RMC-TR-82-03

SUSQUEHANNA STEAM ELECTRIC STATION

Radiological Environmental Monitoring Program

1981 ANNUAL REPORT

Prepared for
PENNSYLVANIA POWER AND LIGHT COMPANY
by
RADIATION MANAGEMENT CORPORATION

JULY 1982

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PROGRAM SUMMARY

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Since April 1972 Radiation Management Corporation (RMC) has conducted the Preoperational Radiological Environmental Monitoring Program (REMP) for Pennsylvania Power and Light Company (PP&L) at the Susquehanna Steam Electric Station (SES). This report presents the analytical results for samples taken during 1981. A total of 3125 analyses on 2239 samples including direct radiation, surface water, well water, potable water, sediment, air particulates, air iodine, precipitation, milk, fish, food products, meat, game, vegetation, pasture grass and soil was performed in 1981.

A variety of radionuclides, both naturally occurring and man-made, were detected in the environs of the Susquehanna SES. Naturally occurring radionuclides were found at levels expected for that environment. The man-made radionuclides found, primarily in air particulates, precipitation and pasture grass, were the fission products typically found in nuclear weapon test fallout. In particular, fallout from the atmospheric nuclear weapon test by the People's Republic of China on October 16, 1980 was observed in samples collected in the first half of the year. The detection of this event indicates that the Susquehanna SES REMP is sensitive to fluctuations in the radiological characteristics of the environment around Susquehanna SES.

INTRODUCTION

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The Susquehanna SES will contain 2 BWR generating units, each with a capacity of about 1050 MWe. Units #1 and #2 are scheduled for initial criticality in 1982 and 1984, respectively. This site is located on a 1075 acre tract along the Susquehanna River, five miles northeast of Berwick in Salem Township, Luzerne County, Pennsylvania.

The area surrounding the site can generally be characterized as rural, with forest and agricultural lands predominating. More specific information on the demography, hydrology, meteorology and land use characteristics of the local area may be found in the Environmental Report(1), the Safety Analysis Report(2) and the Draft Environmental Statement - O.L. (3) for Susquehanna SES.

RMC has previously reported results for the preoperational radiological environmental monitoring program (REMP) from 1972-1980 (4-12); the present document continues the series with coverage for 1981. It presents in detail the type and number of samples collected, the analyses performed and the data generated.

PROGRAM

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The preoperational REMP continued in 1981 and will continue until initial criticality of Unit #1. At that time, the operational phase of the program will be instituted and continue thereafter. The REMP was designed utilizing the guidance in the Branch Technical Position to the Nuclear Regulatory Commission Regulatory Guide 4.8, Rev. 1, November 1979 (13) and ORP/SID 72-2, Environmental Radioactivity Surveillance Guide (14). The REMP was designed:

1. To establish baseline radiological characteristics of the environs of Susquehanna SES for comparison with future data;

2. To assure that media sampled and analyzed are sensitive to fluctuations in the radiological characteristics of the Susquehanna SES environs; and to assure that the program will be responsive to station radioeffluent discharge;

3. To monitor potential critical pathways of station radioeffluent to man.

Samples for the 1981 REMP were taken from direct, waterborne, airborne and ingestion pathways with emphasis on those media which would yield data for the evaluation of radiation dose to man. Specific sampling locations were chosen on the basis of potential water use, site meteorology, local demography and land uses.

Environmental sampling locations were divided into two classes, indicator and control. Indicator samples were those collected at locations which would be expected to manifest future station effects, if any, and were selected on the basis of distance from the site, topography, hydrology, meteorology, demography, and drainage characteristics. Control samples were collected at locations which are expected to be unaffected by station operation.

Table 1 summarizes the Susquehanna REMP as performed in 1981. Appendix A summarizes the results of the REMP analyses and compares indicator and control location results. Appendix B describes the RMC coding system, which specifies sample type and location. Included in Appendix B, Table B-1 gives the pertinent information on individual sampling locations, while Maps B-1 and B-2 show the sampling locations. The data for individual samples are presented in tabular form in Appendix C. A synopsis of the analytical procedures used for the samples appears in Appendix D. Appendix E contains the results of RMC's participation in the EPA inter-laboratory comparison program. Appendix F contains the results of demographic data surveys performed in 1981.

Sample Collection

Waterborne pathways were examined by analyzing samples of surface water, ground water, potable (drinking) water and sediment. Surface, ground and potable water samples were collected in unused two gallon plastic containers weekly and monthly. Susquehanna River sediment was also sampled.

Airborne pathways were examined by analyzing air particulates, air iodine and precipitation. Air particulates were collected weekly on Gelman type-A/E, glass fiber filters with low volume air samplers. Air iodine was collected on one inch deep Science Applications, Inc. charcoal cartridges. Air sample volumes were measured with temperature-compensated dry-gas meters. Precipitation samples were collected in unused two gallon plastic containers monthly.

Ingestion pathways were examined by analyzing samples of fish, milk, pasture grass, game, locally grown food products and soil. Several species of fish samples were collected in spring and late summer at both the control and indicator locations, filleted and frozen for shipment to RMC. Milk, food products and pasture grass were purchased directly from local farmers. Game samples were obtained by hunting or from road killed animals. Twelve plugs were collected at each location. Each plug was split into a topsoil sample and a subsoil sample. The twelve topsoil samples were combined to make one topsoil sample and the twelve subsoil samples were combined to make one subsoil sample. This resulted in one topsoil sample and one subsoil sample from each soil sampling location.

Direct radiation measurements were made using thermoluminescent dosimeters (TLDs) consisting of calcium sulfate doped with thulium ($CaSO_4$(Tm)). The TLDs were placed at locations designed to take advantage of local meteorologic and topographic characteristics and population distribution characteristics.

Data Interpretation

The radioanalytical and direct radiation data collected during 1981, together with that collected previously, will be used as a baseline with which operational data may be compared. Several factors are important in the interpretation of the data. These factors are discussed here to avoid repetition in sections that follow.

Within the data tables (Appendix C) a 95% (±2 sigma) confidence interval is supplied for each result above the lower limit of detection (LLD) with the exception of strontium-89, -90 analyses, which are reported as minimum detectable level (MDL). Numerically, the LLD is equal to 4.66 times the square root of the quotient resulting from the background counts divided by the background counting time. The result is then divided by a dpm/picocurie conversion factor, the counting efficiency and the sample volume. Whereas the MDL is equal to 3 times the square root of the quotient resulting from the background counts divided by the background counting time. This result is then divided by the dpm/picocurie conversion factor, the counter efficiency and the sample aliquot (the exact specifications of the calculations are noted in Appendix D). The MDL or LLD is reported when the 2 sigma error exceeds 100% of the calculated activity. The 2 sigma intervals represent the range of values into which 95% of repeated analyses of the same sample would fall. The LLD quoted for particular sample types (Table C-29) are nominal values. The actual LLD is calculated for each sample analyzed and will show variability due to the amount of sample analyzed, the length of time between sample collection and counting, the length of time a particular sample was counted and fluctuations in counting background.

It is characteristic of environmental monitoring data that many results occur at or below the LLD. In this report, all results occurring at or below the relevant LLD were reported as being "less than" the LLD value.

Results for each type of sample were grouped according to the analysis performed. Averages and standard deviations of these results were calculated when applicable. The calculated standard deviations of grouped data (by location or over time) represent sample rather than analytical variability. For these calculations any values below LLD were considered to be at the LLD; thus, these averages were biased high and the corresponding standard deviations were biased low. Averages were not calculated when a group of data was composed of many (>50%) LLD values.

Program Exceptions

As the REMP for Susquehanna SES progressed in 1981, certain samples and analyses were inadvertently omitted from the schedule. These exceptions are delineated, and the reasons for the omission stated. However, taking into account all program exceptions, it should be noted that the 1981 Susquehanna SES REMP had a 98% completion rate.

Surface Water

1. The monthly samples from stations 12F1 and 12G2 for January and February were not collected because the river was frozen.

2. The monthly analysis for iodine-131 was omitted in February for station 6S5 due to a delay in sample shipment.

3. The weekly samples for iodine-131 analysis were not collected at station 12F1 in January and the first and second weeks of February because the river was frozen.

4. The weekly samples from station 3G2 were not collected in the first three weeks of January and the first week of February because the river was frozen.

5. The weekly sample from station 3G5 was not collected during the second week of February because the river was frozen.

6. Six weekly samples from May and June were lost in shipment. These were two samples from station 5S8 and one sample each from stations 1D3, 3G1, 3G2 and 3G5.

7. The weekly samples for iodine-131 analysis were not collected during the fourth week in December from stations 3G2 and 3G5 because the river was frozen.

Air Particulates and Air Iodine

1. No samples were received from station 12E1 between January 3 and January 11 due to a sampler malfunction.

2. No samples were received from station 12G1 between April 19 and April 26 due to a sampler malfunction.

3. No samples were received from station 7G1 between May 3 and May 10 due to a sampler malfunction.

4. Sample collection was missed on June 24 for station 7H1 due to collector error; therefore, the sample collected on July 2 represents a two week period.

Precipitation

1. No samples were received in January because the water was frozen.

2. No samples were received from stations 11S2 and 12G2 in February because the water was frozen.

Milk

1. No sample was available from station 7C1 and 8D1 in July and 7C1 in September because of the limited supply of goat milk.

2. No sample was received from station 8D1 from January to March because the goat was dry.

Food Products

No samples were received from stations 11D2 and 12F4 because the farmer who farms both farms did not plant this year.

Pasture Grass

No sample was received from station 15A1 from January through March due to snow cover.

TLD

No sample was received from station 7F1 for the third quarter due to a loss in the field.

<u>Program Changes</u>

Additions to the program were made in 1981. These were added in order to better reflect any changes in radioactivity levels during Susquehanna SES operation. These changes are noted.

1. Surface water station 3H3 was changed to 3G5 when it was determined that the wrong designation had been in use.

2. Air particulate and air iodine stations 15S4 and 7G1 were added for weekly collection.

3. Goat milk station 7C1 was added for quarterly iodine-131 analysis. Pasture grass will be sampled during the months milk is not collected.

4. The fish control location designation was changed from 2G to 2H when it was determined that the wrong designation had been in use.

5. Analysis of topsoil and subsoil samples at fourteen locations was added. Samples will be collected at three year intervals at which time the need for further collection will be evaluated.

6. TLD stations 3H1 and 3H2 were changed to 3G3 and 3G4 respectively, when it was determined that the wrong designations had been in use.

7. TLD station 14S2 was relocated to station 14S5 on June 29 in order to avoid obstructions.

8. Two TLD stations 15S4 and 10B3 were added as part of a continuing effort to upgrade the Environmental Monitoring Program.

Some analyses were added as well. These are noted below.

1. Gross alpha and tritium analyses were changed from quarterly composite to monthly for potable water station 12H2 in April.

2. Iodine-131 and gamma spectrometry analyses were increased to semimonthly for milk stations 12B2, 5E1, 13E3 and 10G1 during the months when cows are on pasture, April to September.

Some deletions were made to the program since sufficient data is provided in the remaining program to monitor the radiological characteristics of the environment. These deletions are noted below.

1. Tritium and gamma spectrometry of precipitation samples were changed from monthly to quarterly composite beginning with the second quarter.

2. Food product samples from stations 5S6, 11A3 and 12E3 were taken in 1980 as supplements for that year and therefore, were not collected in 1981.

3. Analysis of meat and game bones and egg shells was discontinued for 1981 samples.

4. A deer sample was not collected due to the difficulty in hunting and obtaining road kill samples.

5. The broad leaf vegetation sampling in the sectors with the highest D/Q was changed from 13S3 and 14S3 to 7S4 and 8S3 because new calculations indicated a change in the sectors with the highest D/Q for 1981.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

All environmental samples and TLDs were analyzed by standard RMC analytical procedures (15). A synopsis of these procedures appears in Appendix D. Since the precision and accuracy of the analytical results is of paramount importance, RMC devoted a fraction (usually 15-20%) of all analyses to quality control including process quality control, instrument quality control, inter-laboratory cross-check analyses and comprehensive data review. The results of RMC's QC program for 1981 are included in a separate RMC report (16). One important aspect in maintaining laboratory quality control is RMC's participation in the United States Environmental Protection Agency (USEPA) inter-laboratory comparison program. This data appears in RMC's annual QC report and is also presented as Appendix E to this report.

The analytical results of the 1981 REMP have been divided into four categories: waterborne, airborne, ingestion and direct radiation. The individual samples and analyses within each category provide an adequate means of estimating radiation doses to individuals from the principal pathways. The analytical results for the 1981 program are summarized in Appendix A. The data for individual samples are presented in tabular form in Appendix C. The sensitivities stated in the Branch Technical Position were met for all samples (13).

Waterborne Pathway

The waterborne pathways of exposure from Susquehanna SES were evaluated by analyzing samples of surface water, well water, potable water and sediment.

Surface Water (Tables C-1, C-2, C-3 and C-4)

The Susquehanna River was sampled monthly at seven locations. Daily grab samples were collected at 12H1 (Merck Company) then composited into a monthly sample. Monthly samples were also composited from weekly grabs at station 5S8 (under the power line) and station 6S5 (outfall area). Monthly grab samples were collected at station 1D3 (Mocanagua Substation), station 13E1 (Glen Brook Reservoir), station 12F1 (Berwick Bridge) and station 12G2 (between Bloomsburg and Berwick). Monthly surface water samples were analyzed for gross beta, gamma emitters and iodine-131. Quarterly composites were analyzed for tritium, strontium-89 and -90.

Weekly grab samples were collected from stations 1D3, 12F1, 2F2 (Retreat Bridge), 3G1 (Lower Bridge Plymouth) 3G2 (Nanticoke Bridge) and 3G5 (Market Street Bridge) and weekly composite samples were collected from stations 5S8 and 12H1 in order to study the occurrence of detectable concentrations of iodine-131 in the river water. A monthly effluent water grab sample was collected at station 1D5 (Shickshinny Sewage Treatment facility) for iodine-131 analysis.

Analysis for beta emitters in samples of surface water showed detectable activity in 72 of 80 samples, with results ranging from 1.0 to 6.9 pCi/l. The gross beta results were consistent with the data previously obtained from 1972-1980 (4-12).

Niobium-95 was observed in five samples and ruthenium-103 was observed in one of eighty samples analyzed for gamma emitters. These nuclides were observed in the first half of the year and are consistent with the data obtained from air particulates and precipitation. The occurrence of these nuclides can be attributed to the atmospheric nuclear weapons test by the People's Republic of China. Potassium-40 and thorium-232 were observed in the June sample from station 12H1. This is probably due to sediment contamination of the sample. These nuclides are typically found in sediment samples. Cobalt-60 was found in the April sample from station 12G2.

Positive iodine results, in surface water, were reported in 68 of 402 samples with values ranging from 0.08 to 1.0 pCi/l. These results were observed sporadically during all months except April and at all weekly stations. Since Susquehanna SES is not in operation, iodine-131 in the surface water can be attributed to other sources of contamination of the river.

The analysis of tritium in surface water showed detectable activity in 17 of 28 samples with results ranging from 68 to 183 pCi/l. This is well below the action level of 20,000 pCi/l as quoted in the Branch Technical Position (13). The average tritium concentrations in surface water samples shows a gradual decline for the period 1973 to 1981. This is likely the result of a reduction in atmospheric tritium from nuclear detonations. Average tritium concentrations for all locations since 1973 were graphed in Figure 1. Positive tritium results are reported when the 2 sigma counting error is less than the result. In some cases, this may cause positive results to be reported, which are lower than the calculated LLDs. For clarification of the method of calculation, see Appendix D, Analysis of Water Samples for Tritium.

Levels of strontium-89 were below MDL (0.6 to 2.7 pCi/l) in twenty-four of twenty-eight samples. Strontium-89 was found in four samples. The range of concentrations (0.4 to 0.8 pCi/l) was comparable to the MDL levels found in the other samples. Levels of detectable strontium-90 ranged from 0.2 to 1.1 pCi/l in ten of the twenty-eight samples. The MDL values ranged from 0.4 to 1.1 pCi/l.

Well Water (Tables C-5, C-6 and C-7)

Three wells, the peach stand on-site (4S2), the Serafin Farm (15A4) and the Berwick Water Co. (12F3), were sampled monthly. Gross beta and gamma analyses were performed on the monthly samples. Gross alpha and tritium analyses were performed on quarterly composites of monthly grab samples.

Gross beta results showed positive values in twenty-six of thirty-six samples with results ranging from 1.2 to 7.4 pCi/l. LLDs ranged from 1.7 to 2.4 pCi/l.

Potassium-40 was observed in two samples collected from station 15A4. Both results were below the LLD normally obtained for potassium-40. This indicates that these analyses were unusually sensitive, however the results may reflect actual concentrations. All other gamma emitting nuclides were less than LLD.

All twelve results for gross alpha were below the LLD which ranged from 0.9 to 2.6 pCi/l. Six of twelve samples showed positive tritium results ranging from 72 to 150 pCi/l with LLDs ranging from 118 to 122 pCi/l. Positive results for gross beta, gross alpha and tritium compared closely to the respective LLDs for those analyses and to results found in previous REMP reports (4-12).

Potable (Drinking) Water (Tables C-8, C-9 and C-10)

Potable water was sampled monthly at two locations, the Berwick Water Company (12F3) and the Danville Water Company (12H2). In addition, weekly samples were collected from station 12H2 for iodine-131 analysis. Gross beta and gamma emitters were analyzed monthly. Strontium-89 and -90 were analyzed as quarterly composites. Gross alpha and tritium were analyzed as quarterly composites for station 12F3 and monthly for station 12H2.

Sixteen of twenty-four samples showed positive gross beta results ranging from 1.3 to 8.5 pCi/l and averaging 2.4 pCi/l. All results from all gamma emitting nuclides were less than LLD.

Two samples collected from January and one sample collected from November showed positive results (0.14-0.3 pCi/l) for iodine-131 analyses at the Danville Water Company. This was found to be consistent with iodine-131 activity in weekly surface water samples. All others were below the LLD.

All fourteen results for gross alpha were below the LLD which ranged from 0.5 to 2.3 pCi/l. These results compare favorably to the EPA drinking water action level of 15 pCi/l for gross alpha (17).

Nine of fourteen samples analyzed showed positive tritium results ranging from 70 to 383 pCi/l, with LLDs ranging from 102 to 122 pCi/l for the others. The results fall below the EPA tritium action level of 20,000 pCi/l for drinking water (17). The tritium results, for potable water, were consistent with results for tritium observed in surface water of the Susquehanna River.

All results for strontium-89 were below the MDL of 0.6 to 1.7 pCi/l. Two detectable concentrations of strontium-90 (0.2 and 0.5 pCi/l) were observed in eight samples. The MDL values ranged from 0.4 to 0.8 pCi/l.

Sediment (Tables C-11 and C-12)

Sediment samples were taken semiannually from three locations in the Susquehanna River. Samples were taken at Bell Bend (7B), downstream near Hess Island (11C) and upstream near Gould Island (2B). Samples were analyzed for gamma emitting nuclides, gross alpha, strontium-89 and -90.

Naturally-occurring K-40, Ra-226 and Th-232 were detected in all samples. Be-7, from cosmic ray activity, was also observed in one of the six samples analyzed. Cs-137 was detected in all samples, with levels ranging from 0.06 to 0.14 pCi/g(dry). Zirconium-95, niobium-95, ruthenium-103, cerium-141 and cerium-144 were observed in the sediment samples especially in the May samples. These nuclides were consistent with those observed in surface water and can be attributed to the atmospheric nuclear weapons test on October 16, 1980.

Gross alpha analyses showed positive values for five of six samples, ranging from 5.2 to 14 pCi/g(dry). One sample analyzed for strontium-89 showed a positive result of 0.15 pCi/g(dry). This result is similar to the MDL values. All other strontium-89 results were below the MDL of 0.1 pCi/g(dry). Three of six samples showed positive strontium-90 results ranging from 0.02 to 0.07 pCi/g(dry). The other results were below the MDL (0.03 to 0.07 pCi/g(dry)).

Airborne Pathway

The airborne pathways of exposure from Susquehanna SES were evaluated by analyzing samples of air particulates, air iodine cartridges and precipitation. Samples of air were collected at twelve stations; the Information Center (2S2), the biological laboratory (5S4 and 5OSQ), the Golomb House (11S2), the transmission line at site 15 (15S4), the transmission line east of route 11 (9B1), the Mocanagua Substation (1D2), near Pond Hill (3D1), the Berwick Hospital (12E1), the Hazelton Chem Lab (7G1), at Bloomsburg (12G1) and the PP&L roof in Allentown (7H1). Station 7G1 began operation in March. Station 15S4 began operation in May. Air filters were analyzed weekly for gross beta and quarterly for gamma emitters, gross alpha and strontium-89 and -90. Air iodine was collected on charcoal cartridges in series with the air particulate filter at all stations. Stations 1D2, 3D1, 7G1 and 12G1 began sampling for air iodine in March while station 15S4 began operation in May. The charcoal cartridges have an efficiency of removal of elemental iodine of 99%. Precipitation samples were collected monthly from stations 5S4, 11S2, 1D2 and 12G1 and analyzed for tritium and gamma emitters. Beginning in April, precipitation samples were composited and analyzed quarterly.

Air Particulates (Tables C-13, C-14 and C-15)

The gross beta concentrations of each sample was determined weekly. These concentrations ranged from 0.004 to 0.384 pCi/m^3 in all samples. The wide range can be attributed to the fallout throughout the year from the atmospheric nuclear weapon test by the People's Republic of China on October 16, 1980. By October 1981, gross beta levels had returned to pre October 1980 nuclear test levels. The annual average for all indicator stations was 0.097 pCi/cubic meter and for all control stations was 0.094 pCi/cubic meter. Figure 2 shows graphically the gross beta activity in air particulates for 1981.

Quarterly composites of air particulate filters from each location were analyzed by gamma spectrometry. Beryllium-7 was detected in forty-six of forty-seven samples. The presence of beryllium-7 throughout the year can be attributed to cosmic ray activity. Cesium-137 was observed in nineteen of forty-seven samples. Manganese-54, niobium-95, zirconium-95, ruthenium-103, cerium-141 and cerium-144 were observed in samples from the first, second and third quarters. These may be attributed to the atmospheric nuclear weapon test by the People's Republic of China on October 16, 1980.

Gross alpha analyses of quarterly composites showed positive results in forty-six of forty-seven samples with values ranging from 0.0012 to 0.0049 pCi/m^3 with the average being 0.0026 pCi/m^3.

The strontium-89 analyses performed on the quarterly composites showed thirty-two of forty-seven samples with detectable activity. These ranged from 0.0005 to 0.0096 pCi/m^3. The positive strontium-89 results were primarily observed in the first, second and third quarters and can be attributed to the October 16, 1980 nuclear test. The MDLs for strontium-89 ranged between 0.0003 and 0.0008 pCi/m^3. Strontium-90 concentrations ranged between <0.0001 and 0.0017 pCi/m^3 with the average being 0.0008 pCi/m^3.

Air Iodine (Table C-16)

Of the 578 air samples analyzed for iodine-131, all were below the LLD. The detection limit for all analyses ranged from 0.003 to 0.07 pCi/m^3.

Precipitation (Table C-17)

Eight of eighteen samples showed positive tritium results, ranging from 127 to 267 pCi/l. All others were less than LLD (219 pCi/l). Beryllium-7, from cosmic radiation, was observed in seventeen samples ranging from 10 to 56 pCi/l. Zirconium-95, niobium-95, ruthenium-103, ruthenium-106, cesium-137, cerium-141 and cerium-144 were observed especially during the first and second quarters. This was consistent with results observed in air particulates. The occurrence of these nuclides can be attributed to the atmospheric nuclear weapons test by the People's Republic of China in October 1980.

Ingestion Pathway

Potential ingestion pathways of exposure for Susquehanna SES were evaluated by analyzing samples of milk, fish, food products, meat, game, pasture grass and soil.

Milk (Tables C-18, C-19 and C-20)

Cow milk samples were collected monthly from eight locations; 12B2, 12B3, 6C1, 10D1, 12D2, 5E1, 13E3 and 10G1. Samples were collected semi-monthly from April to September from stations 12B2, 5E1, 13E3 and 10G1. Each monthly sample was analyzed for I-131, Sr-89 and -90 and gamma emitters. The additional samples were analyzed for iodine-131 and gamma emitters only.

All of the 120 samples analyzed for iodine-131 were below the LLD. The LLDs ranged from 0.07 to 0.2 pCi/l.

Potassium-40, as determined by gamma spectrometry, was found in all milk samples with levels ranging from 1200 to 1700 pCi/l. Cesium-137 was found in 138 of 144 samples with levels ranging from 1.2 to 9.6 pCi/l.

Strontium-89 was detected in seventeen of ninety-six samples analyzed with results ranging between 1.3 and 5.3 pCi/l. The range of MDL values for strontium-89 was 1.4 to 83 pCi/l. The wide range of values for the MDL was due to low chemical yields in some of the samples and delays between sample collection and analysis which causes a large decay correction factor. The concentration of strontium-90 was positive in ninety-five of ninety-six samples analyzed and averaged 5.6 pCi/l. Due to the twenty-eight year half-life and biological assimilation, strontium-90 can be expected to remain long after routine atmospheric testing has ceased. All strontium-89 and -90 analysis chemical yields have been verified by atomic absorption to determine calcium interference.

Goat milk was sampled at two locations quarterly, or more frequently if sufficient milk was available. Goat milk was analyzed for iodine-131 only. Of the thirteen samples analyzed, all were below the LLD. LLDs ranged from 0.1 to 1.8 pCi/l. The high LLDs observed for iodine-131 in goat milk are due to the small quantities which are available for analysis.

Fish (Table C-21)

Fish was collected from two locations. Three to seven fish of each species, enough to obtain one to two kilograms of filets, were collected at each location. The species included were: walleye, white sucker and channel catfish. Analysis of the flesh for gamma emitters and strontium-89, -90 was performed on each species sampled.

Gamma spectrometry was performed on the flesh portions of fish samples. Naturally-occurring potassium-40 was detected in all twelve samples with results ranging from 3.1 to 3.7 pCi/g(wet). Cesium-137 was detected in eleven samples ranging from 0.009 to

0.016 pCi/g(wet). These results were consistent with those previously found. Since the station is not in operation, and there are no other nuclear power installations in the area, the man-made nuclide observed can probably be attributed to nuclear weapons testing fallout.

Strontium-89 was below the MDL (0.01 pCi/g(wet)) in all twelve samples. Strontium-90 was observed in three samples ranging from 0.002 to 0.007 pCi/g(wet). MDLs ranged from 0.003 to 0.006 pCi/g(wet).

Food Products (Table C-22)

Gamma spectrometry was used to analyze various types of food products collected from local farmers within the vicinity of Susquehanna SES. These include apples, honey, corn, cabbage, cantalopes, potatoes, squash, strawberry plant and tomatoes. Naturally-occurring potassium-40 at levels of 0.72 to 10 pCi/g(wet) was found in all samples. Beryllium-7, from cosmic ray activity, was observed in the strawberry plant sample. Niobium-95 and cesium-137 were found in three samples which was not unexpected when compared with other fallout data observed in 1981.

Meat (Table C-23)

Meat samples consisting of eggs, chicken and duck were collected from two local farms. The flesh was analyzed for gamma emitters. Naturally-occurring potassium-40 was detected in all three samples, 0.9 to 2.9 pCi/gram(wet). All other gamma emitters were below the LLD.

Game (Table C-24)

One deer sample and one squirrel sample were collected in the winter and the flesh was analyzed for gamma emitters. Naturally-occurring potassium-40 was found at levels of 2.5 and 2.7 pCi/g(wet), respectively. Cesium-137 was also found at a concentration of 0.10 and 1.5 pCi/g(wet), respectively. These results were consistent with cesium-137 concentrations found in game samples (especially squirrels) analyzed in previous years (7). All other nuclides searched for were less than the LLD.

Vegetation (Table C-25)

Two leafy vegetation samples were collected on site and analyzed by gamma spectrometry. Potassium-40 was found in both samples at concentrations of 7.9 and 8.1 pCi/g (wet). Beryllium-7, from cosmic ray activity, was found in one sample at similar levels to those found in pasture grass. Zirconium-95, niobium-95 and c ium-144 were found in the samples and can be attributed to fallout from the atmosphe . nuclear weapons test on October 16, 1980.

Pasture Grass (Table C-26)

Pasture grass was collected monthly at the closest farm. Pasture grass samples from station 7C1 and station 8D1 were collected when the goat milk was unavailable. Each sample was analyzed by gamma spectrometry. Potassium-40 was found in all twelve samples and ranged from 3.7 to 26 pCi/g(wet). Beryllium-7 was observed in seven of twelve samples with results ranging from 3.1 to 12 pCi/g(wet). The presence of beryllium-7 can be attributed to cosmic radiation. Niobium-95, zirconium-95, ruthenium-103, cesium-137, cerium-141 and cerium-144 were observed throughout the year and are consistent with levels observed in food products and vegetation. These nuclides can be attributed to the atmospheric nuclear weapons test by the Peoples Republic of China on October 16, 1930. These nuclides are typically found in fallout from atmospheric nuclear weapons tests (4-12).

Soil (Table C-27)

Soil was collected at fourteen locations. A topsoil sample and a subsoil sample was collected at each location. Each sample was analyzed for gamma emitters.

Naturally-occurring potassium-40 was observed in all twenty-eight samples ranging from 7.9 to 10 pCi/g(dry). Radium-226 and thorium-232, also naturally-occurring, were observed in all samples. These levels ranged from 0.49 to 2.7 pCi/g(dry) and from 0.55 to 2.9 pCi/g(dry), respectively. Niobium-95 was observed in twenty-one of twenty-eight samples with results ranging from 0.08 to 0.35 pCi/g(dry). Cesium-137 was observed in all samples and ranged from 0.17 to 2.2 pCi/g(dry). Niobium-95 and cesium-137 are typically observed in fallout from atmospheric nuclear weapons tests. The observance of niobium-95 can be attributed to the most recent test by the Peoples Republic of China in October 1980.

Direct Radiation (Table C-28)

Direct radiation measurements were made on a quarterly basis. TLD packets were placed at 68 locations on and surrounding the Susquehanna SES. During 1981, 264 quarterly TLD packets were collected. Each packet included four dosimeters for a total of 1056 analyses.

All TLD results presented in this report have been normalized to a standard month (30.4 days) to eliminate the apparent differences in data caused by variations in length of exposure period. The range of TLD results for indicator locations was 4.40 to 12.63 mrad/standard month and 4.44 to 7.16 mrad/standard month for control locations. Elevated levels at locations 6S4 and 7S3 were due to on-site radiographic activity. The TLD analyses yielded an average dose equivalent rate of 6.31 mrad/standard month at all indicator locations, and an average dose equivalent rate of 5.98 mrad/standard month at all control locations.

The projected annual dose from direct radiation computed from these results is 76 mrads, or 76 mrem assuming a quality factor of 1, at indicator locations, and 72 mrad or 72 mrem at the control locations. The EPA terrestrial and cosmic radiation dose rate calculated for the Wilkes-Barre area is 82 mrem/year, neglecting any neutron contribution (18). This compares favorably with the average TLD measured dose rate of 75 mrem/year for all stations. This difference is not unexpected since the EPA values are gross general averages for an area and do not take into consideration specific terrestrial variations. The average dose rates for all monitoring locations since 1973 are plotted in Figure 3. The differences observed between locations or between sampling periods were similar to those found previously (4-12).

CONCLUSIONS

CONCLUSIONS

The Radiological Environmental Monitoring Program for Susquehanna SES was conducted during 1981 as a continuation of the program initiated in 1972. The data collected during 1981 further develops a baseline for comparison with future operational data.

The purpose for the design and development of the Susquehanna SES REMP were:

1. To establish baseline radiological characteristics of the environs of Susquehanna SES for comparison with future data;

2. To assure that the media sampled and analyzed are sensitive to fluctuations in the radiological characteristics of the Susquehanna SES environs; and to assure that the program will be responsive to station radioeffluent discharge;

3. To monitor potential critical pathways of station radioeffluent to man.

The 1981 REMP further establishes the baseline radiological characteristics for the vicinity of the Susquehanna SES. This is evident by the continuation of sampling and analysis for the aquatic, atmospheric and terrestrial environments, as well as monitoring of direct radiation. The sampling and analysis of these media reflect the normal background radiation found in this environment.

The media sampled by the Susquehanna REMP are sensitive to radiological fluctuations of the environment monitored. This is evident by the measured gradual decline in the surface water concentration of tritium, primarily due to the decrease in atmospheric nuclear detonations. Gross beta and gamma spectrometry analyses of air particulates are sensitive to atmospheric testing of nuclear weapons. Gamma analyses of surface water, sediment, air, food products, vegetation, pasture grass and soil samples showed low concentrations of radioactive nuclides from fallout from the October 16, 1980 atmospheric nuclear weapons test by the People's Republic of China. Iodine-131 was observed in surface water samples throughout the year. Since Susquehanna SES is not in operation, iodine-131 can be attributed to other sources of contamination of the river. These two instances indicate that the Susquehanna SES REMP is sensitive to radiological fluctuations of the environment.

Environmental gamma radiation measurements were made using thermoluminescent dosimeters. Results from the indicator and control locations were found not to be significantly different as would be expected in the absence of any source of gamma radiation.

The media sampled by the Susquehanna REMP also monitors potential critical pathways of station radioeffluent to man.

Monitoring of the waterborne pathway consisted of sampling surface water, well water, potable water and sediment. These sample types were chosen to reflect the characteristics of normal background radiation for this medium. The airborne pathway was monitored by filtering and analyzing the particulate matter, by passing filtered air through a charcoal filter which was analyzed for the presence of iodine-131 and by analysis of precipitation. The ingestion pathway was monitored by the sampling and analysis of milk, fish, game, various food products, vegetation, pasture grass and soil. The results obtained by analysis of these samples were consistent with previously measured levels of radioactivity in their respective media (4-12).

The results obtained from analyses performed on the samples collected in the vicinity of the Susquehanna SES were expected for this environment. The levels and fluctuations of radioactivity detected are consistent with previously accumulated REMP data (4-12).

REFERENCES

REFERENCES

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TABLE 1

SYNOPSIS OF THE SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1981

SAMPLE TYPE	SAMPLING FREQUENCY	NUMBER OF SAMPLING LOCATIONS	NUMBER COLLECTED	ANALYSIS TYPE	ANALYSIS FREQUENCY	NUMBER PERFORMED
WATERBORNE PATHWAY						
Surface Water	M	8	80	Gross Beta	M	80
				I-131	M	57
				Gamma	M	80
				H-3	QC	28
				Sr-89	QC	28
				Sr-90	QC	28
	W	7	345	I-131	W	345
Well Water	M	3	36	Gross Beta	M	36
				Gamma	M	36
				Gross Alpha	QC	12
				Tritium	QC	12
Potable Water	M	2	24	Gross Beta	M	24
				Gamma	M	24
				Gross Alpha	QC	14
				Tritium	QC	14
				Sr-89	QC	8
				Sr-90	QC	8
	W	1	52	I-131	W	52
Sediment	SA	3	6	Gross Alpha	SA	6
				Gamma	SA	6
				Sr-89	SA	6
				Sr-90	SA	6
AIRBORNE PATHWAY						
Air Particulate	W	12	605	Gross Beta	W	605
				Gross Alpha	QC	47
				Gamma	QC	47
				Sr-89	QC	47
				Sr-90	QC	47
Air Iodine	W	12	578	I-131	W	578
Precipitation	M	4	41	Tritium	M/Q	18
				Gamma	M/Q	18
INGESTION PATHWAY						
Milk	M/SM	10	133	I-131	M/SM	133
				Gamma	M/SM	120
				Sr-89	M	96
				Sr-90	M	96
Fish (Flesh)	SA	2	12	Gamma	SA	12
				Sr-89	SA	12
				Sr-90	SA	12
Food Products	A	5	16	Gamma	A	16
Meat & Poultry (Flesh)	SA	2	3	Gamma	SA	3
Game (Flesh)	A	2	2	Gamma	A	2
Vegetation	M	2	2	Gamma	M	2
Pasture Grass	M	3	12	Gamma	M	12
Soil	A	14	28	Gamma	A	28
DIRECT RADIATION						
Dosimeters (TLDs)	Q	68	264	Gamma Dose rate	Q	264
Total			2239			3125

FIG. 1 AVERAGE CONCENTRATIONS OF TRITIUM IN SURFACE WATER IN THE VICINITY OF THE SUSQUEHANNA SES 1973 THROUGH 1981

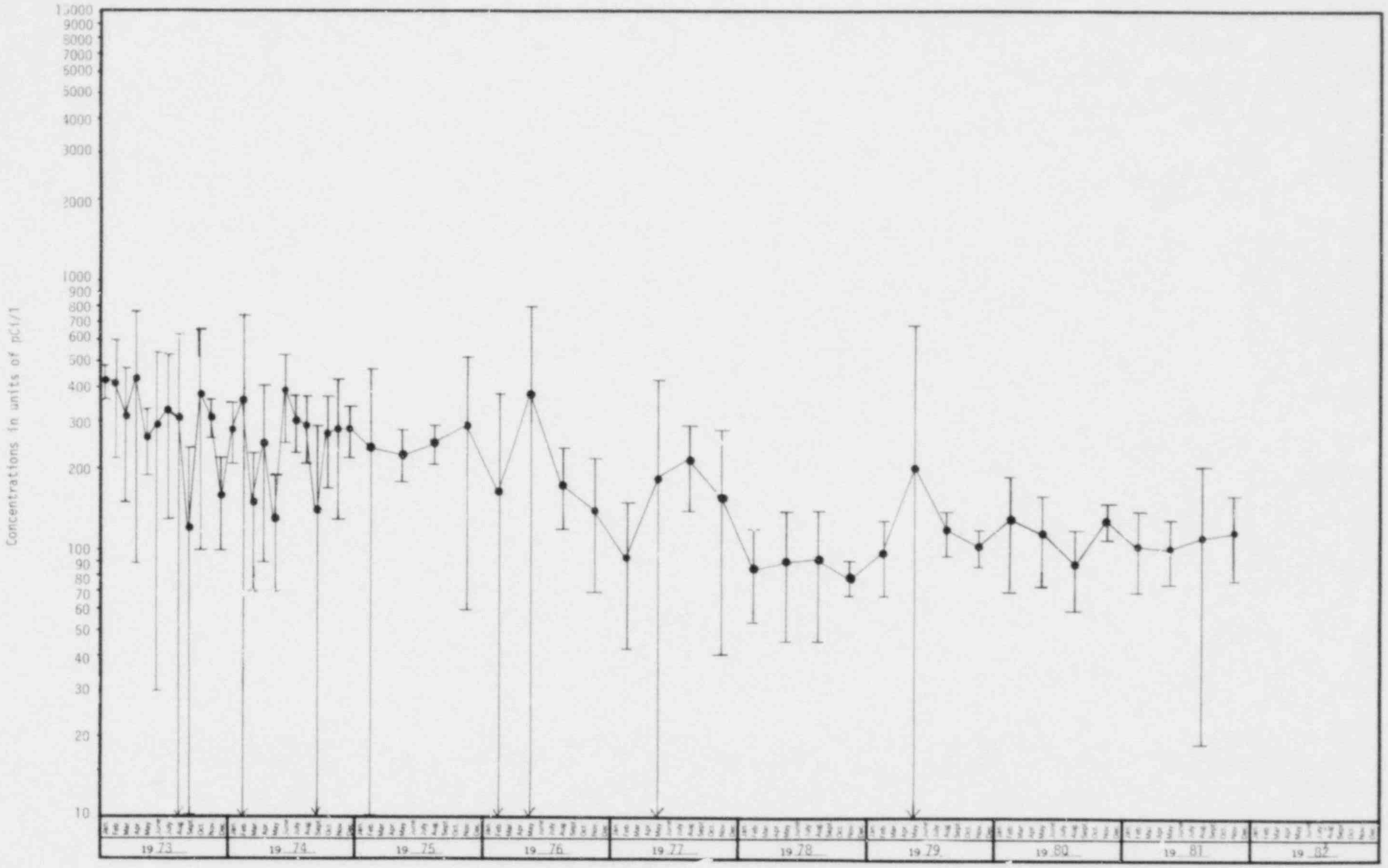


FIG. #2 GROSS BETA ACTIVITY IN AIR PARTICULATES
IN THE VICINITY OF THE SUSQUEHANNA SES SITE 1981

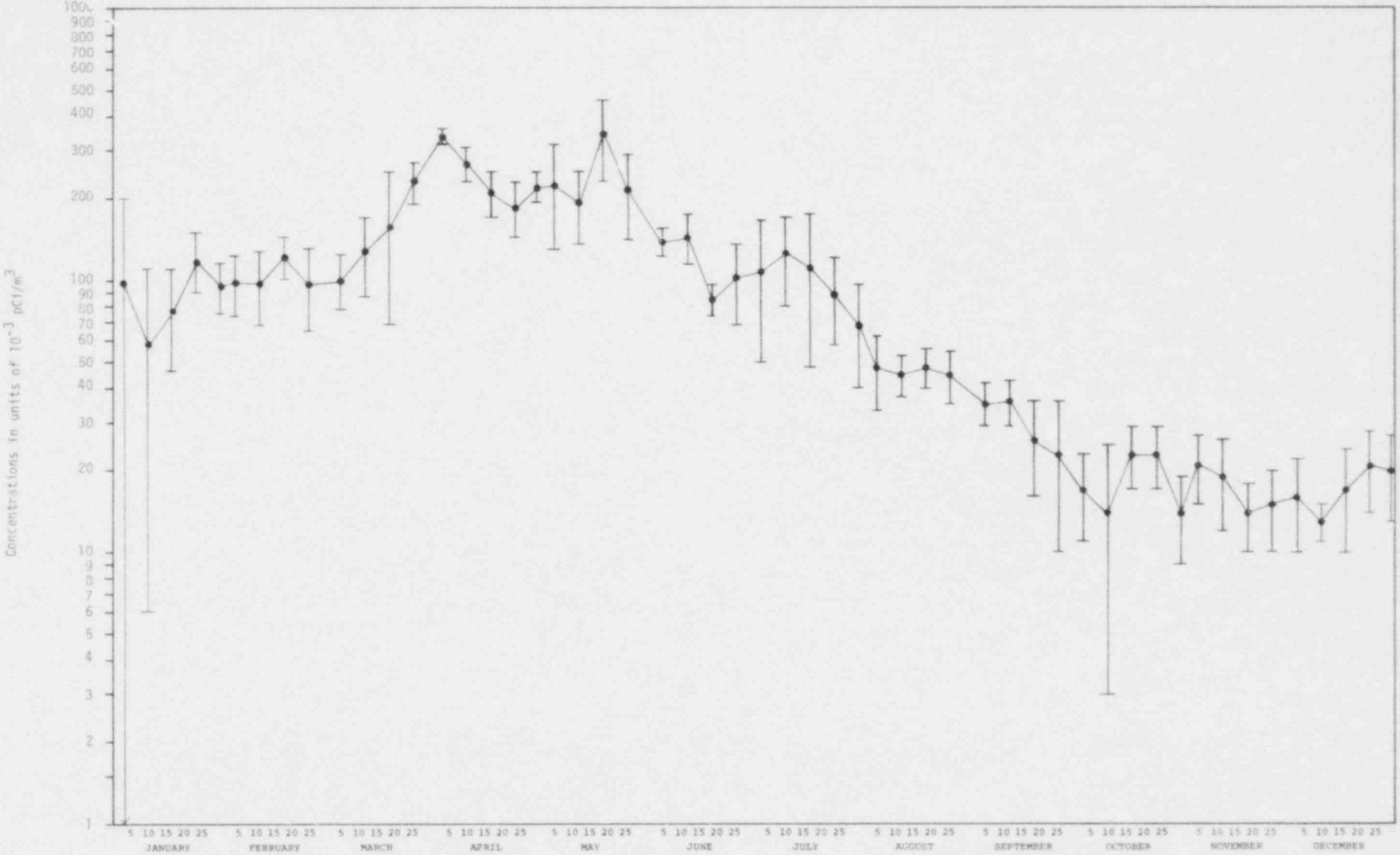
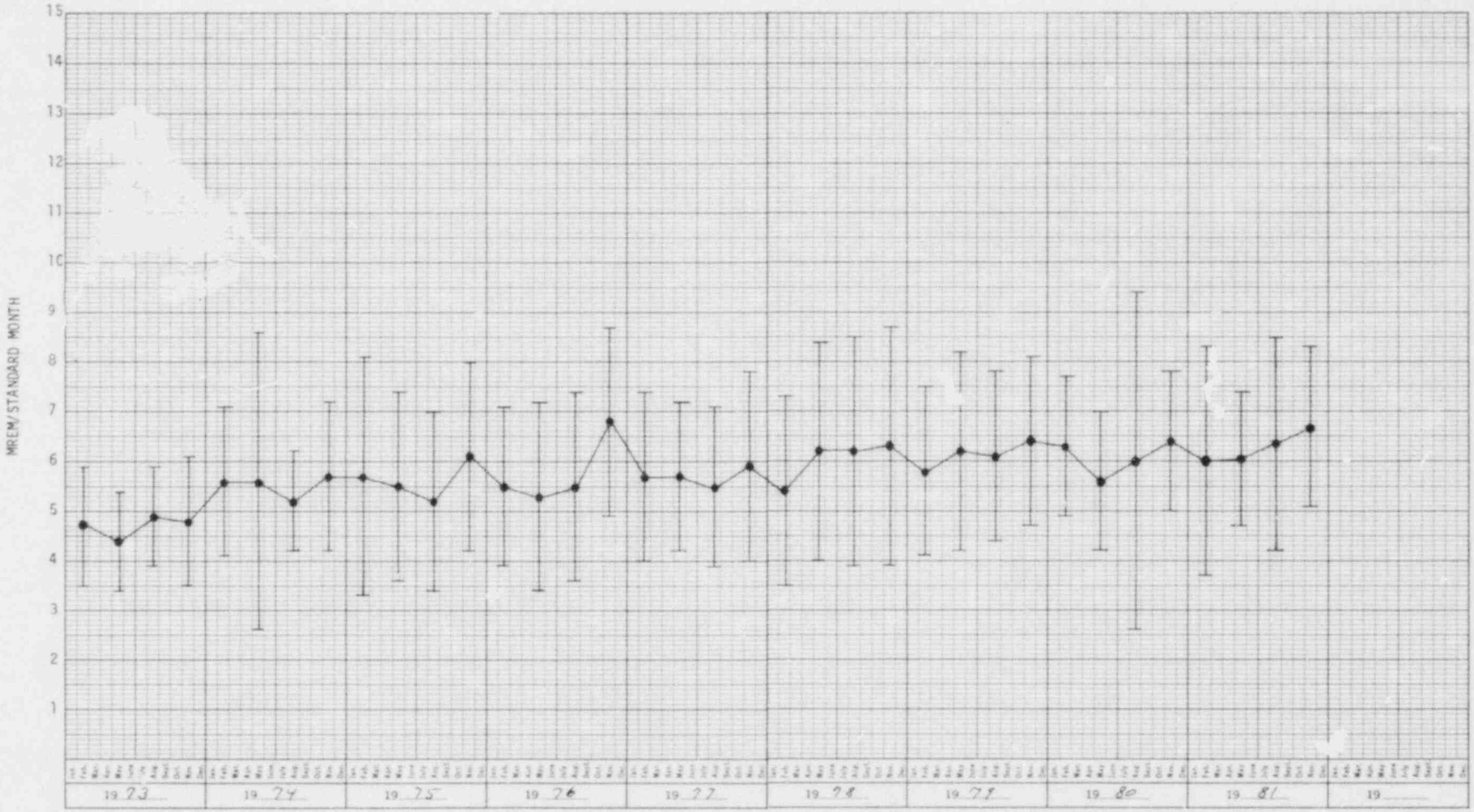


FIG. 3 AVERAGE AMBIENT RADIATION LEVELS IN THE VICINITY OF THE SUSQUEHANNA SES
1973 THROUGH 1981



APPENDIX A

PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM
ANNUAL SUMMARY

APPENDIX A

PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Susquehanna SES   Docket No.: 50-387 & 50-388

Berwick, Pa.   January 1 to December 31, 1981

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATION MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Surface Water (pCi/l)	Gross Beta	80	1.6	3.2 (43/44) (1.4-6.9)	12G2 17 mi WSW	3.6 (12/12) (1.7-6.9)	2.9 (29/36) (1.0-6.4)	0
	Gamma	80						
	K-40		7.8	51 (1/44) (51)	12H1 26 mi WSW	51 (1/12) (51)	- (0/36) -	0
	Co-60		0.6	0.9 (1/44) (0.9)	12G2 17 mi WSW	0.9 (1/10) (0.9)	- (0/36) -	0
	Nb-95		0.6	1.6 (3/44) (1.4-1.9)	5S8 0.8 mi E	2.9 (1/12) (2.9)	2.3 (2/36) (1.6-2.9)	0
	Ru-103		0.6	- (0/44) -	5S8 0.8 mi E	1.1 (1/12) (1.1)	1.1 (1/36) (1.1)	0
	Th-232		1.7	4.5 (1/44) (4.5)	12H1 26 mi WSW	4.5 (1/12) (4.5)	- (0/36) -	0
	I-131	402	0.06	0.24 (12/323) (0.10-0.56)	2F2 7.2 mi NNE	0.29 (10/52) (0.14-0.6)	0.27 (56/79) (0.08-1.0)	0
	H-3	28	87	108 (10/16) (68-183)	6S5 0.9 mi ESE	141 (2/4) (99-183)	121 (7/12) (68-166)	0
	Sr-89	28	0.6	0.6 (2/16) (0.4-0.8)	12F1 5.3 mi WSW	0.8 (1/4) (0.8)	0.5 (2/12) (0.5)	0
	Sr-90	28	0.4	0.6 (7/16) (0.3-1.1)	12F1 5.3 mi WSW	0.8 (2/4) (0.4-1.1)	0.4 (3/12) (0.2-0.8)	0
Well Water (pCi/l)	Gross Beta	36	1.7	3.2 (18/24) (1.2-7.4)	15A4 0.9 mi NW	4.1 (12/12) (1.5-7.4)	1.9 (8/12) (1.5-3.5)	0
	Gamma	36						
	K-40		6.0	7.9 (2/24) (6.3-9.5)	15A4 0.9 mi NW	7.9 (2/12) (6.3-9.5)	- (0/12) -	0
	Gross Alpha	12	0.9	- (0/8) -	N/A	- (0/4) -	- (0/4) -	0
	H-3	12	115	93 (4/8) (72-125)	15A4 0.9 mi NW	125 (1/4) (125)	119 (2/4) (87-150)	0

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Potable Water (pCi/l)	Gross Beta	24	1.7	2.2 (11/12) (1.5-3.3)	12F3 5.2 mi WSW	2.8 (5/12) (1.2-8.5)	2.8 (5/12) (1.2-8.5)	0
	Gamma	24		- (0/12) -	N/A	N/A	- (0/12) -	0
	I-131	52	0.07	0.23 (3/52) (0.14-0.3)	12H2 26 mi WSW	0.23 (3/52) (0.14-0.3)	N/A	0
	Gross Alpha	14	0.5	- (0/10) -	N/A	N/A	- (0/4) -	0
	H-3	14	102	131 (6/10) (70-383)	12H2 26 mi WSW	131 (6/10) (70-383)	101 (3/4) (98-108)	0
	Sr-89	8	0.6	- (0/4) -	N/A	N/A	- (0/4) -	0
	Sr-90	8	0.4	0.4 (2/4) (0.2-0.5)	12H2 26 mi WSW	0.4 (2/4) (0.2-0.5)	- (0/4) -	0
Sediment (pCi/g-dry)	Gamma	6						
	Be-7		0.2	0.6 (1/4) (0.6)	7B 1.2 mi SE	0.6 (1/2) (0.6)	- (0/2) -	0
	K-40			8.6 (4/4) (7.0-10)	7B 1.2 mi SE	10 (2/2) (10)	9.7 (2/2) (9.4-10)	0
	Nb-95			0.43 (4/4) (0.14-1.1)	7B 1.2 mi SE	0.69 (2/2) (0.28-1.1)	0.26 (2/2) (0.22-0.29)	0
	Zr-95		0.07	0.31 (2/4) (0.07-0.55)	7B 1.2 mi SE	0.55 (1/2) (0.55)	0.13 (1/2) (0.13)	0
	Ru-103		0.02	0.18 (1/4) (0.18)	7B 1.2 mi SE	0.18 (1/2) (0.18)	0.04 (1/2) (0.04)	0
	Cs-137			0.10 (4/4) (0.06-0.14)	7B 1.2 mi SE	0.14 (2/2) (0.13-0.14)	0.10 (2/2) (0.10)	0
	Ce-141		0.04	0.11 (1/4) (0.11)	7B 1.2 mi SE	0.11 (1/2) (0.11)	- (0/2) -	0
	Ce-144		0.1	0.4 (1/4) (0.4)	7B 1.2 mi SE	0.4 (1/2) (0.4)	- (0/2) -	0
	Ra-226			0.53 (4/4) (0.38-0.67)	2B 1.6 mi NNE	0.63 (2/2) (0.56-0.69)	0.63 (2/2) (0.56-0.69)	0
	Th-232			0.74 (4/4) (0.55-0.90)	7B 1.2 mi SE	0.90 (2/2) (0.90)	0.82 (2/2) (0.80-0.83)	0

APPENDIX A (cont.)

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Sediment (cont.) (pCi/g-dry)	Sr-89	6	0.05	0.15 (1/4) (0.15)	7B 1.2 mi SE	0.15 (1/2) (0.15)	- (0/2) -	0
	Sr-90	6	0.03	0.07 (1/4) (0.07)	7B 1.2 mi SE	0.07 (1/2) (0.07)	0.03 (2/2) (0.02-0.04)	0
Air Particulates (10^{-3} pCi/m^3)	Gross Beta	605		97 (458/458) (4-384)	5S4 0.8 mi E	107 (53/53) (12-384)	94 (147/147) (8-348)	0
	Gamma	47						
	Be-7		20	72 (34/35) (31-130)	15S4 0.6 mi NW	96 (3/3) (38-130)	66 (12/12) (27-110)	0
	Mn-54		0.7	1.9 (2/35) (1.6-2.1)	9B1 1.3 mi S	2.1 (1/4) (2.1)	- (0/12) -	0
	Nb-95		1.0	49 (26/35) (7.5-100)	7G1 14 mi SE	67 (3/4) (12-97)	52 (9/12) (10-97)	0
	Zr-95		1.6	23 (26/35) (3.5-47)	7G1 14 mi SE	31 (3/4) (5.5-49)	24 (9/12) (5.5-49)	0
	Ru-103		1.0	12 (17/35) (9.2-16)	9B1 1.3 mi S	15 (2/4) (13-16)	12 (6/12) (9.5-17)	0
	Ru-106		6.8	24 (3/35) (22-27)	2S2 0.9 mi NNE	27 (1/4) (27)	22 (1/12) (22)	0
	Cs-137		0.8	3.5 (13/35) (1.4-4.8)	11S2 0.4 mi SW	4.5 (1/4) (4.5)	3.0 (6/12) (1.8-4.1)	0
	Ce-141		1.4	6.8 (17/35) (4.6-12)	15S4 0.6 mi NW	11 (1/3) (11)	7.5 (6/12) (5.4-13)	0
	Ce-144		4.6	41 (25/35) (15-86)	15S4 0.6 mi NW	54 (2/3) (25-83)	41 (8/12) (14-78)	0
	Gross Alpha	47	0.6	2.8 (34/35) (1.4-4.9)	5S4 0.8 mi E	3.2 (4/4) (2.1-4.9)	2.2 (12/12) (1.2-3.2)	0
	Sr-89	47	0.3	4.6 (23/35) (6.5-7.0)	9B1 1.3 mi S	5.9 (3/4) (5.5-6.2)	4.3 (9/12) (0.2-9.6)	0
	Sr-90	47	0.1	0.9 (21/35) (0.1-1.7)	5S4 0.8 mi E	1.3 (2/4) (0.9-1.7)	0.6 (8/12) (0.2-1.4)	0
Air Iodine (10^{-3} pCi/m^3)	I-131	578	3.0	- (0/440) -	N/A -	N/A	- (0/138) -	0

APPENDIX A (cont.)

PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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Precipitation (pCi/l)	H-3	18	183	213 (6/14) (181-267)	11S2 0.4 mi SW	218 (3/4) (151-267)	135 (2/4) (127-142)	0
	Gamma	18						
	Be-7		6.3	24 (13/14) (10-55)	12G2 17 mi WSW	34 (4/4) (21-56)	34 (4/4) (21-56)	0
	Nb-95		0.8	8.6 (8/14) (2.8-21)	11S2 0.4 mi SW	9.8 (2/4) (8.5-11)	6.2 (2/4) (2.4-10)	0
	Zr-95		1.1	7.1 (6/14) (3.0-13)	5S4 0.8 mi E	9.6 (1/5) (9.6)	6.9 (2/4) (2.7-11)	0
	Ru-103		0.7	5.8 (8/14) (1.6-10)	1D2 4.0 mi N	6.3 (3/5) (1.7-10)	5.8 (2/4) (2.2-9.3)	0
	Ru-106		4.9	6.8 (1/14) (6.8)	5S4 0.8 mi E	6.8 (1/5) (6.8)	- (0/4) -	0
	Cs-137		0.5	1.3 (3/14) (0.8-1.8)	5S4 0.8 mi E	1.8 (1/5) (1.8)	1.0 (1/4) (1.0)	0
	Ce-141		0.9	4.7 (5/14) (2.7-6.2)	5S4 0.8 mi E	5.2 (2/5) (4.2-6.2)	4.0 (2/4) (1.2-6.8)	0
	Ce-144		2.8	10 (5/14) (6.0-15)	11S2 0.4 mi SW	12 (1/4) (12)	9.7 (3/4) (4.9-16)	0
Milk (pCi/l)	I-131	133	0.07	- (0/115) -	N/A	N/A	- (0/18) -	0
	Gamma	120						
	K-40			1441 (102/102) (1100-1700)	6C1 2.7 mi ESE	1500 (12/12) (1400-1600)	1411 (18/18) (1300-1500)	0
	Cs-137		1.1	2.9 (96/102) (1.2-7.7)	12B3 2.0 mi WSW	4.6 (12/12) (2.6-7.7)	3.8 (18/18) (2.4-9.6)	0
	Sr-89	96	1.4	3.4 (15/84) (1.7-5.3)	12D2 3.7 mi WSW	5.3 (1/12) (5.3)	3.2 (2/12) (1.9-4.5)	0
	Sr-90	96		5.3 (83/84) (1.3-13)	12B3 2.0 mi WSW	8.8 (12/12) (2.2-13)	1.7 (12/12) (4.6-9.9)	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATION MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Fish (pCi/g-wet)	Gamma	12						
	K-40			3.3 (6/6) (3.1-3.7)	2G 30 mi NNE	3.4 (6/6) (3.2-3.5)	3.4 (6/6) (3.2-3.5)	0
	Cs-137		0.01	0.012 (5/6) (0.009-0.015)	2G 30 mi NNE	0.012 (5/6) (0.009-0.016)	0.012 (5/6) (0.009-0.016)	0
	Sr-89	12	0.006	- (0/6) -	N/A	N/A	- (0/6) -	0
	Sr-90	12	0.003	0.002 (1/6) (0.002)	2G 30 mi NNE	0.005 (2/6) (0.002-0.007)	0.005 (2/6) (0.002-0.007)	0
Food Products (pCi/g-wet)	Gamma	16						
	Be-7		0.03	1.6 (1/11) (1.6)	12F5 8.6 mi WSW	1.6 (1/1) (1.6)	- (0/5) -	0
	K-40			3.0 (11/11) (0.72-10)	12F5 8.6 mi WSW	10 (1/1) (10)	3.1 (5/5) (1.9-4.3)	0
	Nb-95		0.004	0.10 (1/11) (0.10)	12F5 8.6 mi WSW	0.10 (1/1) (0.10)	- (0/5) -	0
	Cs-137		0.003	0.04 (2/11) (0.004-0.07)	7B2 1.5 mi SE	0.07 (1/2) (0.07)	- (0/5) -	0
Meat & Poultry (Flesh) (pCi/g-wet)	Gamma	3						
	K-40			2.0 (3/3) (0.93-2.9)	10D1 3.0 mi SSW	2.9 (1/1) (2.9)	No Control Location	0
Game (Flesh) (pCi/g-wet)	Gamma	2						
	K-40			2.6 (2/2) (2.5-2.7)	Indicator	2.7 (1/1) (2.7)	No Control Location	0
	Cs-137			0.08 (2/2) (0.10-1.5)	Indicator	1.5 (1/1) (1.5)		0
Vegetation (pCi/g-wet)	Gamma	2						
	Be-7		1.3	1.7 (1/2) (1.7)	8S3 1.0 mi SSE	1.7 (1/1) (1.7)	No Control Location	0
	K-40			8.0 (2/2) (7.9-8.1)	8S3 1.0 mi SSE	8.1 (1/1) (8.1)		0

PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Susquehanna SES Docket No.: 50-387 & 50-388

Berwick, Pa. January 1 to December 31, 1981

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATION MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Vegetation (cont.) (pCi/g-wet)	Nb-95		0.39 (2/2) (0.37-0.4)	7S4 1.0 mi SE	0.4 (1/1) (0.4)	No Control Location	0
	Zr-95	0.3	0.18 (1/2) (0.18)	8S3 1.0 mi SSE	0.18 (1/1) (0.18)		0
	Ce-144	0.9	0.5 (1/2) (0.5)	8S3 1.0 mi SSE	0.5 (1/1) (0.5)		0
Pasture Grass (pCi/g-wet)	Gamma 12						
	Be-7	1.1	5.5 (7/12) (1.2-12)	15A1 0.9 mi NW	7.1 (5/9) (1.8-12)	No Control Location	0
	K-40		14 (12/12) (3.7-26)	8D1 3.2 mi SSE	26 (1/1) (26)		0
	Nb-95	0.04	1.4 (8/12) (0.18-8.4)	15A1 0.9 mi NW	2.1 (5/9) (0.18-8.4)		0
	Zr-95	0.06	2.3 (2/12) (0.4-4.2)	15A1 0.9 mi NW	2.3 (2/9) (0.4-4.2)		0
	Ru-103	0.04	1.5 (1/12) (1.5)	15A1 0.9 mi NW	1.5 (1/9) (1.5)		0
	Cs-137	0.03	0.11 (3/12) (0.07-0.2)	15A1 0.9 mi NW	0.14 (2/9) (0.07-0.2)		0
	Ce-141	0.08	1.9 (1/12) (1.9)	15A1 0.9 mi NW	1.9 (1/9) (1.9)		0
	Ce-144	0.3	5.3 (1/12) (5.3)	15A1 0.9 mi NW	5.3 (1/9) (5.3)		0
Soil (pCi/g-dry)	Gamma 28						
	K-40		9.2 (24/24) (7.9-11)	12F4 8.3 mi WSW	11 (2/2) (10-11)	9.1 (4/4) (8.1-10)	0
	Nb-95	0.05	0.17 (18/24) (0.08-0.34)	3D2 3.4 mi NE	0.34 (1/2) (0.34)	0.24 (3/4) (0.15-0.35)	0
	Cs-137		0.49 (24/24) (0.14-2.2)	7G1 14 mi SE	2.2 (2/2) (2.2)	1.2 (4/4) (0.19-2.2)	0
	Ra-226		0.82 (24/24) (0.58-2.7)	3D2 3.4 mi NE	2.2 (2/2) (1.6-2.7)	0.84 (4/4) (0.74-0.92)	0
	Th-232		0.89 (24/24) (0.55-2.9)	3D2 3.4 mi NE	2.4 (2/2) (1.9-2.9)	1.0 (4/4) (0.9-1.1)	0

APPENDIX A (cont.)

PREOPERATIONAL ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Susquehanna SES Docket No.: 50-387 & 50-388

Berwick, Pa. January 1 to December 31, 1981

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD) (1)	ALL INDICATOR LOCATIONS MEAN (2) RANGE	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE & DIRECTION	LOCATION WITH HIGHEST ANNUAL MEAN MEAN (2) RANGE	CONTROL LOCATION MEAN (2) RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Ambient Radiation (mrem/std. mo.)	TLD 264		6.31 (232/232) (4.40-12.63)	6S4 0.2 mi ESE	10.39 (4/4) (7.90-12.63)	5.98 (32/32) (4.44-7.16)	0

\- No detectable measurements were found.

(1) The LLDs quoted are the lowest actual LLD obtained in the various media during the reporting period. A typical gamma LLD was determined for each searched for nuclide as found in Table C-29. Where all nuclides were <LLD for a specific media, no LLD was listed. Strontium-89 and -90 are reported as minimum detectable levels (MDLs) rather than LLDs.

(2) Mean and range are based upon detectable measurements only. Fraction of detectable measurements is indicated in parentheses.

The mean ($\overline{X}$) is defined as follows:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Where: X_i = the activity of an individual measurement (i)

n = number of total measurements

APPENDIX B

SAMPLE DESIGNATION

APPENDIX B

Table B-1 lists the sampling locations and includes both the distance and direction from the Susquehanna SES and the media sampled at each location. Maps B-1 and B-2 show the sampling locations with respect to the Susquehanna SES.

Sample Designation

Samples are identified by a three part code. The first two letters are the power station identification code, in this case "SS" for Susquehanna Steam Electric Station. The next three letters are for the media sampled.

AIO	=	Air Iodine	GAD	=	Game, Deer
AQF	=	Fish	GAS	=	Game, Squirrel
AQS	=	Sediment	GMK	=	Goat Milk
APT	=	Air Particulates	IDM	=	Immersion Dose (TLD)
EWA	=	Effluent Water	MLK	=	Milk
FPB	=	Food Products, Beef	PAS	=	Pasture Grass
FPE	=	Food Products, Eggs	PWT	=	Potable Water, Treated
FPF	=	Food Products, Fruit	RWA	=	Precipitation
FPG	=	Food Products, Grain	SWA	=	Surface Water
FPH	=	Food Products, Honey	WWA	=	Well Water
FPL	=	Food Products, Leafy Vegetables	VGT	=	Vegetation
FPP	=	Food Products, Poultry	SOL	=	Soil
FPV	=	Food Products, Vegetables			

The last four symbols are a location code based on direction and distance from the site. Of these, the first two represent each of the 16 angular sectors of 22-1/2 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction; i.e., 2=NNE, 3=NE, 4=ENE, etc. The next digit is a letter which represents the radial distance from the station:

S	=	Site(1) location	E	=	4-5 miles off-site
A	=	0-1 miles off-site	F	=	5-10 miles off-site
B	=	1-2 miles off-site	G	=	10-20 miles off-site
C	=	2-3 miles off-site	H	=	>20 miles off-site
D	=	3-4 miles off-site			

The last number is the station numerical designation within each sector and zone; e.g., 1, 2, 3, ...

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1. Site is defined as that area within PP&L's property boundary.

TABLE B-1

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1981

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
IND**	0.9-1.4 mile ESE, At or below Discharge structure	AQF
IND***	0-1.0 mile N, NNE and NNW	GAS
1S2	0.2 mile N, Security Fence	IDM
2S2	0.9 mile NNE, Energy Information Center	APT,AIO,IDM
2S3	0.2 mile NNE, Security Fence	IDM
2S4	0.9 mile NNE, Energy Information Center	SOL
3S3	0.5 mile NE, Recreational Area	IDM
3S4	0.3 mile NE, Security Fence	IDM
4S1	1.0 mile ENE, Susquehanna River Flood Plain	IDM
4S2	0.5 mile ENE, Site - Peach Stand	WWA
4S3	0.2 mile ENE, Security Fence	IDM
5S1	0.8 mile E, North of Biological Consultants	IDM
5S4	0.8 mile E, West of Biological Consultants	APT,AIO,IDM,RWA
5S5	0.8 mile E, West of Biological Consultants	SOL
5S7	0.2 mile E, Security Fence	IDM
5S8	0.8 mile E, Area under power line	SWA
6S4	0.2 mile ESE, Security Fence	IDM
6S5	0.9 mile ESE, Outfall Area	SWA
7S1	0.2 mile SE on 230 KV tower	IDM
7S3	0.2 mile SE, Security Fence	IDM
7S4	1.0 mile SE, On Site	VGT
8S2	0.2 mile SSE, Security Fence	IDM
8S3	1.0 mile SSE, On Site	VGT
9S1	0.3 mile S, Security Fence	IDM
10S1	0.4 mile SSW, Security Fence	IDM
11S2	0.4 mile SW, Golomb House	APT,AIO,IDM,RWA
11S3	0.3 mile SW, Security Fence	IDM
11S4	0.4 mile SW, Golomb House	SOL
12S3	0.4 mile WSW, Security Fence	IDM

TABLE B-1 (cont.)

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1981

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
13S2	0.4 mile W, Security Fence	IDM
13S3	0.6 mile W, Site Boundary	VGT
14S2	0.4 mile WNW, Security Fence	IDM
14S5	0.5 mile WNW, Site Boundary	IDM
15S3	0.3 mile NW, Security Fence	IDM
15S4	0.6 mile NW, Transmission Corridor	APT,AIO,IDM,SOL
16S1	0.3 mile NNW, Security Fence	IDM
1A1	0.6 mile N, Thomas Residence	IDM
6A3	0.6 mile ESE, State Police	IDM
7A1	0.4 mile SE, Kline Residence	IDM
11A2	0.6 mile SW, Shortz Residence	IDM
15A1	0.9 mile NW, Serafin Farm	PAS
15A3	0.9 mile NW, Serafin Farm	IDM
15A4	0.9 mile NW, Serafin Farm	WWA
16A2	0.8 mile NNW, Rysinski Farm	IDM
2B***	1.6 miles NNE, Gould Island	AQS
2B3	1.3 miles NNE, Luzerne Outerware	IDM
7B***	1.2 miles SE, Bell Bend	AQS
7B2	1.5 miles SE, Heller's Orchard	FPF,FPH
7B3	1.7 miles SE, Council Cup	IDM
8B1	1.4 miles SSE, Gale Residence	IDM
9B1	1.3 miles S, Transmission Line East of Route 11	APT,AIO,IDM
9B2	1.3 miles S, Transmission Line East of Route 11	SOL
10B2	2.0 miles SSW, Algatt Residence	IDM
10B3	1.7 miles SSW, Car-Mar	IDM

TABLE B-1 (cont.)

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1981

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
12B1	1.3 miles WSW, Kisner Farm	FPE,FPF,FPG,FPP
12B2	1.7 miles WSW, Shultz Farm	MLK
12B3	2.0 miles WSW, Young Farm	MLK
12B4	1.7 miles WSW, Shultz Farm	IDM
16B***	1.1 miles NNW	GAD
16B1	1.6 miles NNW, Walton Power Line	IDM
6C1	2.7 miles ESE, Moyer Farm	MLK
7C1	2.7 miles SE, Ferry Farm	GMK,PAS
11C***	2.6 miles SW, Hess Island	AQS
1D2	4.0 miles N, Near Mocanaqua Substation	APT,AIO,IDM RWA
1D3	3.9 miles N, Near Mocanaqua Substation	SWA
1D4	3.9 miles N, Near Mocanaqua Substation	SOL
1D5	3.9 miles N, Shickshinny Sewage Treatment Facility	EWA
3D1	3.4 miles NE, Pond Hill	APT,AIO,IDM
3D2	3.4 miles NE, Pond Hill	SOL
8D1	3.2 miles SSE, Poltrock Farm	GMK,PAS
8D2	4.0 miles SSE, Mowry Residence	IDM
9D1	3.6 miles S, Smith Farm	IDM
10D1	3.0 miles SSW, Ross Ryman Farm	MLK,FPP
10D2	3.0 miles SSW, Ross Ryman Farm	IDM
11D1	3.3 miles SW, Zehner Farm	FPG,FPL,FPV
11D3	3.3 miles SW, Zehner Farm	SOL
11D4	3.5 miles SW, Lanning Farm	SOL
12D2	3.7 miles WSW, Dogastin Farm	MLK
12D3	3.7 miles WSW, Dogastin Residence	IDM
1E1	4.5 miles N, Lane Residence	IDM
4E1	4.8 miles ENE, Pole #46422 N35-197	IDM
5E1	4.5 miles E, Bloss Farm	MLK
5E2	4.5 miles E, Bloss Farm	IDM

TABLE B-1 (cont.)

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

1981

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
6E1	4.7 miles ESE, St. James Church	IDM
7E1	4.2 miles SE, Harwood Trans. Line Pole #2	IDM
11E1	4.7 miles SW, Jacobsen Residence	IDM
12E1	4.7 miles WSW, Berwick Hospital	APT,AIO,IDM
12E2	4.7 miles WSW, Berwick Hospital	SOL
13E1	4.5 miles W, Glen Brook Reservoir	SWA
13E3	5.0 miles W, Dent Farm	MLK
13E4	4.1 miles W, Kessler Farm	IDM
14E1	4.1 miles WNW, Knouse Farm	IDM
2F1	5.9 miles NNE, St. Adalberts Cemetery	IDM
2F2	7.2 miles NNE, Retreat Bridge	SWA
3F1	9.1 miles NE, Valania Residence	IDM
7F1	9.0 miles SE, Conyngham School	IDM
12F1	5.3 miles WSW, Berwick Bridge	SWA
12F2	5.2 miles WSW, Berwick Substation	IDM
12F3	5.2 miles WSW, Berwick Water Co.	WWA,PWT
12F4	8.3 miles WSW, Lupini Farm	SOL
12F5	8.6 miles WSW, Seescholtz Farm	FPV,SOL
15F1	5.4 miles NW, Zawatski Farm	IDM
16F1	7.8 miles NNW, Hidlay Residence	IDM
3G1	15 miles NE, Lower Bridge Plymouth	SWA
3G2	11 miles NE, Nanticoke Bridge	SWA
3G3	16 miles NE, WB Horton St. Substation	IDM
3G4	17 miles NE, WB Service Center	IDM
3G5	19 miles NE, Market St. Bridge	SWA
4G1	14 miles ENE, Mountain Top - Ind. Park	IDM
7G1	14 miles SE, Hazelton Chem Lab	APT,AIO,IDM,SOL
10G1	14 miles SSW, Davis Farm	MLK

TABLE B-1 (cont.)

SUSQUEHANNA SES RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLING LOCATIONS

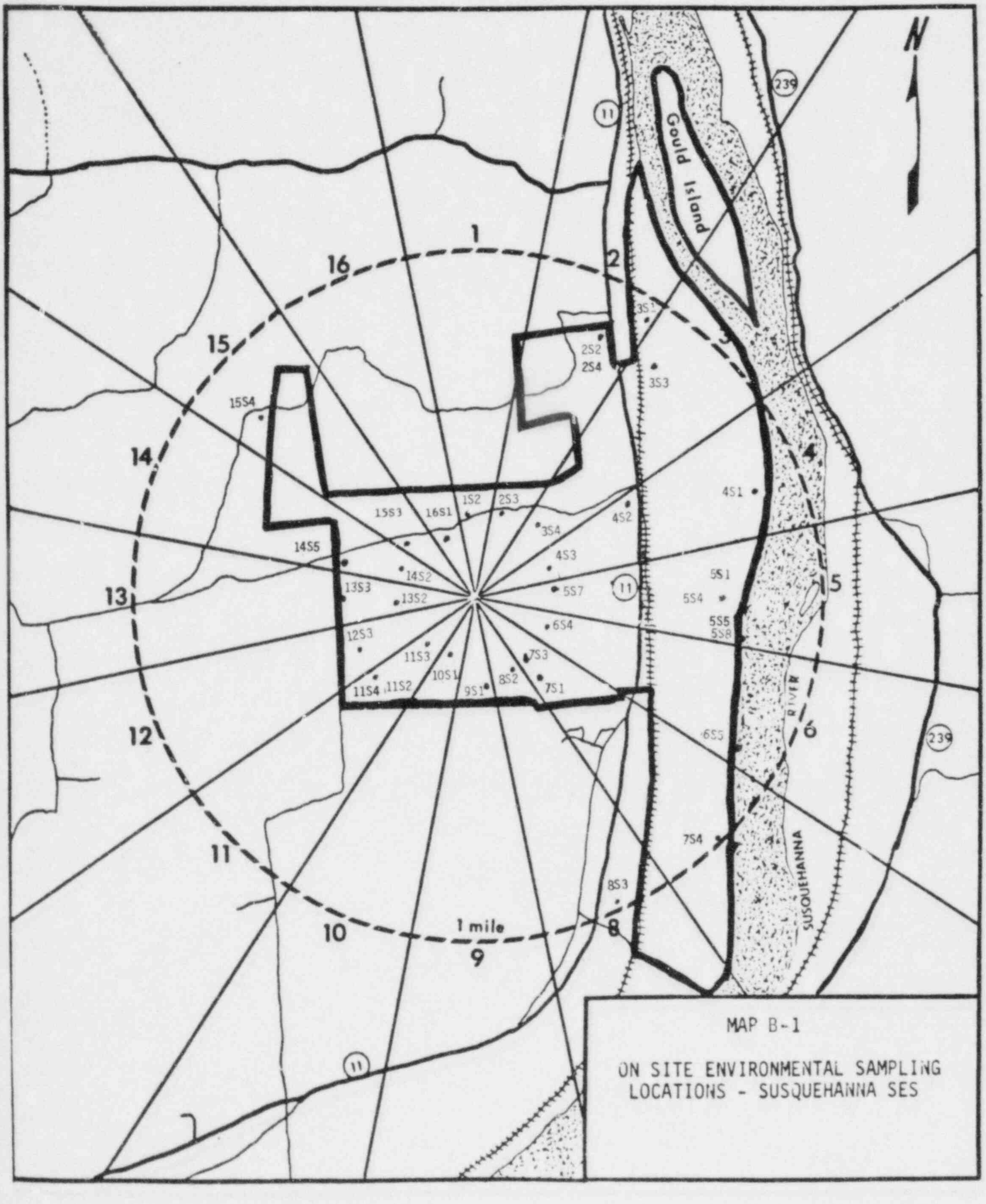
1981

LOCATION CODE	DESCRIPTION*	SAMPLE TYPES
12G1	15 miles WSW, Bloomsburg, PA	APT,AIO,IDM,RWA
12G2	17 miles WSW, between Bloomsburg and Berwick, PA	SWA,RWA
12G3	15 miles WSW, Bloomsburg State College	SOL
12G4	10 miles WSW, Kinery Residence	IDM
2H***	30 miles NNE, Near Falls, PA	AQF
2H1	21 miles NNE, Yalick's Produce Near Dallas	FPL,FPG,FPV
7H1	47 miles SE, PP&L roof, Allentown	APT,AIO,IDM
8H1	92 miles SSE, RMC roof, Philadelphia	IDM
12H1	26 miles WSW, Merck Co.	SWA
12H2	26 miles WSW, Danville Water Company	PWT

* All distances measured from vent.

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

*** Station code is omitted because no permanent locations exist; samples are taken based on availability.

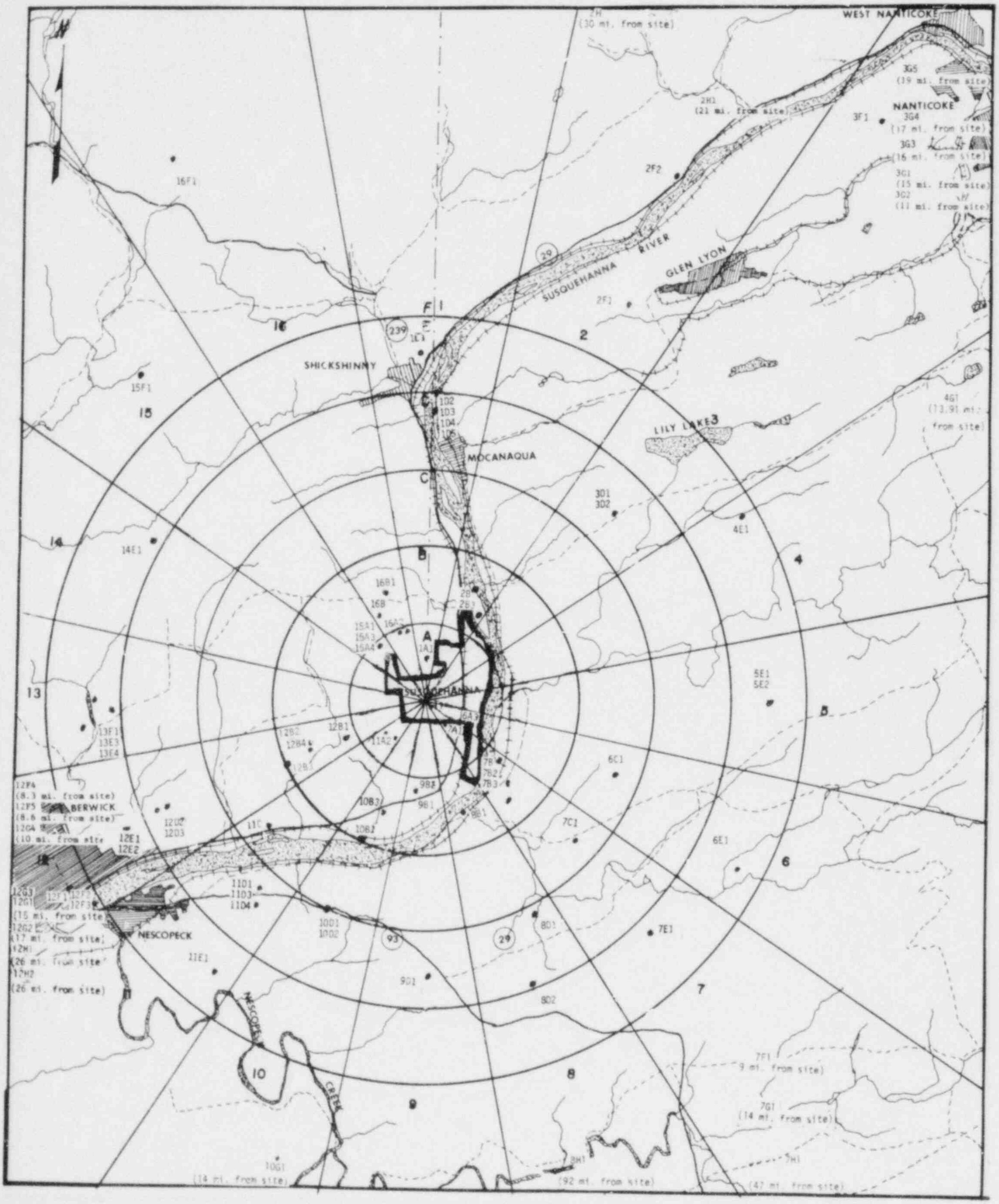


MAP B-1

ON SITE ENVIRONMENTAL SAMPLING LOCATIONS - SUSQUEHANNA SES

MAP B-2

OFF SITE ENVIRONMENTAL SAMPLING LOCATIONS - SUSQUEHANNA SES



APPENDIX C

DATA TABLES

APPENDIX C

DATA TABLES

DATA TABLES

DATA TABLES

TABLE NO.	TABLE TITLE	PAGE
	Direct Radiation	
C-28	Results of Quarterly TLD Measurements in the vicinity of Susquehanna SES	107
C-29	Typical LLDs for Gamma Spectrometry	110

TABLE C-1

CONCENTRATIONS OF BETA EMITTERS IN SURFACE WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-SWA-5S8	1.5±1.2	6.4±1.4	2.3±1.2	2.1±1.[illegible]	2.9±1.2	<2.2
SS-SWA-6S5	1.4±1.2	5.8±1.4	2.0±1.2	2.4±1.2	3.8±1.2	2.1±1.5
SS-SWA-1D3	1.7±1.3	5.5±1.4	5.1±1.4	3.9±1.4	2.4±1.3	2.7±1.2
SS-SWA-13E1	<2.0	2.0±1.2	1.5±1.2	3.1±1.4	<1.8	<1.6
SS-SWA-12F1	(1)	(1)	2.9±1.2	3.9±1.4	1.9±1.2	3.3±1.2
SS-SWA-12G2	(1)	(1)	3.1±1.3	6.9±1.6	1.7±1.2	3.5±1.2
SS-SWA-12H1	1.4±1.2	4.2±1.3	3.3±1.4	3.9±1.4	2.0±1.1	3.1±1.1
Monthly Average	1.6±0.5	4.8±3.5	2.9±2.3	3.7±3.2	2.4±1.5	2.2±2.3

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	YEARLY AVERAGE
SS-SWA-5S8	3.8±1.6	3.3±1.4	2.9±1.1	2.5±1.1	3.9±1.3	2.5±1.1	3.0±2.5
SS-SWA-6S5	3.8±1.6	2.0±1.3	3.1±1.1	2.9±1.1	5.0±1.3	3.0±1.1	3.1±2.6
SS-SWA-1D3	3.3±1.1	3.1±1.3	4.3±1.3	1.9±1.3	2.3±1.6	2.8±1.4	3.3±2.4
SS-SWA-13E1	1.0±0.9	1.8±1.2	1.7±1.1	<1.9	<2.4	<2.0	1.8±1.1
SS-SWA-12F1	2.8±1.1	3.1±1.3	4.1±1.2	2.8±1.3	3.2±1.6	<2.0	3.0±1.4
SS-SWA-12G2	3.3±1.1	6.0±1.5	3.7±1.2	3.2±1.3	2.3±1.6	1.9±1.3	3.6±3.4
SS-SWA-12H1	5.3±1.4	2.7±1.1	3.5±1.4	2.7±1.6	2.0±1.4	3.5±1.3	3.2±2.5
Monthly Average	3.3±2.6	3.1±2.8	3.3±1.8	2.6±1.0	3.0±2.2	2.5±1.2	
						Grand Average	3.0±2.4

(1) No sample was received because the river was frozen.

TABLE C-2

CONCENTRATIONS OF GAMMA EMITTERS* IN SURFACE WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-SWA-5S8						
Nb-95	<0.9	2.9±0.6	<0.8	<1.2	<2.9	<1.3
Ru-103	<0.9	1.1±0.6	<0.8	<1.1	<2.8	<1.2
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-6S5						
Nb-95	<0.9	1.4±0.8	<1.2	<0.8	<1.7	<1.3
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-1D3						
Nb-95	<0.8	1.6±0.7	<1.0	<0.9	<0.7	<0.8
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-13E1	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD
SS-SWA-12F1						
Nb-95	(1)	(1)	<0.9	<1.2	<0.7	1.6±0.8
Others			<LLD	<LLD	<LLD	<LLD
SS-SWA-12G2						
Co-60	(1)	(1)	<0.7	0.9±0.6	<0.9	<0.6
Nb-95			<0.8	1.9±0.8	<1.1	<0.8
Others			<LLD	<LLD	<LLD	<LLD
SS-SWA-12H1						
K-40	<9.2	<9.7	<10	<16	<9.9	51±8
Th-232	<1.8	<2.0	<2.1	<3.1	<2.1	4.5±1.9
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

STATION NO. RADIOACTIVITY	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-SWA-5S8						
Nb-95	<0.7	<0.9	<0.6	<1.0	<0.8	<0.6
Ru-103	<0.7	<0.8	<0.6	<1.0	<0.9	<0.7
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-6S5						
Nb-95	<1.1	<1.8	<0.7	<1.0	<0.9	<0.7
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-1D3						
Nb-95	<0.8	<1.0	<1.3	<0.7	<1.0	<1.2
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-13E1	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD
SS-SWA-12F1						
Nb-95	<1.1	<0.7	<0.9	<0.9	<0.7	<0.9
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-12G2						
Co-60	<0.9	<0.8	<1.1	<0.6	<1.1	<1.0
Nb-95	<1.2	<0.7	<0.9	<0.7	<0.7	<0.9
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-SWA-12H1						
K-40	<10	<14	<10	<14	<8.8	<9.5
Th-232	<2.2	<2.9	<2.0	<2.8	<1.7	<2.0
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.
(1) No sample was received because the river was frozen.

TABLE C-3

CONCENTRATIONS OF IODINE-131 IN SURFACE WATER AND EFFLUENT WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-SWA-5S8	0.5±0.1	<0.1	<0.08	<0.1	<0.1	(1)
	0.17±0.06	<0.1	<0.07	<0.09	<0.08	<0.1
	0.8±0.2	<0.1	<0.07	<0.08	<0.09	0.12±0.04
	0.10±0.04	<0.07	0.09±0.04	<0.07	(1)	0.12±0.04
			0.15±0.07			
SS-SWA-6S5	<0.2	(2)	<0.1	<0.08	<0.1	<0.08
SS-SWA-1D3	0.24±0.07	<0.2	<0.08	<0.08	0.16±0.05	<0.1
	0.37±0.07	<0.2	<0.07	<0.1	<0.1	<0.1
	1.0±0.2	<0.1	<0.1	<0.07	<0.1	<0.1
	0.20±0.06	<0.07	<0.07	<0.08	(1)	0.19±0.05
			<0.1			
SS-SWA-13E1	<0.1	<0.09	<0.09	<0.1	<0.07	<0.09
SS-SWA-2F2	0.23±0.08	<0.1	<0.08	<0.1	0.15±0.05	<0.09
	0.25±0.07	<0.1	<0.08	<0.1	<0.1	<0.1
	0.6±0.2	<0.1	<0.08	<0.07	<0.09	<0.08
	<0.1	<0.07	<0.08	<0.08	<0.1	0.26±0.06
			<0.2			
SS-SWA-12F1	(3)	(3)	<0.1	<0.1	<0.09	<0.09
	(3)	(3)	<0.07	<0.09	<0.1	<0.1
	(3)	<0.1	<0.08	<0.07	<0.1	<0.08
	(3)	<0.08	0.19±0.07	<0.1	<0.1	0.11±0.04
			<0.2			

TABLE C-3 (cont.)

CONCENTRATIONS OF IODINE-131 IN SURFACE WATER AND EFFLUENT WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-SWA-5S8	<0.08	<0.08	<0.09	0.24±0.06	<0.09	<0.08
	0.15±0.06	0.36±0.05	<0.08	0.09±0.04	<0.09	<0.1
	<0.07	0.11±0.05	<0.06	<0.1	0.24±0.06	<0.08
	0.44±0.06	<0.07	<0.09	<0.07	<0.1	0.16±0.05
	<0.08		<0.06			<0.08
SS-SWA-6S5	<0.1	<0.1	<0.09	<0.1	<0.08	<0.1
SS-SWA-1D3	<0.1	<0.1	<0.09	0.15±0.05	<0.08	0.13±0.04
	0.17±0.06	0.46±0.06	<0.09	0.10±0.04	<0.09	<0.09
	<0.09	<0.09	0.09±0.04	<0.1	0.30±0.06	<0.1
	0.50±0.07	<0.07	<0.1	<0.09	<0.1	0.08±0.04
	<0.09		<0.07			<0.09
SS-SWA-13E1	<0.1	<0.06	<0.09	<0.07	<0.1	<0.07
SS-SWA-2F2	<0.09	<0.09	<0.09	<0.06	<0.09	<0.09
	0.17±0.06	0.39±0.07	<0.1	<0.09	<0.1	<0.08
	<0.08	0.14±0.05	<0.08	<0.1	0.28±0.07	<0.1
	0.44±0.07	<0.09	<0.1	<0.08	<0.1	<0.08
	<0.2		<0.09			<0.1
SS-SWA-12F1	<0.1	<0.1	<0.1	0.18±0.06	<0.09	0.18±0.06
	0.24±0.06	0.56±0.07	<0.1	0.14±0.05	<0.1	<0.1
	<0.08	0.21±0.06	<0.08	<0.1	0.35±0.07	<0.1
	0.42±0.06	<0.08	<0.1	<0.07	<0.1	0.19±0.05
	<0.09		<0.09			<0.1

TABLE C-3 (cont.)

CONCENTRATIONS OF IODINE-131 IN SURFACE WATER AND EFFLUENT WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-SWA-3G1	<0.1 <0.1 <0.3 <0.1	<0.1 0.14±0.06 <0.1 <0.07	<0.09 <0.07 <0.08 <0.09 <0.1	<0.1 <0.1 <0.07 <0.08	<0.09 <0.1 <0.08 <0.1	<0.1 <0.1 <0.08 (1)
SS-SWA-3G2	(3) (3) (3) 0.14±0.06	(3) <0.1 <0.1 <0.07	<0.08 <0.09 <0.08 <0.09 <0.1	<0.1 <0.1 <0.07 <0.07	<0.08 <0.1 <0.09 <0.1	<0.09 <0.09 <0.08 (1)
SS-SWA-3G5	<0.1 <0.1 <0.3 <0.09	<0.1 (3) <0.09 <0.09	<0.07 <0.09 <0.07 <0.09 <0.1	<0.1 <0.1 <0.07 <0.09	<0.08 <0.1 <0.09 (1)	<0.1 <0.1 <0.08 0.19±0.06
SS-SWA-12G2	(3)	(3)	<0.09	<0.1	0.10±0.05	<0.09
SS-SWA-12H1	<0.1	<0.09	<0.1	<0.08	<0.09	<0.1
SS-EWA-1D5	<0.1	<0.1	<0.1	<0.2	<0.09	<0.1

TABLE C-3 (cont.)

CONCENTRATIONS OF IODINE-131 IN SURFACE WATER AND EFFLUENT WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-SWA-3G1	<0.09	<0.08	<0.08	<0.06	<0.09	<0.08
	0.23±0.06	0.27±0.06	<0.1	<0.09	<0.1	<0.1
	<0.1	<0.08	<0.08	<0.1	0.25±0.07	<0.1
	0.47±0.07	<0.08	<0.1	<0.1	<0.1	<0.09
	<0.09		<0.09			<0.09
SS-SWA-3G2	<0.09	<0.09	<0.09	<0.08	<0.09	<0.09
	0.20±0.06	0.41±0.07	<0.1	0.12±0.05	<0.1	<0.1
	<0.1	<0.1	<0.09	<0.1	<0.1	<0.1
	0.46±0.07	<0.08	<0.1	<0.09	<0.1	(3)
	<0.09		<0.09			<0.1
SS-SWA-3G5	<0.1	<0.1	<0.1	<0.08	<0.1	<0.09
	0.12±0.06	0.30±0.07	<0.1	<0.09	<0.1	<0.1
	<0.1	<0.1	<0.08	<0.1	0.19±0.06	<0.1
	0.5±0.1	<0.09	<0.1	<0.1	<0.1	(3)
	<0.1		<0.09			<0.1
SS-SWA-12G2	<0.2	<0.1	<0.1	<0.07	<0.1	<0.1
SS-SWA-12H1	<0.09	<0.1	<0.07	<0.07	<0.09	<0.09
SS-EWA-1D5	<0.1	<0.1	<0.1	<0.08	<0.07	<0.09

(1) Sample was lost in shipment.
(2) Sample was not analyzed due to delay in shipment.
(3) No sample was received because the river was frozen.

TABLE C-4

CONCENTRATIONS OF TRITIUM* AND STRONTIUM-89** AND -90 IN QUARTERLY COMPOSITE SAMPLES OF SURFACE WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	JAN TO MAR	APRIL TO JUNE	JULY TO SEPT	OCT TO DEC
SS-SWA-5S8				
H-3	<96	127±59	166±74	129±75
Sr-89	<2.4	<0.7	<0.6	<0.7
Sr-90	0.8±0.6	0.2±0.2	<0.4	<0.5
SS-SWA-6S5				
H-3	<96	99±59	183±74	<122
Sr-89	<2.6	<0.7	<0.7	<0.8
Sr-90	1.0±0.6	0.3±0.3	0.3±0.3	<0.5
SS-SWA-1D3				
H-3	99±70	<87	68±65	<112
Sr-89	0.5±0.4	<1.1	<0.7	<0.7
Sr-90	<0.4	<0.6	<0.4	<0.4
SS-SWA-13E1				
H-3	96±70	<87	<105	160±72
Sr-89	0.5±0.4	<1.2	<0.7	<0.7
Sr-90	<0.4	<0.6	<0.5	0.3±0.2
SS-SWA-12F1				
H-3	<113 (1)	113±54	68±65	99±69
Sr-89	0.8±0.4 (1)	<1.9	<0.7	<0.7
Sr-90	<0.4 (1)	<0.9	1.1±0.3	0.4±0.2
SS-SWA-12G2				
H-3	140±71 (1)	106±54	78±66	100±69
Sr-89	0.4±0.4 (1)	<1.5	<0.8	<0.7
Sr-90	<0.4 (1)	<0.7	<0.5	0.3±0.2
SS-SWA-12H1				
H-3	95±64	<108	<119	<111
Sr-89	<2.7	<0.7	<0.7	<1.0
Sr-90	<1.1	<0.4	0.5±0.3	<0.6
Tritium Average	105±33	104±29	112±93	119±42

* Positive tritium results are reported when the 2 sigma counting error is less than the results. In some cases, positive results to be reported are lower than the calculated LLDs. For clarification, check the method of calculation found in Appendix D, Analysis of Samples for Tritium.

** Sr-89 results are decay corrected to sample stop date.

(1) Analysis of March sample only since no sample was collected in January or February due to freezing conditions.

TABLE C-5

CONCENTRATIONS OF BETA EMITTERS IN WELL WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-WWA-4S2	<2.0	1.2±1.2	1.3±1.2	1.4±1.3	<1.9	<1.7
SS-WWA-15A4	1.7±1.3	4.6±1.4	4.0±1.3	4.0±1.4	5.4±1.4	3.7±1.3
SS-WWA-12F3	<2.1	1.6±1.2	1.6±1.2	1.5±1.3	3.5±1.4	<1.7
Monthly Average	1.9±0.4	2.5±3.7	2.3±3.0	2.3±3.0	3.6±3.5	2.4±2.3

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	YEARLY AVERAGE
SS-WWA-4S2	2.4±1.0	1.7±1.2	·1.2±1.0	<1.9	<2.4	<2.0	1.8±0.8
SS-WWA-15A4	5.3±1.2	2.9±1.3	3.8±1.2	4.5±1.4	7.4±1.8	1.5±1.3	4.1±3.2
SS-WWA-12F3	1.6±1.0	2.2±1.3	1.6±1.1	1.9±1.3	<2.4	<2.1	2.0±1.1
Monthly Average	3.1±3.9	2.3±1.2	2.2±2.8	2.8±3.0	4.1±5.8	1.9±0.6	
						Grand Average	2.6±2.9

TABLE C-6

CONCENTRATIONS OF GAMMA EMITTERS* IN WELL WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-WWA-4S2						
K-40	<8.7	<8.5	<9.0	<8.8	<11	<14
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-WWA-15A4						
K-40	9.5±5.8	<6.0	<8.9	<12	<9.5	<16
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-WWA-12F3						
K-40	<8.2	<9.0	<10	<14	<14	<15
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-WWA-4S2						
K-40	<14	<16	<16	<16	<15	<9.1
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-WWA-15A4						
K-40	<15	<10	<15	6.3±5.2	<11	<11
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
SS-WWA-12F3						
K-40	<8.4	<9.2	<15	<9.2	<8.6	<8.5
Others	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-7

CONCENTRATIONS OF ALPHA EMITTERS AND TRITIUM* IN QUARTERLY COMPOSITE SAMPLES OF WELL WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	JAN TO MAR	APR TO JUN	JUL TO SEPT	OCT TO DEC	YEARLY AVERAGE
SS-WWA-4S2					
Alpha	<1.7	<1.8	<2.3	<1.6	-
Tritium	72±71	<118	73±65	102±69	91±45
SS-WWA-15A4					
Alpha	<1.0	<1.0	<1.3	<0.9	-
Tritium	125±73	<118	<122	<115	-
SS-WWA-12F3					
Alpha	<1.9	<1.9	<2.6	<1.6	-
Tritium	87±69	<118	<122	150±72	119±52

* Positive tritium results are reported when the 2 sigma counting error is less than the results. In some cases, positive results to be reported are lower than the calculated LLDs. For clarification, check the method of calculation found in Appendix D, Analysis of Samples for Tritium.

TABLE C-8

CONCENTRATIONS OF BETA EMITTERS AND GAMMA EMITTERS* IN
POTABLE (DRINKING) WATER SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-PWT-12F3						
Beta	<2.1	<1.8	1.3±1.[illegible]	8.5±1.7	<1.8	<1.7
Gamma Emitters	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD
SS-PWT-12H2						
Beta	2.1±1.2	2.0±1.2	2.0±1.3	2.2±1.3	1.5±1.1	2.4±1.0
Gamma Emitters	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD

STATION NO. RADIOACTIVITY	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	YEARLY AVERAGE
SS-PWT-12F3							
Beta	1.4±1.0	1.6±1.2	1.2±1.0	<1.9	<2.4	<2.0	2.3±4.0
Gamma Emitters	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	
SS-PWT-12H2							
Beta	3.3±1.3	2.3±1.1	2.0±1.3	<2.4	1.8±1.3	2.4±1.3	2.2±0.9
Gamma Emitters	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	All<LLD	
						Beta Grand Average	2.3±2.8

* Typical LLDs are found on Table C-29.

TABLE C-9

CONCENTRATIONS OF IODINE-131 IN POTABLE (DRINKING) WATER SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

SS-PWT-12H2

Results in Units of pCi/l ± 2 sigma

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
<0.1	<0.1	<0.09	<0.1	<0.1	<0.1
<0.1	<0.1	<0.07	<0.1	<0.1	<0.1
0.3±0.2	<0.07	<0.1	<0.08	<0.1	<0.09
0.24±0.06	<0.09	<0.1	<0.08	<0.1	<0.1
<0.1				<0.1	

JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
<0.1	<0.09	<0.09	<0.09	<0.1	<0.1
<0.09	<0.1	<0.08	<0.09	0.14±0.06	<0.1
<0.1	<0.1	<0.1	<0.1	<0.1	<0.09
<0.1	<0.1	<0.08	<0.1	<0.09	<0.1
<0.08			<0.1		

TABLE C-10

CONCENTRATIONS OF ALPHA EMITTERS, TRITIUM AND STRONTIUM-89* AND -90 IN QUARTERLY COMPOSITE SAMPLES OF POTABLE (DRINKING) WATER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	JAN TO MAR	APRIL TO JUNE	JULY TO SEPT	OCT TO DEC
SS-PWT-12F3				
Alpha	<1.9	<1.9	<2.4	<1.6
H-3	98±70	98±54	<122	108±69
Sr-89	<0.6	<1.7	<0.9	<0.7
Sr-90	<0.4	<0.8	<0.5	<0.4
SS-PWT-12H2				
Alpha	<0.5	(1)	(1)	(1)
H-3	81±64	(1)	(1)	(1)
Sr-89	<1.5	<0.7	<0.7	<0.9
Sr-90	<0.6	<0.4	0.2±0.2	0.5±0.4

	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-PWT-12H2									
Alpha	<1.1	<1.4	<1.5	<2.3	<2.3	<1.8	<0.9	<1.2	<0.9
H-3	80±58	70±54	<108	363±65	<122	<119	<102	97±71	77±63

* Sr-89 results are decay corrected to sample stop date.
(1) Changed from quarterly analysis to monthly analysis in April 1981.

TABLE C-11

CONCENTRATIONS OF GAMMA EMITTERS* IN SEDIMENT SAMPLES
FROM THE SUSQUEHANNA RIVER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(dry) ± 2 sigma

STATION NO.	SS-AQS-2B**		SS-AQS-7B**		SS-AQS-11C**		YEARLY
DATE	5-13-81	10-03-81	5-13-81	10-05-81	5-13-81	10-05-81	AVERAGE
Be-7	<0.3	<0.4	0.6±0.2	<0.5	<0.2	<0.3	-
K-40	10±1	9.4±0.9	10±1	10±1	7.4±0.7	7.0±0.7	9.0±2.8
Zr-95	0.13±0.04	<0.08	0.55±0.06	<0.1	0.07±0.03	<0.07	0.2±0.4
Nb-95	0.29±0.03	0.22±0.05	1.1±0.1	0.28±0.05	0.18±0.02	0.14±0.04	0.4±0.7
Ru-103	0.04±0.02	<0.05	0.18±0.03	<0.06	<0.02	<0.04	-
Cs-137	0.10±0.02	0.10±0.02	0.14±0.03	0.13±0.03	0.06±0.02	0.08±0.02	0.10±0.06
Ce-141	<0.05	<0.08	0.11±0.03	<0.1	<0.04	<0.06	-
Ce-144	<0.2	<0.2	0.4±0.1	<0.3	<0.1	<0.2	-
Ra-226	0.56±0.06	0.69±0.07	0.57±0.07	0.67±0.07	0.38±0.05	0.50±0.05	0.6±0.2
Th-232	0.83±0.08	0.80±0.09	0.9±0.1	0.90±0.09	0.55±0.07	0.61±0.08	0.8±0.3

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.
** Station code is omitted because no exact sampling locations exist; samples are taken based on availability.

TABLE C-12

CONCENTRATIONS OF ALPHA EMITTERS AND Sr-89* AND Sr-90 IN SEDIMENT SAMPLES
FROM THE SUSQUEHANNA RIVER IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(dry) ± 2 sigma

STATION NO.	SS-AQS-2B**		SS-AQS-7B**		SS-AQS-11C**		YEARLY
DATE	5-13-81	10-05-81	5-13-81	10-05-81	5-13-81	10-05-81	AVERAGE
Alpha	<5.8	14±6	8.4±5.3	7.1±4.4	5.6±4.8	5.2±3.9	7.7±6.6
Sr-89	<0.1	<0.06	0.15±0.09	<0.06	<0.1	<0.05	-
Sr-90	0.04±0.04	0.02±0.02	<0.07	0.07±0.02	<0.05	<0.03	0.05±0.04

* Sr-89 results are decay corrected to the sample stop date.

** Station code is omitted because no exact sampling locations exist; samples are taken based on availability.

TABLE C-13

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 2S2	SS-APT 5S4	SS-APT 50SQ	SS-APT 11S2	SS-APT 15S4	SS-APT 9B1	SS-APT 1D2	SS-APT 3D1	SS-APT 12E1	AVERAGE
12-29-80	1-03-81	79±8	84±8	84±8	77±8	-	80±8	72±7	82±8	84±8	80±8
1-03-81	1-11-81	47±6	120±13	48±5	43±5	-	44±5	42±4	71±7	(1)	59±57
1-11-81	1-18-81	45±6	95±11	85±9	99±10	-	74±7	73±8	77±8	70±7	77±34
1-18-81	1-25-81	151±15	116±12	132±13	104±10	-	121±12	115±11	111±11	103±10	119±32
1-25-81	2-01-81	95±10	113±11	97±10	97±10	-	85±9	86±9	109±11	93±9	97±20
2-01-81	2-08-81	100±10	99±10	116±12	97±10	-	88±9	91±9	105±10	94±9	99±18
2-08-81	2-15-81	130±13	98±10	99±10	114±11	-	92±9	89±9	90±9	77±8	99±33
2-15-81	2-22-81	113±11	121±12	107±11	117±12	-	114±11	112±11	129±13	120±12	117±13
2-22-81	3-01-81	85±9	126±13	124±12	85±9	-	86±9	102±10	90±9	82±8	98±36
3-01-81	3-08-81	99±10	119±12	103±10	106±11	-	98±10	90±9	101±10	94±9	101±17
3-08-81	3-15-81	126±13	112±11	120±12	129±13	-	123±12	120±12	108±11	124±12	120±14
3-15-81	3-22-81	146±15	281±28	149±15	195±19	-	154±15	143±14	130±13	151±15	169±98
3-22-91	3-29-81	277±28	230±23	217±22	235±23	-	226±23	221±22	236±24	250±25	237±39
3-29-81	4-04-81	334±33	341±34	325±33	343±34	-	352±35	334±33	332±33	346±35	338±17
4-04-81	4-12-81	292±29	285±29	279±28	269±27	-	286±29	265±27	268±27	272±27	277±20
4-12-81	4-19-81	169±17	219±22	199±20	220±22	-	208±21	222±22	192±19	199±20	204±36
4-19-81	4-26-81	158±16	221±22	200±20	204±20	-	194±19	199±20	181±18	180±18	192±38
4-26-81	5-03-81	191±19	225±22	210±21	207±21	-	223±22	233±23	220±22	230±23	217±28
5-03-81	5-10-81	224±22	253±25	245±24	232±23	241±24 (2)	238±24	225±23	103±10	259±26	224±94
5-10-81	5-17-81	191±19	194±19	195±19	181±18	177±18	188±19	170±17	169±17	192±19	184±20
5-17-81	5-25-81	372±37	384±38	357±36	373±37	364±36	376±38	372±37	352±35	344±34	366±26
5-25-81	5-31-81	246±25	234±23	235±23	229±23	231±23	233±23	232±23	214±21	211±21	229±22
5-31-81	6-07-81	141±14	145±14	140±14	147±15	154±15	141±14	144±14	129±13	129±13	141±16
6-07-81	6-14-81	162±16	148±15	150±15	146±15	153±15	143±14	148±15	144±14	162±16	151±14
6-14-81	6-21-81	87±9	84±8	87±9	82±8	85±9	86±9	81±8	83±8	80±8	84±5
6-21-81	6-28-81	124±12 (3)	103±10	106±11	105±10	97±10	116±12 (3)	107±11 (3)	94±9	108±11	107±18

TABLE C-13 (cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 2S2	SS-APT 5S4	SS-APT 50SQ	SS-APT 11S2	SS-APT 15S4	SS-APT 9B1	SS-APT 1D2	SS-APT 3D1	SS-APT 12E1	AVERAGE
6-28-81	7-05-81	117±12 (4)	115±11	115±11	117±12	116±12	132±13 (4)	120±12 (4)	41±4	123±12	111±53
7-05-81	7-12-81	139±14	129±13	127±13	129±13	133±13	127±13	132±13	60±6	134±13	123±48
7-12-81	7-19-81	137±14	122±12	45±5	136±14	122±12	131±13	123±12	49±5	124±12	110±72
7-19-81	7-26-81	99±10	97±10	92±9	94±9	90±9	93±9	92±9	41±4	98±10	88±36
7-26-81	8-02-81	73±7	66±7	65±7	80±8	73±7	76±8	73±7	45±5	83±8	70±22
8-02-81	8-09-81	48±5	50±5	48±5	50±5	53±5	52±5	53±5	47±5	45±5	50±6
8-09-81	8-16-81	49±5	48±5	42±4	48±5	47±5	50±5	46±5	45±5	47±5	47±5
8-16-81	8-23-81	54±5	47±5	47±5	41±4	49±5	50±5	50±5	46±5	55±9	49±8
8-23-81	8-30-81	50±5	53±6	42±4	49±5	42±4	47±5	50±5	41±4	50±5	47±9
8-30-81	9-06-81	36±5	35±5	36±4	32±4	34±4	36±4	35±4	33±4	33±4	34±3
9-06-81	9-13-81	34±4	37±4	36±4	33±4	36±4	39±4	33±3	35±4	38±4	36±4
9-13-81	9-20-81	29±4	27±4	29±4	26±4	29±3	26±4	28±3	19±5	28±4	27±6
9-20-81	9-27-81	25±4	28±4	25±3	28±3	26±3	25±4	27±3	10±2	24±3	24±11
9-27-81	10-04-81	20±4	16±3	15±2	20±3	17±2	17±3	17±3	10±3	21±4	17±7
10-04-81	10-11-81	12±3	13±3	11±2	15±3	12±3	14±3	13±3	4±2	14±6	12±6
10-11-81	10-18-81	22±4	25±3	20±3	27±4	25±3	21±4	22±3	20±3	18±4	22±6
10-18-81	10-25-81	21±4	23±3	21±3	23±4	21±3	22±4	23±3	16±3	30±5	22±7
10-25-81	11-01-81	15±4	13±3	13±3	13±4	14±3	14±4	17±4	9±3	16±3	14±5
11-01-81	11-09-81	25±4	21±3	20±3	20±3	23±3	24±4	22±3	13±3	23±3	21±7
11-09-81	11-15-81	19±4	25±4	17±3	22±4	19±4	17±4	19±3	14±4	19±3	19±6
11-15-81	11-22-81	16±3	14±3	13±3	14±3	13±3	15±3	14±3	9±3	12±2	13±4
11-22-81	11-29-81	15±3	12±3	13±3	14±3	17±3	15±3	14±3	13±3	17±3	14±3
11-29-81	12-06-81	20±4	18±3	15±3	16±3	20±3	16±3	16±3	11±3	14±3	16±6
12-06-81	12-13-81	13±3	14±3	13±3	13±3	13±3	14±3	12±3	10±2	13±2	13±2
12-13-81	12-20-81	16±3	18±3	18±3	17±3	17±3	19±3	21±3	14±2	16±2	17±4
12-20-81	12-28-81	22±3	23±3	23±3	23±3	23±3	24±3	23±3	17±2	21±3	22±4
12-28-81	1-03-82	21±4	24±4	20±3	21±3	22±3	22±3	23±3	16±3	20±3	21±5
Average		101±176	107±185	98±173	101±176	75±162	100±177	98±173	87±168	100±175	
										Indicator Average	97±174

TABLE C-13 (cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 $\pm$ 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 7G1	SS-APT 12G1	SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 7H1	AVERAGE
12-28-80	1-03-81	-	79±8	12-30-80	1-05-81	247±25	163±238
1-03-81	1-11-81	-	71±7	1-05-81	1-12-81	40±5	56±44
1-11-81	1-18-81	-	77±9	1-12-81	1-19-81	70±8	74±10
1-18-81	1-25-81	-	109±11	1-19-81	1-27-81	113±11	111±6
1-25-81	2-01-81	-	82±8	1-27-81	2-03-81	93±9	88±16
2-01-81	2-08-81	-	76±8	2-03-81	2-10-81	113±11	95±52
2-08-81	2-15-81	-	88±9	2-10-81	2-17-81	102±10	95±20
2-15-81	2-22-81	-	128±13	2-17-81	2-24-81	145±15	137±24
2-22-81	3-01-81	-	95±10	2-24-81	3-03-81	91±9	93±6
3-01-81	3-08-81	108±11 (5)	77±8	3-03-81	3-10-81	108±11	98±36
3-08-81	3-15-81	176±18	122±12	3-10-81	3-17-81	162±16	153±56
3-15-81	3-22-81	143±14	132±13	3-17-81	3-24-81	121±12	132±22
3-22-81	3-29-81	208±21	211±21	3-24-81	3-31-81	245±25	221±41
3-29-81	4-04-81	321±32	351±35	3-31-81	4-07-81	323±32	332±34
4-04-81	4-12-81	245±25	262±26	4-07-81	4-15-81	222±22	243±40
4-12-81	4-19-81	221±22	213±21	4-15-81	4-21-81	249±25	228±38
4-19-81	4-26-81	163±16	(1)	4-21-81	4-28-81	163±16	163
4-26-81	5-03-81	233±23	226±23	4-28-81	5-05-81	223±22	227±10
5-03-81	5-10-81	(1)	256±26	5-05-81	5-12-81	174±17	215±116
5-10-81	5-17-81	175±17	212±21	5-12-81	5-18-81	276±28	221±102
5-17-81	5-25-81	348±35	170±17	5-18-81	5-27-81	344±34	287±203
5-25-81	5-31-81	224±22	111±11	5-27-81	6-03-81	171±17	169±113
5-31-81	6-07-81	138±14	128±13	6-03-81	6-10-81	131±13	132±10
6-07-81	6-14-81	143±14	116±12	6-10-81	6-16-81	117±12	125±31
6-14-81	6-21-81	101±10	82±8	6-16-81	7-02-81	86±9 (6)	90±20
6-21-81	6-28-81	110±11	57±6 (3)				84±53

TABLE C-13 (cont.)

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 7G1	SS-APT 12G1	SAMPLE START DATE	SAMPLE STOP DATE	SS-APT 7H1	AVERAGE
6-28-81	7-05-81	124±12	54±7 (4)	7-02-81	7-08-81	121±12	100±79
7-05-81	7-12-81	144±14	113±11	7-08-81	7-15-81	148±15	135±38
7-12-81	7-19-81	127±13	118±12	7-15-81	7-22-81	100±10	115±27
7-19-81	7-26-81	98±10	84±8	7-22-81	7-29-81	86±9	89±15
7-26-81	8-02-81	74±7	36±5	7-29-81	8-05-81	68±7	59±41
8-02-81	8-09-81	52±5	26±4	8-05-81	8-12-81	48±5	42±28
8-09-81	8-16-81	44±4	42±5	8-12-81	8-19-81	36±4	41±8
8-16-81	8-23-81	50±5	42±5	8-19-81	8-28-81	46±5	46±8
8-23-81	8-30-81	43±4	36±5	8-28-81	9-04-81	40±4	40±7
8-30-81	9-06-81	32±4	31±5	9-04-81	9-10-81	42±5	35±12
9-06-81	9-13-81	36±4	28±5	9-10-81	9-16-81	43±5	36±15
9-13-81	9-20-81	30±3	12±3	9-16-81	9-22-81	25±4	22±19
9-20-81	9-27-81	25±3	10±3	9-22-81	9-28-81	27±4	21±19
9-27-81	10-04-81	16±3	14±5	9-28-81	10-05-81	17±3	16±3
10-04-81	10-11-81	14±3	13±5	10-05-81	10-12-81	29±4	19±18
10-11-81	10-18-81	21±3	25±6	10-12-81	10-17-81	26±5	24±5
10-18-81	10-25-81	23±3	24±6	10-17-81	10-25-81	23±3	23±1
10-25-81	11-01-81	12±3	11±4	10-25-81	10-31-81	17±4	13±6
11-01-81	11-09-81	19±3	20±4	10-31-81	11-08-81	24±3	21±5
11-09-81	11-15-81	20±3	15±6	11-08-81	11-14-81	25±4	20±10
11-15-81	11-22-81	12±2	14±3	11-14-81	11-23-81	16±3	14±4
11-22-81	11-29-81	13±3	13±5	11-23-81	11-30-81	20±3	15±8
11-29-81	12-06-81	18±3	12±3	11-30-81	12-05-81	17±5	16±6
12-06-81	12-13-81	13±3	11±3	12-05-81	12-14-81	12±1	12±2
12-13-81	12-20-81	20±3	8±3	12-14-81	12-21-81	18±3	15±13
12-20-81	12-28-81	19±3	11±3	12-21-81	12-28-81	20±3	17±10
12-28-81	1-03-82	20±3	11±3	12-28-81	1-04-82	24±3	18±13
Average		97±180	84±158			101±174	
						Control Average	94±170

\- No result because the sampling station was not in operation.
(1) Sample was not received due to sampler malfunction.
(2) Sampling was initiated on 5-03-81.
(3) Sampling period was 6-21-81 to 6-29-81.
(4) Sampling period was 6-29-81 to 7-05-81.
(5) Sampling was initiated on 3-01-81.
(6) Sample collection missed on 6-24-81; data represents a two week period.

TABLE C-14

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-2S2									
12-28-80 to 3-29-81	48±12	<0.8	50±5	25±3	9.6±2.0	<14	<1.3	6.2±1.7	20±6
3-29-81 to 6-29-81	88±17	<1.8	86±9	37±5	12±3	27±14	4.4±1.4	5.8±2.6	86±12
6-29-81 to 9-27-81	90±16	<1.5	12±2	4.6±1.8	<2.2	<17	<3.4	<1.9	22±6
9-27-81 to 1-03-82	32±14	<1.4	<1.7	<2.5	<1.7	<10	<1.2	<1.6	<5.7
Average	65±58	-	37±77	17±33	-	-	-	-	33±72
SS-APT-5S4									
12-28-80 to 3-29-81	62±16	<1.6	49±5	21±3	12±2	<19	<2.0	7.0±2.1	18±8
3-29-81 to 6-28-81	81±19	<2.2	83±8	39±5	14±3	<27	3.6±1.9	5.8±2.3	71±10
6-28-81 to 9-27-81	100±14	<1.3	15±2	7.3±1.9	<1.8	<15	2.5±1.0	<2.1	28±6
9-27-81 to 1-03-82	50±11	<1.1	<1.7	<2.1	<1.2	<11	<1.1	<2.1	<7.0
Average	73±44	-	37±73	17±33	-	-	-	-	31±56

TABLE C-14 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF
AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-11S2									
12-28-80 to 3-29-81	45±11	<1.0	46±5	21±3	10±2	<13	<1.4	6.5±1.3	15±4
3-29-81 to 6-28-81	90±23	<2.0	100±10	42±5	12±3	<37	4.5±1.7	6.7±2.8	83±11
6-28-81 to 9-27-81	91±14	<1.1	12±2	4.7±1.5	<1.7	<14	<1.5	<2.6	19±7
9-27-81 to 1-03-82	41±14	<1.5	<2.2	<3.0	<1.9	<15	<1.5	<3.2	<10
Average	67±55	-	40±88	18±36	-	-	-	-	32±69
SS-APT-15S4									
5-03-81 to 6-28-81	130±33	<3.7	98±10	47±7	10±4	<43	4.4±2.5	11±4	83±17
6-28-81 to 9-27-81	120±15	<1.2	14±2	6.4±1.7	<1.6	<26	<1.5	<1.9	25±7
9-27-81 to 1-03-82	38±10	<0.9	<1.5	<1.9	<1.0	<6.8	<0.9	<1.4	<4.6
Average	96±101	-	38±105	18±50	-	-	-	-	38±81

TABLE C-14 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-9B1									
12-28-80 to 3-29-81	60±13	<1.0	42±4	24±3	13±2	<12	<1.6	3.5±1.6	15±5
3-29-81 to 6-29-81	80±21	2.1±1.4	91±9	37±5	16±3	<31	4.1±2.0	5.1±2.6	78±12
6-29-81 to 9-27-81	92±16	<1.3	12±2	7.0±2.1	<1.6	<15	<1.4	<1.7	24±5
9-27-81 to 1-03-82	48±16	<1.6	<2.3	<3.3	<2.0	<14	<1.5	<3.1	<10
Average	70±39	-	37±80	18±31	-	-	-	-	32±63
SS-APT-102									
12-28-80 to 3-29-81	52±15	<1.3	37±4	20±3	9.6±1.3	<14	<1.5	5.5±1.6	16±5
3-29-81 to 6-29-81	86±22	<1.8	87±9	35±4	11±3	22±12	4.6±1.4	4.6±2.2	73±10
6-29-81 to 9-27-81	110±15	<1.2	13±2	4.1±2.0	<2.0	<17	1.6±1.0	<2.1	24±7
9-27-81 to 1-03-82	<20	<0.9	<1.3	<1.9	<1.2	<6.8	<1.0	<2.4	<8.9
Average	67±79	-	35±76	15±31	-	-	-	-	30±58

TABLE C-14 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-3D1									
12-28-80 to 3-29-81	47±13	<1.2	37±4	18±3	9.2±1.9	<14	<1.5	5.9±2.7	<16
3-29-81 to 6-28-81	94±17	1.6±0.8	78±8	34±4	11±2	24±11	3.6±1.3	4.8±2.6	71±10
6-28-81 to 9-27-81	63±13	<1.3	7.5±1.5	3.5±1.7	<2.0	<16	<1.2	<2.9	15±7
9-27-81 to 1-03-82	31±11	<0.8	<1.5	<2.3	<1.2	<10	<1.1	<2.1	<7.4
Average	59±54	-	31±70	14±30	-	-	-	-	-
SS-APT-12E1									
12-28-80 to 3-29-81	46±14	<1.0	39±4	23±3	12±2	<15	<1.2	7.1±1.5	16±5
3-29-81 to 6-28-81	66±17	<1.8	83±8	38±5	9.9±3.0	<23	3.9±1.4	7.1±1.8	71±8
6-28-81 to 9-27-81	100±17	<1.6	11±2	5.4±2.3	<2.0	<17	2.3±1.1	<2.7	25±3
9-27-81 to 1-03-81	42±10	<0.8	<1.0	<2.1	<1.1	<8.1	<0.8	<2.4	<8.6
Average	64±53	-	34±73	17±33	-	-	-	-	30±56

TABLE C-14 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-7G1									
12-28-80 to 3-29-81	97±33	<3.8	97±10	49±7	17±5	<39	<4.6	13±4	34±18
3-29-81 to 6-28-81	78±24	<2.6	91±9	38±5	11±3	<25	3.4±1.6	5.7±2.9	78±12
6-28-81 to 9-27-81	89±13	<1.2	12±2	5.5±1.7	<1.7	<14	1.8±1.0	<1.4	20±5
9-27-81 to 1-03-82	49±14	<1.3	<1.7	<2.4	<1.7	<14	<1.6	<2.5	<8.5
Average	78±42	-	50±101	24±47	-	-	-	-	35±61
SS-APT-12G1									
12-28-80 to 3-29-81	40±12	<1.0	36±4	20±3	12±2	<13	<1.3	7.3±1.5	14±4
3-29-81 to 6-29-81	83±24	<2.0	88±9	38±5	12±3	<28	3.9±1.8	5.8±2.7	68±12
6-29-81 to 9-27-81	70±16	<1.2	10±2	6.6±2.0	<2.1	<12	2.5±1.2	<3.4	<14
9-27-81 to 1-03-82	27±15	<2.1	<3.0	<4.1	<2.9	<22	<2.1	<4.5	<14
Average	55±52	-	34±77	17±31	-	-	-	-	-

TABLE C-14 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF
AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. AND DATE	Be-7	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Cs-137	Ce-141	Ce-144
SS-APT-7H1									
12-30-80 to 3-31-81	53±11	<1.2	49±5	25±3	9.5±1.6	<14	<1.3	7.9±1.6	20±6
3-31-81 to 7-02-81	54±15	<2.4	74±7	31±4	9.9±2.1	22±12	4.1±2.0	5.4±1.7	65±7
7-02-81 to 9-28-81	110±14	<1.3	12±2	5.5±1.4	<1.6	<14	2.1±0.9	<2.1	28±8
9-28-81 to 1-04-82	46±10	<0.7	<1.1	<1.6	<1.4	<10	<1.2	<2.8	<9.0
Average	66±59	-	34±67	16±29	-	-	-	-	31±49
SS-APT-50SQ									
12-28-80 to 3-29-81	80±23	<1.6	75±8	39±5	16±3	<20	<2.1	12±2	25±6
3-29-81 to 6-28-81	81±22	<1.9	91±9	39±4	11±2	<27	4.8±1.3	5.7±2.4	73±11
6-28-81 to 9-27-81	96±13	<1.0	12±2	3.8±1.3	<1.2	<10	1.4±0.8	<2.0	19±6
9-27-81 to 1-03-82	51±11	<1.1	<1.2	<1.9	<1.3	<9.8	<1.1	<2.0	<6.6
Average	77±38	-	45±90	21±42	-	-	-	-	31±58

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-15

CONCENTRATIONS OF ALPHA EMITTERS, STRONTIUM-89* AND -90 IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

STATION NO. RADIOACTIVITY	JANUARY TO MARCH	APRIL TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	YEARLY AVERAGE
SS-APT-2S2					
Alpha	2.6±0.6	4.5±1.4	3.1±0.5	2.3±0.4	3.1±2.0
Sr-89	4.9±1.0	6.0±1.1	1.3±0.4	<0.3	3.1±5.5
Sr-90	<0.8	1.1±0.5	0.9±0.2	<0.2	0.8±0.8
SS-APT-5S4					
Alpha	4.9±0.9	2.1±0.6	3.3±0.5	2.5±0.4	3.2±2.5
Sr-89	5.6±0.6	5.6±0.9	<0.8	<0.3	3.1±5.9
Sr-90	<0.5	1.7±0.5	0.9±0.3	<0.2	0.8±1.3
SS-APT-11S2					
Alpha	2.8±0.6	2.8±0.8	3.2±0.5	1.9±0.4	2.7±1.1
Sr-89	4.7±1.0	6.3±0.9	1.1±0.4	<0.3	3.1±5.7
Sr-90	<0.8	1.3±0.4	0.4±0.2	<0.2	0.7±1.0
SS-APT-15S4					
Alpha	-	<0.6 (1)	3.4±0.5	2.3±0.4	2.1±2.8
Sr-89	-	5.6±1.2	0.5±0.4	<0.3	2.1±6.0
Sr-90	-	1.6±0.7	0.8±0.2	<0.1	0.8±1.5
SS-APT-5OSQ					
Alpha	4.6±0.8	2.0±0.6	3.1±0.4	2.5±0.4	3.1±2.3
Sr-89	6.3±0.9	6.0±0.8	0.9±0.3	<0.3	3.4±6.4
Sr-90	<0.4	1.4±0.4	0.3±0.2	0.1±0.1	0.6±1.2
SS-APT-9B1					
Alpha	2.4±0.5	2.2±0.6	3.6±0.5	2.3±0.4	2.6±1.3
Sr-89	5.5±0.8	6.2±0.9	6.0±0.4	<0.3	4.5±5.6
Sr-90	<0.7	1.6±0.4	0.6±0.2	<0.2	0.8±1.2
SS-APT-1D2					
Alpha	3.2±0.6	1.7±0.5	3.4±0.4	2.2±0.4	2.5±1.6
Sr-89	3.6±0.7	7.0±0.7	<0.5	<0.3	2.9±6.3
Sr-90	0.6±0.4	0.8±0.4	0.9±0.2	<0.1	0.6±0.7
SS-APT-3D1					
Alpha	4.0±0.7	2.4±0.6	2.2±0.4	1.4±0.3	2.5±2.2
Sr-89	4.8±0.6	5.4±0.8	<0.5	<0.3	2.8±5.5
Sr-90	<0.5	1.1±0.4	0.5±0.2	<0.2	0.6±0.8
SS-APT-12E1					
Alpha	2.8±0.6	2.1±0.6	2.9±0.5	2.6±0.4	2.6±0.7
Sr-89	5.8±0.8	6.5±1.0	1.0±0.4	<0.3	3.4±6.4
Sr-90	0.5±0.5	1.4±0.5	0.5±0.2	<0.2	0.7±1.0
SS-APT-7G1					
Alpha	1.4±0.7 (2)	1.5±0.5	2.8±0.4	2.2±0.4	2.0±1.3
Sr-89	9.6±1.6	5.8±0.8	0.8±0.4	0.2±0.2	4.1±8.9
Sr-90	<1.4	1.1±0.4	0.6±0.2	<0.2	0.8±1.1
SS-APT-12G1					
Alpha	3.2±0.6	1.7±0.6	2.6±0.5	1.2±0.3	2.2±1.8
Sr-89	5.0±0.8	4.5±1.0	<0.6	<0.4	2.6±4.9
Sr-90	0.6±0.4	1.4±0.5	0.5±0.2	<0.2	0.7±1.0
SS-APT-7H1					
Alpha	2.4±0.5	1.9±0.4	3.2±0.5	2.0±0.4	2.4±1.2
Sr-89	6.0±0.7	1.4±0.3	5.4±0.2	<0.3	3.3±5.7
Sr-90	<0.6	0.3±0.2	0.4±0.1	0.2±0.1	0.4±0.3

* Sr-89 results are corrected for decay to the sample stop date.
(1) Station SS-APT-15S4 began operation on 5-03-81; therefore, the second quarter composite contained only May and June samples.
(2) Station SS-APT-7G1 began operation on 3-01-81; therefore, the first quarter composite contained only the March sample.

TABLE C-16

CONCENTRATIONS OF IODINE-131* IN FILTERED AIR IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	SS-AIO 2S2	SS-AIO 5S4	SS-AIO 5OSQ	SS-AIO 11S2	SS-AIO 15S4	SS-AIO 9B1	SS-AIO 1D2	SS-AIO 3D1	SS-AIO 12E1	SS-AIO 7G1	SS-AIO 12G1
12-28-80	1-03-81	<12	<9.3	<9.3	<7.1	-	<9.3	-	-	<10	-	-
1-03-81	1-11-81	<8.8	<	<7.7	<7.2	-	<7.7	-	-	(1)	-	-
1-11-81	1-18-81	<73 (2)	<21	<10	<11	-	<8.7	-	-	<9.9	-	-
1-18-81	1-25-81	<8.1	<7.6	<6.3	<6.7	-	<8.6	-	-	<6.6	-	-
1-25-81	2-01-81	<8.3	<9.8	<8.2	<7.0	-	<5.6	-	-	<9.0	-	-
2-01-81	2-08-81	<8.4	<7.5	<8.1	<5.7	-	<6.6	-	-	<5.8	-	-
2-08-81	2-15-81	<8.6	<11	<7.0	<7.1	-	<6.9	-	-	<7.3	-	-
2-15-81	2-22-81	<7.9	<9.6	<8.0	<6.3	-	<7.0	-	-	<6.7	-	-
2-22-81	3-01-81	<7.2	<12	<6.1	<6.1	-	<5.8	-	-	<5.9	-	-
3-01-81	3-08-81	<9.1	<9.5	<6.4	<7.0	-	<5.8	<6.7 (3)	<7.9 (3)	<6.3	<6.9 (3)	<6.9 (3)
3-08-81	3-15-81	<8.6	<8.0	<6.2	<6.4	-	<6.4	<6.5	<6.2	<6.0	<6.4	<6.4
3-15-81	3-22-81	<7.5	<13	<5.9	<6.1	-	<6.1	<6.0	<6.8	<5.8	<6.2	<6.6
3-22-81	3-29-81	<8.2	<8.3	<8.2	<7.8	-	<8.7	<7.7	<7.6	<7.0	<7.5	<9.5
3-29-81	4-04-81	<11	<11	<11	<8.6	-	<10	<9.4	<10	<9.4	<9.2	<10
4-04-81	4-12-81	<6.7	<7.0	<6.0	<6.2	-	<5.7	<5.4	<6.1	<5.0	<6.2	<6.0
4-12-81	4-19-81	<9.0	<8.8	<8.1	<7.2	-	<7.5	<11	<10	<6.7	<6.1	<5.5
4-19-81	4-26-81	<7.5	<9.0	<7.6	<8.5	-	<7.5	<6.9	<7.7	<8.0	<9.3	(1)
4-26-81	5-03-81	<11	<7.2	<5.9	<6.8	-	<6.0	<5.6	<6.4	<4.0	<14	<9.5
5-03-81	5-10-81	<6.8	<8.6	<4.7	<7.3	<8.9 (4)	<7.3	<5.3	<4.6	<5.7	(1)	<12
5-10-81	5-17-81	<6.9	<7.7	<5.6	<7.6	<7.9	<6.9	<3.7	<6.0	<4.4	<6.9	<11
5-17-81	5-25-81	<5.8	<6.0	<7.0	<6.3	<7.0	<5.9	<5.0	<5.5	<6.0	<9.2	<8.4
5-25-81	5-31-81	<9.6	<7.2	<10	<9.1	<10	<8.8	<7.9	<7.0	<5.6	<9.1	<11
5-31-81	6-07-81	<7.4	<5.7	<8.2	<7.4	<5.4	<6.9	<4.8	<5.0	<7.1	<7.9	<9.4
6-07-81	6-14-81	<9.1	<6.8	<8.9	<8.1	<6.8	<7.3	<5.8	<7.1	<11	<7.2	<9.5
6-14-81	6-21-81	<8.0	<5.9	<8.5	<8.3	<5.1	<8.2	<5.1	<6.2	<4.9	<6.7	<11
6-21-81	6-28-81	<7.5 (5)	<11	<15	<9.3	<7.1	<6.2 (5)	<4.2 (5)	<6.2	<7.3	<13	<9.9 (5)

TABLE C-16 (cont.)

CONCENTRATIONS OF IODINE-131* IN FILTERED AIR IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	SS-AIO 2S2	SS-AIO 5S4	SS-AIO 5OSQ	SS-AIO 11S2	SS-AIO 15S4	SS-AIO 9B1	SS-AIO 1D2	SS-AIO 3D1	SS-AIO 12E1	SS-AIO 7G1	SS-AIO 12G1
6-28-81	7-05-81	<13 (6)	<7.0	<9.2	<7.9	<5.1	<11 (6)	<7.3 (6)	<5.3	<6.2	<8.7	<16 (6)
7-05-81	7-12-81	<13	<5.1	<7.2	<7.1	<5.9	<7.2	<5.1	<5.5	<12	<11	<15
7-12-81	7-19-81	<9.9	<4.6	<7.3	<7.0	<5.3	<6.1	<4.3	<5.1	<12	<7.3	<11
7-19-81	7-26-81	<6.6	<5.9	<5.1	<5.5	<4.5	<5.3	<5.2	<5.3	<5.8	<4.5	<8.5
7-26-81	8-02-81	<7.8	<6.5	<3.6	<7.1	<5.3	<6.4	<4.6	<5.7	<6.0	<5.6	<9.1
8-02-81	8-09-81	<6.7	<4.9	<5.1	<7.1	<7.4	<6.4	<5.8	<6.1	<5.1	<5.0	<8.4
8-09-81	8-16-81	<6.9	<6.2	<4.9	<6.0	<4.9	<5.8	<5.1	<7.6	<5.0	<5.8	<11
8-16-81	8-23-81	<6.0	<4.8	<4.4	<5.4	<4.6	<4.8	<3.9	<5.2	<15	<5.0	<8.1
8-23-81	8-30-81	<6.8	<9.3	<5.7	<6.5	<5.5	<7.0	<5.5	<6.6	<5.2	<6.5	<9.9
8-30-81	9-06-81	<6.8	<7.3	<6.2	<6.0	<6.2	<8.4	<6.7	<6.6	<5.6	<5.4	<8.3
9-06-81	9-13-81	<8.2	<8.2	<7.7	<6.6	<5.2	<7.4	<5.1	<6.4	<4.5	<8.6	<15
9-13-81	9-20-81	<6.5	<6.6	<5.7	<7.0	<4.8	<6.9	<5.5	<9.9	<6.0	<4.9	<8.0
9-20-81	9-27-81	<7.5	<5.6	<4.1	<5.4	<4.5	<6.3	<5.4	<4.8	<6.8	<5.8	<8.2
9-27-81	10-04-81	<8.6	<5.8	<4.7	<6.2	<4.7	<6.7	<4.9	<6.6	<8.1	<5.4	<13
10-04-81	10-11-81	<7.9	<7.1	<6.2	<5.9	<5.6	<7.9	<6.1	<5.2	<17	<6.6	<17
10-11-81	10-18-81	<6.4	<6.7	<5.9	<6.6	<5.5	<7.0	<5.5	<6.6	<8.0	<7.5	<13
10-18-81	10-25-81	<7.5	<5.3	<5.5	<6.5	<5.2	<6.6	<5.6	<6.2	<10	<5.1	<13
10-25-81	11-01-81	<6.0	<5.0	<3.0	<5.8	<5.5	<6.6	<5.7	<6.7	<4.3	<5.4	<6.9
11-01-81	11-09-81	<5.7	<5.0	<4.3	<5.3	<4.6	<5.7	<4.4	<5.2	<3.7	<5.1	<6.9
11-09-81	11-15-81	<7.8	<6.5	<5.9	<7.1	<5.9	<7.8	<5.6	<7.1	<5.0	<6.2	<16
11-15-81	11-22-81	<7.1	<5.4	<8.3	<5.8	<5.7	<6.1	<6.0	<6.9	<7.0	<6.9	<8.6
11-22-81	11-29-81	<7.3	<6.3	<6.9	<5.5	<5.2	<6.4	<5.5	<7.4	<4.7	<6.6	<18
11-29-81	12-06-81	<6.2	<6.0	<7.5	<4.8	<4.9	<6.1	<5.4	<4.7	<4.5	<7.6	<8.4
12-06-81	12-13-81	<6.4	<5.9	<5.5	<5.0	<5.0	<5.7	<5.1	<4.6	<4.5	<6.1	<8.3
12-13-81	12-20-81	<5.1	<4.6	<4.2	<6.5	<5.1	<6.1	<6.2	<4.6	<5.1	<6.0	<9.9
12-20-81	12-28-81	<4.6	<4.7	<5.4	<3.9	<3.7	<4.3	<4.0	<3.3	<3.4	<6.3	<7.8
12-28-81	1-03-82	<7.2	<5.8	<6.3	<5.8	<5.5	<5.9	<5.9	<4.5	<5.6	<6.6	<7.1

TABLE C-16 (cont.)

CONCENTRATIONS OF IODINE-131* IN FILTERED AIR IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of 10^{-3} pCi/m^3 ± 2 sigma

START DATE	STOP DATE	SS-AIO-7H1	START DATE	STOP DATE	SS-AIO-7H1
12-30-80	1-05-81	<6.8	7-02-81	7-08-81	<6.6
1-05-81	1-12-81	<6.7	7-08-81	7-15-81	<4.8
1-12-81	1-19-81	<14	7-15-81	7-22-81	<5.2
1-19-81	1-27-81	<6.8	7-22-81	7-29-81	<4.4
1-27-81	2-03-81	<5.1	7-29-81	8-05-81	<5.5
2-03-81	2-10-81	<4.7	8-05-81	8-12-81	<3.5
2-10-81	2-17-81	<5.7	8-12-81	8-19-81	<3.8
2-17-81	2-24-81	<6.6	8-19-81	8-28-81	<5.0
2-24-81	3-03-81	<6.5	8-28-81	9-04-81	<5.6
3-03-81	3-10-81	<4.4	9-04-81	9-10-81	<9.4
3-10-81	3-17-81	<5.7	9-10-81	9-16-81	<4.7
3-17-81	3-24-81	<7.8	9-16-81	9-22-81	<5.6
3-24-81	3-31-81	<4.9	9-22-81	9-28-81	<6.0
3-31-81	4-07-81	<4.8	9-28-81	10-05-81	<5.5
4-07-81	4-15-81	<3.3	10-05-81	10-12-81	<5.2
4-15-81	4-21-81	<5.3	10-12-81	10-17-81	<9.6
4-21-81	4-28-81	<6.2	10-17-81	10-25-81	<9.0
4-28-81	5-05-81	<4.5	10-25-81	10-31-81	<7.4
5-05-81	5-12-81	<4.4	10-31-81	11-08-81	<5.4
5-12-81	5-18-81	<4.2	11-08-81	11-14-81	<6.4
5-18-81	5-27-81	<3.1	11-14-81	11-23-81	<6.8
5-27-81	6-03-81	<3.4	11-23-81	11-30-81	<5.1
6-03-81	6-10-81	<5.5	11-30-81	12-05-81	<15
6-10-81	6-16-81	<4.7	12-05-81	12-14-81	<4.0
6-16-81	7-02-81	<3.4 (7)	12-14-81	12-21-81	<7.0
			12-21-81	12-28-81	<5.3
			12-28-81	1-04-82	<7.8

* Iodine results are decay corrected to sample stop date.
\- No result because sampling station was not in operation.
(1) Sample was not received due to sampler malfunction.
(2) High LLD due to low sample volume.
(3) Sampling was initiated on 3-01-81.
(4) Sampling was initiated on 5-03-81.
(5) Sampling period was 6-21-81 to 6-29-81.
(6) Sampling period was 6-29-81 to 7-05-81.
(7) Sample collection missed on 6-24-81; data represents a two week period.

TABLE C-17

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS* IN PRECIPITATION SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	FEBRUARY	MARCH	APRIL** TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	YEARLY AVERAGE
SS-RWA-5S4						
Tritium	<211	227±66	184±110	<193	<219	-
Gamma Emitters						
Be-7	24±9	35±6	10±4	21±5	11±5	20±21
Zr-95	<2.3	9.6±1.1	<1.6	<1.3	<1.1	-
Nb-95	3.4±1.0	21±2	3.2±0.6	<0.9	<0.8	6±17
Ru-103	4.5±1.0	9.4±1.0	1.6±0.6	<0.9	<0.7	3.4±7.3
Ru-106	<9.0	6.8±3.9	<5.5	<5.6	<5.0	-
Cs-137	<0.9	1.8±0.6	<1.0	<0.7	<0.6	-
Ce-141	4.2±1.6	6.2±0.9	<1.0	<1.4	<0.9	-
Ce-144	<5.5	15±3	6.8±2.2	4.7±2.8	<2.8	7.0±9.4
SS-RWA-11S2						
Tritium	(1)	233±66	267±120	151±120	<219	218±97
Gamma Emitters						
Be-7		48±8	15±7	24±5	<6.3	23±36
Zr-95		8.0±1.5	5.3±1.1	<1.2	<1.2	3.9±6.7
Nb-95		11±1	8.5±1.1	<0.8	<0.8	5.3±11
Ru-103		8.7±1.1	2.9±1.0	<0.8	<0.8	3.3±7.5
Ru-106		<8.8	<6.3	<4.9	<5.4	-
Cs-137		1.2±0.6	<0.7	<0.5	<0.7	-
Ce-141		5.0±1.4	<2.5	<1.8	<1.2	-
Ce-144		12±4	<5.1	<5.4	<4.1	-
SS-RWA-1D2						
Tritium	<211	215±66	<183	<193	<219	-
Gamma Emitters						
Be-7	27±5	55±7	24±5	22±6	19±6	29±29
Zr-95	3.9±1.0	13±1	3.0±0.7	<1.1	<1.6	4.5±9.7
Nb-95	5.5±0.8	13±1	2.8±0.5	<0.9	<1.1	5±10
Ru-103	7.2±0.8	10±1	1.7±0.6	<0.8	<1.0	4.1±8.4
Ru-106	<5.6	<8.5	<5.4	<5.5	<8.2	-
Cs-137	<0.6	<0.9	0.8±0.4	<0.6	<0.9	-
Ce-141	2.7±1.2	5.5±1.3	<1.8	<1.0	<1.8	-
Ce-144	<4.8	12±4	6.0±3.3	<3.3	<6.2	-

TABLE C-17 (cont.)

CONCENTRATIONS OF TRITIUM AND GAMMA EMITTERS* IN PRECIPITATION SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	FEBRUARY	MARCH	APRIL** TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	YEARLY AVERAGE
SS-RWA-12G2						
Tritium	(1)	142±97	127±110	<193	<219	170±86
Gamma Emitters						
Be-7		56±7	23±5	34±6	21±6	34±32
Zr-95		11±1	2.7±0.8	<1.3	<1.9	4.2±9.1
Nb-95		10±1	2.4±0.5	<1.0	<1.2	3.7±8.6
Ru-103		9.3±1.0	2.2±0.6	<1.0	<1.1	3.4±7.9
Ru-106		<8.8	<6.2	<5.9	<8.4	-
Cs-137		1.0±0.5	<0.7	<0.7	<0.9	-
Ce-141		6.8±1.3	1.2±0.7	<1.4	<1.7	-
Ce-144		16±4	8.3±2.2	4.9±2.9	<5.7	8.7±10

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

** Beginning in April 1981, tritium and gamma analyses of precipitation were performed on quarterly composite samples.

(1) No precipitation samples were collected because of weather conditions.

TABLE C-18

CONCENTRATIONS OF IODINE-131* IN MILK IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-MLK-12B2	<0.1	<0.1	<0.1	<0.1 <0.1	<0.1 <0.1	<0.08 <0.09
SS-MLK-12B3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.09
SS-MLK-6C1	<0.1	<0.07	<0.1	<0.1	<0.2	<0.08
SS-MLK-10D1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.09
SS-MLK-12D2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.09
SS-MLK-5E1	<0.1	<0.1	<0.09	<0.1 <0.1	<0.1 <0.1	<0.08 <0.1
SS-MLK-13E3	<0.09	<0.09	<0.1	<0.1 <0.1	<0.1 <0.1	<0.08 <0.1
SS-MLK-10G1	<0.1	<0.1	<0.1	<0.2 <0.1	<0.1 <0.2	<0.09 <0.1
SS-GMK-7C1	-	-	-	-	-	<0.4 (1)
SS-GMK-8D1	(2)	(2)	(2)	<0.2	<0.2	<0.2

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SS-MLK-12B2	<0.1 <0.1	<0.1 <0.09	<0.08 <0.1	<0.09	<0.09	<0.1
SS-MLK-12B3	<0.1	<0.1	<0.08	<0.08	<0.09	<0.1
SS-MLK-6C1	<0.09	<0.1	<0.09	<0.09	<0.09	<0.09
SS-MLK-10D1	<0.1	<0.1	<0.1	<0.09	<0.1	<0.08
SS-MLK-12D2	<0.1	<0.08	<0.09	<0.1	<0.1	<0.1
SS-MLK-5E1	<0.1 <0.1	<0.09 <0.1	<0.1 <0.1	<0.08	<0.1	<0.1
SS-MLK-13E3	<0.1 <0.09	<0.09 <0.1	<0.1 <0.1	<0.09	<0.08	<0.1
SS-MLK-10G1	<0.1 <0.1	<0.1 <0.1	<0.1 <0.1	<0.1	<0.08	<0.1
SS-GMK-7C1	(3)	<0.9	(3)	<0.5	<0.6	<1.8
SS-GMK-8D1	(3)	<0.1	<0.1	<0.2	<0.2	<0.2

* Iodine-131 results are corrected for decay to the sample stop date.
\- No result because the sampling station was not in operation.
(1) Station SS-GMK-7C1 was initiated on June 22, 1981.
(2) Milk was not available January through March because the goat was dry.
(3) Goat milk was not available; therefore, pasture grass was sampled.

TABLE C-19

CONCENTRATIONS OF GAMMA EMITTERS* IN MILK IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION MONTH	SS-MLK-12B2 K-40	 Cs-137	SS-MLK-12B3 K-40	 Cs-137	SS-MLK-6C1 K-40	 Cs-137	SS-MLK-10D1 K-40	 Cs-137
JANUARY	1400±140	1.5±0.9	1500±150	2.6±0.9	1600±160	1.9±0.9	1400±140	2.7±0.9
FEBRUARY	1400±140	<1.1	1400±140	3.1±0.9	1400±140	1.4±0.8	1400±140	2.4±0.8
MARCH	1400±140	1.5±0.7	1400±140	2.7±0.9	1500±150	1.8±0.9	1500±150	2.1±1.0
APRIL	1500±150 1400±140	1.9±1.0 1.6±0.8	1300±130	4.0±0.9	1500±150	1.9±0.9	1500±150	2.5±0.7
MAY	1400±140 1200±120	1.3±0.8 1.4±0.9	1400±140	4.9±1.0	1500±150	1.8±0.8	1400±140	2.3±0.7
JUNE	1400±140 1400±140	1.2±0.7 1.9±1.0	1400±140	7.7±1.0	1500±150	4.8±1.0	1500±150	1.9±0.9
JULY	1400±140 1300±130	1.9±0.9 1.8±0.8	1400±140	5.9±1.0	1400±140	4.6±1.1	1500±150	4.0±0.8
AUGUST	1300±130 1500±150	2.9±0.8 3.3±1.0	1300±130	6.5±1.0	1400±140	3.8±1.0	1400±140	2.9±1.0
SEPTEMBER	1500±150 1200±120	2.3±0.7 1.7±0.9	1300±130	5.2±1.0	1400±140	3.1±0.8	1500±150	2.7±1.0
OCTOBER	1500±150	2.4±1.0	1400±140	4.7±1.1	1600±160	3.0±1.0	1600±160	2.5±1.1
NOVEMBER	1600±160	<1.6	1700±170	3.5±0.8	1600±160	3.1±0.8	1600±160	2.6±1.0
DECEMBER	1600±160	1.6±1.0	1600±160	4.2±1.1	1600±160	2.6±0.8	1300±130	3.1±0.8
AVERAGE	1411±226	1.8±1.2	1425±243	4.6±3.1	1500±171	2.8±2.3	1467±178	2.6±1.1

TABLE C-19 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN MILK IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION	SS-MLK-12D2		SS-MLK-5E1		SS-MLK-13E3		SS-MLK-10G1	
MONTH	K-40	Cs-137	K-40	Cs-137	K-40	Cs-137	K-40	Cs-137
JANUARY	1700±170	<1.2	1500±150	2.1±0.7	1500±150	1.8±0.9	1400±140	3.6±0.9
FEBRUARY	1500±150	1.4±0.7	1500±150	2.4±0.7	1500±150	2.4±0.8	1400±140	9.6±1.0
MARCH	1500±150	<1.5	1400±140	3.8±1.0	1600±160	3.1±0.8	1500±150	3.7±1.0
APRIL			1400±140	2.1±1.0	1600±160	1.9±0.9	1500±150	3.7±0.9
	1400±140	1.5±0.7	1300±130	2.1±0.8	1400±140	2.1±0.8	1400±140	3.1±0.9
MAY			1300±130	2.9±0.9	1500±150	2.6±0.9	1400±140	3.6±1.1
	1500±150	<1.3	1100±110	6.8±1.0	1400±140	4.4±1.2	1400±140	3.3±1.0
JUNE			1500±150	4.2±0.9	1500±150	4.0±0.9	1400±140	5.8±1.0
	1300±130	4.2±1.1	1200±120	3.9±0.9	1500±150	4.5±0.8	1500±150	3.4±0.9
JULY			1400±140	4.3±1.1	1400±140	4.0±1.0	1400±140	2.8±1.0
	1500±150	2.1±0.8	1300±130	4.0±1.0	1400±140	3.2±0.9	1300±130	4.4±1.1
AUGUST			1400±140	2.7±0.8	1400±140	3.2±0.8	1300±130	2.4±0.9
	1400±140	2.1±1.0	1500±150	3.0±1.1	1500±150	3.1±0.8	1400±140	3.5±0.9
SEPTEMBER			1300±130	3.6±0.8	1400±140	2.4±0.8	1400±140	3.7±1.0
	1300±130	1.4±0.6	1200±120	1.8±0.8	1300±130	3.5±0.8	1400±140	2.7±0.8
OCTOBER	1600±160	2.0±0.7	1400±140	2.1±0.9	1500±150	3.0±1.0	1500±150	3.5±0.8
NOVEMBER	1600±160	<1.7	1600±160	2.6±0.7	1500±150	2.2±0.8	1500±150	3.6±0.9
DECEMBER	1600±160	2.3±0.8	1400±140	2.7±0.9	1400±140	1.7±1.0	1300±130	2.9±0.9
AVERAGE	1492±248	1.9±1.6	1372±253	3.2±2.4	1461±156	3.0±1.8	1411±135	3.8±3.3

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-20

CONCENTRATIONS OF STRONTIUM-89* AND -90 IN MILK
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SS-MLK-12B2						
Sr-89	<5.8	<19	4.6±3.3	<5.3	<4.6	<9.3
Sr-90	4.9±1.3	1.9±1.1	<2.4	3.3±1.5	3.8±0.9	1.9±0.9
SS-MLK-12B3						
Sr-89	<1.9	<2.0	<1.4	5.2±3.7	<8.1	<11
Sr-90	2.2±0.6	4.0±0.7	11±1	10±2	13±2	13±1
SS-MLK-6C1						
Sr-89	4.4±1.3	<11	<5.3	<4.0	<5.9	<15
Sr-90	1.4±0.6	4.4±0.7	4.7±1.7	4.9±1.2	6.9±1.3	6.0±1.5
SS-MLK-10D1						
Sr-89	<2.1	3.3±1.2	<5.7	<3.5	<4.7	<3.9
Sr-90	2.3±0.7	4.2±0.7	7.6±1.9	6.4±1.1	9.3±1.7	4.6±1.5
SS-MLK-12D2						
Sr-89	5.3±1.7	<2.2	<4.0	<2.7	<6.3	<7.5
Sr-90	2.2±0.8	2.3±0.9	3.4±1.2	2.1±0.8	2.9±2.0	9.2±2.7
SS-MLK-5E1						
Sr-89	<2.6	<14	<3.5	<3.5	<7.2	<15
Sr-90	1.9±0.8	4.6±1.0	7.7±1.3	7.0±1.1	5.7±2.3	8.7±5.3
SS-MLK-13E3						
Sr-89	<56	3.8±1.0	<2.5	<3.5	<6.4	<4.4
Sr-90	3.5±0.9	2.1±0.6	6.3±1.0	4.7±1.1	6.2±2.1	5.0±1.6
SS-MLK-10G1						
Sr-89	<83	4.5±1.4	<4.0	<5.3	<6.0	<11
Sr-90	7.5±1.3	4.6±0.8	7.6±1.6	9.4±1.6	9.9±2.0	7.9±1.1

TABLE C-20 (cont.)

CONCENTRATIONS OF STRONTIUM-89* AND -90 IN MILK
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/l ± 2 sigma

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVERAGE
SS-MLK-12B2							
Sr-89	<1.7	1.3±0.9	<1.8	<1.9	<1.8	<1.5	-
S -90	1.3±0.6	1.5±0.6	3.0±0.7	2.1±0.8	2.5±0.7	1.6±0.6	2.5±2.1
SS-MLK-12B3							
Sr-89	<9.0	3.2±1.7	2.9±2.1	<4.4	<2.0	<3.0	-
Sr-90	10±3	7.8±1.1	9.2±1.3	9.3±1.6	6.9±0.8	9.1±1.2	8.8±6.5
SS-MLK-6C1							
Sr-89	3.2±2.2	<7.1	<3.6	<2.2	<2.7	<2.8	-
Sr-90	6.7±1.3	7.2±1.4	7.5±1.4	3.8±0.9	7.7±1.1	6.0±1.0	5.6±3.7
SS-MLK-10D1							
Sr-89	<3.7	2.1±1.8	<6.1	<2.4	<2.6	2.8±2.1	-
Sr-90	6.3±1.4	5.5±1.1	9.4±2.2	5.7±1.0	4.3±0.9	6.7±1.2	6.0±4.2
SS-MLK-12D2							
Sr-89	<1.7	<1.9	<2.1	<1.9	<7.8	<3.6	-
Sr-90	1.6±0.6	1.9±0.7	2.5±0.8	2.2±0.8	3.7±1.7	2.9±1.2	3.1±4.0
SS-MLK-5E1							
Sr-89	4.1±1.7	<2.0	<4.2	2.9±2.7	<18	<2.5	-
Sr-90	3.3±1.0	4.6±0.8	8.2±1.6	4.2±1.6	7.6±3.7	5.8±0.9	5.8±4.2
SS-MLK-13E3							
Sr-89	1.7±1.3	<2.4	<3.8	<2.4	<5.4	<3.0	-
Sr-90	2.9±0.8	5.4±1.0	6.3±1.4	4.4±1.0	7.3±1.3	6.3±1.1	5.0±3.2
SS-MLK-10G1							
Sr-89	<27	<3.4	<3.4	1.9±1.6	<4.5	<3.5	-
Sr-90	6.9±1.1	6.9±1.3	7.9±1.3	5.9±1.0	8.5±1.6	9.2±1.4	7.7±3.0

* Sr-89 results are decay corrected to sample stop date.

TABLE C-21

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN FISH FLESH
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NUMBER	SAMPLE TYPE	SAMPLE DATE	K-40	Cs-137	Sr-89	Sr-90
SS-AQF-INDICATOR	White Sucker	4-01-81	3.2±0.3	<0.01	<0.009	<0.004
	Walleye	4-01-81	3.2±0.3	0.009±0.005	<0.01	<0.005
	Channel Catfish	4-01-81 to 4-02-81	3.1±0.3	0.015±0.005	<0.009	<0.005
	White Sucker	9-11-81	3.7±0.4	0.011±0.005	<0.008	<0.003
	Walleye	9-11-81	3.7±0.4	0.010±0.005	<0.006	0.002±0.002
	Channel Catfish	9-11-81 to 9-15-81	3.1±0.3	0.013±0.005	<0.006	<0.003
SS-AQF-2H***	White Sucker	4-06-81	3.4±0.3	0.011±0.004	<0.006	<0.003
	Walleye	4-06-81	3.2±0.3	0.012±0.004	<0.01	<0.006
	Channel Catfish	4-06-81 to 4-07-81	3.2±0.3	0.014±0.005	<0.007	<0.003
	White Sucker	9-09-81	3.3±0.3	0.009±0.005	<0.006	<0.003
	Walleye	9-09-81	3.5±0.4	0.016±0.006	<0.006	0.002±0.002
	Channel Catfish	9-09-81 to 9-10-81	3.5±0.4	<0.01	<0.007	0.007±0.002
		Average	3.3±0.4	0.012±0.005	-	-

* All other gamma emitters searched for were <LLD; typical LLDs are found)n Table C-29.
** Sr-89 results are decay corrected to sample stop date.
*** Station code is omitted because no exact sampling locations exist; samples are taken based on availability.

TABLE C-22

CONCENTRATIONS OF GAMMA EMITTERS* IN VARIOUS FOOD PRODUCTS
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	Be-7	K-40	Nb-95	Cs-137
SS-FPF-7B2	9-03-81	Apples	<0.05	0.72±0.07	<0.008	<0.005
SS-FPH-7B2	9-03-81	Honey	<0.3	1.0±0.4	<0.04	0.07±0.02
SS-FPF-12B1	9-03-81	Apples	<0.04	0.85±0.09	<0.006	0.004±0.002
SS-FPG-12B1	9-03-81	Corn	<0.09	2.4±0.2	<0.01	<0.008
SS-FPL-11D1	9-03-81	Cabbage	<0.2	3.3±0.4	<0.03	<0.03
SS-FPV-11D1	9-03-81	Cantalopes	<0.03	2.8±0.3	<0.005	<0.03
SS-FPG-11D1	9-03-81	Corn	<0.1	2.4±0.2	<0.02	<0.01
SS-FPV-11D1	9-03-81	Potatoes	<0.07	3.5±0.4	<0.01	<0.007
SS-FPV-11D1	9-03-81	Squash	<0.05	3.6±0.4	<0.007	<0.004
SS-FPV-11D1	9-03-81	Tomatoes	<0.04	2.3±0.2	<0.006	<0.003
SS-FPV-12F5	9-03-81	Strawberry Plant	1.6±0.6	10±1	0.10±0.06	<0.09
SS-FPL-2H1	9-04-81	Cabbage	<0.4	3.9±0.7	<0.05	<0.04
SS-FPG-2H1	9-04-81	Corn	<0.08	2.6±0.3	<0.01	<0.007
SS-FPV-2H1	9-04-81	Squash	<0.07	2.9±0.3	0.01	<0.006
SS-FPV-2H1	9-04-81	Tomatoes	<0.03	1.9±0.2	<0.004	<0.003
SS-FPV-2H1	9-04-81	Potatoes	<0.05	4.3±0.4	<0.008	<0.004

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-23

CONCENTRATIONS OF GAMMA EMITTERS* IN MEAT SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	K-40
SS-FPE-12B1	12-19-81	Eggs	0.93±0.09
SS-FPP-12B1	12-19-81	Chicken	2.1±0.2
SS-FPD-10D1	12-19-81	Duck	2.9±0.3

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-24

CONCENTRATIONS OF GAMMA EMITTERS* IN GAME SAMPLES
IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	K-40	Cs-137
SS-GAS-Indicator**	12-29-81 to 12-30-81	Squirrel	2.7±0.3	1.5±0.2
SS-GAD-16B***	11-30-81	Deer Flesh	2.5±0.3	0.10±0.01

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.
** Indicator stations are 1A, 2A and 15A.
*** Station code is omitted because no exact station exists; samples are taken based on availability.

TABLE C-25

CONCENTRATIONS OF GAMMA EMITTERS* IN VEGETATION IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	Be-7	K-40	Zr-95	Nb-95	Ce-144
SS-VGT-7S4	8-05-81	Vegetation	<1.3	7.9±2.1	<0.3	0.4±0.1	<0.9
SS-VGT-8S3	8-05-81	Vegetation	1.7±0.5	8.1±1.2	0.18±0.07	0.37±0.06	0.5±0.2

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-26

CONCENTRATIONS OF GAMMA EMITTERS* IN PASTURE GRASS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(wet) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	Be-7	K-40	Zr-95	Nb-95	Ru-103	Cs-137	Ce-141	Ce-144
SS-PAS-15A1	1-31-81 (1)	Grass								
SS-PAS-15A1	2-28-81 (1)	Grass								
SS-PAS-15A1	3-29-81 (1)	Grass								
SS-PAS-15A1	4-10-81	Grass	12±1	17±2	4.2±0.4	8.4±0.8	1.5±0.2	0.2±0.1	1.9±0.2	5.3±0.8
SS-PAS-15A1	5-08-81	Grass	<1.6	20±3	<0.4	0.7±0.2	<0.2	<0.2	<0.3	<1.1
SS-PAS-15A1	6-05-81	Grass	<1.3	13±2	0.4±0.2	0.7±0.1	<0.2	<0.2	<0.3	<1.0
SS-PAS-15A1	6-29-81	Grass	<1.1	16±2	<0.2	0.3±0.1	<0.1	<0.1	<0.3	<1.1
SS-PAS-15A1	8-05-81	Grass	<1.2	16±2	<0.3	<0.2	<0.1	<0.1	<0.2	<0.9
SS-PAS-15A1	9-04-81	Grass	3.1±0.7	6.8±1.3	<0.2	0.18±0.07	<0.1	<0.1	<0.2	<0.9
SS-PAS-15A1	10-09-81	Grass	1.8±0.2	3.7±0.5	<0.06	<0.04	<0.04	<0.03	<0.08	<0.3
SS-PAS-15A1	11-06-81	Grass	8.7±0.9	14±2	<0.2	<0.1	<0.1	<0.1	<0.2	<0.9
SS-PAS-15A1	12-04-81	Grass	10±1	6.3±0.9	<0.1	<0.1	<0.08	0.07±0.04	<0.1	<0.[illegible]
SS-PAS-7C1 (2)	6-30-81	Grass	<1.7	17±3	<0.4	0.5±0.1	<0.2	<0.2	<0.3	<1.3
SS-PAS-7C1 (2)	9-04-81	Grass	1.9±0.6	12±2	<0.2	0.31±0.08	<0.1	<0.1	<0.1	<0.4
SS-PAS-8D1 (2)	6-30-81	Grass	1.2±0.4	26±3	<0.1	0.26±0.07	<0.08	0.07±0.04	<0.2	<0.6

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.
\- Indicates that no LLD was calculated for that nuclide in that media.
(1) No sample was collected due to snow cover.
(2) Pasture grass is sampled from SS-PAS-7C1 and SS-PAS-8D1 during the months milk is not collected.

TABLE C-27

CONCENTRATIONS OF GAMMA EMITTERS* IN SOIL SAMPLES IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of pCi/g(dry) ± 2 sigma

STATION NO.	SAMPLE DATE	DESCRIPTION	K-40	Nb-95	Cs-137	Ra-226	Th-232
SS-SOL-2S4	8-17-81	Topsoil	9.9±1.0	0.16±0.03	0.17±0.03	0.64±0.06	0.94±0.09
		Subsoil	9.3±0.9	<0.06	0.18±0.03	0.68±0.07	0.78±0.09
SS-SOL-5S5	8-17-81	Topsoil	8.3±0.8	0.20±0.04	0.31±0.04	0.67±0.07	0.8±0.1
		Subsoil	8.8±0.9	0.12±0.04	0.26±0.03	0.73±0.07	0.80±0.08
SS-SOL-11S4	8-17-81	Topsoil	9.7±1.0	0.11±0.04	1.2±0.1	0.50±0.06	0.64±0.09
		Subsoil	8.9±0.9	0.08±0.03	0.79±0.08	0.49±0.05	0.51±0.07
SS-SOL-15S4	8-17-81	Topsoil	9.8±1.0	0.24±0.03	0.20±0.03	0.77±0.08	0.89±0.09
		Subsoil	8.7±0.9	0.13±0.03	0.14±0.03	0.85±0.09	1.0±0.1
SS-SOL-9B2	8-17-81	Topsoil	10±1	0.14±0.03	0.47±0.05	0.58±0.06	0.63±0.08
		Subsoil	8.7±0.9	0.12±0.04	0.68±0.07	0.58±0.06	0.6±0.1
SS-SOL-1D4	8-18-81	Topsoil	8.1±0.8	0.10±0.02	0.22±0.02	0.58±0.0[illegible]	0.77±0.08
		Subsoil	7.9±0.8	<0.06	0.18±0.03	0.60±0.0[illegible]	0.79±0.08
SS-SOL-3D2	8-18-81	Topsoil	9.3±0.9	0.34±0.05	1.4±0.1	1.6±0.2	1.9±0.2
		Subsoil	10±1	<0.1	2.2±0.2	2.7±0.3	2.9±0.3
SS-SOL-11D3	8-18-81	Topsoil	10±1	0.23±0.03	0.38±0.04	1.1±0.1	1.0±0.1
		Subsoil	10±1	<0.06	0.37±0.04	1.0±0.1	1.0±0.1
SS-SOL-11D4	8-18-81	Topsoil	9.6±1.0	0.19±0.04	0.34±0.03	0.75±0.08	0.8±0.1
		Subsoil	9.7±1.0	<0.06	0.33±0.03	0.85±0.09	0.77±0.09
SS-SOL-12E2	8-17-81	Topsoil	7.9±0.8	0.16±0.04	0.39±0.04	0.63±0.06	0.7±0.1
		Subsoil	8.0±0.8	<0.05	0.31±0.03	0.59±0.06	0.59±0.07
SS-SOL-12F4	8-18-81	Topsoil	11±1	0.22±0.03	0.30±0.04	0.73±0.07	0.69±0.08
		Subsoil	10±1	0.11±0.04	0.29±0.03	0.78±0.08	0.7±0.1
SS-SOL-12F5	8-18-81	Topsoil	8.5±0.9	0.22±0.03	0.31±0.03	0.59±0.06	0.55±0.08
		Subsoil	9.2±0.9	0.13±0.04	0.31±0.03	0.58±0.06	0.57±0.07
SS-SOL-7G1	8-18-81	Topsoil	8.1±1.0	0.35±0.05	2.2±0.2	0.83±0.09	1.1±0.1
		Subsoil	8.4±0.8	0.15±0.05	2.2±0.2	0.74±0.08	1.0±0.1
SS-SOL-12G3	8-18-81	Topsoil	10±1	0.22±0.06	0.26±0.04	0.86±0.09	0.9±0.1
		Subsoil	10±1	<0.08	0.19±0.03	0.92±0.09	1.1±0.1

* All other gamma emitters searched for were <LLD; typical LLDs are found on Table C-29.

TABLE C-28

RESULTS OF QUARTERLY TLD MEASUREMENTS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of mrem/standard month

STATION NO.	JANUARY TO MARCH	APRIL TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	ANNUAL AVERAGE
SS-IDM-1S2	6.45±0.80	5.99±0.60	6.56±0.95	7.16±0.76	6.54±0.96
SS-IDM-2S2	5.57±0.94	5.98±0.54	6.10±0.23	6.54±0.80	6.05±0.80
SS-IDM-2S3	6.06±0.10	6.47±0.41	6.78±0.37	6.91±0.98	6.56±0.76
SS-IDM-3S3	5.56±0.24	5.43±0.45	6.06±0.90	5.82±1.04	5.72±0.56
SS-IDM-3S4	6.00±0.26	5.95±0.39	6.14±0.58	6.46±0.88	6.14±0.46
SS-IDM-4S1	5.25±0.26	5.56±0.27	5.19±0.14	5.72±0.15	5.43±0.50
SS-IDM-4S3	7.15±0.50	6.16±0.15	6.26±0.92	6.77±0.94	6.59±0.92
SS-IDM-5S1	5.22±0.17	5.37±0.12	5.38±0.47	5.49±0.31	5.37±0.22
SS-IDM-5S4	5.91±0.50	5.81±0.99	6.10±0.49	6.85±0.36	6.17±0.94
SS-IDM-5S7	6.05±0.61	5.98±0.67	6.35±0.61	6.49±0.46	6.22±0.48
SS-IDM-6S4	12.63±1.19	7.90±1.02	10.65±0.18	10.37±1.36	10.39±3.88
SS-IDM-7S1	5.96±0.88	5.60±0.65	5.29±0.33	5.80±0.48	5.66±0.58
SS-IDM-7S3	9.02±1.08	5.82±0.43	7.80±1.01	8.46±0.71	7.78±2.79
SS-IDM-8S2	7.14±1.01	6.26±0.39	6.58±0.57	6.57±0.64	6.64±0.73
SS-IDM-9S1	6.38±0.80	6.00±0.63	5.52±0.31	6.28±0.80	6.05±0.77
SS-IDM-10S1	5.69±0.51	5.84±0.24	5.86±0.53	6.43±0.17	5.96±0.65
SS-IDM-11S2	5.71±0.31	5.58±0.41	5.84±0.41	5.24±0.75	5.59±0.52
SS-IDM-11S3	5.84±0.61	5.18±0.82	5.99±0.38	6.10±0.35	5.78±0.82
SS-IDM-12S3	7.04±0.41	6.83±0.38	7.59±0.47	7.47±1.05	7.23±0.71
SS-IDM-13S2	6.44±0.75	6.68±0.87	6.69±0.68	7.06±0.38	6.72±0.51
SS-IDM-14S2	6.20±0.35 (1)	-	-	-	6.20±0.35
SS-IDM-14S5	-	5.92±0.72	11.07±1.61	7.55±1.12	8.18±5.26
SS-IDM-15S3	6.52±1.01	6.53±0.69	8.06±0.28	7.64±0.72	7.19±1.57
SS-IDM-15S4	-	-	5.57±0.31 (2)	6.11±0.30	5.84±0.76
SS-IDM-16S1	6.50±0.58	6.79±0.90	7.22±0.48	7.20±0.59	6.93±0.69
SS-IDM-1A1	5.48±0.39	6.37±0.41	6.48±0.94	6.72±0.82	6.26±1.08
SS-IDM-6A3	5.68±1.08	6.46±0.53	6.69±0.81	6.74±0.68	6.39±0.98
SS-IDM-7A1	5.79±0.93	6.00±0.56	6.09±0.74	6.36±0.90	6.06±0.47
SS-IDM-11A2	4.40±0.20	4.57±0.31	5.62±0.66	5.97±0.43	5.14±1.55
SS-IDM-15A3	5.57±0.31	6.17±0.28	6.30±0.99	6.54±0.73	6.15±0.83
SS-IDM-16A2	4.70±0.24	5.80±0.40	5.85±0.38	6.34±1.08	5.67±1.39

TABLE C-28 (cont.)

RESULTS OF QUARTERLY TLD MEASUREMENTS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of mrem/standard month

STATION NO.	JANUARY TO MARCH	APRIL TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	ANNUAL AVERAGE
SS-IDM-2B3	5.44±0.32	5.87±0.31	6.85±0.46	6.71±0.98	6.22±1.35
SS-IDM-7B3	5.56±0.65	6.33±0.31	6.33±0.49	6.99±0.11	6.30±1.17
SS-IDM-8B1	5.03±1.14	6.05±0.40	5.72±0.59	6.41±0.54	5.80±1.17
SS-IDM-9B1	5.29±0.65	5.69±0.77	5.49±0.93	6.30±0.25	5.69±0.87
SS-IDM-10B2	4.52±0.63	4.65±1.10	5.10±0.32	5.51±0.43	4.95±0.90
SS-IDM-10B3	-	5.38±0.69 (3)	5.35±0.57	6.04±0.79	5.59±0.78
SS-IDM-12B4	5.70±0.43	5.99±0.49	6.02±0.27	6.55±0.46	6.07±0.71
SS-IDM-16B1	5.21±0.72	5.36±0.49	5.31±0.45	5.90±0.34	5.45±0.62
SS-IDM-1D2	5.54±0.57	6.02±0.49	6.36±0.90	7.13±0.26	6.26±1.34
SS-IDM-3D1	6.39±0.72	7.06±0.43	7.36±0.70	7.31±0.86	7.03±0.89
SS-IDM-8D2	6.01±0.12	6.34±0.68	6.08±0.75	6.79±0.56	6.31±0.71
SS-IDM-9D1	6.41±0.67	6.08±0.28	6.42±0.51	6.70±0.34	6.40±0.51
SS-IDM-10D2	6.11±0.97	5.33±0.28	6.63±0.48	6.[illegible]7±0.41	6.26±1.43
SS-IDM-12D3	6.43±1.02	6.74±0.41	6.56±0.72	7.22±0.58	6.74±0.69
SS-IDM-1E1	5.17±0.98	5.29±0.57	5.44±0.48	6.09±0.42	5.50±0.82
SS-IDM-4E1	6.07±0.57	6.28±0.65	6.43±0.74	7.02±0.58	6.45±0.82
SS-IDM-5E2	6.72±1.12	6.43±0.62	7.15±0.40	6.74±1.05	6.76±0.59
SS-IDM-6E1	7.49±0.57	6.95±0.96	7.72±1.28	8.13±0.08	7.57±0.98
SS-IDM-7E1	5.74±0.59	5.84±0.48	6.74±0.89	7.39±0.70	6.43±1.57
SS-IDM-11E1	4.98±0.89	5.00±0.92	5.34±0.41	5.59±0.62	5.23±0.59
SS-IDM-12E1	5.68±0.81	6.34±0.45	6.40±0.90	6.05±0.47	6.12±0.66
SS-IDM-13E4	6.40±0.34	6.30±0.44	6.46±1.17	7.05±0.22	6.55±0.68
SS-IDM-14E1	6.69±1.63	6.16±0.42	6.41±0.10	6.60±0.92	6.47±0.47
SS-IDM-2F1	5.32±0.29	6.44±0.49	5.65±0.49	6.83±1.84	6.06±1.39
SS-IDM-3F1	5.57±0.47	6.67±1.16	5.66±0.30	6.54±0.34	6.11±1.15
SS-IDM-7F1	5.28±0.39	6.31±0.20	(4)	6.43±0.52	6.01±1.26
SS-IDM-12F2	6.41±0.74	6.66±0.39	6.54±0.24	7.01±1.21	6.66±0.52
SS-IDM-15F1	6.15±1.28	7.02±0.58	6.80±1.03	7.31±0.64	6.82±0.99
SS-IDM-16F1	5.97±0.18	6.21±0.36	6.35±0.59	6.58±1.03	6.28±0.51
SS-IDM-3G3	6.77±0.67	6.67±0.33	6.66±0.[illegible]	7.16±1.32	6.82±0.47
SS-IDM-3G4	6.21±0.22	6.72±1.21	6.55±0.93	6.58±0.73	6.52±0.43

TABLE C-28 (cont.)

RESULTS OF QUARTERLY TLD MEASUREMENTS IN THE VICINITY OF SUSQUEHANNA SES

Results in Units of mrem/standard month

STATION NO.	JANUARY TO MARCH	APRIL TO JUNE	JULY TO SEPTEMBER	OCTOBER TO DECEMBER	ANNUAL AVERAGE
SS-IDM-4G1	5.82±0.21	6.21±1.24	5.59±0.39	6.70±0.17	6.08±0.97
SS-IDM-7G1	6.31±0.23	6.67±0.20	6.32±0.57	7.11±0.31	6.60±0.75
SS-IDM-12G1	5.00±0.57	4.73±0.30	5.02±0.37	5.50±0.09	5.06±0.64
SS-IDM-12G4	6.28±0.52	6.87±1.26	6.80±0.69	7.03±0.29	6.75±0.65
SS-IDM-7H1	4.52±0.49	4.45±0.09	4.44±0.54	4.83±0.50	4.56±0.37
SS-IDM-8H1	5.41±0.57	5.05±0.71	5.39±0.13	5.98±0.41	5.46±0.77
Average	6.02±2.25	6.05±1.31	6.35±2.14	6.66±1.60	
				Grand Average	6.27±1.92

\- No result because sampling station was not in operation.
(1) Station 14S2 was moved to 14S5 on 6-29-81.
(2) Station began operation on 6-29-81.
(3) Station began operation on 4-05-81.
(4) TLD lost in field.

TABLE C-29

TYPICAL LLDs* FOR GAMMA SPECTROMETRY

NUCLIDE	SURFACE WATER (pCi/l)	WELL WATER (pCi/l)	POTABLE WATER (pCi/l)	SEDIMENT (pCi/g-dry)	AIR PARTICULATES (10^{-3} pCi/m^3)	PRECIPITATION (pCi/l)	MILK (pCi/l)
Be-7	4.9	5.2	4.8	0.2	2.0	6.3	9.1
K-40	8.0	6.0	7.9	**	9.2	7.4	**
Cr-51	5.0	5.3	5.8	0.2	10	6.1	9.9
Mn-54	0.5	0.5	0.5	0.03	0.8	0.5	1.1
Co-57	0.3	0.3	0.3	0.02	0.5	0.4	0.6
Co-58	0.5	0.5	0.5	0.02	0.7	0.6	1.2
Fe-59	1.1	1.2	1.1	0.05	1.1	1.3	3.6
Co-60	0.6	0.6	0.6	0.03	0.9	0.6	1.4
Zn-65	1.1	1.1	1.1	0.06	1.5	1.2	3.5
Zr-95	0.9	0.9	0.9	0.07	1.6	1.1	2.1
Nb-95	0.6	0.7	0.7	**	1.0	0.8	1.4
ZrNb-95(1)	-	0.7	0.5	-	-	-	-
Mo-99	1.7	3.5	3.2	0.1	6.7	7.6	13
Ru-103	0.6	0.7	0.6	0.02	1.0	0.7	1.2
Ru-106	4.6	4.4	4.4	0.2	6.8	4.9	8.4
Ag-110m	4.4	0.5	0.5	0.03	0.8	0.5	1.0
Sb-125	1.5	1.5	1.5	0.06	2.4	1.6	2.6
Te-129m	19	21	19	0.8	29	23	45
I-131	0.9	1.2	1.7	0.2	2.3	1.5	2.5
I-133	100	-	110	-	-	-	-
Cs-134	0.5	0.5	0.5	0.03	0.6	0.5	0.9
Cs-136	0.7	0.9	0.7	0.03	0.8	1.1	2.2
Cs-137	0.5	0.5	0.5	**	0.8	0.5	1.1
Ba-140	3.1	3.6	3.2	0.2	6.0	4.7	8.8
La-140	1.0	1.2	1.0	0.04	0.8	1.5	1.8
BaLa-140	-	2.2	2.0	-	-	-	-
Ce-141	0.7	0.7	0.8	0.04	1.4	0.9	1.4
Ce-144	2.7	2.7	2.8	0.1	4.6	2.8	4.7
Ra-226	1.0	1.0	1.0	**	1.9	1.2	1.9
Th-232	1.6	1.8	1.8	**	2.3	1.7	3.0
Np-239	9.8	19	14	0.8	28	47	87

TABLE C-29 (cont.)

TYPICAL LLDs* FOR GAMMA SPECTROMETRY

NUCLIDE	FISH (pCi/g-wet)	FOOD PRODUCTS (pCi/g-wet)	MEAT (Flesh) (pCi/g-wet)	GAME (Flesh) (pCi/g-wet)	SOIL (Flesh) (pCi/g-wet)	VEGETATION (pCi/g-dry)	PASTURE GRASS (pCi/g-wet)
Be-7	0.6	0.03	0.05	0.1	0.3	1.1	1.2
K-40	**	-	**	**	**	**	**
Cr-51	0.07	0.04	0.06	0.2	0.3	0.6	0.3
Mn-54	0.006	0.003	0.005	0.009	0.03	0.07	0.03
Co-57	0.003	0.002	0.004	0.01	0.02	0.04	0.03
Co-58	0.007	0.003	0.006	0.01	0.03	0.07	0.03
Fe-59	0.02	0.009	0.01	0.03	0.07	0.2	0.07
Co-60	0.006	0.004	0.008	0.009	0.03	0.08	0.04
Zn-65	0.02	0.008	0.01	0.02	0.07	0.02	0.07
Zr-95	0.01	0.006	0.01	0.02	0.06	0.2	0.06
Nb-95	0.009	0.004	0.006	0.01	0.05	-	0.04
ZrNb-95(1)	-	-	-	-	-	-	-
Mo-99	0.5	0.2	0.4	0.5	0.3	0.3	0.3
Ru-103	0.008	0.004	0.006	0.02	0.04	0.08	0.04
Ru-106	0.05	0.02	0.04	0.08	0.3	0.7	0.3
Ag-110m	0.006	0.003	0.005	0.02	0.04	0.07	0.03
Sb-125	0.02	0.007	0.01	0.03	0.08	0.2	0.06
Te-129m	0.3	0.003	0.2	0.5	1.3	2.7	1.2
I-131	0.03	0.02	0.02	0.05	0.08	0.1	0.08
I-133	-	-	-	-	-	-	21
Cs-134	0.005	0.002	0.005	0.008	0.04	0.07	0.03
Cs-136	0.02	0.01	0.01	0.02	0.06	0.1	0.05
Cs-137	0.01	0.003	0.005	**	**	0.08	0.03
Ba-140	0.07	0.05	0.06	0.1	0.3	0.5	0.2
La-140	0.02	0.009	0.01	0.02	0.06	0.1	0.06
BaLa-140	-	-	-	-	-	-	-
Ce-141	0.009	0.006	0.01	0.03	0.05	-	0.08
Ce-144	0.03	0.01	0.03	0.05	0.1	0.09	0.3
Ra-226	0.01	0.005	0.01	0.02	**	0.02	0.06
Th-232	0.02	0.008	0.02	0.03	**	0.02	0.09
Np-239	-	0.9	3.1	3.5	1.7	1.2	1.5

* Decay corrected to sample stop date. The large LLDs are due to short half-life.
** Indicates a positive concentration was measured in all samples analyzed.
\- Indicates that no LLD was calculated for that nuclide in that media.
(1) Not decay corrected.

APPENDIX D

SYNOPSIS OF ANALYTICAL PROCEDURES

GROSS ALPHA ANALYSIS OF SAMPLES

Total Water (AØ)

A 250 ml aliquot is evaporated to dryness and transferred to a preweighed, 2" x 1/4" ringed planchet and reweighed. The planchet is then counted in a low background gas-flow proportional counter. Self-absorption corrections are made based on the measured residue weight and calculated thickness. The calibration standard used is Pu-239. A 250 ml sample of distilled water is evaporated in the same manner and used as a blank.

Sediment (A9)

A 200 mg portion of finely divided sediment is slurried with water, transferred to a planchet and dried. The sample is counted in a low background, gas-flow proportional counter. Self absorption corrections are made on the basis of the weight of material counted. An empty planchet is prepared with water and used as a blank.

Air Particulates (AE)

A 20% aliquot of the leached sample is evaporated to dryness on a preweighed, 2" x 1/4", ringed, stainless steel planchet and the planchet is reweighed. The planchet is counted in a low background, gas-flow proportional counter. Self absorption corrections are made on the basis of residual weight. An unused filter paper is prepared in the same manner and counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD).

Result (pCi/vol or mass) = $((S/T) - (B/t)) / (2.22 \ V \ E \ TF)$

2 sigma error (pCi/vol or mass) = $2 \ ((S/T^2) + (B/t^2))^{1/2} / (2.22 \ V \ E \ TF)$

LLD (pCi/vol or mass) = $4.66 \ (B^{1/2}) / (2.22 \ V \ E \ TF \ t)$

Where:
- S = Gross counts of sample including blank
- B = Counts of blank
- E = Fractional Pu-239 counting efficiency
- T = Number of minutes sample was counted
- t = Number of minutes blank was counted
- V = Volume of aliquot (liters, cubic meters or grams)
- TF = Transmission factor (based on net weight of sample in counting planchet)

GROSS BETA ANALYSIS OF SAMPLES

Total Water (BØ)

A 250 ml aliquot is evaporated to dryness and transferred to a preweighed, 2" x 1/4" ringed planchet and reweighed. The planchet is then counted in a low background gas-flow proportional counter. Self-absorption corrections are made based on the measured residue weight and calculated thickness. The calibration standard used is Sr-90 - Y-90. A 250 ml sample of distilled water is evaporated in the same manner and used as a blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD).

Result (pCi/l) = $((S/T) - (B/t)) / (2.22\ V\ E\ TF)$

2 sigma error (pCi/l) = $2\ ((S/T^2) + (B/t^2))^{1/2} / (2.22\ V\ E\ TF)$

LLD (pCi/l) = $4.66\ (B^{1/2}) / (2.22\ V\ E\ TF\ t)$

Where:
- S = Gross counts of sample including blank
- B = Counts of blank
- E = Fractional Sr-90 - Y-90 counting efficiency
- T = Number of minutes sample was counted
- t = Number of minutes blank was counted
- V = Sample aliquot size (liters)
- TF = Transmission factor (based on net weight of sample in counting planchet)

Air Particulates (BD)

After a delay of two to five days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter. An unused filter paper is counted as the blank.

Calculations of the results, the two sigma error and the lower limit of detection (LLD).

Result (pCi/m^3) = $((S/T) - (B/t)) / (2.22\ V\ E)$

2 sigma error (pCi/m^3) = $2\ ((S/T^2) + (B/t^2))^{1/2} / (2.22\ V\ E)$

LLD (pCi/m^3) = $4.66\ (B^{1/2}) / (2.22\ V\ E\ t)$

Where:
- S = Gross counts of sample including blank
- B = Counts of blank
- E = Fractional Sr-90-Y-90 counting efficiency
- T = Number of minutes sample was counted
- t = Number of minutes blank was counted
- V = Sample aliquot size (cubic meters)

ENVIRONMENTAL DOSIMETRY (D1)

By RMC definition, a thermoluminescent dosimeter (TLD) is considered one end of a capillary tube containing calcium sulfate (Tm) powder as the thermoluminescent material. This material was chosen for its characteristic high light output, minimal thermally induced signal loss (fading), and negligible self-dosing. The energy response curve has been flattened by a complex multiple element energy compensator shield supplied by Panasonic Corporation, manufacturer of the TLD reader. There exists four dosimeters per station sealed in a polyethylene bag to demonstrate integrity at the time of measurement, and for visualization of the sample placement instructions. The zero dose is determined from TLDs located in the lead shield found at RMC, Philadelphia.

Following the predesignated exposure period the TLDs are placed in the TLD reader. The reader heats the calcium sulfate (Tm) and the measured light emission (luminescence) is used to calculate the environmental radiation exposure.

Data are normalized to standard machine conditions by correcting machine settings to designated values before readout. Data are also corrected for in-transit dose using a set of TLDs kept in a lead shield in the field, exposed only during transit. The average dose per exposure period, and its associated error is then calculated.

The Cs-137 source is used to expose TLDs as a reference sample. An absorbed dose in tissue is determined using the 0.955 rad/Roentgen conversion factor and dose equivalent (mrem) by using a quality factor of 1.

Calculation of results and two sigma error:

Gross TLD (i) = (TLD(i)-DØ(i)) x CF (i) x CF (ins) x 0.955 mrad/mRoentgen

ITD = NET (site Ø) - (NET(RMC Ø) (D(sta) / D (RMC Ø)))

NET TLD(i) = gross TLD(i) - ITD

$$AVG = \left(\left(\sum_{i=1}^{n} NET\ TLD\right) / n\right) \left(D(STD) / D(EX)\right)$$

ERROR (95% CL) = t(n-1) (sigma NET TLD (i) / n) (D(STD) / D (EX))

where:

Gross TLD(i)	=	Individual TLD reading corrected to standard instrument conditions
TLD(i)	=	Gross reading of dosimeter i
NET TLD(i)	=	Net dose obtained during exposure period in the field
CF(ins)	=	Correction factor of reader = (6.21) ($ELS^{-0.95}$)
ELS	=	External light source
DØ(i)	=	Zero for dosimeter, i
CF(i)	=	Calibration factor for dosimeter i
ITD	=	In-transit dose
NET(site)Ø	=	Mean of n dosimeters in site lead shield
NET(RMC)Ø	=	Mean of n dosimeters in RMC lead shield

D(sta)	=	Exposure period of station
D(RMCØ)	=	Exposure period of RMCØ
AVG	=	Mean exposure per standard exposure period at a given station
n	=	Number of readings
D(EX)	=	Days exposed
D(STD)	=	Days in standard exposure period
t(n-1)	=	T-distribution (student) factor for 95% CL
sigma NET TLD(i)	=	Standard deviation of n readings of NET TLD(i)
ERROR	=	The 95% confidence limit error of AVG

GAMMA SPECTROMETRY OF SAMPLES

Water (G1)

Four liters of sample is reduced to 100 ml and sealed in a standard container. The container is counted with a Ge(Li) detector coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Milk (G7)

A three liter aliquot is dried at 175°C, ashed at 500°C until no carbon residue is present, compressed and sealed in a standard container. The container is counted with a Ge(Li) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Dried Solids (G8)

A large quantity of the sample is dried at a low temperature, less than 100°C. A 100 gram aliquot (or the total sample if less than 100 grams) is taken, compressed to unit density and sealed in a standard container. The container is counted with a Ge(Li) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Air Dried Solids (GA)

A large quantity of sample is air dried, compressed to a known geometry and sealed in a standard container. The container is counted with a Ge(Li) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Air Particulate (GB)

All samples received for the month are mixed and sealed in the standard container. The container is counted with the high resolution Ge(Li) detector, coupled to a multi-channel pulse-height analyzer.

Calculation of results, two sigma error and the lower limit of detection (LLD).

The data are obtained by smoothing the spectrum to minimize the effects of random statistical fluctuations. Peaks are identified by changes in the slope of the gross spectrum. The net area, in counts, above the baseline is determined. The calculations of the results, two sigma error and the lower limit of detection (LLD) for each nuclide are then expressed in activity (pCi) per unit volume or mass (liters or grams).

RESULT (pCi/vol. mass) $= ((S/T) - (B/t)) \, / \, (2.22 \; E \; V \; F)$

2 SIGMA ERROR (pCi/vol. or mass) $= ((S/T^2) + (B/t^2))^{1/2} \, / \, (2.22 \; E \; V \; F)$

$\overline{LLD}$ (pCi/vol. or mass) $= 4.66 (6\ S)^{1/2} / (2.22\ E\ V\ F\ T)$

where:

S = Net area, in counts, of sample (Region of spectrum of interest)
B = Net area, in counts, of background (Region of spectrum of interest)
T = Number of minutes sample was counted
t = Number of minutes background was counted
E = Detector efficiency for energy of interest
V = Sample aliquot size (liters, cubic meters or grams)
F = Fractional gamma abundance (specific for each emitted nuclide)
Q = Channel number

ANALYSIS OF SAMPLES FOR TRITIUM

Water (H2)

A 15 ml aliquot of the sample is vacuum distilled to eliminate dissolved gasses and non-volatile matter. The distillate is frozen in a trap cooled with a dry ice-isopropanol mixture. Eight (8) ml of the distillate are mixed with ten (10) ml of Insta-Gel liquid scintillation solution. The sample is then counted for tritium in a liquid scintillation counter. A sample of low tritium (< 50 pCi/l) water is vacuum distilled as a blank and is counted with each batch of samples. In the calculation of the result it is assumed that the condensated and original sample are of equivalent volumes. The volume change associated with the removal of dissolved gases and non-volatile matter is not significant compared to the other errors in the analysis.

Calculations of the results, the two sigma error and the lower limit of detection (LLD).

$$\text{RESULT (pCi/l)} = ((S/T) - (B/t)) / (2.22\ V\ E)$$

$$\text{2 SIGMA ERROR (pCi/l)} = 2\ ((S/T^2) + (B/t^2))^{1/2} / (2.22\ V\ E)$$

$$\text{LLD (pCi/l)} = 4.66\ (B^{1/2}) / (2.22\ V\ E\ t)$$

where:

S = Gross counts of sample including blank
B = Counts of blank
E = Fractional H-3 counting efficiency
T = Number of minutes sample was counted
t = Number of minutes blank was counted
V = Sample aliquot size (liters)

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water (IØ)

The initial stable iodide concentration in milk is determined with an iodide ion specific electrode. Thirty milligrams of stable iodide carrier is then added to four (4) liters of milk. The iodide is removed from the milk by passage through ion-exchange resin. The iodide is eluted from the resin with sodium hypochlorite, and purified by a series of solvent extractions with the final extraction into a toluene phase. The toluene phase is mixed with a toluene-based liquid scintillation solution. The sample is then counted in a beta-gated gamma coincidence detector, shielded by six inches of steel. Distilled water is used as a blank. The yield is calculated from stable iodide recovery based on the recovered volume. Results are corrected for decay from the sampling time to the middle of the counting period, using a half-life value for I-131 of 8.06 days.

The data are obtained by smoothing the spectrum to minimize random statistical fluctuations. Iodine-131 is identified by changes in the slope of the gross spectrum, and noting the net area, in counts, above the baseline projection. The calculations of the results, the two sigma error and the lower limit of detection (LLD) for iodine-131 are then expressed in activity (pCi) per unit volume (liter).

Calculation of results, two sigma error and the lower limit of detection (LLD).

RESULT (pCi/l) $= S / (2.22\ E\ V\ Y\ F\ T)$

2 SIGMA ERROR (pCi/l) $= 2\ (S+B)^{1/2} / (2.22\ E\ V\ Y\ F\ T)$

LLD (pCi/l) $= 4.66\ (B^{1/2}) / (2.22\ E\ V\ Y\ T)$

where:
- S = Sample counts in I-131 peak
- B = Baseline counts in region of I-131 peak
- T = Number of minutes sample was counted
- E = I-131 counting efficiency
- V = Sample aliquot size
- F = Fractional gamma abundance (0.824 for I-131)
- Y = Chemical yield of Iodine

Air Cartridges (I1)

An iodine adsorber composed of charcoal is emptied into an aluminum can (6 cms high by 8 cms in diameter) and counted with a NaI(Tl) detector, coupled to a multi-channel pulse height analyzer.

The data are obtained by smoothing the spectrum to minimize random statistical fluctuations. Iodine-131 is identified by changes in the slope of the gross spectrum, and noting the net area, in counts, above the baseline projection. The calculations of the results, the two sigma error and the lower limit of detection (LLD) for iodine-131 are then expressed in activity (pCi) per unit volume.

$$\underset{(pCi/m^3)}{\text{RESULT}} = S \,/\, (2.22\ E\ V\ F\ T)$$

$$\underset{(pCi/m^3)}{\text{2 SIGMA ERROR}} = 2\,(S+B)^{1/2} \,/\, (2.22\ E\ V\ F\ T)$$

$$\underset{(pCi/m^3)}{\text{LLD}} = 4.66\,(.63(Q^{1/2})B)^{1/2} \,/\, (2.22\ V\ E\ F\ T)$$

where:
- S = Sample counts in I-131 peak
- B = Baseline counts in region of I-131 peak
- T = Number of minutes sample was counted
- Q = Channel number (36 for I-131)
- E = I-131 counting efficiency
- V = Sample aliquot size
- F = Fractional gamma abundance (0.824 for I-131)

ANALYSIS OF SAMPLES FOR STRONTIUM-89 AND -90

Total Water (SØ, TØ)

A two liter aliquot of sample is used. Stable strontium carrier is added to the liquid to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron/rare earth hydroxide precipitations and barium chromate separations are performed to remove suspected interfering nuclides. The purified strontium is converted to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Milk (S4, T4)

A one and half liter aliquot of milk is ashed to destroy organic material and then dissolved in concentrated mineral acid. Stable strontium is added to the eluted liquid or dissolved ash to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron/rare earth hydroxide precipitations and barium chromate separations are performed to remove suspected interferring nuclides. The purified strontium is converted to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Sediment (S6, T6)

Sediment samples are leached with HCl and HNO_3 after being dried. Stable strontium carrier is added to facilitate chemical isolation of Sr-89 and -90 and for determination of the strontium recovery in the procedure. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional hydroxide precipitations and barium chromate separations are performed. The purified strontium is converted to a carbonate for weighing and counting. Gross beta counts are made soon after the strontium isolation and again after a 14 day interval and Sr-90 and Sr-89 activities are calculated on the basis of appropriate Sr-89 decay and Y-90 ingrowth equations. A sample of distilled water is used as a blank.

Organic Solids (S8, T8)

A 250 g wet portion of the sample is ashed, then dissolved in concentrated nitric or mineral acid. Stable strontium carrier is added to the dissolved sample to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron/rare earth hydroxide precipitations and barium chromate separations were performed. The purified strontium is converted to a carbonate for weighing and counting. Soon after the separation, the sample is counted in a low-background gas-flow proportional counter. After about 14 days, the sample is recounted, then Sr-89 and -90 activities are calculated on the basis of Y-90 ingrowth and Sr-89 decay. A sample of distilled water is used as a blank.

Air Particulates (SA,TA)

Air particulate filters are leached with HCl and HNO_3. Stable strontium carrier is added to facilitate chemical isolation of Sr-89 and -90 and for determination of the strontium recovery. Strontium concentration and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron/rare earth precipitations and barium chromate separations are performed to remove suspected interfering nuclides. The purified strontium is converted to a carbonate for weighing and counting. Gross beta counts are made soon after the strontium isolation and again after a 14 day interval and Sr-90 and Sr-89 activities are calculated on the basis of appropriate Sr-89 decay and Y-90 ingrowth equations. Unused filter papers are used as a blank.

Calculations of the results, the two sigma errors and minimum detectable levels (MDL) for Sr-89, -90 are expressed in activity (pCi) per unit volume (liter) or mass (gram).

RESULT Sr-90 = ((Z(S1-B1) - (S2-B2)) / (2.22 K V E9 Y T)
(pCi/vol. or mass)

2 SIGMA ERROR Sr-90 = $2\ (Z^2(S1+B1) + S2+B2)^{1/2}\ /\ (2.22\ (K^2)^{1/2}\ V\ E9\ Y\ T)$
(pCi/vol. or mass)

MDL Sr-90 = $(-9\ -6(2\ B2+Z(S1-B1) + 2.25 + Z^2\ (S1+B1))^{1/2}\ /\ 2\ K)\ /\ (2.22\ V\ E9\ Y\ T)$
(pCi/vol. or mass)

RESULT Sr-89 = (F(S1-B1) + H(S2-B2)) / (2.22 V E8 Y T exp. (-.693t4/52.7))
(pCi/vol. or mass)

2 SIGMA ERROR Sr-89 = $2\ (F^2(S1+B1) + H^2(S2+B2))^{1/2}\ /\ (2.22\ V\ E8\ Y\ T\ exp.\ (-.693t4/52.7)$
(pCi/vol. or mass)

MDL Sr-89 = (F(X-B1) + H(S2-B2)) / (2.22 V E8 Y T exp. (-.693t4/52.7))
(pCi/vol. or mass)

where:

Sr-89(1)	=	Sr-89 counts on first count
Sr-89(2)	=	Sr-89 counts on second count
Sr-90	=	Counts of Sr-90
Y-90(1)	=	Counts of Y-90 on first count
Y-90(2)	=	Counts of Y-90 on second (after equil.)
S1	=	Sr-89(1) + Sr-90 + Y-90(1) + B(1)
S2	=	Sr-89(2) + Sr-90 + Y-90(2) + B(2)
B1	=	Background counts in first count
B2	=	Background counts in second count
t1	=	Time in hours from separation time to S1
t2	=	Time in days from separation time to S2
t3	=	Time in days from S1 to S2
t4	=	Time in days from sampling date to separation date
E1	=	1 - exp (-.693t1/64 hours)
E2	=	1 - exp (-.693t2/2.667 days)
Z	=	exp (-.693t3/52.7 days)
R	=	E9/EY
H	=	(1 + E1/R) /K

K	=	$Z (E1/R + 1) - 1 - (E2/R)$
F	=	$1 - (Z/K) - Z (E1/KR)$
C	=	$(-9 F^2 B1) - 9 H^2 (S2+B2) + (F B1)^2 - 2 F H B1 S2+2 F H B1 B2 + (H(S2-B2))^2$
B	=	$2 F H (S2-B2) - (2 F^2 B1) - 9 F^2$
X	=	$((B^2 - 4 F^2 C)^{1/2} - B) / (2 F^2)$
E9	=	Counting eff. of Sr-90 = .3590 - .7082 X (Wt. in g of strontium carbonate)
EY	=	Counting eff. of Y-90 = .4380 - .1337 X (Wt. in g of strontium carbonate)
E8	=	Counting eff. of Sr-89 = .4568 - .2060 X (Wt. in g of strontium carbonate)
T	=	Number of minutes sample and blank were counted
Y	=	Yield
V	=	Sample aliquot size (liters, cubic meters or grams)

APPENDIX E

RESULTS OF THE EPA INTER-LABORATORY COMPARISON PROGRAM

INTER-LABORATORY COMPARISON PROGRAM

RMC participates in the EPA radiological interlaboratory comparison (cross check) program. This participation includes a number of analyses on various sample media as found in the Susquehanna SES REMP. As a result of participation in the program an objective measure of analytical precision and accuracy as well as a bias estimation of RMC results is obtained. Of the 113 analyses performed, 99 fell within the EPA mean and standard deviation. Reference 16 discusses any discrepancies between the data. Tables E-1, E-2, E-3, E-4 and E-5 summarize the results of the 1981 samples.

TABLE E-1

INTER-LABORATORY COMPARISONS
GROSS ALPHA AND BETA IN WATER
(pCi/liter) and AIR PARTICULATES (pCi/filter)

DATE	RMC #	SAMPLE TYPE	ANALYSIS	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
Jan 1981	43613	Water	α	10±2	9±5	9±3
			β	40±3	44±5	44±6
March 1981	53663	APT	α	33±1	30±8	32±5
			β	74±2 (a)	50±5	56±11
March 1981	54441	Water	α	26±3	25±6	24±6
			β	31±2	25±5	28±5
April 1981	54841	Water	α	64±7	91±23	76±24
			β	134±9	141±7	140±21
May 1981	55883	Water	α	25±2	21±5	19±5
			β	15±2	14±5	16±4
June 1981	56994	APT	α	30±2	28±7	32±6
			β	79±5 (a)	54±5	64±10
July 1981	57789	Water	α	19±3	22±6	13±5
			β	16±1	15±5	17±4
Sept 1981	60388	Water	α	48±4	33±8	28±8
			β	26±1	28±5	25±6
Sept 1981	60776	APT	α	27±3	25±6	26±6
			β	63±7	51±5	61±10
Oct 1981	62491	Water	α	52±5	80±20	70±17
			β	106±3	111±6	103±15
Nov 1981	64277	Water	α	24±2	21±5	20±5
			β	21±1	23±5	23±5

(a) Investigation confirmed results. The low standard deviation indicates good agreement among the three samples that RMC received. Gross alpha [illegible] spec and strontium-90 analyses of these samples agreed with EPA mean. [illegible] beta discrepancy between RMC and the EPA is due to either contamination at RMC or an error in preparation by the EPA.

TABLE E-2

INTER-LABORATORY COMPARISONS
GAMMA(1)

DATE	RMC #	SAMPLE TYPE	ISOTOPE	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
Jan 1981	43514	Milk	I-131	<203 (a)	26±10	26±6
			Cs-137	42±3	43±9	42±7
			Ba-140	<177	0	4±5
			K	1647±0	1550±134	1529±155
Feb 1981	44441	Water	Cr-51	<67	0	49±11
			Co-60	25±1	25±5	25±4
			Zn-65	89±1	85±5	89±11
			Ru-106	<28	0	50±43
			Cs-134	35±2	36±5	33±5
			Cs-137	5±1	4±5	5±2
March 1981	44815	Food	I-131	103±6	119±12	123±13
			Cs-137	58±2	53±5	53±6
			Ba-140	<51	0	0
			K	2933±0	2640±132	2749±311
March 1981	53663	APT	Cs-137	14±1	14±5	16±4
April 1981	54841	Water	Co-60	<4	0	0
			Cs-134	12±3	10±5	10±3
			Cs-137	16±1	15±5	15±3
May 1981	55248	Milk	I-131	24±2	26±6	27±7
			Cs-137	21±2	22±5	23±3
			Ba-140	<26	0	0
			K	1777±77	1559±78	1563±104
June 1981	56246	Water	Cr-51	<39	0	15±23
			Co-60	17±3	17±5	17±3
			Zn-65	<6	0	0
			Ru-106	<27	15±5	12±9
			Cs-134	20±2	21±5	20±3
			Cs-137	30±2	31±5	31±5
June 1981	56994	APT	Cs-137	15±4	16±5	20±5
July 1981	57331	Food	I-131	78±8	82±8	87±15
			Cs-137	43±1	45±5	46±6
			Ba-140	0	0	0
			K	2739±68	2640±172	2819±323

TABLE E-2 (cont.)

INTER-LABORATORY COMPARISONS
GAMMA(1)

DATE	RMC #	SAMPLE TYPE	ISOTOPE	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
July 1981	57812	Milk	I-131	<8	0	7±7
			Cs-137	31±1	31±5	32±4
			Ba-140	<25	0	0
			K	1136±49	1600±80	1593±99
Sept 1981	60776	APT	Cs-137	18±3	19±5	24±6
Oct 1981	62282	Water	Cr-51	<75 (a)	34±5	36±9
			Co-60	25±2	22±5	23±3
			Zn-65	25±2	24±5	24±4
			Ru-106	<29	0	0
			Cs-134	21±1	21±5	20±4
			Cs-137	33±2	32±5	33±4
Oct 1981	62491	Water	Co-60	<3	0	0
			Cs-134	11±1	12±5	12±2
			Cs-137	16±1	15±5	16±3
Oct 1981	62547	Milk	I-131	53±1	52±6	53±7
			Cs-137	26±2	25±5	27±3
			Ba-140	<17	0	0
			K	1526±0	1530±77	1532±108
Nov 1981	63205	Food	Co-60	26±2	30±5	30±4
			Cs-137	27±1	33±5	34±4
			Ba-140	<35	0	6±6
			K	2113±0	2730±137	2758±331

(1) Results reported in pCi/liter for milk and water, pCi/sample for air particulates, and pCi/kilograms for food products except K which is reported in mg/liter for milk and mg/kilogram for food products.

(a) Sample was not analyzed within one half-life resulting in large LLD due to a long decay period.

TABLE E-3

INTER-LABORATORY COMPARISONS
TRITIUM IN WATER
pCi/liter

DATE	RMC #	SAMPLE TYPE	ANALYSIS	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
Feb 1981	44003	Water	H-3	1680±137	1760±341	1778±230
Apr 1981	53660	Water	H-3	2727±6	2710±355	2717±373
June 1981	56309	Water	H-3	2053±32	1950±344	1946±241
Aug 1981	58155	Water	H-3	2693±40	2630±354	2616±361
Oct 1981	61871	Water	H-3	2467±106	2210±348	2133±214
Dec 1981	64936	Water	H-3	2637±90	2700±355	2676±244

TABLE E-4

INTER-LABORATORY COMPARISONS
IODINE-131 IN WATER
pCi/liter

DATE	RMC #	SAMPLE TYPE	ANALYSIS	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
Apr 1981	53750	Water	I-131	31±3	30±6	29±5
Aug 1981	58205	Water	I-131	66±5	73±7	72±7
Dec 1981	64544	Water	I-131	64±3	76±8	[illegible]9±10

TABLE E-5

INTER-LABORATORY COMPARISONS
STRONTIUM-89 AND STRONTIUM-90[1]

DATE	RMC #	SAMPLE TYPE	ANALYSIS	RMC MEAN±s.d.	EPA MEAN±s.d.	All Participants MEAN±s.d.
Jan 1981	43229	Water	Sr-89	24±11	16±5	15±5
			Sr-90	27±7	34±2	32±5
Jan 1981	43514	Milk	Sr-89	<8	0	29±37
			Sr-90	22±3	20±3	19±3
March 1981	44815	Food	Sr-89	74±13 (a)	47±5	43±18
			Sr-90	32±2	29±2	27±8
March 1981	53663	APT	Sr-90	16±2	18±2	17±3
Apr 1981	54841	Water	Sr-39	32±6	38±5	34±9
			Sr-90	29±5	28±2	26±7
May 1981	54879	Water	Sr-89	51±2	36±5	32±10
			Sr-90	26±10	22±2	22±6
May 1981	55248	Milk	Sr-89	9±2	25±5	22±6
			Sr-90	9±1	11±2	10±3
June 1981	56994	APT	Sr-90	18±2	19±2	19±3
July 1981	57331	Food	Sr-89	36±14	44±5	44±9
			Sr-90	23±1	31±2	29±3
July 1981	57812	Milk	Sr-89	20±7	25±5	24±6
			Sr-90	16±0	17±2	16±2
Sept 1981	59585	Water	Sr-89	21±5	23±5	22±3
			Sr-90	6±2	11±2	11±2
Sept 1981	60776	APT	Sr-90	16±1	16±2	17±3
Oct 1981	62491	Water	Sr-89	24±7	21±5	22±6
			Sr-90	9±6	14±2	13±3
Oct 1981	62547	Milk	Sr-89	26±2	23±5	22±5
			Sr-90	17±2	18±2	18±3
Nov 1981	63205	Food	Sr-89	31±6	38±5	35±6
			Sr-90	21±2	23±2	23±4

(1) Results reported in pCi/l for water and milk, pCi/filter for air particulates, and pCi/kg for food.

(a) Very low yields for all samples and long decay period from collection to analysis resulted in questionable results.

APPENDIX F

SITE SPECIFIC DEMOGRAPHIC DATA

SITE SPECIFIC DEMOGRAPHIC DATA

The Branch Technical Position (13) requires the annual collection of certain demographic data in order to determine if any changes to the REMP are necessary. The nearest milk producer and vegetable garden over 50 square meters in each sector must be determined. The nearest residence in each sector was also determined.

Dairy Animal Survey

In August 1981, a dairy animal survey was performed in the vicinity of the Susquehanna Steam Electric Station. The information, pertaining to the location of the nearest dairy animal (within 5 miles) is listed in Table F-1. Since there are no changes in the location of the nearest dairy animal, no change in the REMP is necessary.

Vegetable Garden Survey

The location of the nearest vegetable garden over 50 square meters in each sector is listed in Table F-2. In addition, broad leaf vegetation was collected from gardens in the sectors with the two highest D/Q and analyzed for iodine-131. This data appears in Table C-25.

Residence

The location of the nearest residence in each sector is listed in Table F-3.

TABLE F-1

NEAREST DAIRY ANIMAL OPERATION BY SECTOR

Sector	Direction	1981 Distance
1	N	>5
2	NNE	>5
3	NE	>5
4	ENE	3.7
5	E	2.7
6	ESE	2.4
7	SE	2.1+
8	SSE	3.2+*
9	S	2.4
10	SSW	3.0*
11	SW	3.5
12	WSW	1.7*
13	W	5.0*
14	WNW	>5
15	NW	0.9*
16	NNW	4.2

\+ Goat farm.
* Participant in Susquehanna SES Radiological Environmental Monitoring Program.

TABLE F-2

NEAREST VEGETABLE GARDENS

Sector	Direction	1981 Distance
1	N	0.6
2	NNE	1.0
3	NE	2.3
4	ENE	2.4
5	E	0.5
6	ESE	1.4
7	SE	0.4
8	SSE	0.7
9	S	1.2
10	SSW	1.5
11	SW	0.6
12	WSW	1.2
13	W	1.3
14	WNW	0.7
15	NW	0.9
16	NNW	1.4

TABLE F-3

NEAREST RESIDENCE

Sector		Distance (Miles)	Residence
1	N	0.6	Bruce Thomas
2	NNE	1.0	L. M. Robbins
3	NE	2.3	John Henry Owner: Norman Reinhimer
4	ENE	2.1	James Cruise
5	E	0.5	Dorothy Walters Owner: PP&L
6	ESE	0.5	Christopher Zwolinski Owner: Robert Zwolinski
7	SE	0.4	Dennis Kline Owner: Harry Kline
8	SSE	0.7	John Naunczek
9	S	1.1	J. D. Bower
10	SSW	1.5	Frank Rehrig
11	SW	0.6	Stanley Shortz
12	WSW	1.2	William Kisner
13	W	0.8	W. Johnson
14	WNW	0.7	H. E. Folk
15	NW	0.9	M. Serafin
16	NNW	0.6	William Metzler