	La-140	11	15	4.20E-01 (11) (-1.50E+00 - 7.00E+00)	12H2T 26	mi	WSW	4.20E-01 (11) (-1.50E+00 - 7.00E+00)		0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION			MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Fish	Gamma Spec									
(pCi/kg wet)	K-40	13		3.38E+03 (7) (3.06E+03 - 3.69E+03)	LTAW on site		NE-ESE	3.59E+03 (1) (3.59E+03 - 3.59E+03)	3.42E+03 (6) (2.94E+03 - 4.09E+03)	0
	Mn-54	6	130	2.27E+00 (3) (-5.10E+00 - 1.00E+01)	IND 0.9-1.4	mi	ESE	2.27E+00 (3) (-5.10E+00 - 1.00E+01)	-2.43E+00 (3) (-8.90E+00 - 1.60E+00)	0
	Co-58	6	130	6.07E+00 (3) (0.00E+00 - 1.60E+01)	IND 0.9-1.4	mi	ESE	6.07E+00 (3) (0.00E+00 - 1.60E+01)	-7.57E-01 (3) (-5.00E+00 - 1.80E+00)	0
	Fe-59	6	260	4.53E+00 (3) (-8.40E+00 - 2.20E+01)	2H 30	mi	NNE	4.80E+00 (3) (-3.00E+00 - 1.40E+01)	4.80E+00 (3) (-3.00E+00 - 1.40E+01)	0
	Co-60	6	130	-5.33E-01 (3) (-4.00E+00 - 4.10E+00)	2H 30	mi	NNE	3.03E+00 (3) (-9.20E+00 - 1.20E+01)	3.03E+00 (3) (-9.20E+00 - 1.20E+01)	0
	Zn-65	6	260	-6.93E+00 (3) (-1.40E+01 - 2.90E+00)	2H 30	mi	NNE	1.60E+01 (3) (-1.70E+01 - 5.30E+01)	1.60E+01 (3) (-1.70E+01 - 5.30E+01)	0
	Zr-95	6		1.70E+00 (3) (-1.60E+01 - 1.30E+01)	2H 30	mi	NNE	1.20E+01 (3) (1.70E+00 - 2.70E+01)	1.20E+01 (3) (1.70E+00 - 2.70E+01)	0
	Nb-95	6		4.87E+00 (3) (-5.80E+00 - 1.10E+01)	IND 0.9-1.4	mi	ESE	4.87E+00 (3) (-5.80E+00 - 1.10E+01)	3.67E+00 (3) (-1.30E+01 - 1.30E+01)	0
	Cs-134	6	130	1.67E-01 (3) (-9.90E+00 - 5.50E+00)	2H 30	mi	NNE	4.01E+00 (3) (8.40E-01 - 9.00E+00)	4.01E+00 (3) (8.40E-01 - 9.00E+00)	0
	Cs-137	6	150	1.41E+01 (3) (6.90E+00 - 2.70E+01)	IND 0.9-1.4	mi	ESE	1.41E+01 (3) (6.90E+00 - 2.70E+01)	1.87E+00 (3) (-1.30E+01 - 9.40E+00)	0
	Ba-140	6		3.20E+01 (3) (-4.10E+00 - 6.00E+01)	IND 0.9-1.4	mi	ESE	3.20E+01 (3) (-4.10E+00 - 6.00E+01)	9.70E+00 (3) (-1.20E+00 - 2.70E+01)	0
	La-140	6		2.33E+00 (3) (-1.10E+01 - 1.80E+01)	IND 0.9-1.4	mi	ESE	2.33E+00 (3) (-1.10E+01 - 1.80E+01)	2.17E+00 (3) (-1.50E+01 - 1.40E+01)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Sediment	Gamma Spec						
(pCi/kg dry)	Be-7	8	2.48E-01 (6) (5.12E-02 - 5.40E-01)	7B 1.2 mi SE	3.02E-01 (2) (6.40E-02 - 5.40E-01)	2.70E-01 (2) (8.38E-02 - 4.57E-01)	0
	K-40	8	7.71E+03 (6) (3.85E+03 - 1.19E+04)	LTAW on site NE-ESE	9.43E+03 (2) (6.96E+03 - 1.19E+04)	8.01E+03 (2) (5.82E+03 - 1.02E+04)	0
	Mn-54	4	4.63E+00 (3) (-3.40E+00 - 1.50E+01)	LTAW on site NE-ESE	1.50E+01 (1) (1.50E+01 - 1.50E+01)	7.20E+00 (1) (7.20E+00 - 7.20E+00)	0
	Co-58	4	-8.23E+00 (3) (-1.40E+01 - -2.40E+00)	12F 6.9 mi WSW	-2.40E+00 (1) (-2.40E+00 - -2.40E+00)	-1.50E+01 (1) (-1.50E+01 - -1.50E+01)	0
	Fe-59	4	3.30E+01 (3) (3.20E+01 - 3.40E+01)	2B 1.6 mi NNE	5.30E+01 (1) (5.30E+01 - 5.30E+01)	5.30E+01 (1) (5.30E+01 - 5.30E+01)	0
	Co-60	4	7.53E+00 (3) (-2.20E+00 - 1.50E+01)	12F 6.9 mi WSW	1.50E+01 (1) (1.50E+01 - 1.50E+01)	0.00E+00 (1) (0.00E+00 - 0.00E+00)	0
	Zn-65	4	3.40E+01 (3) (-3.90E+01 - 1.40E+02)	7B 1.2 mi SE	1.40E+02 (1) (1.40E+02 - 1.40E+02)	-2.50E+01 (1) (-2.50E+01 - -2.50E+01)	0
	Zr-95	4	3.93E+01 (3) (-3.20E+01 - 8.60E+01)	12F 6.9 mi WSW	8.60E+01 (1) (8.60E+01 - 8.60E+01)	-6.10E+01 (1) (-6.10E+01 - -6.10E+01)	0
	Nb-95	4	4.73E+01 (3) (4.40E+01 - 5.20E+01)	12F 6.9 mi WSW	5.20E+01 (1) (5.20E+01 - 5.20E+01)	3.00E+01 (1) (3.00E+01 - 3.00E+01)	0
	Cs-134	4 150	3.97E+01 (3) (2.70E+01 - 5.40E+01)	LTAW on site NE-ESE	5.40E+01 (1) (5.40E+01 - 5.40E+01)	4.00E+01 (1) (4.00E+01 - 4.00E+01)	0
	Cs-137	7 180	3.45E+01 (5) (-4.20E+00 - 9.27E+01)	2B 1.6 mi NNE	6.42E+01 (2) (3.18E+01 - 9.65E+01)	6.42E+01 (2) (3.18E+01 - 9.65E+01)	0
	Ba-140	4	-4.43E+01 (3) (-7.90E+01 - 7.00E+00)	2B 1.6 mi NNE	8.00E+01 (1) (8.00E+01 - 8.00E+01)	8.00E+01 (1) (8.00E+01 - 8.00E+01)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Sediment (cont)	La-140 4		-9.07E+01 (3)	2B	3.20E+01 (1)	3.20E+01 (1)	0
(pCi/kg dry)			(-1.20E+02 - -4.20E+01)	1.6 mi NNE	(3.20E+01 - 3.20E+01)	(3.20E+01 - 3.20E+01)	
	Ra-226 7		1.21E+03 (5)	12F	1.78E+03 (1)	9.70E+02 (2)	0
			(3.95E+02 - 1.78E+03)	6.9 mi WSW	(1.78E+03 - 1.78E+03)	(6.00E+02 - 1.34E+03)	
	Th-228 5		9.49E+02 (3)	7B	1.04E+03 (1)	8.27E+02 (2)	0
			(7.98E+02 - 1.04E+03)	1.2 mi SE	(1.04E+03 - 1.04E+03)	(7.17E+02 - 9.37E+02)	
Ground Water	Gamma Spec						
(pCi/l)	K-40 49		-7.78E+00 (39)	2S2	3.50E+01 (10)	5.15E+00 (10)	0
			(-2.30E+02 - 6.04E+02)	0.9 mi NNE	(-2.00E+02 - 6.04E+02)	(-2.20E+02 - 2.76E+02)	
	Mn-54 49	15	4.04E-01 (39)	4S5	1.04E+00 (9)	4.72E-01 (10)	0
			(-1.60E+00 - 3.10E+00)	0.5 mi ENE	(-3.00E-01 - 3.10E+00)	(-3.10E+00 - 3.10E+00)	
	Co-58 49	15	-5.44E-01 (39)	4S4	-3.52E-01 (10)	-4.92E-01 (10)	0
			(-2.00E+00 - 1.36E+00)	0.5 mi ENE	(-1.50E+00 - 7.70E-01)	(-1.40E+00 - 1.10E+00)	
	Fe-59 49	30	2.97E-01 (39)	12F3	1.06E+00 (10)	1.06E+00 (10)	0
			(-8.60E+00 - 6.90E+00)	5.2 mi WSW	(-4.80E-01 - 4.80E+00)	(-4.80E-01 - 4.80E+00)	
	Co-60 49	15	1.04E-01 (39)	12S1	3.16E-01 (10)	-8.78E-02 (10)	0
			(-3.30E+00 - 2.10E+00)	0.4 mi WSW	(-6.80E-01 - 1.70E+00)	(-3.30E+00 - 4.30E+00)	
	Zn-65 49	30	-7.96E-02 (39)	4S5	6.18E-01 (9)	-8.12E-01 (10)	0
			(-1.48E+01 - 1.20E+01)	0.5 mi ENE	(-5.80E+00 - 1.20E+01)	(-6.64E+00 - 4.20E+00)	
	Zr-95 49	30	3.13E-01 (39)	12F3	1.84E+00 (10)	1.84E+00 (10)	0
			(-7.70E+00 - 8.90E+00)	5.2 mi WSW	(-4.00E+00 - 4.90E+00)	(-4.00E+00 - 4.90E+00)	
	Nb-95 49	15	1.63E+00 (39)	2S2	1.84E+00 (10)	1.39E+00 (10)	0
			(-3.50E+00 - 7.00E+00)	0.9 mi NNE	(0.00E+00 - 3.30E+00)	(0.00E+00 - 5.60E+00)	
	Cs-134 47	15	1.43E-01 (38)	12S1	1.10E+00 (10)	2.12E-01 (9)	0
			(-5.01E+00 - 3.60E+00)	0.4 mi WSW	(0.00E+00 - 3.60E+00)	(-1.70E+00 - 1.80E+00)	

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to January 17, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION			MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Ground Water (cont) (pCi/l)	Cs-137	49	18	1.34E+00 (39) (-1.40E+00 - 4.40E+00)	2S2 0.9	mi	NNE	1.56E+00 (10) (-1.20E+00 - 4.25E+00)	1.22E+00 (10) (-1.20E+00 - 4.82E+00)	0
	Ba-140	48	60	-3.30E-01 (39) (-8.80E+01 - 2.35E+01)	4S4 0.5	mi	ENE	2.48E+00 (10) (-1.00E+01 - 2.35E+01)	6.11E-01 (9) (-9.50E+00 - 1.10E+01)	0
	La-140	49	15	-9.47E-01 (39) (-3.11E+01 - 8.70E+00)	4S5 0.5	mi	ENE	2.92E+00 (9) (-3.00E+00 - 8.70E+00)	-3.33E+00 (10) (-1.90E+01 - 3.50E+00)	0
	H-3	60	2000	4.54E+01 (48) (-5.96E+01 - 2.05E+02)	4S4 0.5	mi	ENE	8.60E+01 (12) (0.00E+00 - 2.05E+02)	2.80E+01 (12) (-5.94E+01 - 9.65E+01)	0
Air Particulates (E-03 pCi/m3)	Gross Beta	520	10	1.43E+01 (416) (4.60E+00 - 3.50E+01)	3S2 0.5	mi	NE	1.50E+01 (52) (5.00E+00 - 3.50E+01)	1.31E+01 (104) (4.60E+00 - 2.80E+01)	0
Air Iodine (E-03 pCi/m3)	I-131	399	70	-2.92E-03 (319) (-8.96E-02 - 5.80E-03)	10S3 0.6	mi	SSW	-1.52E-03 (40) (-3.51E-02 - 3.50E-03)	-3.32E-03 (80) (-8.29E-02 - 5.00E-03)	0
Air Particulates	Gamma Spec									
Quarterly Composite (E-03 pCi/m3)	Be-7	40		8.77E+01 (32) (6.22E+01 - 1.25E+02)	3S2 0.5	mi	NE	9.36E+01 (4) (7.47E+01 - 1.19E+02)	8.22E+01 (8) (5.85E+01 - 1.04E+02)	0
	K-40	30		1.43E+00 (24) (-9.50E+00 - 2.50E+01)	13S6 0.4	mi	W	9.08E+00 (3) (-2.10E-01 - 2.50E+01)	3.76E+00 (6) (-3.00E+00 - 2.80E+01)	0
	Mn-54	30		1.59E-02 (24) (-1.20E-01 - 1.50E-01)	6G1 13.5	mi	ESE	5.60E-02 (3) (2.90E-02 - 9.90E-02)	4.83E-02 (6) (-1.80E-02 - 9.90E-02)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Air Particulates (cont)								
Quarterly Composite (E-03 pCi/m3)	Co-58	30		-5.31E-02 (24) (-3.00E-01 - 2.80E-01)	6G1 13.5 mi ESE	1.87E-01 (3) (0.00E+00 - 3.20E-01)	3.67E-03 (6) (-3.60E-01 - 3.20E-01)	0
	Fe-59	30		3.37E-01 (24) (-5.90E-01 - 2.10E+00)	12S1 0.4 mi WSW	9.17E-01 (3) (1.80E-01 - 1.60E+00)	1.67E-02 (6) (-4.90E-01 - 4.50E-01)	0
	Co-60	30		-2.25E+01 (24) (-5.40E+02 - 3.40E-01)	8G1 12 mi SSE	2.37E-01 (3) (-3.90E-02 - 5.10E-01)	1.32E-01 (6) (-3.90E-02 - 5.10E-01)	0
	Zn-65	30		-1.37E-02 (24) (-4.40E-01 - 3.00E-01)	7S7 0.4 mi SE	1.30E-01 (3) (-1.10E-01 - 2.70E-01)	-4.18E-02 (6) (-3.70E-01 - 1.10E-01)	0
	Zr-95	30		3.87E-02 (24) (-6.30E-01 - 8.10E-01)	13S6 0.4 mi W	2.57E-01 (3) (1.70E-01 - 3.30E-01)	2.04E-01 (6) (-1.10E-01 - 5.40E-01)	0
	Nb-95	30		7.66E-02 (24) (-6.30E-01 - 3.00E-01)	3S2 0.5 mi NE	1.60E-01 (3) (1.10E-01 - 2.00E-01)	3.88E-02 (6) (-9.40E-02 - 2.00E-01)	0
	Cs-134	30	50	1.00E-03 (24) (-1.10E-01 - 1.30E-01)	8G1 12 mi SSE	5.43E-02 (3) (2.80E-02 - 6.90E-02)	2.70E-02 (6) (-4.60E-02 - 6.90E-02)	0
	Cs-137	30	60	-5.00E+01 (24) (-1.20E+03 - 1.30E-01)	5S4 0.8 mi E	8.43E-02 (3) (1.30E-02 - 1.30E-01)	-6.00E-03 (6) (-1.00E-01 - 6.70E-02)	0
	Ba-140	30		-9.30E+00 (24) (-8.60E+01 - 3.40E+01)	10S3 0.6 mi SSW	1.70E+01 (3) (4.00E+00 - 2.80E+01)	-2.00E+01 (6) (-6.80E+01 - 2.50E+01)	0
	La-140	30		-6.04E+00 (24) (-7.60E+01 - 5.30E+01)	12S1 0.4 mi WSW	1.71E+01 (3) (-1.70E+00 - 5.30E+01)	-1.43E+01 (6) (-3.60E+01 - 1.10E+00)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Milk (pCi/l)	I-131	74	1	4.09E-02 (58) (-1.20E-01 - 1.90E-01)	10D2 3.1 mi SSW	4.57E-02 (15) (-4.30E-02 - 1.00E-01)	1.86E-02 (16) (-1.30E-01 - 1.60E-01)	0
	Gamma Spec							
	K-40	89		1.39E+03 (70) (1.10E+03 - 2.09E+03)	7C1 2.6 mi SE	1.51E+03 (19) (1.10E+03 - 2.09E+03)	1.36E+03 (19) (1.23E+03 - 1.60E+03)	0
	Mn-54	73		3.00E-01 (57) (-4.40E+00 - 2.30E+00)	10D3 3.5 mi SSW	8.87E-01 (11) (-6.60E-01 - 2.30E+00)	-2.54E-01 (16) (-9.60E+00 - 2.50E+00)	0
	Co-58	73		2.29E-01 (57) (-6.50E+00 - 3.20E+01)	7C1 2.6 mi SE	1.68E+00 (16) (-2.30E+00 - 3.20E+01)	4.79E-02 (16) (-2.30E+00 - 1.60E+00)	0
	Fe-59	73		2.02E+00 (57) (-9.60E+00 - 4.60E+01)	10D3 3.5 mi SSW	3.12E+00 (11) (-4.00E+00 - 2.60E+01)	2.21E+00 (16) (-5.80E+00 - 2.10E+01)	0
	Co-60	73		1.02E+00 (57) (-3.20E+00 - 1.67E+01)	10G1 14 mi SSW	1.87E+00 (16) (-2.70E+00 - 3.03E+01)	1.87E+00 (16) (-2.70E+00 - 3.03E+01)	0
	Zn-65	73		-5.79E-01 (57) (-1.16E+01 - 6.10E+00)	10D1 3 mi SSW	1.05E+00 (15) (-3.80E+00 - 6.10E+00)	9.66E-01 (16) (-4.60E+00 - 7.70E+00)	0
	Zr-95	73		6.34E-01 (57) (-1.20E+01 - 1.30E+01)	10D1 3 mi SSW	1.67E+00 (15) (-3.10E+00 - 1.00E+01)	9.56E-01 (16) (-1.10E+01 - 8.70E+00)	0
	Nb-95	70		8.37E-01 (55) (-4.70E+00 - 3.20E+00)	10G1 14 mi SSW	1.48E+00 (15) (-5.30E-01 - 3.77E+00)	1.48E+00 (15) (-5.30E-01 - 3.77E+00)	0
	Cs-134	66	15	-6.49E-02 (52) (-5.56E+00 - 2.90E+00)	10D1 3 mi SSW	2.56E-01 (13) (-9.40E-01 - 1.60E+00)	1.50E-01 (14) (-1.80E+00 - 3.10E+00)	0
	Cs-137	73	18	9.09E-01 (57) (-3.40E+01 - 1.17E+01)	10D1 3 mi SSW	2.50E+00 (15) (0.00E+00 - 1.17E+01)	2.46E+00 (16) (-2.10E+00 - 1.72E+01)	0
	Ba-140	72	60	-1.70E+01 (57) (-1.90E+03 - 1.10E+03)	10G1 14 mi SSW	1.69E+02 (15) (-5.30E+00 - 2.50E+03)	1.69E+02 (15) (-5.30E+00 - 2.50E+03)	0
	La-140	68	15	-1.45E+01 (54) (-5.00E+02 - 4.40E+02)	10D2 3.1 mi SSW	3.07E+01 (14) (-1.13E+01 - 4.40E+02)	-3.39E+01 (14) (-4.80E+02 - 5.40E+00)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Soil	Gamma Spec						
(pCi/kg dry)	K-40	8	1.06E+04 (6) (8.50E+03 - 1.40E+04)	3S2 0.5 mi NE	1.27E+04 (2) (1.13E+04 - 1.40E+04)	1.15E+04 (2) (1.10E+04 - 1.20E+04)	0
	Mn-54	8	1.19E+01 (6) (4.50E+00 - 1.80E+01)	8G1 12 mi SSE	1.62E+01 (2) (9.40E+00 - 2.30E+01)	1.62E+01 (2) (9.40E+00 - 2.30E+01)	0
	Co-58	8	-7.50E+00 (6) (-2.40E+01 - 6.70E+00)	12S1 0.4 mi WSW	2.30E+00 (2) (-2.10E+00 - 6.70E+00)	-6.35E+00 (2) (-6.50E+00 - -6.20E+00)	0
	Fe-59	8	-3.17E+01 (6) (-1.40E+02 - 1.90E+01)	8G1 12 mi SSE	2.02E+02 (2) (5.40E+01 - 3.50E+02)	2.02E+02 (2) (5.40E+01 - 3.50E+02)	0
	Co-60	8	1.85E+00 (6) (-1.10E+00 - 4.20E+00)	13S6 0.4 mi W	2.95E+00 (2) (2.70E+00 - 3.20E+00)	5.00E-01 (2) (-3.80E+00 - 4.80E+00)	0
	Zn-65	8	-3.57E+01 (6) (-1.30E+02 - -6.20E+00)	13S6 0.4 mi W	-1.45E+01 (2) (-2.20E+01 - -6.90E+00)	-4.97E+01 (2) (-1.00E+02 - 5.40E-01)	0
	Zr-95	8	8.43E+00 (6) (-6.80E+01 - 6.80E+01)	12S1 0.4 mi WSW	3.50E+01 (2) (2.30E+01 - 4.70E+01)	-1.65E+00 (2) (-7.10E+00 - 3.80E+00)	0
	Nb-95	8	-2.55E+02 (6) (-3.90E+02 - 1.30E+02)	3S2 0.5 mi NE	-1.30E+02 (2) (-3.90E+02 - 1.30E+02)	-1.76E+02 (2) (-3.70E+02 - 1.80E+01)	0
	Cs-134	8	3.25E+01 (6) (1.80E+01 - 4.70E+01)	13S6 0.4 mi W	4.35E+01 (2) (4.00E+01 - 4.70E+01)	3.55E+01 (2) (3.50E+01 - 3.60E+01)	0
	Cs-137	8	6.07E+01 (6) (2.30E+00 - 1.40E+02)	12S1 0.4 mi WSW	1.40E+02 (2) (1.40E+02 - 1.40E+02)	1.05E+01 (2) (0.00E+00 - 2.10E+01)	0
	Ba-140	0	(0) (0.00E+00 - 0.00E+00)		(0) (0.00E+00 - 0.00E+00)	(0) (0.00E+00 - 0.00E+00)	0
	La-140	0	(0) (0.00E+00 - 0.00E+00)		(0) (0.00E+00 - 0.00E+00)	(0) (0.00E+00 - 0.00E+00)	0

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Soil (cont)	Ra-226	8	1.70E+03 (6)	3S2	2.35E+03 (2)	1.21E+03 (2)	0
(pCi/kg dry)			(1.10E+03 - 2.50E+03)	0.5 mi NE	(2.20E+03 - 2.50E+03)	(2.10E+02 - 2.20E+03)	
	Th-228	8	1.97E+03 (6)	8G1	2.35E+03 (2)	2.35E+03 (2)	0
			(1.50E+03 - 2.50E+03)	12 mi SSE	(2.00E+03 - 2.70E+03)	(2.00E+03 - 2.70E+03)	
Food/Garden Crops	Gamma Spec						
(pCi/kg wet)	Be-7	43	8.31E+00 (33)	14B3	3.21E+01 (4)	6.41E+00 (10)	0
			(-2.10E+02 - 1.65E+02)	1.3 mi WNW	(-1.90E+01 - 1.65E+02)	(-2.60E+01 - 6.70E+01)	
	K-40	48	2.56E+03 (37)	14B3	3.55E+03 (4)	2.05E+03 (11)	0
			(8.74E+02 - 5.18E+03)	1.3 mi WNW	(1.03E+03 - 5.18E+03)	(6.73E+02 - 3.80E+03)	
	Mn-54	43	1.59E+02 (33)	14B3	1.30E+03 (4)	4.45E-01 (10)	0
			(-3.20E+00 - 5.18E+03)	1.3 mi WNW	(2.10E+00 - 5.18E+03)	(-5.58E+00 - 3.20E+00)	
	Co-58	43	-5.95E-01 (33)	11B1	9.89E-01 (9)	-1.14E+00 (10)	0
			(-1.47E+01 - 1.40E+01)	1.9 mi SW	(-5.11E+00 - 1.40E+01)	(-5.70E+00 - 2.30E+00)	
	Fe-59	43	5.98E-01 (33)	14B3	9.05E+00 (4)	1.84E+00 (10)	0
			(-1.40E+01 - 4.57E+01)	1.3 mi WNW	(-8.70E+00 - 4.57E+01)	(-6.79E+00 - 6.40E+00)	
	Co-60	43	9.35E-01 (33)	12S7	5.30E+00 (3)	1.26E+00 (10)	0
			(-1.30E+01 - 1.90E+01)	1.1 mi WSW	(1.80E+00 - 1.17E+01)	(-8.20E-01 - 5.99E+00)	
	Zn-65	43	-1.09E+00 (33)	12S7	1.00E+01 (3)	-2.52E+00 (10)	0
			(-7.04E+01 - 3.60E+01)	1.1 mi WSW	(-5.70E+00 - 3.60E+01)	(-6.60E+00 - 1.90E+00)	
	Zr-95	43	7.62E+00 (33)	14B3	2.42E+01 (4)	-2.18E+00 (10)	0
			(-2.30E+01 - 9.73E+01)	1.3 mi WNW	(-8.40E+00 - 9.73E+01)	(-1.90E+01 - 1.50E+01)	
	Nb-95	43	3.05E+00 (33)	13G2	4.53E+01 (10)	4.53E+01 (10)	0
			(-9.49E+00 - 2.28E+01)	16 mi W	(1.00E+00 - 4.20E+02)	(1.00E+00 - 4.20E+02)	
	I-131	43	1.92E+01 (33)	12S7	5.87E+01 (3)	-3.49E+00 (10)	0
			(-3.37E+01 - 2.36E+02)	1.1 mi WSW	(1.90E+00 - 1.72E+02)	(-3.51E+01 - 3.70E+00)	

TABLE G
SUMMARY OF DATA FOR SSES
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 2000
NAME OF FACILITY: SUSQUEHANNA STEAM ELECTRIC STATION
LOCATION OF FACILITY: LUZERNE COUNTY, PENNSYLVANIA
Reporting Period: December 28, 1999 to May 1, 2001

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 (3) RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	MEAN (3) RANGE	CONTROL LOCATION MEAN (3) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS(4)
Food/Garden Crops (cont)							
(pCi/kg wet)	Cs-134	40	-4.42E+00 (30) (-6.80E+01 - 4.20E+00)	14B3 1.3 mi WNW	1.50E+00 (3) (1.90E-01 - 4.10E+00)	6.52E-01 (10) (-3.60E+00 - 3.50E+00)	0
	Cs-137	43	5.47E+00 (33) (-8.23E+00 - 2.58E+01)	14B3 1.3 mi WNW	8.31E+00 (4) (-4.60E-01 - 2.58E+01)	4.38E+00 (10) (-8.81E-01 - 1.10E+01)	0
	Ba-140	41	-7.95E+00 (31) (-1.91E+02 - 2.90E+01)	11B1 1.9 mi SW	7.42E+00 (8) (-4.80E+00 - 2.90E+01)	6.77E+00 (10) (-9.70E+00 - 3.00E+01)	0
	La-140	41	-3.27E+00 (31) (-6.86E+01 - 1.60E+01)	13G2 16 mi W	3.22E+00 (10) (-7.40E+00 - 3.11E+01)	3.22E+00 (10) (-7.40E+00 - 3.11E+01)	0

1. The total number of analysis does not include duplicates, splits, or repeated analyses.
2. The Technical Requirement LLD's are shown when applicable.
3. The means are based on all analysis results.
4. USNRC reporting levels are specified in the Technical Requirements.

APPENDIX H

COMPARISON OF INDICATOR AND CONTROL 2000 REMP ANNUAL MEANS FOR SELECTED MEDIA ANALYSIS RESULTS WITH MEANS FROM PREOPERATIONAL AND PRIOR OPERATIONAL PERIODS

The data presented in the following tables were included if specific analysis results routinely exceeded the applicable MDCs in 2000 and/or routinely may have done so in previous years. The comparisons may be useful for observing any step changes that may occur in the environment over a wide area. However, the importance attached to these comparisons should be tempered by the understanding that changes in methods of analysis, typical MDCs achieved by the analyses, and averaging methods over the years may tend to blur the picture in some cases.

AMBIENT RADIATION MONITORING

TABLE H 1

AMBIENT RADIATION LEVELS AS MEASURED BY TLDS (mR/STD QTR)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	18.5-19.2	14.7-20.8	--	15.0-17.9	14.8-20.8	--
Mean	18.9	17.9	19.7	16.3	17.8	19.1

AQUATIC PATHWAY MONITORING

TABLE H 2

SURFACE WATER GROSS BETA ACTIVITIES (pCi/l)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	3.2-4.9	3.0-7.7	--	2.9-5.2	2.8-6.7	--
Mean	3.8	5.6	5.3	4.0	3.9	2.8

TABLE H 3

SURFACE WATER IODINE-131 ACTIVITIES (pCi/l)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1979-81	**1982-99**	**2000**	**1979-81**	**1982-99**	**2000**
Range	0.24-0.37	0.06-0.60	--	0.29-0.43	0.03-1.0	--
Mean	0.29	0.29	0.35	0.36	0.28	0.39

TABLE H 4

SURFACE WATER TRITIUM ACTIVITIES (pCi/l)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99***	**2000**	**1978-81**	**1982-99***	**2000**
Range	101-122	126-1217	--	119-319	-239-212	--
Mean	109	517	764	171	55	+45

*1990 results were not averaged with 1982-99 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

TABLE H 5

DRINKING WATER GROSS ALPHA ACTIVITIES (pCi/l)			
Period	**Preoperational**	**Operational**	
	1980 - 81	**1982 - 99**	**2000**
Range	--	0.1 – 10.0	--
Mean	1.3	1.6	0.56

TABLE H 6

DRINKING WATER GROSS BETA ACTIVITIES (pCi/l)			
Period	**Preoperational**	**Operational**	
	1977 - 81	**1982 - 99**	**2000**
Range	2.2 - 3.2	2.4 - 5.4	--
Mean	2.7	3.2	3.4

TABLE H 7

DRINKING WATER TRITIUM ACTIVITIES (pCi/l)			
Period	**Preoperational**	**Operational**	
	1977 - 81	**1982 - 99**	**2000**
Range	101 - 194	-247 - 220	--
Mean	132	64	54

TABLE H 8

FISH POTASSIUM-40 ACTIVITIES (pCi/g wet)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1977-81	**1982-99**	**2000**	**1977-81**	**1982-99**	**2000**
Range	2.7 - 3.5	3.1 - 5.3	--	2.8 - 3.6	3.1 - 4.2	--
Mean	3.2	3.8	3.4	3.2	3.6	3.4

TABLE H 9

SEDIMENT POTASSIUM-40 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	8.6-10.4	7.4-13.2	--	7.5-11.0	6.2-13.0	--
Mean	9.3	10.6	12.7	7.7	10.7	8.01

TABLE H 10

SEDIMENT RADIUM-226 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	0.5-0.7	0.5-1.9	--	0.6-1.9	0.4-2.1	--
Mean	0.6	1.5	1.2	0.7	1.5	1.0

TABLE H 11

SEDIMENT THORIUM-228 ACTIVITIES (pCi/g dry)				
Location	**Indicator**		**Control**	
Period	**1984 - 99***	**2000**	**1984 - 99***	**2000**
Range	1.0 - 1.3	--	1.0 - 1.4	--
Mean	1.1	0.9	1.1	0.8

*Th-232 was reported instead of Th-228 in 1990.

TABLE H 12

SEDIMENT CESIUM-137 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	0.08-0.15	0.04-0.17	--	0.08-0.21	0.06-0.21	--
Mean	0.10	0.09	0.04	0.11	0.11	0.06

ATMOSPHERIC PATHWAY MONITORING

TABLE H 13

AIR PARTICULATE GROSS BETA ACTIVITIES (E-3 pCi/m^3)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99**	**2000**	**1978-81**	**1982-99**	**2000**
Range	24 - 97	13 - 29	--	24 - 102	12 - 28	--
Mean	61	17	14	62	16	13

TABLE H 14

AIR PARTICULATE BERYLLIUM-7 ACTIVITIES (E-3 pCi/m^3)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1982-99***	**2000**	**1978-81**	**1982-99***	**2000**
Range	69 - 81	62 - 132	--	59 - 85	53 - 126	--
Mean	76	93	88	72	88	82

*1990 results were not averaged with 1982-99 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

TERRESTRIAL PATHWAY MONITORING

TABLE H 15

SOIL POTASSIUM-40 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1979&81	**1984-99**	**2000**	**1979&81**	**1984-99**	**2000**
Range	9.2 - 9.7	9.4-14.3	--	9.1-11.0	7.4-14.1	--
Mean	9.5	11.5	10.6	10.1	10.5	11.5

TABLE H 16

SOIL RADIUM-226 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1979&81	**1984-99**	**2000**	**1979&81**	**1984-99**	**2000**
Range	0.8 - 1.3	0.8 - 2.5	--	0.8 - 1.2	1.0 - 2.1	--
Mean	1.1	1.6	1.7	1.0	1.8	1.2

TABLE H 17

SOIL THORIUM-228 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1979&81	**1984-99**	**2000**	**1979&81**	**1984-99**	**2000**
Range	0.9 - 1.3	0.8 - 1.3	--	--	0.7 - 1.2	--
Mean	1.1	1.0	2.0	1.0	1.0	2.4

TABLE H 18

SOIL CESIUM-137 ACTIVITIES (pCi/g dry)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1979&81	**1982-99**	**2000**	**1979&81**	**1982-99**	**2000**
Range	0.5 - 0.7	0.05 - 0.5	--	0.2 - 1.2	0.2 - 1.2	--
Mean	0.6	0.3	0.06	0.7	0.4	0.11

TABLE H 19

MILK POTASSIUM-40 ACTIVITIES (pCi/l)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1978-81	**1985-99**	**2000**	**1978-81**	**1985-99**	**2000**
Range	1222-1500	1241-1357	--	1273-1500	1247-1363	--
Mean	1325	1325	1392	1390	1332	1365

TABLE H 20

FRUITS/VEGETABLES POTASSIUM-40 ACTIVITIES (pCi/g wet)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1980-81	**1982-99***	**2000**	**1980-81**	**1982-99***	**2000**
Range	2.5 - 3.0	2.0-4.2	--	3.0 - 3.1	2.2 - 2.8	--
Mean	2.8	2.7	2.6	3.1	2.5	2.1

*1990 results were not averaged with 1982-99 data because the validity of the 1990 values is questionable in some instances. Laboratory analysis error is suspected. See the 1990 Annual Report.

TABLE H 21

GROUND WATER TRITIUM ACTIVITIES (pCi/l)						
Location	**Indicator**			**Control**		
Period	**Pre-Op**	**Operational**		**Pre-Op**	**Operational**	
	1980-81	**1982-99**	**2000**	**1980-81**	**1982-99**	**2000**
Range	94-109	-206 - 180	--	117 - 119	-206 - 260	--
Mean	101	60	45	118	73	28

APPENDIX I

SPECIFIC ANALYSIS RESULTS TABULATED BY MEDIA AND SAMPLING PERIOD

Results of analyses are generally reported in the following tables to two significant figures. Random uncertainties of counting are reported to the same decimal place as the result.

Calculated values for analysis results are reported with the random uncertainty of counting at two standard deviations (2S), determined by considering both the sample and background count rates. The uncertainty of an activity is influenced by the volume or mass of the sample, the background count rate, the count times, the method used to round off the value obtained to reflect its degree of significance, and other factors. The uncertainties of activities determined by gamma spectrometric analyses are also influenced by the relative concentrations of the radionuclides in the sample, the energies and intensities of the gammas emitted by those radionuclides, and the assumptions used in selecting the radionuclides to be quantitatively determined.

Results reported as less than (<) in these tables are below the minimum detectable concentrations (MDCs). The MDC is an estimate of the detection capabilities of the overall measurement method, taking into account not only the counting system, but also the characteristics of the sample being counted. When the MDC is used as the level to decide whether or not to enter a measured value into a table, there is a 50% chance that the value will be entered when the actual sample activity is equivalent to the MDC. There is only a five percent chance that a value representing a fluctuation in background activity will be entered as sample activity in such an instance.

Measured values for the activities of specific radionuclides, such as the man-made gamma-emitting radionuclides beryllium-7 and cesium-137, only appear in the following tables for each specific medium when the levels that are measured exceed the MDC values for those measurements and those radionuclides are actually identified as present in the samples. Measured values for the analyses that are not radionuclide specific, such as gross alpha and beta analyses, also are presented in the tables for specific media only when the levels that are measured actually exceed the MDCs.

TABLE I-1
ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results (1) are in mR/std. qtr (2) ± 2S (3)

Location	First Quarter 01/11/00 to 04/13/00	Second Quarter 04/11/00 to 07/17/00	Third Quarter 07/17/00 to 10/18/00	Fourth Quarter 10/16/00 to 01/17/01
ONSITE				
1S2 +	21.9 ± 1.4	19.9 ± 0.9	22.3 ± 1.4	26.8 ± 2.2
2S2	18.6 ± 0.8	16.7 ± 0.6	17.5 ± 1.0	22.1 ± 1.0
2S3 +	20.3 ± 1.6	17.5 ± 0.7	20.3 ± 2.4	25.3 ± 1.6
3S2	16.8 ± 1.0	14.9 ± 1.9	16.1 ± 1.0	20.7 ± 0.8
3S3	17.1 ± 1.2	15.4 ± 1.0	15.7 ± 1.0	20.8 ± 1.6
3S4 +	17.2 ± 0.8	14.8 ± 0.7	15.9 ± 0.6	20.6 ± 1.6
4S3 +	22.5 ± 0.8	19.4 ± 1.5	21.1 ± 2.4	26.3 ± 2.4
4S6	17.9 ± 1.2	16.3 ± 0.6	16.2 ± 1.2	21.7 ± 1.2
5S4	16.2 ± 0.8	13.9 ± 1.3	15.9 ± 1.6	19.5 ± 1.0
5S7 +	17.8 ± 1.0	15.3 ± 1.5	17.1 ± 1.4	21.6 ± 1.6
6S4 +	25.5 ± 1.6	22.3 ± 1.1	25.1 ± 2.6	30.6 ± 2.0
6S9 +	24.2 ± 0.8	21.6 ± 1.3	24.0 ± 1.4	28.4 ± 2.2
7S6 +	24.9 ± 0.8	20.8 ± 2.0	22.9 ± 1.8	28.4 ± 2.2
7S7	17.7 ± 1.2	15.5 ± 1.3	15.8 ± 0.8	20.5 ± 1.2
7S8	17.3 ± 1.2	15.6 ± 0.6	16.3 ± 2.4	18.3 ± 0.8
8S2 +	22.8 ± 1.6	21.0 ± 1.7	20.7 ± 1.8	27.6 ± 1.2
9S2 +	38.4 ± 1.6	34.9 ± 1.5	36.5 ± 2.6	46.2 ± 2.7
10S1 +	16.6 ± 1.0	14.2 ± 0.9	16.4 ± 1.4	19.6 ± 1.2
10S2	29.3 ± 1.2	25.7 ± 0.9	28.3 ± 2.2	34.3 ± 3.3
10S3	16.7 ± 0.8	14.7 ± 0.9	15.6 ± 1.0	18.9 ± 1.6
11S3 +	26.0 ± 0.6	23.3 ± 1.5	24.9 ± 3.0	30.8 ± 1.6
11S7	18.8 ± 0.8	16.8 ± 0.7	18.5 ± 1.4	22.7 ± 2.0

TAI I-1

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results (1) are in mR/std. qtr (2) ± 2S (3)

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
	01/11/00 to 04/13/00	04/11/00 to 07/17/00	07/17/00 to 10/18/00	10/16/00 to 01/17/01
Location				
12S1	19.3 ± 0.8	16.7 ± 1.1	18.7 ± 1.4	22.7 ± 2.2
12S3 +	23.7 ± 1.4	20.4 ± 1.7	22.6 ± 1.8	27.3 ± 1.6
12S4	23.2 ± 1.0	20.7 ± 0.7	22.4 ± 2.0	27.2 ± 1.2
12S5	21.3 ± 1.4	18.6 ± 0.9	20.4 ± 1.4	24.8 ± 2.0
12S6	20.1 ± 1.0	19.1 ± 1.1	21.5 ± 1.2	24.9 ± 2.4
12S7	16.6 ± 1.0	14.5 ± 0.8	15.2 ± 0.8	18.8 ± 1.8
13S2 +	22.0 ± 1.0	19.5 ± 1.7	21.3 ± 1.8	25.9 ± 1.4
13S4	22.3 ± 0.8	20.0 ± 1.1	21.8 ± 1.4	25.6 ± 2.0
13S5	24.0 ± 0.8	21.5 ± 0.9	23.5 ± 1.4	27.1 ± 1.4
13S6	22.0 ± 0.8	19.5 ± 1.1	20.9 ± 1.2	25.4 ± 0.6
14S5 +	21.5 ± 0.4	18.4 ± 0.7	20.7 ± 0.4	26.2 ± 2.4
14S6	20.5 ± 0.4	18.3 ± 0.7	19.9 ± 1.8	23.5 ± 2.0
15S5 +	19.5 ± 1.4	17.2 ± 1.5	19.0 ± 1.0	23.3 ± 1.2
16S1 +	21.5 ± 1.0	19.4 ± 1.5	21.7 ± 1.8	25.9 ± 1.4
16S2 +	22.4 ± 1.2	19.8 ± 1.3	22.8 ± 2.0	27.2 ± 1.6

See the comments at the end of this table.

TABLE I-1
ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results (1) are in mR/std. qtr (2) ± 2S (3)

Location	First Quarter 01/11/00 to 04/13/00	Second Quarter 04/11/00 to 07/17/00	Third Quarter 07/17/00 to 10/18/00	Fourth Quarter 10/16/00 to 01/17/01
0-1 MILE OFFSITE				
6A4 +	20.2 ± 1.2	18.3 ± 1.1	18.3 ± 1.0	23.1 ± 0.4
8A3	16.9 ± 0.6	15.4 ± 1.1	(5)	19.3 ± 0.8
15A3	18.9 ± 0.8	16.8 ± 0.7	18.1 ± 1.2	21.1 ± 1.4
16A2	16.3 ± 0.8	14.2 ± 0.9	16.4 ± 1.4	18.9 ± 2.0
1-2 MILES OFFSITE				
1B1	18.4 ± 1.4	(5)	14.7 ± 1.8	19.7 ± 0.8
2B3 +	18.3 ± 1.2	15.8 ± 1.3	16.5 ± 1.4	20.2 ± 1.8
2B4	18.1 ± 1.4	15.8 ± 1.0	16.4 ± 1.6	21.6 ± 0.6
5B3	16.6 ± 0.4	14.0 ± 0.8	15.6 ± 1.4	18.7 ± 1.2
7B2	18.0 ± 1.0	15.8 ± 0.8	15.7 ± 0.6	19.6 ± 1.6
8B2 +	18.1 ± 0.2	15.1 ± 1.1	17.1 ± 1.4	20.4 ± 1.8
9B1	16.6 ± 1.4	15.0 ± 1.3	15.0 ± 1.6	19.7 ± 1.4
10B2	14.5 ± 1.0	12.5 ± 1.0	12.8 ± 1.2	17.1 ± 0.4
10B3	16.0 ± 1.0	13.9 ± 0.8	14.5 ± 1.0	18.8 ± 1.0
10B4	19.0 ± 1.4	16.8 ± 1.3	18.2 ± 2.2	22.9 ± 1.0
12B4	17.9 ± 1.0	16.0 ± 1.0	15.9 ± 1.4	21.0 ± 1.4
13B1	17.5 ± 1.2	15.9 ± 1.0	17.0 ± 1.8	21.0 ± 1.0
14B3 +	18.0 ± 1.0	15.6 ± 1.5	15.8 ± 1.2	21.6 ± 0.8
15B1	17.5 ± 1.0	15.8 ± 1.0	16.0 ± 1.2	20.8 ± 1.2
16B2	16.4 ± 1.0	14.4 ± 1.3	14.7 ± 0.8	19.5 ± 1.0
2-3 MILES OFFSITE				
11C1	20.7 ± 0.8	18.7 ± 1.7	19.1 ± 1.2	(5)

See the comments at the end of this table.

TA[illegible] I-1

ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results (1) are in mR/std. qtr (2) ± 2S (3)

Location	First Quarter 01/11/00 to 04/13/00	Second Quarter 04/11/00 to 07/17/00	Third Quarter 07/17/00 to 10/18/00	Fourth Quarter 10/16/00 to 01/17/01
3-4 MILES OFFSITE				
1D5 +	20.8 ± 0.8	18.3 ± 0.8	19.8 ± 1.8	23.4 ± 1.8
6D1	20.5 ± 0.6	17.3 ± 1.7	18.8 ± 1.2	23.3 ± 1.6
8D3 +	19.0 ± 0.8	15.8 ± 0.8	17.8 ± 1.6	21.2 ± 1.4
9D4 +	19.7 ± 1.0	16.5 ± 0.9	18.4 ± 1.2	21.9 ± 1.4
10D1 +	19.4 ± 2.0	15.7 ± 0.6	17.2 ± 1.4	20.8 ± 1.6
12D2	19.7 ± 1.0	18.3 ± 1.1	19.4 ± 1.4	24.1 ± 1.4
14D1	19.2 ± 0.8	17.1 ± 0.6	17.7 ± 0.4	22.2 ± 1.4
4-5 MILES OFFSITE				
3E1	16.4 ± 0.6	13.9 ± 0.8	15.1 ± 1.0	18.6 ± 1.6
4E2	20.3 ± 2.2	16.7 ± 0.2	18.2 ± 1.2	22.4 ± 2.0
5E2 +	18.7 ± 0.6	16.1 ± 1.1	18.0 ± 1.0	21.2 ± 0.8
6E1 +	21.6 ± 1.2	18.7 ± 1.3	20.4 ± 1.2	24.5 ± 0.6
7E1 +	20.0 ± 0.6	16.7 ± 0.6	18.5 ± 1.4	21.9 ± 0.8
11E1 +	16.2 ± 1.0	13.9 ± 0.4	15.4 ± 1.2	18.2 ± 1.0
12E1 +	17.5 ± 0.8	15.3 ± 0.6	15.5 ± 1.0	19.8 ± 0.8
13E4 +	18.9 ± 1.0	17.0 ± 0.6	17.7 ± 2.0	23.5 ± 1.6
5-10 MILES OFFSITE				
2F1 +	18.5 ± 0.8	16.3 ± 1.1	17.7 ± 1.0	20.3 ± 0.6
8F2	17.7 ± 0.8	15.2 ± 1.1	16.8 ± 1.4	20.3 ± 1.2
12F2	19.3 ± 1.8	17.1 ± 1.1	17.6 ± 1.4	22.7 ± 1.8
15F1 +	19.5 ± 0.4	18.4 ± 0.6	18.1 ± 1.6	23.4 ± 1.8
16F1 +	20.9 ± 1.4	18.7 ± 1.0	18.5 ± 1.0	24.0 ± 2.2

See the comments at the end of this table.

TABLE I-1
ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY RESULTS
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results (1) are in mR/std. qtr (2) ± 2S (3)

Location	First Quarter 01/11/00 to 04/13/00	Second Quarter 04/11/00 to 07/17/00	Third Quarter 07/17/00 to 10/18/00	Fourth Quarter 10/16/00 to 01/17/01
10-20 MILES				
3G4	21.1 ± 1.2	17.4 ± 0.6	18.5 ± 1.0	23.4 ± 1.0
4G1 +	20.8 ± 0.8	18.5 ± 0.6	20.8 ± 3.2	24.1 ± 1.6
6G1	21.8 ± 1.0	19.7 ± 0.6	21.4 ± 2.8	25.2 ± 2.0
7G1 +	18.7 ± 0.6	15.8 ± 1.7	17.4 ± 1.0	20.9 ± 1.4
7G2	(5)	16.5 ± 0.8	17.9 ± 1.0	21.6 ± 1.2
8G1	16.8 ± 0.8	14.0 ± 1.1	15.2 ± 0.8	19.1 ± 0.4
12G1 +	16.6 ± 0.8	14.8 ± 1.1	15.6 ± 1.0	19.5 ± 1.4
12G4	20.3 ± 1.0	17.8 ± 2.3	18.4 ± 0.6	23.4 ± 0.2

See the comments at the end of this table.

Location				
Indicator				
Average (6)	19.8 ± 0.0	17.4 ± 0.0	18.7 ± 0.0	23.0 ± 0.0
Control				
Average (6)	19.4 ± 0.0	16.8 ± 0.0	18.2 ± 0.0	22.2 ± 0.0

COMMENTS

(1) Individual monitor location results are normally the average of the elemental doses of six calcium elements from the TLDs assigned to each monitoring location.

(2) A standard (std.) quarter (qtr.) is considered to be 91.25 days. Results obtained for monitoring periods of other durations are normalized by multiplying them by 91.25/x, where x is the actual duration in days of the period.

(3) Uncertainties for individual monitoring location results are two standard deviations of the elemental doses of six calcium elements from the two TLDs assigned to each monitoring location, representing the variability between the elemental doses of each of the six TLD elements.

(4) TLDs were not in the field at this monitoring location during this quarter. Refer to Appendix A of this report for an explanation of program changes to the REMP.

(5) No measurement could be made because the TLDs were lost, stolen, or damaged.

(6) Uncertainties associated with quarterly indicator and control averages are two standard deviations, representing the variability between the results of the individual monitoring locations.

(7) Data were invalidated for this period because of an unacceptably high coefficient of variation among element readings.

\+ ODCM -listed locations.

TABLE I-2

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	TRITIUM	GR-BETA	OTHER ACTIVITY	COMMENTS
6S6	12/28/99 - 1/31/00	<112	2.4 ± 0.7		
2S7	12/28/99 - 1/31/00	326 ± 73	7.6 ± 0.8		(1)
6S5	1/03/00 - 1/31/00	<112	4.4 ± 0.9		
LTAW	01/17/2000	137 ± 67	0.32 ± 0.64		
6S6	1/31/00 - 2/28/00	<112	2.4 ± 0.6		(2)
2S7	1/31/00 - 2/28/00	<112	4.9 ± 0.8		
6S5	2/7/00 - 2/28/00	<112	5.1 ± 0.9		
LTAW	02/14/2000	<113	0.45 ± 0.65		
6S6	2/28/00 - 3/27/00	<106	2.4 ± 0.7		(3)
2S7	2/28/00 - 3/27/00	258 ± 68	6.8 ± 0.7		
6S5	3/6/00 - 3/27/00	<106	2.0 ± 0.6		
LTAW	03/13/2000	<112	3.1 ± 0.7		
6S6	3/27/00 - 5/01/00	<111	<1.0		
2S7	3/27/00 - 5/01/00	6627 ± 122	13.3 ± 0.9		
6S5	4/03/00 - 5/1/00	<111	<1.4		
LTAW	04/17/2000	130 ± 66	2.4 ± 0.6		
6S6	5/01/00 - 5/30/00	<106	3.5 ± 0.7		
2S7	5/01/00 - 5/30/00	2831 ± 94	3.8 ± 1.0		
6S5	5/08/00 - 5/30/00	<106	1.1 ± 0.5		
LTAW	05/16/2000	<112	3.7 ± 0.7		
6S6	5/30/00 - 6/26/00	<108	1.3 ± 0.9		(4)
2S7	5/30/00 - 6/12/00	<108	6.0 ± 0.8		(5)
2S7	06/19/2000	148 ± 67	21.4 ± 1.6		
2S7	6/19/00 - 6/26/00	503 ± 71	3.3 ± 1.0		
6S5	6/05/00 - 6/26/00	<108	3.5 ± 0.7		
LTAW	06/12/2000	<109	9.6 ± 0.8		

TABLE I-2

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	TRITIUM	GR-BETA	OTHER ACTIVITY	COMMENTS
6S6	6/26/00 - 7/31/00	<104	5.9 ± 0.97		
2S7	6/26/00 - 7/31/00	232 ± 66	24.4 ± 1.1		
6S5	7/03/00 - 7/31/00	<104	5.7 ± 0.77		
LTAW	07/17/2000	<108	2.5 ± 0.91		
6S6	7/31/00 - 8/28/00	<106			
2S7	7/31/00 - 8/28/00	8521 ± 134	8.2 ± 0.8		
6S5	8/07/00 - 8/28/00	<106	2.8 ± 0.7		
LTAW	08/14/2000	120 ± 66	1.5 ± 0.1		
6S6	8/28/00 - 9/25/00	<117	2.5 ± 0.9		(6)
2S7	8/28/00 - 9/25/00	2139 ± 66	8.9 ± 1.4		(7)
6S5	9/05/00 - 9/25/00	<117	2.5 ± 0.7		
LTAW	09/11/2000	<106	5.4 ± 0.7		
6S6	9/25/00 - 10/30/00	125 ± 66	3.3 ± 0.6		(8)
2S7	9/25/00 - 10/30/00	2071 ± 88	5.0 ± 1.2		(9)
6S5	10/02/00 - 10/30/00	<106	7.3 ± 1.0		
LTAW	10/16/2000	<115	3.5 ± 0.7		
6S6	10/30/00 - 11/27/00	<106	2.9 ± 0.6		(10)
2S7	10/30/00 - 11/27/00	2483 ± 92	9.1 ± 0.9		(11)
6S5	11/06/00 - 11/27/00	<106	3.6 ± 0.6		
LTAW	11/13/2000	193 ± 68	4.9 ± 0.7		
6S6	11/27/00 - 12/26/00	<106	7.6 ± 1.0		(12)
2S7	11/27/00 - 12/26/00	159 ± 67	6.9 ± 0.8		(13)
6S5	12/4/00 - 12/26/00	<106	3.6 ± 0.7		
LTAW	12/11/2000	159 ± 67	2.9 ± 0.7		

TA' I-2

GROSS BETA, TRITIUM, AND GAMMA* SPE. .OSCOPIC ANALYSES OF SURFACE WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. During the sample compositing period from 1/17/00 through 1/31/00, four aliquots of water were not collected by the ACS at monitoring location 2S7 between 13:29 and 15:34 on 1/17/00.

2. During the sample compositing period from 1/31/00 through 2/28/00, the volumes per aliquot of water collected by the ACS at monitoring location 6S6 decreased between 2/24/00 and 2/28/00.

3. During the sample compositing period from 2/28/00 through 3/27/00, water was observed to be dripping into the ACS's collection container at monitoring location 6S6 between 3/9/00 and 3/13/00.

4. During the sample compositing period from 5/30/00 through 6/26/00, the volumes per aliquot of water collected at monitoring location 6S6 decreased between 6/12/00 and 6/19/00.

5. During the scheduled sample compositing period from 5/30/00 through 6/26/00, the ACS's collection container at monitoring location 2S7 was observed to be overflowing between 6/12/00 and 6/19/00. A grab sample was collected on 6/19/00. Weeks one and two of the scheduled compositing period were composited for analysis. The grab sample and week four of the scheduled compositing period were analyzed separately.

6. For the composited sample representing the period 8/28/00 through 9/25/00 from monitoring location 6S6, the analysis sensitivities required by SSES Technical Requirements for Nb-95, Ba-140, and La-140 were not met.

7. For the composited sample representing the period 8/28/00 through 9/25/00 from monitoring location 2S7, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

8. For the composited sample representing the period 9/25/00 through 10/30/00 from monitoring location 6S6, the analysis sensitivities required by SSES Technical Requirements for Nb-95 and La-140 were not met.

9. For the composited sample representing the period 9/25/00 through 10/30/00 from monitoring location 2S7, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

10. For the composited sample representing the period 10/30/00 through 11/27/00 from monitoring location 6S6, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

11. For the composited sample representing the period 10/30/00 through 11/27/00 from monitoring location 2S7, the analysis sensitivity required by SSES Technical Requirements for La-140 was not met.

12. For the composited sample representing the period 11/27/00 through 12/26/00 from monitoring location 6S6, the analysis sensitivity required by SSES Technical Requirements for Ba-140 and La-140 were not met.

13. For the composited sample representing the period 11/27/00 through 12/26/00 from monitoring location 2S7, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

* Refer to Appendix F of this report for additional details regarding exceptions to SSES Technical Requirements for sampling and analyses.

TABLE I-3
IODINE-131 ANALYSES OF SURFACE WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
6S6	01/03/00-01/17/00	<.20	
2S7	01/03/00-01/17/00	0.28 ± 0.12	
6S5	01/10/00-01/17/00	0.18 ± 0.08	
6S6	01/17/00-01/31/00	0.67 ± 0.15	
2S7	01/17/00-01/31/00	0.91 ± 0.17	(1)
6S5	01/24/00-01/31/00	0.67 ± 0.11	
LTAW	01/17/2000	<.08	
6S6	01/31/00-02/14/00	0.65 ± 0.15	
2S7	01/31/00-02/14/00	1.20 ± 0.10	
6S5	02/07/00-02/14/00	0.21 ± 0.09	
LTAW	02/14/2000	<.08	
6S6	02/14/00-02/28/00	0.43 ± 0.10	(2)
2S7	02/14/00-02/28/00	1.20 ± 0.20	
6S5	02/22/00-02/28/00	0.25 ± 0.08	
LTAW	03/13/2000	<.09	
6S6	02/28/00-03/13/00	<.20	(3)
2S7	02/28/00-03/13/00	0.26 ± 0.14	
6S5	03/06/00-03/13/00	<.20	
6S6	03/13/00-03/27/00	<.20	
2S7	03/13/00-03/27/00	0.36 ± 0.12	
6S5	03/20/00-03/27/00	<.10	

TABLE I-3
IODINE-131 ANALYSES OF SURFACE WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
6S6	03/27/00-04/10/00	<.20	
2S7	03/27/00-04/10/00	<.20	
6S5	04/03/00-04/10/00	<.10	
LTAW	04/17/2000	<.07	
6S6	04/10/00-04/24/00	<.20	
2S7	04/10/00-04/24/00	<.20	
6S5	04/17/00-04/24/00	<.20	
6S6	04/24/00-05/08/00	<.20	
2S7	04/24/00-05/08/00	<.20	
6S5	05/01/00-05/08/00	0.15 ± 0.09	
LTAW	05/16/2000	<.08	
6S6	05/08/00-05/22/00	0.27 ± 0.11	
2S7	05/08/00-05/22/00	0.55 ± 0.12	
6S5	05/15/00-05/22/00	0.27 ± 0.08	
6S6	05/22/00-06/05/00	<.20	
2S7	05/22/00-06/05/00	0.50 ± 0.13	
6S5	05/30/00-06/05/00	<.20	
6S6	06/05/00-06/19/00	0.40 ± 0.20	(4)
6S7	06/05/00-06/19/00	0.92 ± 0.19	(5)
6S5	06/12/00-06/19/00	<.20	
LTAW	06/12/2000	<.08	

TABLE I-3
IODINE-131 ANALYSES OF SURFACE WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
6S6	06/19/00-07/03/00	<.40	
2S7	06/19/00-07/03/00	0.90 ± 0.26	
6S5	06/26/00-07/03/00	<.40	
6S6	07/03/00-07/17/00	<.20	
2S7	07/03/00-07/17/00	0.32 ± 0.12	
6S5	07/10//-07/17/00	0.22 ± 0.19	
LTAW	07/17/2000	<.09	
6S6	07/17/00-07/31/00	0.53 ± 0.18	
2S7	07/17/00-07/31/00	0.96 ± 0.16	
6S5	07/24/00-07/31/00	0.46 ± 0.10	
6S6	07/31/00-08/14/00	<.30	
2S7	07/31/00-08/14/00	0.45 ± 0.18	
6S5	08/07/00-08/14/00	<.20	
LTAW	08/14/2000		(6)
6S6	08/14/00-08/28/00	1.20 ± 0.20	
2S7	08/14/00-08/28/00	0.72 ± 0.14	
6S5	08/21/00-08/28/00	0.78 ± 0.12	
6S6	08/28/00-09/11/00	0.59 ± 0.18	
2S7	08/28/00-09/11/00	1.00 ± 0.20	
6S5	09/05/00-09/11/00	0.57 ± 0.17	
LTAW	09/11/2000	<.20	
6S6	09/11/00-09/25/00	1.40 ± 0.60	
2S7	09/11/00-09/25/00		(7)
6S5	09/18/00-09/25/00	2.00 ± 0.50	

TABLE I-3
IODINE-131 ANALYSES OF SURFACE WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	I-131	COMMENTS
6S6	09/25/00-10/09/00	0.89 ± 0.14	
2S7	09/25/00-10/09/00	1.90 ± 0.20	
6S5	10/02/00-10/09/00	1.10 ± 0.20	
6S6	10/09/00-10/23/00	<2	
6S6	10/23/00-11/06/00	<29	
2S7	10/09/00-10/23/00	<32	
2S7	10/23/00-11/06/00	<7	
6S5	10/16/00-10/23/00	<4	
6S5	10/30/00-11/06/00	<22	
LTAW	10/16/2000	<50	
6S6	11/06/00-11/20/00	<0.64	
6S6	11/20/00-12/04/00	<0.64	
2S7	11/06/00-11/20/00	<14	
2S7	11/20/00-12/04/00	<11	
6S5	11/13/00-11/20/00	<11	
6S5	11/27/00-12/04/00	<1	
LTAW	11/13/2000	<864	
6S6	12/04/00-12/18/00	<1.3	
6S6	12/18/00-01/02/01	<0.6	
2S7	12/04/00-12/18/00	<1.4	
2S7	12/18/00-01/02/01	<0.7	
6S5	12/11/00-12/18/00	<0.9	
6S5	12/26/00-1/02/01	<0.4	
LTAW	12/11/2000	<0.6	

TABLE I-3
IODINE-131 ANALYSES OF SURFACE WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. During the sample compositing period from 1/17/00 through 1/31/00, four aliquots of water were not collected by the ACS at monitoring location 2S7 between 13:29 and 15:34 on 1/17/00.

2. During the sample compositing period from 2/14/00 through 2/28/00, the volumes per aliquot of water collected by the ACS at monitoring location 6S6 decreased between 2/24/00 and 2/28/00.

3. During the sample compositing period from 2/28/00 through 3/13/00, water was observed to be dripping into the ACS's collection container at monitoring location 6S6 between 3/9/00 and 3/13/00.

4. During the sample compositing period from 6/5/00 through 6/19/00, the volumes per aliquot of water collected at monitoring location 6S6 decreased between 6/12/00 and 6/19/00.

5. During the scheduled sample compositing period from 6/5/00 through 6/19/00, the ACS's collection container at monitoring location 2S7 was observed to be overflowing between 6/12/00 and 6/19/00. Water was also collected during the period 6/5/00 through 6/19/00 at the alternate CTBD line sampling location 6S7. Results of the sample obtained from 6S7 are being used to represent the CTBD line for this period.

6. This sample was never analyzed due to a technician's error at the contracted REMP radioanalytical laboratory.

7. This sample was never analyzed due to its destruction during shipment to the contracted REMP radioanalytical laboratory.

* Refer to Appendix F of this report for additional details regarding exceptions to SSES Technical Requirements for sampling and analyses.

TABLE I-4

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	COMMENTS
12H2T	12/28/99-01/17/00	<1.0	2.2 ± 0.8	<113		(1)
12H2T	01/24/00-01/31/00	<2.0	2.0 ± 0.9	<112	I-131 0.40 +/- 0.10	
12H2T	01/31/00-02/28/00	<1.0	3.1 ± 0.8	136 ± 70	I-131 0.38 +/- 0.14	
12H2T	02/14/00-02/28/00				I-131 0.33 +/- 0.10	
12H2T	02/28/00-03/13/00	<0.7	1.5 ± 0.8	<106		(2)
12H2T	03/20/00-03/27/00	<1.0	2.2 ± 0.7	<106		
12H2T	03/30/00-04/17/00	<0.8	1.6 ± 0.8	<111		(3)
12H2T	04/24/2000	<1.0	3.9 ± 0.9	<111		
12H2T	04/24/00-05/01/00	<1.0	1.3 ± 0.7	<111		
12H2T	05/01/00-05/30/00	<0.8	2.8 ± 0.8	<106		
12H2T	05/30/00-06/26/00	<1.0	2.7 ± 0.8	<108		
12H2T	06/05/00-06/19/00				I-131 0.41 +/- 0.12	
12H2T	06/26/00-07/31/00	<1.0	2.6 ± 0.8	<104		
12H2T	07/17/00-07/31/00				I-131 0.24 +/- 0.11	
12H2T	07/31/00-08/28/00	<0.8	2.0 ± 0.9	<106		
12H2T	08/14/00-08/28/00				I-131 0.55 +/- 0.12	
12H2T	08/28/00-09/25/00	<2.0	3.8 ± 1.0	<117		(4)

TABLE I-4

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	GR-ALPHA	GR-BETA	TRITIUM	OTHER ACTIVITY	COMMENTS
12H2T	09/11/00-09/25/00				I-131 0.70 +/- 0.38	
12H2T	09/25/00-10/09/00				I-131 0.51 +/- 0.11	
12H2T	09/25/00-10/30/00	2.0 ± 0.6	1.3 ± 0.7	<106		(5)
12H2T	10/30/00-11/27/00	1.6 ± 0.7	12.5 ± 1.1	<106		(6)
12H2T	11/27/00-12/26/00	1.5 ± 0.5	3.7 ± 0.6	<106		(7)

TABLE I-4

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. During the scheduled sample compositing period from 12/28/99 through 1/31/00, the ACS's collection container at monitoring location 12H2T was observed to be overflowing on 1/24/00 and 1/27/00. Grab samples were collected on 1/24/00 and 1/31/00 and composited for analysis.

2. During the scheduled sample compositing period from 2/28/00 through 3/27/00, sampling at monitoring location 12H2T was interrupted during the weeks of 3/13/00 and 3/20/00. Grab samples were collected on 3/20/00 and 3/27/00 and composited for analysis.

3. During the scheduled sample compositing period from 3/27/00 through 5/1/00, the ACS's solenoid malfunctioned at monitoring location 12H2T between 3/27/00 and 3/30/00. The ACS's solenoid pin broke during the week of 3/17/00 and was replaced on 4/24/00. A grab sample was collected on 4/24/00.

4. For the composited sample representing the period 8/28/00 through 9/25/00 from monitoring location 12H2T, the analysis sensitivities required by SSES Technical Requirements for Nb-95, Ba-140, and La-140 were not met.

5. For the composited sample representing the period 9/25/00 through 10/30/00 from monitoring location 12H2T, the analysis sensitivities required by SSES Technical Requirements for Nb-95, Ba-140, and La-140 were not met.

6. For the composited sample representing the period 10/30/00 through 11/27/00 from monitoring location 12H2T, the analysis sensitivities required by SSES Technical Requirements for Ba-140, and La-140 were not met.

7. For the composited sample representing the period 11/27/00 through 12/26/00 from monitoring location 12H2T, the analysis sensitivity required by SSES Technical Requirements for Ba-140 and La-140 were not met.

* Refer to Appendix F of this report for additional details regarding exceptions to SSES Technical Requirements for sampling and analyses.

TABLE I-5
GROSS BETA AND GAMMA* SPECTROSCOPIC ANALYSES OF FISH
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/gm (wet) ± 2S

LOCATION	SAMPLE TYPE	COLLECTION DATE	K-40	COMMENTS
2H	Smallmouth Bass	06/05/00 - 06/05/00	4.09 ± 0.41	
2H	White Sucker	06/05/00 - 06/05/00	3.55 ± 0.46	
2H	Channel Catfish	06/05/00 - 06/06/00	3.27 ± 0.33	
IND	Smallmouth Bass	05/31/00 - 05/31/00	3.24 ± 0.37	
IND	White Sucker	05/31/00 - 05/31/00	3.69 ± 0.47	
IND	Channel Catfish	06/06/00 - 06/07/00	3.18 ± 0.43	(1)
2H	Smallmouth Bass	11/14/00	3.49 ± 0.10	
2H	Shorthead Redhorse	11/14/00	3.19 ± 0.10	
2H	Channel Catfish	11/14/00 - 11/15/00	2.94 ± 0.08	
IND	Smallmouth Bass	11/03/00	3.61 ± 0.08	
IND	Channel Catfish	11/03/00 - 11/06/00	3.30 ± 0.09	
IND	Shorthead Redhorse	11/06/00	3.06 ± 0.08	
LTAW	Largemouth Bass	11/13/00	3.59 ± 0.10	

TABLE I-5
GROSS BETA AND GAMMA* SPECTROSCOPIC ANALYSES OF FISH
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. The interval between the sampling of Channel Catfish at monitoring location IND on 6/7/00 and the previous sampling of these fish at that location on 10/27/99 exceeded the time permitted by SSES Technical Requirements between collections for semi-annual sampling by one day.

TABLE I-6

GAMMA* SPECTROSCOPIC ANALYSES OF SHORELINE SEDIMENT

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/gm (dry) ± 2S

LOCATION	COLLECTION DAT	K-40	Cs-137	Ra-226	TH-228	OTHER ACTIVITY
2B	05/08/2000	10.2 ± 1.0	0.10 ± 0.03	1.34 ± 0.43	0.94 ± 0.09	
7B	05/08/2000	10.2 ± 1.0	0.09 ± 0.04	1.56 ± 0.56	1.04 ± 0.10	
12F	05/08/2000	8.90 ± 0.89	<30	1.78 ± 0.37	0.80 ± 0.08	
LTAW	05/08/2000	11.9 ± 1.0	<30	1.65 + 0.46	1.01 ± 0.10	
2B	12/12/2000	5.82 ± 0.09	.032 ± .003	0.60 ± 0.05	0.72 ± 0.24	(1)
7B	12/12/2000	3.85 ± 0.07	0.02 ± .002	0.40 ± 0.06	<.00002	
12F	12/12/2000	4.42 ± 0.07	0.02 ± .003	<.0002	<0.6	
LTAW	12/12/2000	6.96 ± 0.10	<.007	0.68 ± 0.07	<.00002	

TABLE I-6
GAMMA* SPECTROSCOPIC ANALYSES OF SHORELINE SEDIMENT
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. Sediment sampling was performed at alternative monitoring location 5S9 instead of location 2B on 12/12/00. Sampling at location 2B was not possible at that time due to ice cover and unsafe boating conditions.

TABLE I-7

TRITIUM AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	TRITIUM	OTHER ACTIVITY
12F3	01/17/2000	<108	
2S2	01/17/2000	171 ± 68	
4S4 Treated	01/17/2000	205 ± 68	
4S5	01/17/2000	137 ± 67	
12S1	01/17/2000	<108	
12F3	02/14/2000	<113	
2S2	02/14/2000	<113	
4S4 Treated	02/14/2000	<113	
4S5	02/14/2000	<113	
12S1	02/14/2000	<113	
12F3	03/13/2000	<112	
2S2	03/13/2000	<112	
4S4 Treated	03/13/2000	>112	
4S5	03/13/2000	<112	
12S1	03/13/2000	<112	
12F3	04/17/2000	<107	
2S2	04/17/2000	<105	
4S4 Treated	04/17/2000	194 ± 67	
4S5	04/17/2000	<107	
12S1	04/17/2000	<105	
12F3	05/15/2000	<112	
2S2	05/16/2000	<112	
4S4 Treated	05/15/2000	<112	
4S5	05/16/2000	<112	
12S1	05/15/2000	<112	

TABLE I-7

TRITIUM AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	TRITIUM	OTHER ACTIVITY
12F3	06/12/2000	<109	
2S2	06/12/2000	<109	
4S4 Treated	06/12/2000	<109	
4S5	06/12/2000	<109	
12S1	06/12/2000	<109	
12F3	07/17/2000	<108	
2S2	07/17/2000	<108	
4S4 Treated	07/17/2000	<108	
4S5	07/17/2000	<108	
12S1	07/17/2000	<108	
12F3	08/14/2000	<107	
2S2	08/14/2000	<107	
4S4 Treated	08/14/2000	<107	
4S5	08/14/2000	<107	
12S1	08/14/2000	<107	
12F3	09/11/2000	<106	K-40 84.8 ± 23.5
2S2	09/11/2000	<106	K-40 124 ± 28
4S4 Treated	09/11/2000	<106	
4S5	09/11/2000	<106	
12S1	09/11/2000	<106	K-40 127 ± 26
12F3	10/16/2000	<115	
2S2	10/16/2000	<115	
4S4 Treated	10/16/2000	170 ± 72	
4S5	10/16/2000	<115	
12S1	10/16/2000	<115	

TABLE I-7

TRITIUM AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND WATER

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	TRITIUM	OTHER ACTIVITY
12F3	11/13/2000	<107	
2S2	11/13/2000	<107	
4S4 Treated	11/13/2000	<107	
4S5	11/13/2000	<107	
12S1	11/13/2000	<107	
12F3	12/11/2000	<106	K-40 120 ± 50
2S2	12/11/2000	<106	
4S4 Treated	12/11/2000	<106	
4S5	12/11/2000	<106	K-40 100 ± 40
12S1	12/11/2000	<106	K-40 99 ± 38

TAL .-8

GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in E-03 pCi/Cu. M. ± 2S

MONTH	COLLECTION DATE	8G1	6G1	3S2	5S4	12S1	13S6	9B1	7S7	10S3	12E1
JAN	12/28/99 - 1/05/00	19 ± 2	23 ± 2	26 ± 2	28 ± 2	24 ± 2	26 ± 2	25 ± 2	26 ± 2	26 ± 2	8.8 ± 1.2 (1)
	1/05/00 - 1/12/00	17 ± 2	19 ± 2	16 ± 3 (2)	23 ± 2	19 ± 2	20 ± 2	22 ± 2	21 ± 2	20 ± 2	19 ± 2
	1/12/00 - 1/19/00	13 ± 2	12 ± 1	13 ± 2	14 ± 2	12 ± 1	14 ± 2	12 ± 2	13 ± 2	11 ± 1	14 ± 2
	1/19/00 - 1/26/00	20 ± 2	23 ± 2	23 ± 2	23 ± 2	23 ± 2	24 ± 2	23 ± 2	26 ± 2	24 ± 2	25 ± 2
	1/26/00 - 2/01/00	17 ± 2	21 ± 2	21 ± 2	23 ± 2	19 ± 2	20 ± 2	22 ± 2	19 ± 2	19 ± 2	20 ± 2
FEB	2/01/00 - 2/08/00	14 ± 2	15 ± 2	18 ± 2	15 ± 2	16 ± 2	18 ± 2	17 ± 2	17 ± 2	15 ± 2	15 ± 2
	2/08/00 - 2/15/00	21 ± 2	20 ± 2	25 ± 2	21 ± 2	22 ± 2	22 ± 2	23 ± 2	24 ± 2	22 ± 2	22 ± 2
	2/15/00 - 2/22/00	15 ± 2	15 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	17 ± 2	18 ± 2	16 ± 2	16 ± 2
	2/22/00 - 2/29/00	13 ± 2	14 ± 2	19 ± 2	18 ± 2	18 ± 2	17 ± 2	17 ± 2	17 ± 2	19 ± 2	18 ± 2
	2/29/00 - 3/07/00	11 ± 2	8.6 ± 1.4	12 ± 2	13 ± 2	11 ± 1	12 ± 2	10 ± 2	9.1 ± 1.6	12 ± 2	11 ± 2
MAR	3/07/00 - 3/14/00	14 ± 2	12 ± 2	13 ± 2	15 ± 2	13 ± 2	14 ± 2	12 ± 2	14 ± 2	14 ± 2	15 ± 2
	3/14/00 - 3/21/00	12 ± 2	12 ± 2	15 ± 2	12 ± 2	12 ± 2	13 ± 2	13 ± 2	13 ± 2	13 ± 2	14 ± 2
	3/21/00 - 3/28/00	12 ± 2	8.1 ± 1.4	12 ± 2	12 ± 1	12 ± 2	10 ± 1	11 ± 2	12 ± 2	11 ± 1	12 ± 2
	3/28/00 - 4/04/00	10 ± 2	10 ± 1	12 ± 2	12 ± 2	12 ± 2	11 ± 2	11 ± 2	11 ± 2	11 ± 2	12 ± 2
APR	4/04/00 - 4/11/00	9 ± 1.7	9.2 ± 1.7	9.8 ± 1.6	10 ± 2	10 ± 2	9 ± 1.7	9.6 ± 1.8	10 ± 2	9.7 ± 1.7	10 ± 2
	4/11/00 - 4/18/00	9.5 ± 1.4	8.8 ± 1.4	11 ± 1	11 ± 1	9.7 ± 1.4	10 ± 1	12 ± 2	11 ± 1	8.9 ± 1.4	9 ± 1.4
	4/18/00 - 4/25/00	6.7 ± 1.3	5.8 ± 1.2	7.7 ± 1.2	7.5 ± 1.2	6.2 ± 1.2	7.5 ± 1.3	7.7 ± 1.3	6.8 ± 1.2	6.8 ± 1.2	6.5 ± 1.2
	4/25/00 - 5/02/00	10 ± 1	10 ± 1	12 ± 2 (3)	12 ± 2 (3)	12 ± 1	12 ± 2	12 ± 2	11 ± 1 (3)	11 ± 1	10 ± 2
MAY	5/02/00 - 5/09/00	19 ± 2	19 ± 2	19 ± 2	20 ± 2	19 ± 2	16 ± 2	18 ± 2	19 ± 2	19 ± 2	21 ± 2
	5/09/00 - 5/16/00	14 ± 2	20 ± 2	15 ± 2	14 ± 2	14 ± 2	16 ± 2	13 ± 1	14 ± 1	13 ± 2	14 ± 2
	5/16/00 - 5/24/00	9.3 ± 1.3	7.1 ± 1.2	9.6 ± 1.3	12 ± 1	11 ± 1	9 ± 1.3	9.5 ± 1.2	10 ± 1	9.8 ± 1.3	9.3 ± 1.3
	5/24/00 - 5/30/00	6.1 ± 1.3	7.3 ± 1.3	8.3 ± 1.3	8.5 ± 1.4	8.8 ± 1.5	7.8 ± 1.4	8.7 ± 1.4	7.5 ± 1.4	7.8 ± 1.4	6 ± 1.3
JUN	5/30/00 - 6/06/00	10 ± 2	8.9 ± 1.4	7.7 ± 1.4	9 ± 1.5	9.6 ± 1.4	9.6 ± 1.4	10 ± 1	9.8 ± 1.4	7.6 ± 1.3	13 ± 2
	6/06/00 - 6/13/00	15 ± 2	14 ± 2	17 ± 2	18 ± 2	16 ± 2	13 ± 2	17 ± 2	16 ± 2	15 ± 2	17 ± 2
	6/13/00 - 6/20/00	4.7 ± 1.2	4.6 ± 1.2	5 ± 1.1	5.4 ± 1.3	5.4 ± 1.3	4.6 ± 1.1	5.9 ± 1.2	5.2 ± 1.1	5.5 ± 1.3	5.2 ± 1.1
	6/20/00 - 6/27/00	12 ± 2	13 ± 2	13 ± 2	14 ± 2	15 ± 2	13 ± 2	13 ± 2	15 ± 2	13 ± 2	17 ± 2
	6/27/00 - 7/05/00	13 ± 1	13 ± 1	13 ± 1	14 ± 1	14 ± 2	12 ± 1	13 ± 1	13 ± 1	13 ± 1	15 ± 2

TABLE I-8
GROSS BETA ANALYSES OF AIR PARTICULATE FILTERS
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in E-03 pCi/Cu. M. ± 2S

MONTH	COLLECTION DATE	8G1	6G1	3S2	5S4	12S1	13S6	9B1	7S7	10S3	12E1
JUL	7/05/00 - 7/11/00	8.9 ± 1.6	7.6 ± 1.5	10 ± 2	9.4 ± 1.6	8.2 ± 1.6	10 ± 2	11 ± 2	9.4 ± 1.6	9 ± 1.6	9.4 ± 1.7
	7/11/00 - 7/18/00	8.8 ± 1.4	12 ± 1	11 ± 1	12 ± 1	13 ± 2	9.8 ± 1.3	11 ± 1	12 ± 1	13 ± 2	11 ± 2
	7/18/00 - 7/26/00	9.3 ± 1.3	9.8 ± 1.2	8.2 ± 1.2	8.7 ± 1.2	8.9 ± 1.3	8.9 ± 1.2	11 ± 1	9.5 ± 1.3	9.3 ± 1.2	9.7 ± 1.3
	7/26/00 - 8/02/00	4.6 ± 1.2	4.8 ± 1.2	6.6 ± 1.3	6.3 ± 1.3	6.2 ± 1.4	6.1 ± 1.2	5.5 ± 1.3	6.9 ± 1.4	7 ± 1.4	5.9 ± 1.3
AUG	8/02/00 - 8/09/00	15 ± 2	15 ± 2	15 ± 2	14 ± 2	13 ± 2	14 ± 2	13 ± 2	15 ± 2	16 ± 2	13 ± 2
	8/09/00 - 8/16/00	11 ± 1	13 ± 2	13 ± 1	13 ± 1	11 ± 2	12 ± 1	14 ± 2	12 ± 2	11 ± 2	12 ± 1
	8/16/00 - 8/23/00	9.2 ± 1.4	9.6 ± 1.4	9.8 ± 1.4	9.3 ± 1.3	11 ± 2	9.9 ± 1.4	11 ± 1	10 ± 1	10 ± 2	11 ± 2
	8/23/00 - 8/30/00	18 ± 2	19 ± 2	24 ± 2	21 ± 2	21 ± 2	23 ± 2	22 ± 2	21 ± 2	18 ± 2	25 ± 2
SEP	8/30/00 - 9/06/00	9.8 ± 1.5	11 ± 2	13 ± 2	12 ± 2	10 ± 2	10 ± 1	9.4 ± 1.5	11 ± 1	12 ± 1	11 ± 2
	9/06/00 - 9/13/00	16 ± 2	16 ± 2	19 ± 2	17 ± 2	18 ± 2	15 ± 2	18 ± 2	18 ± 2	17 ± 2	17 ± 2
	9/13/00 - 9/20/00	12 ± 2	12 ± 1	14 ± 1	15 ± 2	14 ± 2	14 ± 2	15 ± 2	14 ± 2	14 ± 1	14 ± 2
	9/20/00 - 9/27/00	8.5 ± 1.4	8.8 ± 1.4	9.9 ± 1.4	10 ± 1	11 ± 2	10 ± 1	11 ± 2	11 ± 2	11 ± 1	12 ± 2
	9/27/00 - 10/04/00	16 ± 2	17 ± 2	16 ± 2	16 ± 2	17 ± 2	15 ± 2	18 ± 2	18 ± 2	17 ± 2	18 ± 2
OCT	10/04/00 - 10/11/00	10 ± 0.5	9 ± 0.5	11 ± 0.5	8 ± 0.5	9 ± 0.5	9 ± 0.5	7 ± 0.5	8 ± 0.5	9 ± 0.5	9 ± 0.5
	10/11/00 - 10/18/00	20 ± 0.5	17 ± 0.5	21 ± 0.5	21 ± 0.5	23 ± 0.5	22 ± 0.5	23 ± 0.5	21 ± 0.5	21 ± 0.5	21 ± 0.5
	10/18/00 - 10/25/00	17 ± 0.5	16 ± 0.5	19 ± 0.5	19 ± 0.5	21 ± 0.5	17 ± 0.5	19 ± 0.5	15 ± 0.5	16 ± 0.5	17 ± 0.5
	10/25/00 - 11/01/00	12 ± 0.5	28 ± 0.5	13 ± 0.5	15 ± 0.5	13 ± 0.5	18 ± 0.5	17 ± 0.5	12 ± 0.5	12 ± 0.5	12 ± 0.5
NOV	11/01/00 - 11/08/00	15 ± 0.5	9 ± 0.5	15 ± 0.5	17 ± 0.5	13 ± 0.5	11 ± 0.5	10 ± 0.5	20 ± 0.5	12 ± 0.5	14 ± 0.5
	11/08/00 - 11/15/00	10 ± 0.5	11 ± 0.5	35 ± 0.5	10 ± 0.5	11 ± 0.5	11 ± 0.5	10 ± 0.5	13 ± 0.5	12 ± 0.5	12 ± 0.5
	11/15/00 - 11/21/00	22 ± 0.5	22 ± 0.5	23 ± 0.5	21 ± 0.5	23 ± 0.5	11 ± 0.5	20 ± 0.5	23 ± 0.5	25 ± 0.5	25 ± 0.5
	11/21/00 - 11/28/00	8 ± 0.5	8 ± 0.5	8 ± 0.5	8 ± 0.5	9 ± 0.5	9 ± 0.5	10 ± 0.5	9 ± 0.5	9 ± 0.5	10 ± 0.5
DEC	11/28/00 - 12/06/00	12 ± 0.5	13 ± 0.5	14 ± 0.5	13 ± 0.5	16 ± 0.5	16 ± 0.5	16 ± 0.5	14 ± 0.5	14 ± 0.5	14 ± 0.5
	12/06/00 - 12/13/00	13 ± 0.5	16 ± 0.5	21 ± 0.5	20 ± 0.5	16 ± 0.5	15 ± 0.5	16 ± 0.5	22 ± 0.5	17 ± 0.5	17 ± 0.5
	12/13/00 - 12/21/00	19 ± 0.5	18 ± 0.5	20 ± 0.5	18 ± 0.5	20 ± 0.5	20 ± 0.5	19 ± 0.5	21 ± 0.5	19 ± 0.5	21 ± 0.5
	12/21/00 - 12/27/00	18 ± 0.5	20 ± 0.5	19 ± 0.5	20 ± 0.5	19 ± 0.5	21 ± 0.5	23 ± 0.5	18 ± 0.5	21 ± 0.5	18 ± 0.5
	12/27/00 - 01/03/01	12 ± 0.5	12 ± 0.5	13 ± 0.5	10 ± 0.5	12 ± 0.5	11 ± 0.5	11 ± 0.5	12 ± 0.5	13 ± 0.5	13 ± 0.5

TABLE I-8
TRITIUM, AND GAMMA* SPECTROSCOPIC ANALYSES OF GROUND WATER
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. During the week of 12/28/99 through 1/5/00 at monitoring location 12E1, the particulate filter was not completely covering the air sampling head.

2. During the scheduled monitoring period of 1/5/00 through 1/12/00 at monitoring location 3S2, the sampling pump malfunctioned and stopped running. The actual sampling period was determined to be from 1/5/00 through 1/8/00 based on the electrical timer reading. As a result of the pump malfunctioning, a lower than normal sample volume was collected for the period.

3. During the week of 4/25/00 through 5/2/00 at monitoring locations 3S2, 5S4, and 7S7, the electrical timers indicated that sampling was interrupted for a period of about 30 minutes as the result of a loss of electrical power.

TABLE I-9

GAMMA* SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in E-03 pCi/Cu. M. ± 2S

LOCATION	COLLECTION DATE	Be-7	K-40	OTHER ACTIVITY
6G1	12/28/99 - 3/28/00	104 ± 10		
8G1	12/28/99 - 3/28/00	99.9 ± 10		
7S7	12/28/99 - 3/28/00	118 ± 12		
10S3	12/28/99 - 3/28/00	125 ± 12		
3S2	12/28/99 - 3/28/00	119 ± 12		
5S4	12/28/99 - 3/28/00	115 ± 11		
9B1	12/28/99 - 3/28/00	120 ± 12		
12E1	12/28/99 - 3/28/00	96.6 ± 9.7		
12S1	12/28/99 - 3/28/00	108 ± 11		
13S6	12/28/99 - 3/28/00	105 ± 10		
6G1	3/28/00 - 6/27/00	76.7 ± 8.8		
8G1	3/28/00 - 6/27/00	89.4 ± 8.9		
7S7	3/28/00 - 6/27/00	66.0 ± 8.2		
10S3	3/28/00 - 6/27/00	93.8 ± 9.4		
3S2	3/28/00 - 6/27/00	89.7 ± 9.0		
5S4	3/28/00 - 6/27/00	112 ± 11		
9B1	3/28/00 - 6/27/00	91.5 ± 10.2		
12E1	3/28/00 - 6/27/00	95.3 ± 9.6		
12S1	3/28/00 - 6/27/00	82.4 ± 8.2	5.6 ± 1.8	
13S6	3/28/00 - 6/27/00	73.7 ± 8.1		

TABLE I-9

GAMMA* SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in E-03 pCi/Cu. M. ± 2S

LOCATION	COLLECTION DATE	Be-7	K-40	OTHER ACTIVITY
6G1	6/27/00 - 9/27/00	87.2 ± 8.7		
8G1	6/27/00 - 9/27/00	81.6 ± 8.2	28 ± 3	
7S7	6/27/00 - 9/27/00	66.1 ± 6.6		
10S3	6/27/00 - 9/27/00	87.7 ± 8.8		
3S2	6/27/00 - 9/27/00	90.9 ± 9.1		
5S4	6/27/00 - 9/27/00	75.3 ± 7.5		
9B1	6/27/00 - 9/27/00	90 ± 6		
12E1	6/27/00 - 9/27/00	80.9 ± 8.1		
12S1	6/27/00 - 9/27/00	90.0 ± 9		
13S6	6/27/00 - 9/27/00	75.3 ± 7.5	25 ± 3	
6G1	9/27/00 - 12/27/00	58.5 ± 3.0		
8G1	9/27/00 - 12/27/00	60.2 ± 2.9		
7S7	9/27/00 - 12/27/00	68.3 ± 3.5		
10S3	9/27/00 - 12/27/00	66.9 ± 3.1		
3S2	9/27/00 - 12/27/00	74.7 ± 3.8		
5S4	9/27/00 - 12/27/00	62.2 ± 3.0		
9B1	9/27/00 - 12/27/00	66.7 ± 3.2		
12E1	9/27/00 - 12/27/00	64.9 ± 3.2		
12S1	9/27/00 - 12/27/00	68.7 ± 3.3		
13S6	9/27/00 - 12/27/00	65.2 ± 3.2		

TABLE I-9
GAMMA*SPECTROSCOPIC ANALYSES OF COMPOSITED AIR PARTICULATE FILTERS
SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. Samples collected from monitoring locations 10D1 and 10D2 on 4/24/00 were lost in transit to the REMP radioanalytical laboratory. These samples were never analyzed.

2. For the samples collected on 7/25/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

3. For the samples collected on 9/22/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

4. For the samples collected on 11/6/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivity required by SSES Technical Requirements for I-131 was not met.

5. For the samples collected on 12/4/00 from the monitoring locations 10D1 and 10G1, the analysis sensitivities required by SSES Technical Requirements for I-131 and La-140 were not met.

6. For the samples collected on 12/4/00 from the monitoring locations 10D2 and 10D3, the analysis sensitivities required by SSES Technical Requirements for I-131 and La-140 were not met.

TABLE I-10

IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	K-40	OTHER ACTIVITY	COMMENTS
10G1	01/10/00	1400 ± 140		
10D1	01/10/00	1190 ± 120		
10D2	01/10/00	1380 ± 140		
7C1	01/10/00	1380 ± 140		
10G1	02/08/00	1430 ± 140		
10D1	02/08/00	1190 ± 120		
10D2	02/08/00	1250 ± 120		
7C1	02/08/00	1480 ± 150		
10G1	03/07/00	1260 ± 130		
10D1	03/07/00	1400 ± 140		
10D2	03/07/00	1370 ± 140		
7C1	03/07/00	1360 ± 140		
10G1	04/10/00	1360 ± 140		
10D1	04/10/00	1380 ± 140		
10D2	04/10/00	1370 ± 140		
7C1	04/10/00	1390 ± 140		
10G1	04/24/00	1270 ± 130		
10D1	04/24/00			(1)
10D3	04/24/00	1280 ± 130		
7C1	04/24/00	1420 ± 140		
10G1	05/08/00	1440 ± 140		
10D1	05/08/00	1330 ± 130		
10D2	05/08/00	1300 ± 130		
10D3	05/08/00	1160 ± 120		
7C1	05/08/00	1340 ± 130		

TABLE I-10

IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	K-40	OTHER ACTIVITY	COMMENTS
10G1	05/24/00	1340 ± 130		
10D1	05/24/00	1260 ± 130		
10D2	05/24/00	1420 ± 140		
10D3	05/24/00	1300 ± 130		
7C1	05/24/00	1470 ± 150		
10G1	06/09/00	1260 ± 130		
10D1	06/09/00	1220 ± 120		
10D2	06/09/00	1210 ± 120		
10D3	06/09/00	1260 ± 130		
7C1	06/09/00	1450 ± 140		
10G1	06/23/00	1230 ± 120		
10D1	06/23/00	1320 ± 130		
10D2	06/23/00	1300 ± 130		
10D3	06/23/00	1270 ± 130		
7C1	06/23/00	1420 ± 140		
10G1	07/10/00	1300 ± 130		
10D1	07/10/00	1280 ± 130		
10D2	07/10/00	1350 ± 140		
10D3	07/10/00	1180 ± 120		
7C1	07/10/00	1630 ± 160		
10G1	07/25/00	1360 ± 81		(2)
10D1	07/25/00	1500 ± 100		(2)
10D2	07/25/00	1420 ± 105		(2)
10D3	07/25/00	1310 ± 92		(2)
7C1	07/25/00	2060 ± 101		

TABLE I-10

IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	K-40	OTHER ACTIVITY		COMMENTS
10G1	08/08/00	1400 ± 81	Ra-226 23.7 ± 3.0	Th-228 10.7 ± 3.0	
10D1	08/08/00	1500 ± 92			
10D2	08/08/00	1370 ± 75			
10D3	08/08/00	1440 ± 81	Ra-226 9.7 ± 2.6	Th-228 5.1 ± 3.0	
7C1	08/08/00	1420 ± 87			
10G1	08/22/00	1310 ± 89			
10D1	08/22/00	1520 ± 79			
10D2	08/22/00	1200 ± 85			
10D3	08/22/00	1360 ± 96			
7C1	08/22/00	1100 ± 63			
10G1	09/07/00	1380 ± 140			
10D1	09/07/00	1460 ± 150			
10D2	09/07/00	1450 ± 150			
10D3	09/07/00	1330 ± 130			
7C1	09/07/00	1550 ± 160			
10G1	09/22/00	1600 ± 100			(3)
10D1	09/22/00	1400 ± 100			(3)
10D2	09/22/00	1400 ± 100			(3)
10D3	09/22/00	1500 ± 100			(3)
7C1	09/22/00	1500 ± 100			
10G1	10/09/00	1440 ± 140			
10D1	10/09/00	1390 ± 140			
10D2	10/09/00	1220 ± 120			
10D3	10/09/00	1330 ± 130			
7C1	10/09/00	2090 ± 210			

TABLE I-10

IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/liter ± 2S

LOCATION	COLLECTION DATE	K-40	OTHER ACTIVITY	COMMENTS
10G1	10/23/00	1410 ± 61		
10D1	10/23/00	1450 ± 62		
10D2	10/23/00	1350 ± 64		
10D3	10/23/00	1420 ± 70		
7C1	10/23/00	1560 ± 73		
10G1	11/06/00	1320 ± 60		(4)
10D1	11/06/00	1500 ± 68		(4)
10D2	11/06/00	1390 ± 73		(4)
10D3	11/06/00	1330 ± 64		(4)
7C1	11/06/00	1460 ± 67		
10G1	12/04/00	1420 ± 70		(5)
10D1	12/04/00	1490 ± 60		(5)
10D2	12/04/00	1420 ± 73		(6)
10D3	12/04/00	1330 ± 59		(6)
7C1	12/04/00	1620 ± 74		

TABLE I-10

IODINE-131, AND GAMMA* SPECTROSCOPIC ANALYSES OF MILK

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Comments

1. Samples collected from monitoring locations 10D1 and 10D2 on 4/24/00 were lost in transit to the REMP radioanalytical laboratory. These samples were never analyzed.

2. For the samples collected on 7/25/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met..

3. For the samples collected on 9/22/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivities required by SSES Technical Requirements for Ba-140 and La-140 were not met.

4. For the samples collected on 11/6/00 from the monitoring locations 10D1, 10D2, 10D3, and 10G1, the analysis sensitivity required by SSES Technical Requirements for I-131 was not met.

5. For the samples collected on 12/4/00 from the monitoring locations 10D1 and 10G1, the analysis sensitivities required by SSES Technical Requirements for I-131 and La-140 were not met.

6. For the samples collected on 12/4/00 from the monitoring locations 10D2 and 10D3, the analysis sensitivity required by SSES Technical Requirements for I-131 was not met.

TABLE I-11
GAMMA* SPECTROSCOPIC ANALYSES OF SOIL
SUSQUEHANNA STEAM ELECTRIC STATION - 2000
Results in pCi/gm (dry) ± 2S

LOCATION	COLLECTION DATE	K-40	Cs-137	Ra-226	Th-228
8G1 TOP	09/20/00	12.0 ± 0.0	0.21 ± 0.02	2.1 ± 0.3	2.7 ± 0.7
8G1 BOT	09/20/00	11.0 ± 0.0		2.2 ± 0.3	2.0 ± 0.7
3S2 TOP	09/20/00	11.3 ± 0.40	.039 ± .011	2.5 ± 0.5	2.2 ± 0.7
3S2 BOT	09/20/00	14.0 ± 1.0		2.2 ± 0.8	2.6 ± 0.8
12S1 TOP	09/20/00	10.0 ± 0.0	0.14 ± 0.01	1.3 ± 0.2	2.1 ± 0.7
12S1 BOT	09/20/00	9.7 ± 0.20	0.14 ± 0.01	1.3 ± 0.1	1.5 ± 0.6
13S6 TOP	09/20/00	8.5 ± 0.3		1.1 ± 0.3	2.0 ± 0.9
13S6 BOT	09/20/00	10.0 ± 0.0		1.8 ± 0.6	1.5 ± 0.8

TAI -12

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/gm (wet) ± 2S

LOCATION	SAMPLE TYPE	COLLECTION DATE	K-40	OTHER ACTIVITY	
10B5	Apples	09/18/2000	3.78 ± 0.38		
12S7	Apples	09/18/2000	3.02 ± 0.30		
12S7	Apples	10/23/2000	0.87 ± 0.06		
13G2	Beans	07/18/2000	1.54 ± 0.15		
11B1	Beans	08/15/2000	2.08 ± 0.21		
10B5	Wax Beans	07/24/2000	2.07 ± 0.21		
12F7	Wax Beans	07/24/2000	3.36 ± 0.34		
13G2	Beets	08/29/2000	2.99 ± 0.30		
11B1	Beets	07/24/2000	3.12 ± 0.31		
14B3	Beets	07/24/2000	5.18 ± 0.52		
14B3	Broccoli	08/22/2000	3.36 ± 0.34		
13G2	Cabbage	08/29/2000	1.91 ± 0.19		
10B5	Cabbage	07/05/2000	2.28 ± 0.23		
14B3	Cabbage	07/24/2000	1.03 ± 0.10		
13G2	Corn	08/08/2000	2.47 ± 0.25		
11D1	Corn	08/15/2000	2.35 ± 0.20	Ra-226 0.15 ± 0.01	
11B1	Corn	08/15/2000	4.23 ± 0.36	Ra-226 0.28 ± 0.02	
12S7	Corn	08/15/2000	2.53 ± 0.23	Ra-226 0.12 ± 0.02	
10B5	Corn	08/15/2000	2.38 ± 0.29	Ra-226 0.11 ± 0.02	Th-228 0.07 ± 0.02
14B3	Corn	08/22/2000	4.64 ± 0.57	Ra-226 1.03 ± 0.45	
13G2	Cucumber	07/18/2000	1.47 ± 0.15		
7A3	Cucumber	08/15/2000	1.31 ± 0.12	Ra-226 0.02 ± 0.006	Th-228 0.02 ± 0.005
10B5	Cucumber	08/15/2000	1.60 ± 0.16		Th-228 0.02 ± 0.005
13G2	Onion	07/18/2000	0.67 ± 0.07		
10B5	Onion	07/24/2000	2.28 ± 0.23		Th-228 0.01 ± 0.006
11B1	Onion	07/24/2000	1.56 ± 0.16		

TABLE I-12

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

SUSQUEHANNA STEAM ELECTRIC STATION - 2000

Results in pCi/gm (wet) ± 2S

LOCATION	SAMPLE TYPE	COLLECTION DATE	K-40	OTHER ACTIVITY			
13G2	Peppers	08/08/2000	1.61 ± 0.11				
7A3	Peppers	07/24/2000	1.56 ± 0.16				
11B1	Peppers	08/15/2000	1.36 ± 0.14				
10B5	Peppers	09/18/2000	3.09 ± 0.31				
13G2	Potato	07/18/2000	3.80 ± 0.38				
10B5	Potato	07/24/2000	4.86 ± 0.49				
12F7	Potato	08/30/2000	2.84 ± 0.28				
11B1	Potato	09/18/2000	1.03 ± 0.10	Be-7	0.08 ± 0.05		
12F7	Potato	10/23/2000	3.34 ± 0.09				
13G2	Pumpkin	10/24/2000	1.50 ± 0.07				
11B1	Pumpkin	09/18/2000	4.96 ± 0.50				
11D1	Pumpkin	09/18/2000	2.15 ± 0.21				
12S7	Pumpkin	09/18/2000	1.44 ± 0.14				
11D1	Pumpkin	10/23/2000	1.68 ± 0.08				
12S7	Pumpkin	10/23/2000	3.02 ± 0.10				
10B5	Squash	09/18/2000	0.92 ± 0.20				
13G2	Tomato	08/08/2000	2.51 ± 0.25			Cs-137	0.010 ± 0.006
7A3	Tomato	08/15/2000	2.98 ± 0.30				
10B5	Tomato	08/15/2000	3.23 ± 0.32				
11B1	Tomato	09/18/2000	1.49 ± 0.15				
13G2	Zucchini	08/08/2000	2.12 ± 0.21				
11B1	Zucchini	07/24/2000	1.65 ± 0.16				

APPENDIX J

PERFORMANCE SUMMARY FOR THE RADIOANALYSES OF SPIKED ENVIRONMENTAL SAMPLE MEDIA - 2000

TELEDYNE BROWN ENGINEERING
&
PPL CORPORATION
CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY RESULTS

The data in the tables that follow show how well Teledyne Brown Engineering Environmental Services (TBE) and PPL's Corporate Environmental Radioactivity Measurements Laboratory (CERML) performed in the analysis of radioactively spiked environmental sample media. Table J-1 provides the performance results for TBE in the analyses of spiked environmental media obtained through participation in the Environmental Resource Associates (ERA) Interlaboratory Comparison Program. Table J-2 shows the agreement of TBE's analysis results with the levels of radioactivity reported by Analytics, Inc., for spiked samples procured by TBE as part of its QC Spike Program. Table J-3 presents the analysis results of TBE and the levels of radioactivity reported by Analytics for spiked environmental sample media procured from Analytics by PPL as part of its quality control for the PPL Radiological Environmental Monitoring Program (REMP). The spiked samples represented in both Tables J-2 and J-3, and J-4 are prepared by Analytics as part of its Environmental Radioactivity Cross-Check Program. The spiked sample analysis results in Table J-4 are for analyses performed by CERML, which performs the primary analyses for tritium in surface water, drinking water and ground water samples collected for the REMP throughout 2000 and the primary analyses for all other media during October, November and part of December.

TABLE J-1
ENVIRONMENTAL RESOURCE ASSOCIATES (ERA)
PROFICIENCY TESTING PROGRAM - 2000
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Collection Date	Identification No.	Media	Nuclide	ERA Known Result (a)	TBE Results (a)	Ratio (b)	Expected Dev. Known (c)	Control Limits (c)	
February-00	RAD 13		Gr. Alpha	71.8	14.0	0.19	18.0	40.9 - 103	(1)
			Gr. Beta	194.0	34.0	0.18	29.1	144 - 244	(1)
			Sr-89	16.4	15.7	0.96	5.0	7.70 - 25.1	
			Sr-90	28.9	29.0	1.00	5.0	20.2 - 37.6	
			Co-60	64.4	68.3	1.06	5.0	55.7 - 73.1	
			Cs-134	12.3	12.0	0.98	5.0	3.60 - 21.0	
			Cs-137	72.2	76.3	1.06	5.0	63.5 - 80.9	
February-00	RAD 14		Gr. Alpha	25.4	14.0	0.55	6.4	18.1 - 32.7	(1)
			Gr. Beta	42.1	34.0	0.81	5.0	36.3 - 47.9	
February-00	RAD 15		Ba-133	98.2	91.7	0.93	9.8	81.5 - 115	
			Co-60	99.6	101.0	1.01	5.0	90.9 - 108	
			Cs-134	49.2	48.0	0.98	5.0	40.5 - 57.9	
			Cs-137	209.0	76.3	0.37	10.4	191 - 221	(1)
			Zn-65	313.0	<1.0		31.3	260 - 367	(1)
February-00	RAD 17		Gr. Alpha	58.4	83.6	1.43	14.6	33.3 - 83.5	(1)
			Gr. Beta	16.8	15.4	0.92	5.0	8.1 - 25.5	
Mar-00	RAD 20		H-3	23800.0	22300.0	0.94	12380.0	21100 - 26500	
May-00	RAD 16		Sr-89	22.5	18.3	0.81	5.0	13.8 - 31.2	
			Sr-90	9.6	8.3	0.87	5.0	0.9 - 18.3	
May-00	RAD 18		I-131	19.9	2.0	0.10	3.0	14.7 - 25.1	(1)

(a) Results are the average of three measurements, reported in units of pCi/l.
(b) Ratio is TBE to ERA.
(c) Per guidelines of the EPA'S National Standards for Water Proficiency Testing Criteria Document, December 1998.

TABLE J-1
ENVIRONMENTAL RESOURCE ASSOCIATES (ERA)
PROFICIENCY TESTING PROGRAM - 2000
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Collection Date	Identification No.	Media	Nuclide	ERA Known Result (a)	TBE Results (a)	Ratio (b)	Expected Dev. Known (c)	Control Limits (c)
September-00	RAD 24	Water	Sr-90	26.2	28.6	1.09	1.4	17.5 - 34.9
September-00	RAD 25	Water	Gr. Alpha	7.2	6.9	0.96	1.11	DL – 15.9
			Gr. Beta	87.5	88.8	1.01	9.76	70.2 – 105
September-00	RAD 26	Water	H-3	8320.0	8740.0	1.05	174	6910 – 9730

Comments:

(1) The Quality Assurance Manager of the contracted REMP radioanalytical laboratory generally attributes all of the deviations from the known values to be the result of analyst's errors or equipment malfunctions at its former facility. Further investigation of these deviationsis considered by the laboratory to be impractical due to the essentially complete replacement of laboratory personnel, the relocation and re-calibration of equipment at its new facility, and, in some cases, the use of new equipment at the new facility.

(a) Results are the average of three measurements, reported in units of pCi/l.
(b) Ratio is TBE to ERA.
(c) Per guidelines of the EPA'S National Standards for Water Proficiency Testing Criteria Document, December 1998.

TABLE J-2

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000

TELEDYNE QUALITY CONTROL SPIKE PROGRAM

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)
March-00	E1823-396	Milk	I-131	20 ± 1	18 ± 1	0.9
			Cr-51	387 ± 19	381 ± 38	0.98
			Cs-134	143 ± 7	132 ± 13	0.92
			Cs-137	114 ± 6	128 ± 13	1.12
			Co-58	79 ± 4	89 ± 9	1.13
			Mn-54	176 ± 9	195 ± 20	1.11
			Fe-59	144 ± 7	161 ± 16	1.12
			Zn-65	165 ± 8	171 ± 17	1.04
			Co-60	176 ± 9	179 ± 18	1.02
			Sr-89	25 ± 1	13 ± 3	0.52 (1)
			Sr-90	19 ± 1	16 ± 1	0.84
June-00	E1826-396	AP Filter	Ce-141	132 ± 7	143 ± 8	1.08
			Cr-51	198 ± 10	229 ± 17	1.16
			Cs-134	81 ± 4	74 ± 4	0.91
			Cs-137	115 ± 6	143 ± 8	1.24
			Co-58	77 ± 4	89 ± 5	1.16
			Mn-54	84 ± 4	102 ± 6	1.21
			Fe-59	75 ± 4	98 ± 6	1.31
			Zn-65	139 ± 7	188 ± 11	1.35
			Co-60	104 ± 5	113 ± 7	1.09
			Sr-90	96 ± 5	88 ± 5	0.92
			Gr. Alpha	93 ± 5	103 ± 6	1.11
			Gr. Beta	193 ± 10	210 ± 6	1.09
June-00	E1824-396	Charcoal Filter	I-131	88 ± 4	106 ± 6	1.2

(a) Units are pCi/l for water and milk and pCi for AP Filters and charcoal cartridges.
Counting error is two standard deviations.

(b) Ratio is TBE to Analytics.

TABLE J-2
ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
TELEDYNE QUALITY CONTROL SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)
September-00	E1827-396	Milk	I-131	87 ± 4	97 ± 10	1.11
			Ce-141	77 ± 4	83 ± 8	1.08
			Cr-51	304 ± 15	323 ± 40	1.06
			Cs-134	102 ± 5	98 ± 10	0.96
			Cs-137	107 ± 5	117 ± 12	1.09
			Co-58	60 ± 3	64 ± 6	1.07
			Mn-54	88 ± 4	99 ± 10	1.13
			Fe-59	119 ± 6	132 ± 13	1.11
			Zn-65	196 ± 10	218 ± 22	1.11
			Co-60	197 ± 10	209 ± 21	1.06
			Sr-89	15 ± 1	14 ± 1	0.93
			Sr-90	14 ± 1	18 ± 1	1.29

Comments:

(1) Caused by incorrect rinsing of the strontium extraction column.
Additional training was conducted and was documented in the analyst's training file.
Subsequent tests on two milk samples spiked with Sr-89 produced correct results.

(a) Units are pCi/l for water and milk and pCi for AP Filters and charcoal cartridges.
Counting error is two standard deviations.
(b) Ratio is TBE to Analytics.

TABLE J-3
ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)	
March-00	E2110-186	Charcoal Filter	I-131	81 ± 3	75 ± 8	0.93	
	E2111-186	Charcoal Filter	I-131	90 ± 3	82 ± 8	0.91	
	E2112-186	Charcoal Filter	I-131	73 ± 3	66 ± 7	0.90	
March-00	E2109-186	Milk	Ce-141	460 ± 15	489 ± 49	1.06	
			Cr-51	256 ± 9	257 ± 40	1.00	
			Cs-134	150 ± 5	144 ± 14	0.96	
			Cs-137	138 ± 5	162 ± 16	1.17	
			Co-58	47 ± 1	53 ± 6	1.13	
			Mn-54	171 ± 6	180 ± 18	1.05	
			Fe-59	99 ± 3	116 ± 12	1.17	
			Zn-65	208 ± 7	227 ± 23	1.09	
			Co-60	125 ± 4	136 ± 14	1.09	
			I-131	84 ± 3	227 ± 38	2.70	
March-00	E2113-186	Sediment	Ce-141	849 ± 28	749 ± 75	0.88	
			Cr-51	473 ± 16	360 ± 192	0.76	(1)
			Cs-134	276 ± 9	260 ± 33	0.94	
			Cs-137	382 ± 13	357 ± 38	0.93	
			Co-58	87 ± 3	94 ± 24	1.08	
			Mn-54	316 ± 11	301 ± 36	0.95	
			Fe-59	184 ± 6	218 ± 60	1.18	
			Zn-65	383 ± 13	336 ± 54	0.88	
			Co-60	231 ± 8	242 ± 32	1.05	

(a) Units are pCi/l for milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment.
Counting error is two standard deviations.
(b) Ratio is TBE to Analytics results.

TABLE J-3

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)	
June-00	E2287-186	Charcoal Filter	I-131	72 ± 2	86 ± 9	1.19	
	E2288-186	Charcoal Filter	I-131	93 ± 3	97 ± 9	1.04	
	E2289-186	Charcoal Filter	I-131	61 ± 2	60 ± 6	0.98	
June-00	E2284-186	AP Filter	Ce-141	67 ± 2	76 ± 8	1.13	
			Cr-51	205 ± 7	209 ± 34	1.02	
			Cs134	89 ± 3	86 ± 9	0.97	
			Cs-137	185 ± 6	214 ± 21	1.16	
			Co-58	101 ± 4	115 ± 11	1.14	
			Mn-54	115 ± 4	130 ± 13	1.13	
			Fe-59	49 ± 2	64 ± 11	1.31	(2)
			Zn-65	149 ± 5	159 ± 16	1.07	
			Co-60	138 ± 5	148 ± 15	1.07	
	E2285-186	AP Filter	Ce-141	93 ± 3	110 ± 11	1.18	
			Cr-51	285 ± 10	370 ± 45	1.30	(2)
			Cs134	123 ± 4	117 ± 12	0.95	
			Cs-137	257 ± 9	322 ± 32	1.25	(2)
			Co-58	140 ± 5	158 ± 16	1.13	
			Mn-54	160 ± 6	188 ± 19	1.18	
			Fe-59	68 ± 2	88 ± 12	1.30	(2)
			Zn-65	199 ± 7	242 ± 24	1.22	
			Co-60	191 ± 7	220 ± 22	1.15	

(a) Units are pCi/l for milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment.
Counting error is two standard deviations.

(b) Ratio is TBE to Analytics results.

TABLE J-3

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)	
June-00	E2286-186	AP Filter	Ce-141	61 ± 2	62 ± 6	1.02	
			Cr-51	187 ± 7	247 ± 29	1.32	(2)
			Cs134	81 ± 3	76 ± 8	0.94	
			Cs-137	169 ± 6	194 ± 19	1.15	
			Co-58	92 ± 3	104 ± 10	1.13	
			Mn-54	105 ± 4	121 ± 12	1.15	
			Fe-59	45 ± 2	54 ± 9	1.19	
			Zn-65	131 ± 5	157 ± 16	1.20	
			Co-60	126 ± 4	136 ± 14	1.08	
September-00	E2405-186	Milk	Ce-141	164 ± 5	227 ± 38	1.38	(1)
			Cr-51	198 ± 7			(3)
			Cs-134	110 ± 4	100 ± 4	0.91	
			Cs-137	188 ± 6	192 ± 1	1.02	
			Co-58	51 ± 2	50 ± 2	0.98	
			Mn-54	80 ± 3	82 ± 1	1.03	
			Fe-59	47 ± 1			(3)
			Zn-65	115 ± 4	111 ± 5	0.97	
			Co-60	212 ± 7	212 ± 1	1.00	
			I-131	58 ± 2			(1)
December-00	E2515-186	Charcoal Filter	I-131	72 ± 2	78 ± 16	1.08	
	E2516-186	Charcoal Filter	I-131	68 ± 2	70 ± 15	1.02	
	E2517-186	Charcoal Filter	I-131	63 ± 2	81 ± 16	1.29	(1)

(a) Units are pCi/l for milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment.
Counting error is two standard deviations.
(b) Ratio is TBE to Analytics results.

TABLE J-3

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES (TBE

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	TBE Results (a)	Ratio (b)	
December-00	E2514-186	Milk	Ce-141	356 ± 12	356 ± 10	1.00	
			Cr-51	503 ± 17	520 ± 50	1.03	
			Cs-134	85 ± 3	80 ± 2	0.94	
			Cs-137	199 ± 7	205 ± 5	1.03	
			Co-58	76 ± 3	77 ± 4	1.01	
			Mn-54	152 ± 5	156 ± 4	1.03	
			Fe-59	82 ± 3	85 ± 8	1.04	
			Zn-65	148 ± 5	145 ± 8	0.98	
			Co-60	184 ± 6	193 ± 4	1.05	
			I-131	85 ± 3	64 ± 66	0.75	(1)

Comments:

(1) No explanation has been provided by the radioanalytical laboratory for the difference between known and measured results.
(2) This radioanalytical laboratory consistently reports results for certain radionuclides exceeding known values in this medium. An investigation is on-going to determine the reason. Differences in source geometries between calibration standards and spiked filters are suspected to account for much of the observed differences. Similar results were reported in the Analytics Environmental Cross-Check Program 1999 Summary Report for other participating laboratories.
(3) This spiked sample was prepared on September 21, 2000, but it was not analyzed by the radioanalytical laboratory until January 15, 2000. The long decay time between preparation and counting, the magnitudes of the initial activity concentrations, and the analytical sensitivities are believed to have been an obstacle to the identification and quantification of these relatively short-lived radionuclides.

(a) Units are pCi/l for milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment. Counting error is two standard deviations.
(b) Ratio is TBE to Analytics results.

TABLE J-4

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
PPL CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY (CERML)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	CERML Results (a)	Ratio (b)	
March-00	E2119-186	Water	H-3	4170 ± 140	3941 ± 106	0.95	
March-00	E2115-186	Charcoal Filter	I-131	73 ± 3	66 ± 3	0.90	
	E2116-186	Charcoal Filter	I-131	76 ± 3	73 ± 4	0.96	
	E2117-186	Charcoal Filter	I-131	89 ± 3	78 ± 3	0.88	
March-00	E2114-186	Milk	Ce-141	460 ± 15	412 ± 11	0.90	
			Cr-51	256 ± 9	272 ± 49	1.06	
			Cs-134	150 ± 5	129 ± 6	0.86	
			Cs-137	138 ± 5	143 ± 6	1.04	
			Co-58	47 ± 1	49 ± 5	1.04	
			Mn-54	171 ± 6	179 ± 7	1.05	
			Fe-59	99 ± 3	121 ± 9	1.22	
			Zn-65	208 ± 7	217 ± 12	1.04	
			Co-60	125 ± 4	128 ± 5	1.02	
			I-131	84 ± 3	80 ± 18	0.95	
March-00	E2118-186	Sediment	Ce-141	849 ± 28	687 ± 13	0.81	
			Cr-51	473 ± 16	414 ± 61	0.88	
			Cs-134	276 ± 9	205 ± 9	0.74	(1)
			Cs-137	382 ± 13	339 ± 8	0.89	
			Co-58	87 ± 3	76 ± 5	0.87	
			Mn-54	316 ± 11	292 ± 7	0.92	
			Fe-59	184 ± 6	165 ± 11	0.90	
			Zn-65	383 ± 13	337 ± 16	0.88	
			Co-60	231 ± 8	195 ± 5	0.84	

(a) Units are pCi/l for water and milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment. Counting error is two standard deviations.

(b) Ratio is CERML to Analytics results.

TABLE J-4

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
PPL CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY (CERML)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	CERML Results (a)	Ratio (b)	
June-00	E2281-186	Charcoal Filter	I-131	63 ± 2	60 ± 2	0.95	
	E2282-186	Charcoal Filter	I-131	89 ± 3	81 ± 3	0.91	
	E2283-186	Charcoal Filter	I-131	62 ± 2	58 ± 3	0.94	
June-00	E2278-186	AP Filter	Ce-141	90 ± 3	93 ± 3	1.03	
			Cr-51	276 ± 10	296 ± 37	1.07	
			Cs134	119 ± 4	98 ± 2	0.82	
			Cs-137	249 ± 9	274 ± 4	1.10	
			Co-58	136 ± 5	140 ± 4	1.03	
			Mn-54	154 ± 5	161 ± 3	1.05	
			Fe-59	66 ± 2	82 ± 5	1.24	
			Zn-65	193 ± 7	224 ± 7	1.16	
			Co-60	185 ± 6	191 ± 3	1.03	
	E2279-186	AP Filter	Ce-141	75 ± 3	74 ± 3	0.98	
			Cr-51	231 ± 8	239 ± 26	1.03	
			Cs134	100 ± 4	80 ± 2	0.80	(1)
			Cs-137	208 ± 7	227 ± 3	1.09	
			Co-58	113 ± 4	117 ± 3	1.04	
			Mn-54	129 ± 5	144 ± 4	1.12	
			Fe-59	55 ± 2	69 ± 5	1.26	(2)
			Zn-65	161 ± 6	185 ± 6	1.15	
			Co-60	155 ± 5	160 ± 3	1.03	

(a) Units are pCi/l for water and milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment.
Counting error is two standard deviations.

(b) Ratio is CERML to Analytics results.

TABLE J-4

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
PPL CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY (CERML)
(Page 3 of 4)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	CERML Results (a)	Ratio (b)	
June-00	E2280-186	AP Filter	Ce-141	76 ± 3	70 ± 2	0.93	
			Cr-51	232 ± 8	227 ± 25	0.98	
			Cs134	100 ± 4	78 ± 2	0.78	(1)
			Cs-137	209 ± 7	223 ± 4	1.07	
			Co-58	114 ± 4	115 ± 3	1.01	
			Mn-54	130 ± 5	141 ± 3	1.08	
			Fe-59	55 ± 2	68 ± 5	1.24	
			Zn-65	162 ± 6	186 ± 6	1.15	
			Co-60	156 ± 5	165 ± 4	1.06	
September-00	E2404-186	Water	H-3	8947 ± 298	8847 ± 135	0.99	
September-00	E2403-186	Milk	Ce-141	164 ± 5	137 ± 7	0.84	
			Cr-51	198 ± 7	199 ± 44	1.01	
			Cs-134	110 ± 4	91 ± 5	0.83	
			Cs-137	188 ± 6	184 ± 7	0.98	
			Co-58	51 ± 2	52 ± 5	1.01	
			Mn-54	80 ± 3	79 ± 5	0.98	
			Fe-59	47 ± 1	55 ± 9	1.16	
			Zn-65	115 ± 4	119 ± 11	1.03	
			Co-60	212 ± 7	215 ± 6	1.01	
			I-131	58 ± 2	55 ± 10	0.94	
December-00	E2511-186	Charcoal Filter	I-131	62 ± 2	66 ± 8	1.06	
	E2512-186	Charcoal Filter	I-131	68 ± 2	64 ± 8	0.94	
	E2513-186	Charcoal Filter	I-131	72 ± 2	72 ± 8	1.00	

(a) Units are pCi/l for water and milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment.
Counting error is two standard deviations.
(b) Ratio is CERML to Analytics results.

TABLE J-4

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM - 2000
PPL SUSQUEHANNA, LLC REMP QC SPIKE PROGRAM
PPL CORPORATE ENVIRONMENTAL RADIOACTIVITY MEASUREMENTS LABORATORY (CERML)

Collection Date	Identification No.	Media	Nuclide	Analytics Calculated Results (a)	CERML Results (a)	Ratio (b)
December-00	E2510-186	Milk	Ce-141	356 ± 12	299 ± 9	0.84
			Cr-51	503 ± 17	464 ± 47	0.92
			Cs-134	85 ± 3	74 ± 5	0.87
			Cs-137	199 ± 7	203 ± 7	1.02
			Co-58	76 ± 3	79 ± 5	1.03
			Mn-54	152 ± 5	161 ± 7	1.06
			Fe-59	82 ± 3	98 ± 8	1.20
			Zn-65	148 ± 5	158 ± 11	1.07
			Co-60	184 ± 6	192 ± 7	1.04
			I-131	85 ± 3	82 ± 8	0.96

Comments:

(1) This radioanalytical laboratory consistently reports results for Cs-134 below known values for more than one medium. Summing of photons emitted by Cs-134 in the spiked samples is believed to be a significant contributor to the low results.

(2) No explanation has been provided by the radioanalytical laboratory for the difference between known and measured results. Similar results were reported in the Analytics Environmental Cross-Check Program 1999 Summary Report for other participating laboratories.

(a) Units are pCi/l for water and milk, pCi for AP Filters and charcoal cartridges, and pCi/kg for sediment. Counting error is two standard deviations.

(b) Ratio is CERML to Analytics results.