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SALEM NUCLEAR GENERATING
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PUBLIC SERVICE ELECTRIC AND GAS
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SUBJECT:

1981 ANNUAL RADIOLOGICAL REPORT.

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RMC-TR-82-01

1981 INTERIM REPORT
PENDING THE COMPILATION OF ADDITIONAL RESULTS

ARTIFICIAL ISLAND RADIOLOGICAL
ENVIRONMENTAL MONITORING PROGRAM

January 1 to December 31, 1981

Prepared for

Public Service Electric and Gas Company

by

Radiation Management Corporation

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SUMMARY

During the period January 1 to December 31, 1981, Radiation Management Corporation (RMC) participated in the Operational Radiological Environmental Monitoring Program conducted by Public Service Electric and Gas Company (PSE&G) at Artificial Island, New Jersey. Salem Nuclear Generating Station (SNGS) Unit #1 became critical on December 11, 1976, thereby initiating the operational phase of the Radiological Environmental Monitoring Program (REMP). This program was designed to identify and quantify concentrations of radioactivity in various environmental media and to quantify ambient radiation levels in the environs of Artificial Island. Unit #2 achieved initial criticality on August 2, 1980. During the operational phase, the program will monitor the operations of SNGS Units #1 and #2 and will fulfill the requirements of the SNGS Environmental Technical Specifications. This report presents the results of thermoluminescent dosimetry and radiochemical analyses of environmental samples collected during 1981.

A total of 2299 analyses were performed on 1422 environmental samples during the period covered by this report. Samples of air particulates, air iodine, surface, ground and drinking water, benthos, sediment, milk, fish, crabs, vegetables, game, fodder crops, and precipitation were collected. Thermoluminescent dosimeters were used to measure ambient radiation levels.

A variety of radionuclides, both naturally occurring and man-made, were found in the above samples. These nuclides were detected at levels similar to those found during the preoperational phase of this program. In general, results at indicator stations compared favorably to control stations. It is concluded that the radiological characteristics of the environment around Artificial Island during 1981 were not affected by the operation of SNGS Units #1 and #2.

INTRODUCTION

Radiation Management Corporation has participated in the Artificial Island Radiological Environmental Monitoring Program since January 1973. RMC has previously reported results from the preoperational phase of the REMP for 1973(1), 1974(2), 1975(3) and 1976(4). On December 11, 1976, SNGS Unit #1 first achieved criticality thereby initiating the operational phase of the REMP. RMC has also reported results from the initial operating period between December 11 and December 31, 1976(5), January 1 and December 31, 1977 (6), January 1 and December 31, 1978 (7), January 1 and December 31, 1979 (8) and January 1 and December 31, 1980 (9). This report summarizes the operational period between January 1 and December 31, 1981.

Artificial Island is the site of two nuclear power reactor which are part of the Salem Nuclear Generating Station. Units #1 and #2 are pressurized water reactors (PWR), 1090 MWe and 1115 MWe respectively. Both are presently operational.

Artificial Island is actually a man-made peninsula in the Delaware River, created by the deposition of dredging spoils. It is located in Lower Alloways Township, Salem County, New Jersey. The environment around Artificial Island is characterized mainly by the Delaware River and Bay, extensive tidal marshes, and grass lands. These land types make up approximately 85% of the land area within five miles of the site. Most of the remaining land is used for agricultural production (10).

More specific information on the demography, hydrology, meteorology, and land use characteristics of the local area may be found in the Environmental Report (10), Environmental Statement (11), and the Final Safety Analyses Report (Units 1 and 2 for SNGS (12).

THE PROGRAM

In the operational phase of the REMP, the program was conducted in accordance with Section 3.2 of the SNGS Environmental Technical Specifications (ETS). Radioanalytical data were collected and compared with results from the preoperational phase. Differences between these periods were examined statistically, where applicable, to determine whether any station operational effects existed.

Objectives

The objectives of the operational radiological environmental program are:

1. To fulfill the obligations of the Radiological Surveillance-Environmental sections of the Environmental Technical Specifications for SNGS.

2. To determine whether any significant increase occurs in the concentration of radionuclides in critical pathways.

3. To determine if SNGS has caused an increase in the radioactive inventory of long lived radionuclides.

4. To detect any change in ambient gamma radiation levels.

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

This report as required by Section 5.6 of the Salem ETS (13) summarizes the findings of the 1981 REMP. Results of the four year preoperational program have been summarized for purposes of comparison with subsequent operational reports. (4)

Sample Collection

In order to meet the stated objectives, an appropriate operational REMP was developed by RMC in cooperation with Public Service Electric and Gas Company. Samples of various media were selected to obtain data for the evaluation of the radiation dose to man and other organisms. The selection of sample types was based on: (1) established critical pathways for the transfer of radionuclides through the environment to man, and (2) experience gained during the preoperational phase. Sampling locations were determined from site meteorology, Delaware estuarine hydrology, local demography, and land uses.

Sampling locations were divided into two classes--indicator and control. Indicator stations are those which are expected to manifest station effects, if any exist; control samples are collected at locations which are believed to be unaffected by station operations. Fluctuations in the levels of radionuclides and direct radiation at indicator stations are evaluated with respect to analogous fluctuations at control stations, which are unaffected by station operation. Indicator and control station data are also evaluated relative to preoperational data. The REMP for the Artificial Island Site includes additional samples and analyses not specifically required by the Salem ETS. The summary tables in this report include these additional samples and analyses.

Air particulates were collected on Schleicher-Schuell No. 25 glass fiber filters with low-volume air samplers. Iodine was collected from air by absorption on TEDA charcoal cartridges connected in series behind the air particulate filters. Air sample volumes were measured with calibrated dry-gas meters corrected to standard temperature and pressure.

Precipitation was collected on a 95-square-inch rain gauge. Samples were collected monthly and transferred to new polyethylene bottles. The rain gauge was rinsed at collection with distilled water to include residual particulates in the precipitation samples. Results of subsequent analyses were corrected for the increase in volume. Tritium results were also corrected for the tritium content of the distilled water.

Ambient radiation levels in the environs were measured with energy-compensated $CaSO_4$ (Tm) thermoluminescent dosimeters (TLDs). Packets containing four TLDs each were placed on and around the Artificial Island Site at various distances and were exposed on a monthly, quarterly and semi-annual basis.

Monthly well and potable water samples were taken in new two-gallon polyethylene bottles. Separate raw and treated potable water samples were composited daily by personnel of the Salem Water Company.

Surface water samples were collected by Icthyological Associated and shipped to RMC for analysis in new polyethylene bottles. Sample containers were rinsed twice with the sample medium prior to collection. Edible fish and crabs were taken by net, sealed in a bag or jar and shipped frozen. Benthos and sediment were taken with a bottom grab sampler.

Milk samples were taken in new polyethylene bottles and shipped fresh. Food products, fodder crops, game and bovine thyroid samples were taken and sealed in plastic bags or jars. Perishable samples were frozen at the time of sampling without any preservatives.

Appendix A describes and summarizes, in the format of Table 5.6-1 of the Salem ETS, the entire operational program as performed in 1981. Appendix B describes the RMC coding system, which specifies sample type and relative locations at a glance. Also 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.

Data Interpretation

Radiation Management Corporation has an extensive quality assurance program designed to maximize confidence in the analytical procedures used. The analytical methods utilized in this program are summarized in Appendix D. Approximately 20% of the total analytical effort is spent on quality control, including process quality control, instrument quality control, inter-laboratory cross-check analyses, and comprehensive data review. Results of the EPA inter-laboratory comparison program appear in Appendix E. A full discussion of these results can be found in the "Quality Control Data 1981 - Annual Report" (14). Several factors are important in the interpretation of the data. These factors are discussed here to avoid repetition in sections that follow.

Grab sampling is a useful and acceptable procedure for taking environmental samples of a medium in which the concentration of radionuclides is expected to vary slowly with time or where intermittent sampling is deemed sufficient to establish the radiological characteristics of the medium. This method, however, is only representative of the sampled medium for that specific location and instant of time. As a result, variation in the radionuclide concentrations of the samples will normally occur. Since these variations will tend to counterbalance one another, the extraction of averages based upon repetitive grab samples is valid.

Within the data tables (Appendix C) an approximate 95% (±2 sigma) confidence interval is supplied for those data points above the lower limit of detection (LLD). An exception to this is Sr-89 and -90 detection capabilities which are based on the minimum detectable limit (MDL). These intervals represent the range of values into which 95% of repeated analyses of the same sample should fall.

Results for each type of sample were grouped according to the analysis performed. Means and standard deviations of these results were calculated when applicable. The calculated standard deviations of grouped data found in Appendix C represent sample and not analytical variability. When a group of data was composed of mainly (>50%) LLD values, averages were not calculated.

It is characteristic of environmental monitoring data that many results occur at or below the lower limit of detection. For reporting and calculation of averages, any result occurring at or below the lower limit of detection is considered to be at that limit. As a result, averages obtained using this method are biased high.

Program Changes

Beginning on October 1, 1981, modifications were made to the portion of the Radiological Environmental Monitoring Program for the Salem Nuclear Generating Station performed by RMC. The following is a list of analyses no longer analyzed by RMC. It should be noted that all analyses not performed by RMC are being analyzed by the Research Corp., a wholly owned subsidiary of PSE&G.

1. Air Particulates - all analyses (gross alpha, gross beta, gamma emitters, Sr-89 and -90) have been discontinued by RMC.

2. Soil - analyses for Sr-90 and gamma emitters have been discontinued by RMC.

3. Well Water - tritium and Sr-89 and -90 analyses have been discontinued by RMC.

4. Rain Water - tritium analyses have been discontinued by RMC.

In order to insure quality of the results obtained by their laboratory, PSE&G has instituted a quality assurance program in which a portion of those samples analyzed by PSE&G will also be analyzed by RMC. This program is discussed below.

1. Milk - Station MLK-3G1 will continue to be analyzed for Sr-89 and -90 on a monthly basis by RMC. Each month one additional station will be chosen by Public Service Electric & Gas Company to receive Sr-89 and -90 analyses.

2. Surface Water - Station SWA-12C1 will continue to be analyzed for tritium on a monthly basis, and for Sr-89 and -90 on a quarterly composite basis by RMC. In addition, one other station will be chosen by PSE&G to receive monthly tritium analyses and quarterly composite Sr-89 and -90 analyses.

3. Potable Water - Monthly tritium analyses and quarterly composite analyses for Sr-89 and -90 will be continued on station PWT-2F3 by RMC.

RESULTS AND DISCUSSION

The analytical results of the 1981 REMP samples are divided into categories based on exposure pathways: airborne, direct, water, aquatic and ingestion. The analytical results for the 1981 REMP samples are summarized in Appendix A. The data for individual samples are presented in Appendix C.

Airborne

Air Particulates (Tables C-1, C-2, C-3, C-4)

Air particulate samples were analyzed for alpha, beta, gamma emitters, and Sr-89 and -90. The weekly air particulate samples were analyzed for gross beta activity at eight stations and for gross alpha activity at two stations. Quarterly composites were prepared using the weekly samples from each station and analyzed for Sr-89, Sr-90 and specific gamma emitters.

Weekly gross beta analyses showed concentrations ranging from 0.029 to 0.471 pCi/m^3 with the average for the eight sampling stations being 0.141 pCi/m^3. Figure 1 shows the relation between gross beta activity in air and precipitation for the preoperational and the operational periods, showing both seasonal and weapons-testing fluctuations.

Of the 78 weekly air particulate samples (two stations) analyzed for gross alpha emitters, 66 were above detectable concentrations. The range of gross alpha activity was from 0.0006 to 0.0027 pCi/m^3 and averaged 0.0013 pCi/m^3.

Results of gamma spectrometry showed detectable levels of several radionuclides, both naturally occurring and man-made (Be-7, K-40, Mn-54, Nb-95, Zr-95, Ru-103, Ru-106, Sb-125, Cs-137, Ce-141 and Ce-144). The level of man-made nuclides detected during the first and second quarters can be attributed primarily to fallout from the October 16, 1980 atmospheric nuclear weapons test. Concentrations of these nuclides decreased significantly during the third quarter. The presence of Be-7 throughout the year can be attributed to cosmic ray activity. The highest activity detected was 0.12 pCi/m^3 of Nb-95 in the second quarter composite for station APT-5D1.

The Sr-89 analyses performed on the quarterly composites showed 23 out of 24 samples with detectable activity. These ranged between 0.0007 and 0.0093 pCi/m^3 with the average being 0.0052 pCi/m^3. The positive Sr-89 results can also be attributed to the fallout from the atmospheric nuclear weapons test. Sr-90 concentrations ranged between 0.0003 and 0.0022 pCi/m^3 with the average being 0.0009 pCi/m^3.

Air Iodine (Table C-5)

Iodine cartridges were connected in series behind each of the air particulate filters for absorption of air iodine. The absorption media used in these cartridges was "TEDA" impregnated charcoal. All results for I-131 were below the LLD and ranged from <0.0054 to <0.026 pCi/m^3.

FIGURE 1

COMPARISON OF AVERAGE CONCENTRATIONS OF BETA EMITTERS IN PRECIPITATION AND IN AIR PARTICULATES, 1973 THROUGH 1981

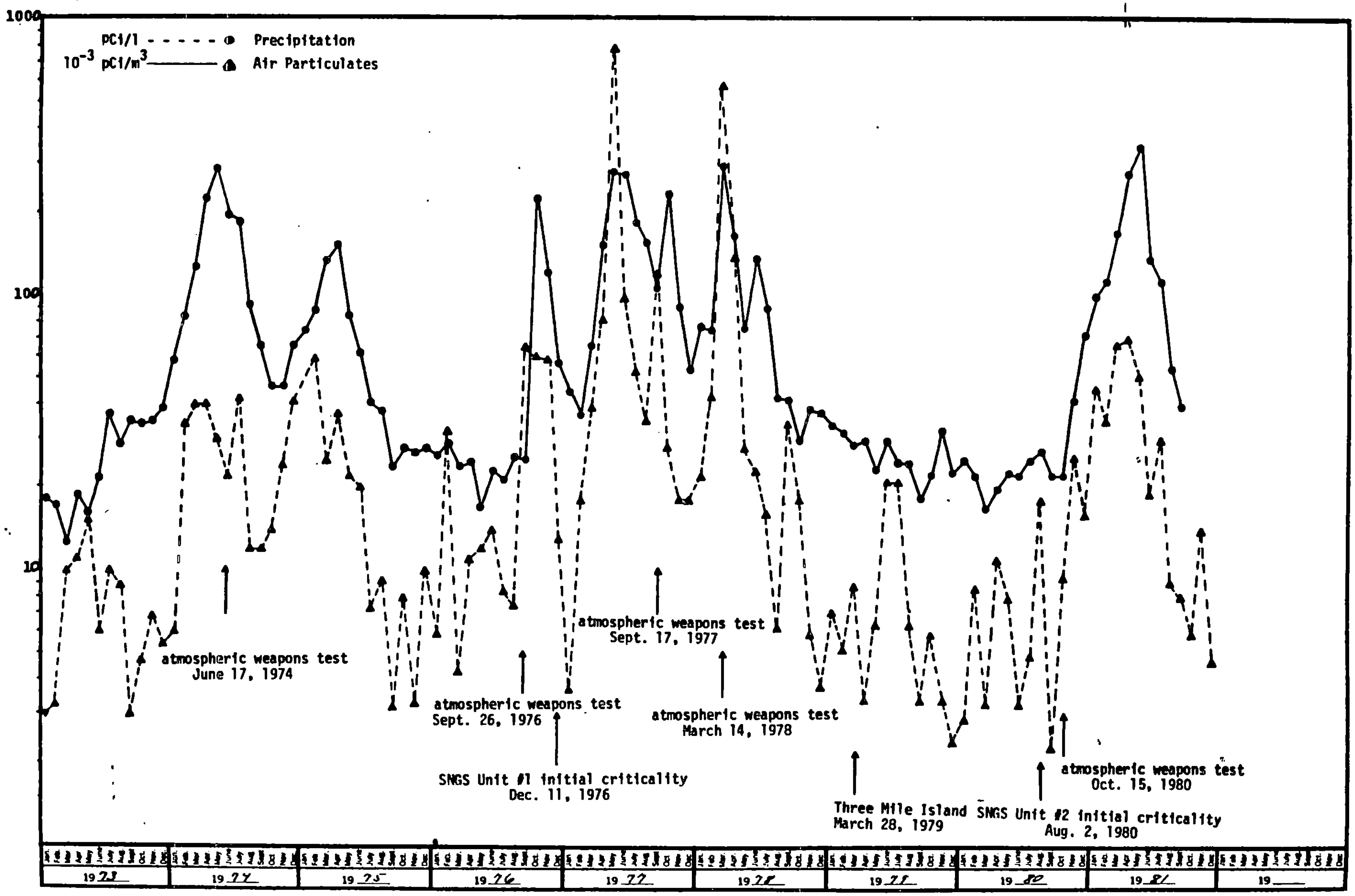
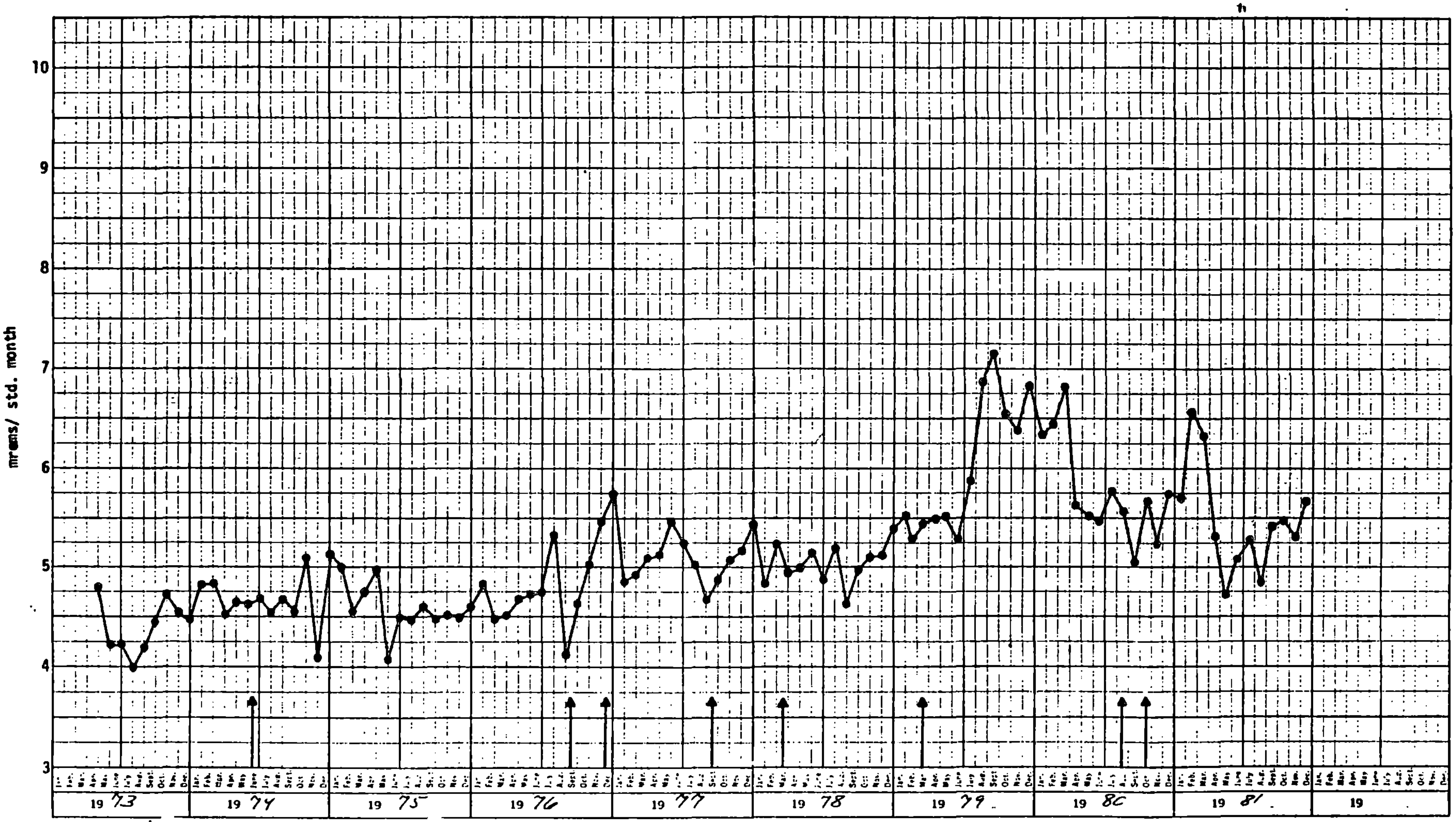


FIGURE 2

AVERAGE AMBIENT RADIATION LEVELS FROM MONTHLY TLDs IN THE VICINITY OF ARTIFICIAL ISLAND, 1973 THROUGH 1981



atmospheric weapons test June 17, 1974

atmospheric weapons test Sept. 26, 1976

atmospheric weapons test Sept. 17, 1977

atmospheric weapons test March 14, 1978

Three Mile Island March 28, 1979

atmospheric weapons test Oct. 15, 1980

SNGS Unit #1 initial criticality Dec. 11, 1976

SNGS Unit #2 initial criticality Aug. 2, 1980

Precipitation (Tables C-7, C-8)

Although not specifically required by the Salem ETS, precipitation was sampled continuously and collected monthly at the Salem substation sampling location. The precipitation was analyzed for tritium, gross alpha and gross beta emitters on a monthly basis. Tritium activity was detected in three samples and ranged from 86 to 124 pCi/l. The LLDs ranged from <87 to <124 pCi/l. Of the twelve monthly rain water samples analyzed for gross alpha emitters, three showed detectable concentrations. The range of gross alpha activity was from 1.2 to 2.3 pCi/l with the average being 1.6 pCi/l. The LLDs ranged from <0.6 to <1.2 pCi/l. Gross beta emitter concentrations were detected in all samples and ranged from 4.7 to 70 pCi/l with an average of 30 pCi/l.

Quarterly composites of precipitation were analyzed for radiostrontium and gamma emitters. Sr-89 analyses showed positive results for the first three quarters of 1981. The concentrations ranged from 0.6 to 7.5 pCi/l, and averaged 3.8 pCi/l. Sr-90 concentrations ranged between 0.8 and 1.4 pCi/l with the average being 1.1 pCi/l. Results of gamma spectrometry showed detectable levels of several radionuclides. All of the detected nuclides are man-made and can be attributed to fallout from the October 16, 1980 atmospheric nuclear weapons test. By the fourth quarter, activities had returned to LLD levels.

Direct (Tables C-9, C-10, C-11)

Direct radiation measurements were made at 41 different locations, 24 monthly and quarterly locations and 17 semi-annual locations using $CaSO_4$ (Tm) thermoluminescent dosimeters. During 1981, 288 monthly, 96 quarterly and 34 semi-annual TLD packets were collected. Each packet included four dosimeters for a total of 1672 analyses. These analyses resulted in an average dose rate of 5.47 mrads/standard month for monthly TLDs, 5.37 mrads/standard month for quarterly TLDs and 5.54 mrads/standard month for semi-annual TLDs. All TLD results presented in this report have been normalized to a standard month (30.4 days) to eliminate the apparent differences caused by variations in exposure periods. When the monthly data is plotted as in Figure 2, a slight peak is observed after June 1979. This peak is attributed to the elevated readings from two on-site TLD stations. Since the two stations, 10S1 and 11S1, are on-site they do not represent any environmental dose to the public. A comparison of the direct radiation data for 1981 shows a similarity between the average monthly dose for both indicator stations (5.40 mrads/std. month) and control stations (5.84 mrads/std. month).

In order to better evaluate the variation between TLD results, a statistical model which is capable of separating a contribution by SNGS from the background component has been developed. The statistical method utilized is a linear regression analysis which involves determining the functions which best describe the background component by the least squares method. Six models were originally tested and are described in a separate publication (14). The equation which describes the model selected is:

$$Y_{jmi} = f\ (\overline{X}_j\ (CON_{im}\ /\ COT_i)\ (COT_i\ /\ COT_p)$$

where:

f = denotes a function of

Y_{jmi} = predicted value for station j, month m, and year i

$\overline{X}_j$ = preoperational mean for station j

CON_{im} = average of the control stations for month m and year i

COT_i = average of the control station for year i (a "p" in place of "i" represents the preoperational period)

A computer program was developed for multiple regression analysis. The least squares fit (LSF) line based on all 1981 data was determined along with the statistics for this line. The data for 1981 was tested against predicted values and prediction limits determined from the model period line. Differences between predicted and observed values are termed residuals. Residuals outside the prediction limits of the predicted value are identified as outliers. For 1981, 22 outliers were predicted from a possible 288.

Four outliers at station 10S1 and sixteen outliers at station 11S1 can be attributed to the refueling of Unit #1. These stations are located in the vicinity of the Refueling Water Storage Tank. Since these locations are on-site they do not represent a dose to the public. No TLDs located beyond the plant boundary indicated any additional dose from SNGS operation.

The remaining two outliers at stations 7S1 and 14D1 can be attributed to statistical fluctuations.

<u>Water</u>

Surface Water (Tables C-12, C-13, C-14, C-15, C-16)

Monthly surface water samples were taken at five locations in the Delaware estuary. One is downstream from the outfall area, one is in the outfall area, and another is directly west of the outfall area at the mouth of the Appoquinimink River. Two other stations are located upstream--one station is in the river and the other is in the Chesapeake and Delaware Canal. The station located at the mouth of the Appoquinimink River serves as the operational control. Surface water samples were analyzed for tritium, gross alpha emitters, gross beta emitters, strontium-89 and -90, and gamma emitters.

FIGURE 3

AVERAGE CONCENTRATIONS OF TRITIUM IN THE DELAWARE RIVER IN
THE VICINITY OF ARTIFICIAL ISLAND, 1973 THROUGH 1981

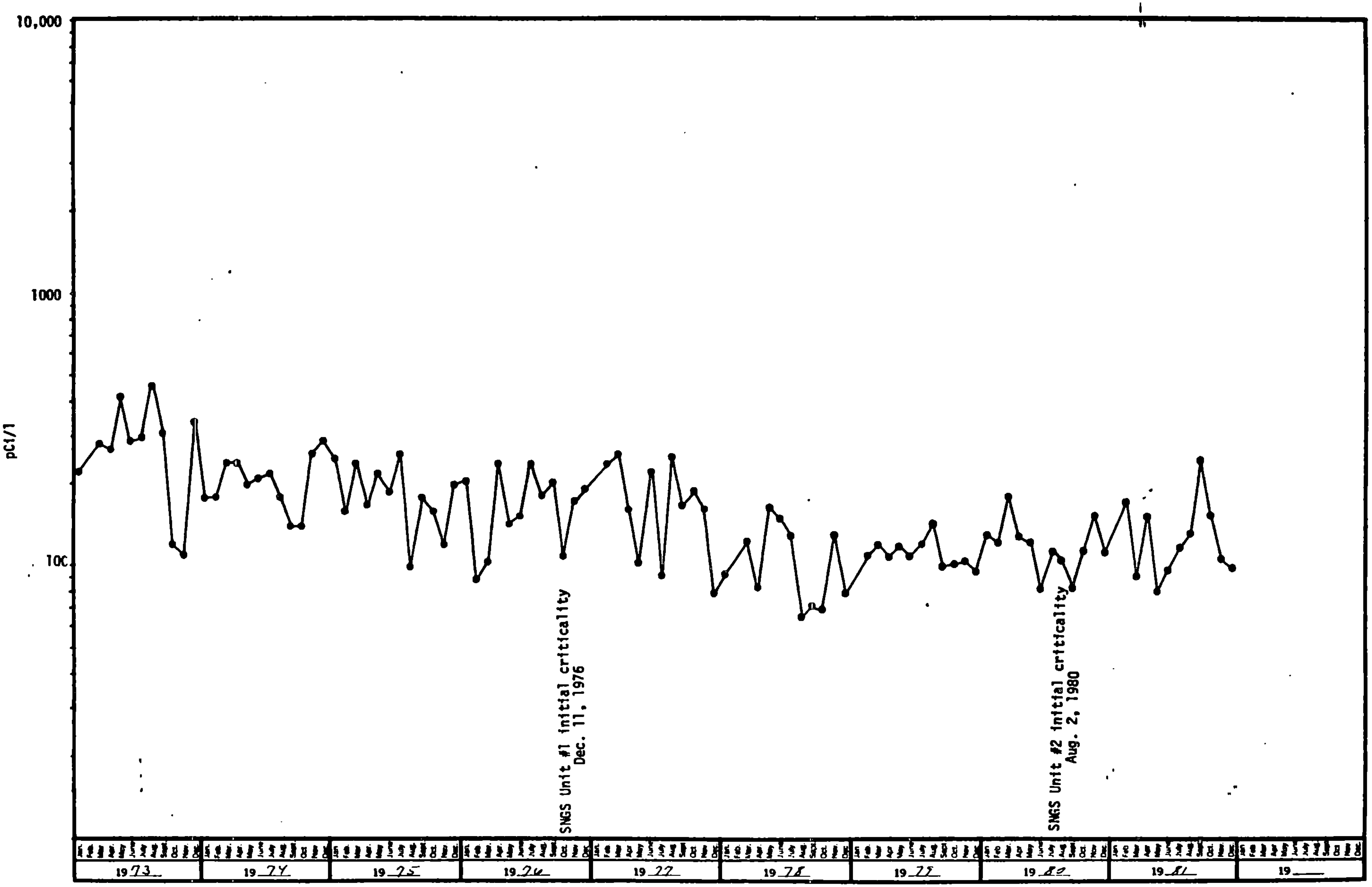
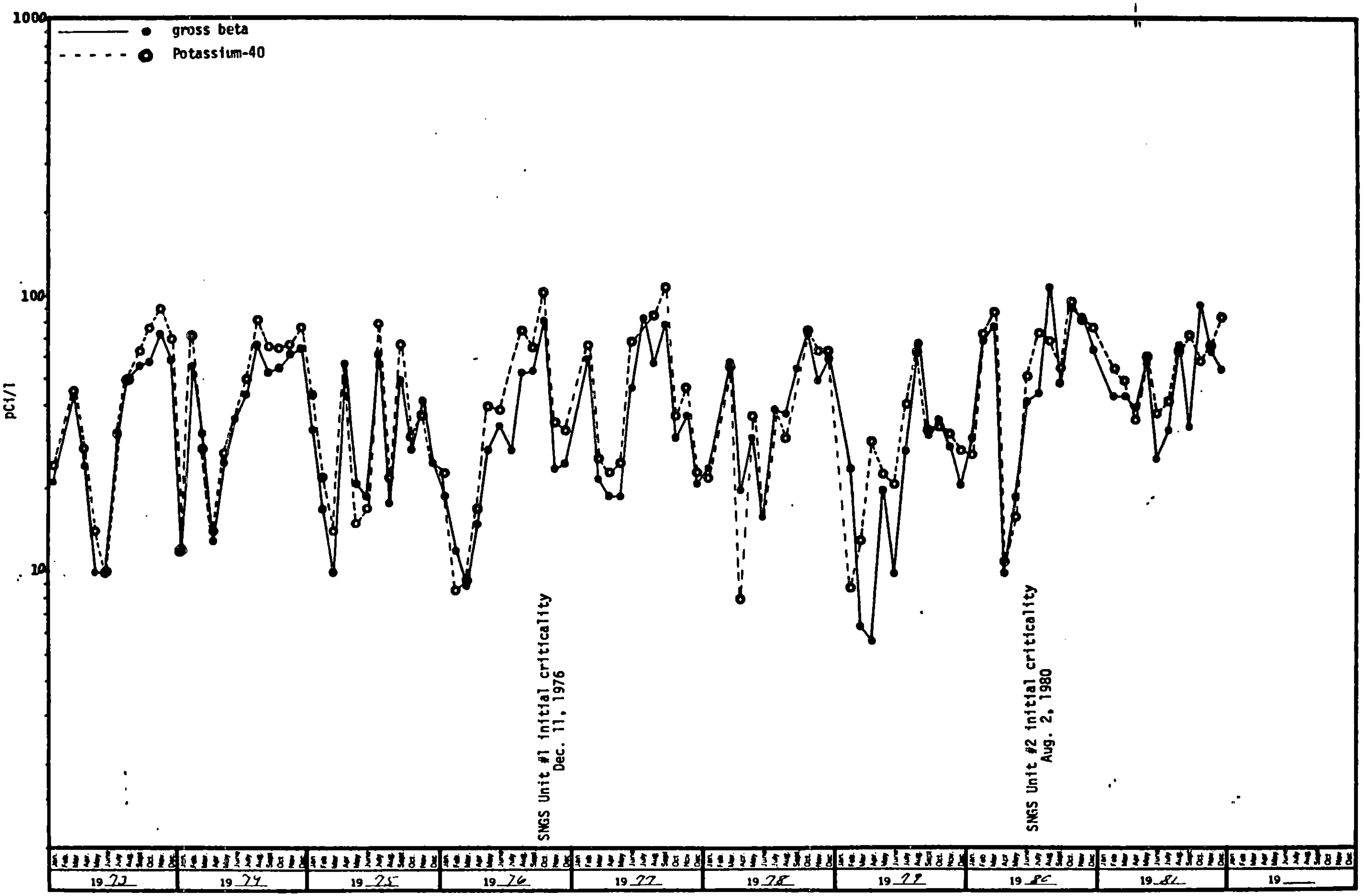


FIGURE 4

AVERAGE CONCENTRATIONS OF BETA EMITTERS AND POTASSIUM-40 IN THE DELAWARE RIVER IN THE VICINITY OF ARTIFICIAL ISLAND, 1973 THROUGH 1981



Analysis of surface water for tritium yielded an average concentration of 160 pCi/l and ranged from 58 to 412 pCi/l. These levels are similar to those measured in the preoperational program as shown in Figure 3. A gradual decrease in tritium activity from 1973 to 1981 can be attributed to general reduction in the world-wide tritium inventory with the cessation of routine atmospheric weapons testing.

Gross alpha concentrations were generally below LLD, which ranged from <0.2 to <1.3 pCi/l. Eleven of the 55 samples analyzed showed detectable gross alpha activity. The average (0.3 pCi/l) was within the same range as the LLDs for the year. Gross alpha activity may be expected in suspended solids from naturally occurring radionuclides especially during periods of high surface runoff.

Gross beta concentrations ranged from 10 to 129 pCi/l and averaged 51 pCi/l. Nearly all of the beta activity was contributed by K-40, a natural component of salt and brackish waters, as illustrated in Figure 4, which compares gross beta and K-40 concentrations in the Delaware River. Due to the flow rate variations and the tidal nature of the estuarine environment, large variations in the gross beta concentrations were observed throughout the year. Much of this variation can be attributed to the tidal stage at the time of sampling.

Levels of Sr-89 were below MDL (<0.6 to <2.3 pCi/l) in thirteen of seventeen samples. Concentrations of detected Sr-89 ranged from 0.5 to 1.5 pCi/l, and averaged 0.8 pCi/l. Levels of detectable Sr-90 ranged from 0.4 to 1.3 pCi/l in four of the seventeen samples. The MDL values for the remaining samples ranged from <0.3 to <0.9 pCi/l. The maximum level of Sr-90 detected in the preoperational program was 1.6 pCi/l (4).

Gamma spectrometric analysis of surface water samples showed detectable concentrations of K-40 in 53 of 55 samples. The average K-40 concentration was 57 pCi/l and ranged from 20 to 120 pCi/l. K-40 is a naturally occurring radionuclide which is expected to be found in salt and brackish waters.

Well Water (Tables C-17, C-18)

Monthly well water samples were taken from two indicator wells and one control well. All well water samples were analyzed for tritium, gross alpha and gross beta activity, and K-40 (by atomic absorption). Quarterly composites were analyzed for gamma emitters, and Sr-89 and Sr-90.

Detectable concentrations of tritium were observed in two of the twenty-seven samples with levels of 106 and 268 pCi/l. The LLDs ranged from <88 pCi/l to <174 pCi/l. Gross alpha concentrations were generally below LLD which ranged from <0.8 to <3.6 pCi/l. Two of the 36 samples analyzed showed detectable gross alpha activity (1.7 and 2.2 pCi/l). The concentrations of gross beta emitters averaged 11 pCi/l and ranged from 2.6 to 16 pCi/l. The potassium-40 activity as determined by atomic absorption averaged 8.5 pCi/l. This indicates that the gross beta activity observed in these samples is primarily the result of naturally occurring K-40, a beta emitter.

The only nuclide detected by gamma spectrometry was K-40 (19 to 22 pCi/l) in three of twelve samples. All results for Sr-89 were below the MDL of <0.6 to <2.2 pCi/l. Sr-90 was found in one sample with a concentration of 0.4 pCi/l. The range of MDLs for Sr-90 was <0.4 to <1.1 pCi/l.

Potable Water (Tables C-19, C-20)

Both raw and treated water samples were taken at the Salem Water Company, the only drinking water processing plant in the vicinity of Artificial Island. The raw water source for this plant is Laurel Lake (a tributary of the Delaware River) and several adjacent wells. Potable water samples were analyzed monthly for tritium, gross alpha and gross beta activity, and K-40 (by atomic absorption); Sr-89 and -90, and gamma emitters were analyzed on a quarterly basis.

The concentration of tritium averaged 104 pCi/l for all analyses, with no significant differences between the raw and treated samples. Detectable gross alpha activity was observed in 15 of 24 samples ranging between 0.5 pCi/l and 1.8 pCi/l with an average of 1.0 pCi/l. Gross beta and K-40 concentrations were lower than in the saline surface water, as expected for fresh water, with K-40 generally contributing less than 50% of the beta activity. The average gross beta concentrations were 3.9 pCi/l (raw) and 2.7 pCi/l (treated). The average K-40 results were 1.4 pCi/l (raw) and 1.5 pCi/l (treated).

Quarterly composites of raw and treated samples were analyzed for gamma emitters and Sr-89 and -90. No nuclides were detected by gamma spectrometry in any of the samples. Of the seven samples analyzed for Sr-89, two showed detectable concentrations (0.5 and 0.7 pCi/l). The MDL range for Sr-89 was <0.7 to <0.9 pCi/l. Sr-90 was observed in four of the seven samples with concentrations ranging from 0.3 to 1.1 pCi/l, and the average being 0.7 pCi/l.

Aquatic

Benthos (Table C-21)

Benthic organisms were collected at four locations and analyzed for Sr-89 and Sr-90. Levels of Sr-89 were below MDL (<0.2 to <169 pCi/g-dry) for all eight analyses. The wide fluctuations in MDL values were due to inconsistencies in sample size (0.01 to 9 grams dry). Three of eight samples showed detectable Sr-90 concentration averaging 1.2 pCi/g-dry. The detectable activity of these samples is within the MDL range (<0.8 to <83 pCi/g-dry) of the other analyses. The MDL for radiostrontium as required by the Environmental Technical Specifications for benthic organisms was not met in all of the samples due to the impracticality of obtaining a sufficiently large sample size of benthic organisms.

Sediment (Table C-22)

Sediment was collected semiannually at four locations and analyzed for Sr-90 and gamma emitters.

Levels of Sr-90 were below MDL (<0.04 to <0.1 pCi/g-dry) in seven of the eight samples analyzed. The single concentration (0.04 pCi/g-dry) was within the MDL range.

Results of gamma spectrometry showed detectable levels of a variety of naturally occurring radionuclides as well as man-made radionuclides. Various fallout nuclides were observed intermittently in the sediment samples.

Ingestion

Milk (Tables C-23, C-24)

Milk samples were taken twice a month from six local farms during 1981 and analyzed for I-131; gamma emitters, Sr-89 and Sr-90 were analyzed monthly. I-131 was not observed in any milk samples during 1981. Figure 5 shows the average I-131 concentrations in milk samples resulting from atmospheric nuclear weapons tests by the Peoples Republic of China (June 1974, March 1978, and October 1980) and the Three Mile Island incident in 1979.

Gamma spectrometry showed detectable concentrations of K-40 in all samples and Cs-137 in 36 of the 72 samples analyzed. The annual average concentrations were 1500 pCi/l for K-40 and 2.9 pCi/l for Cs-137. These levels were not significantly different between control and indicator stations.

Strontium-89 was detected in twelve of the sixty samples analyzed with results ranging between 1.8 pCi/l and 8.5 pCi/l. The range of MDL values for Sr-89 was <1.8 pCi/l to <37 pCi/l. The wide range of values for the MDL was due to low chemical yields and long decay periods in some of the analyses. All of the positive results detected were within the MDL range. The concentration of Sr-90 was positive in 53 of the 60 samples analyzed and averaged 3.6 pCi/l. The MDL range was <0.7 pCi/l to <8.9 pCi/l. Sr-90 concentrations were similar at indicator and control stations, indicating no contribution from SNGS. Due to the 28 year half-life and biological assimilation, Sr-90 can be expected to remain long after routine atmospheric testing has ceased. All Sr-89 and -90 analyses have been chemical yield verified by atomic absorption spectroscopy.

Fish (Tables C-26, C-27)

Edible fish samples (American Eel, White Perch, Channel Catfish, Spot, etc.) were collected at three locations and analyzed for tritium and gamma emitters. Fish bones were analyzed for Sr-89 and Sr-90.

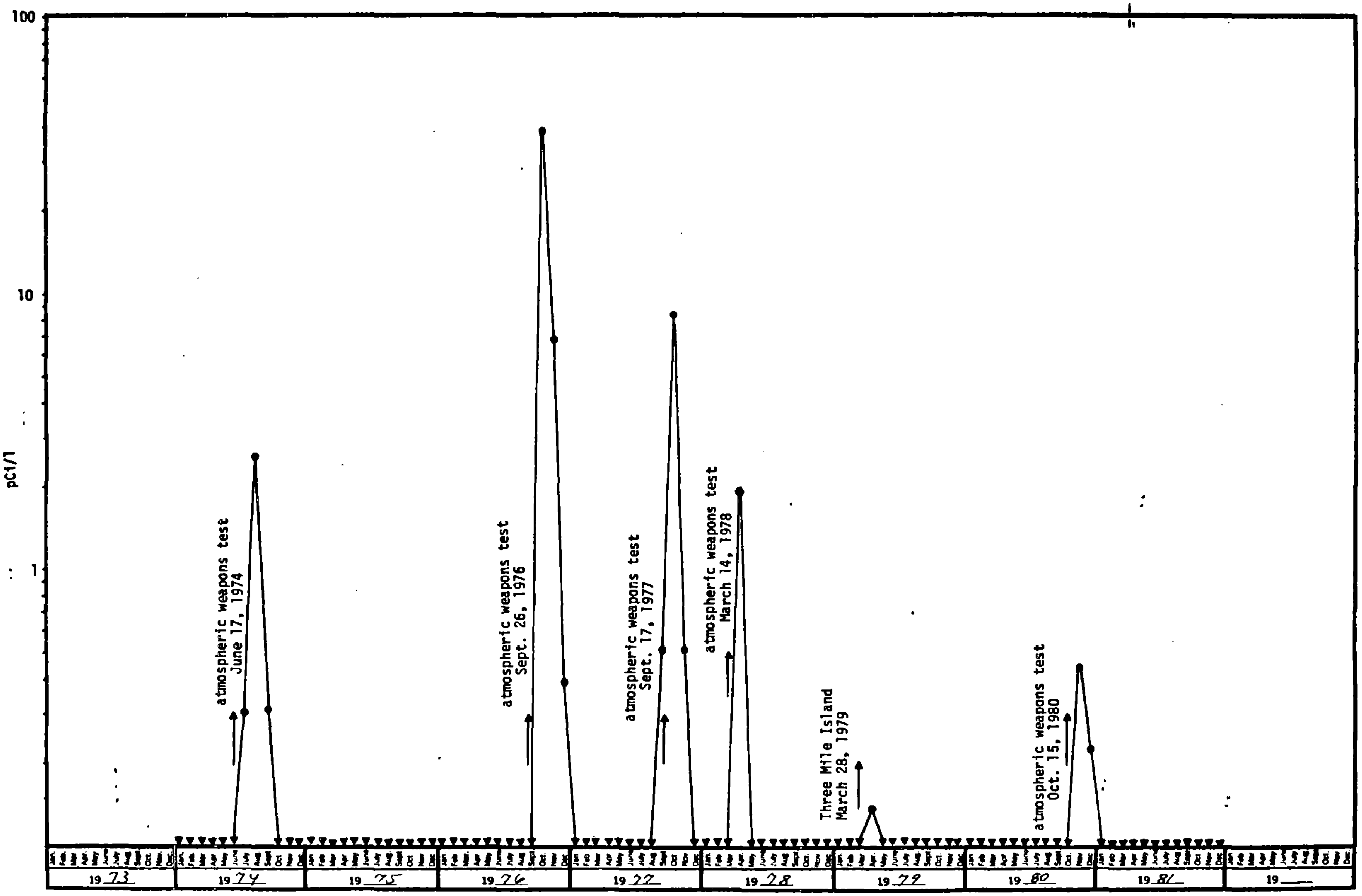
Tritium analyses were performed on both aqueous and organic fractions of the flesh portions of these samples. The average concentration of tritium was 82.5 pCi/l for the aqueous fraction and 200 pCi/l for the organic fraction. Of the six samples analyzed, all results are essentially the same as those found in surface water for the same period.

Gamma spectrometry of these samples showed K-40 in all six samples analyzed at an average concentration of 3.6 pCi/g-wet with a range of 2.9-4.6 pCi/g-wet.

All six bone samples analyzed for Sr-89 were below the MDL (<0.06 to <0.2 pCi/g-dry). Two of the six samples analyzed for Sr-90 had detectable concentrations of 0.04-0.05 pCi/g-dry. The maximum level detected during the preoperational period was 0.94 pCi/g-dry.

FIGURE 5

AVERAGE CONCENTRATIONS OF IODINE-131 IN MILK IN THE VICINITY OF ARTIFICIAL ISLAND, MAY 1974 THROUGH DECEMBER 1981



Blue Crab (Tables C-28, C-29)

Blue crab samples were collected at two locations and the flesh was analyzed for tritium in the aqueous fraction, gamma emitters and Sr-89 and -90. The shells were analyzed for Sr-89 and Sr-90.

One sample from station 11A1 showed detectable concentrations of tritium. The result (123±68 pCi/l) was comparable to tritium values found in surface water for this same period.

K-40 was the only gamma emitter detected with an average of 2.1 pCi/g-wet.

Detectable concentrations of Sr-89 were found in two of the four shell samples, and averaged 1.3 pCi/g-dry. The MDL range for Sr-89 in shells was <0.08 to <0.1 pCi/g-dry. All results for Sr-89 in flesh were below MDL with a range of 0.01 to 0.08 pCi/g-dry.

Three of four samples showed detectable activity with concentrations of 0.007 to 0.07 pCi/g-wet of Sr-90 in flesh. The MDL value was <0.007 pCi/g-wet. All of the shells had detectable activity of Sr-90. The range of activities was 0.24 to 1.0 pCi/g-dry with no difference observed between indicator and control stations.

Food Products (Table C-30)

A wide variety of other human food products was sampled and analyzed for gamma emitters and Sr-89 and -90. These included cucumbers, asparagus, peppers, cabbage, corn, squash and tomatoes. All samples contained K-40 at concentrations from 1.5 to 5.9 pCi/g-wet. No other gamma emitters were detected in these food products. Sr-89 concentrations were all below MDL, which ranged from <0.006 to <0.2 pCi/g-wet. Eight of the fourteen samples analyzed showed detectable Sr-90 activity ranging from 0.003 to 0.015 pCi/g-wet. The MDLs ranged from <0.003 to <0.007 pCi/g-wet.

Game (Table C-31)

Two samples of muskrat were taken during this period. Flesh from both samples was analyzed for gamma emitters while muskrat bones were analyzed for Sr-89 and Sr-90. Only naturally occurring K-40 was detected in the flesh samples ranging from 2.4 to 3.1 pCi/g. Both results for Sr-89 in muskrat bones were below MDL (<0.2 and <0.9 pCi/g-dry). Detectable Sr-90 concentrations averaging 0.5 pCi/g-dry were observed in both samples.

Beef (Table C-31)

Three beef samples were collected during this reporting period. Only naturally occurring K-40 was detected in these samples at concentrations ranging between 1.7 and 2.7 pCi/g-wet.

Beef Thyroid (Table C-31)

Three beef thyroids were taken during this period and analyzed for gamma emitters. One sample showed a detectable concentration of naturally occurring K-40 at a concentration of 1.3 pCi/g-wet. The other samples had LLDs for K-40 of <0.6 and <1.1 pCi/g-wet. No I-131 was detected in the samples with LLDs between <0.076 and <0.095 pCi/g-wet.

Fodder Crops (Table C-32)

Nine fodder crop samples were taken at six local farms and analyzed for gamma emitters. Gamma spectrometry of these samples showed several radionuclides, both man-made and naturally occurring. Of the naturally occurring gamma emitters present, only K-40 was observed in all samples with an average of 11 pCi/g-dry. The other detected naturally occurring nuclide was Be-7 which occurred in one weed chop sample. The man-made nuclide Cs-137 was observed in one soybean sample. The presence of Cs-137 can be attributed to fallout from atmospheric nuclear weapons tests.

CONCLUSIONS

The Radiological Environmental Monitoring Program for Salem Nuclear Generating Station at Artificial Island was conducted during 1981 in accordance with the SNGS Environmental Technical Specifications. The objectives of the program were met during this period. The data collected assists in demonstrating that SNGS Units #1 and #2 were operated in compliance with Environmental Technical Specifications.

From the results obtained, it can be concluded that the levels and fluctuations of radioactivity in environmental samples were as expected for an estuarine environment. In addition no increases were observed in either radionuclide concentrations in critical pathways or with respect to radionuclide build up. Ambient radiation levels were relatively low, averaging about 5.84 mrad/std. month. No other unusual radiological characteristics were observed in the environs of Artificial Island. The operation of SNGS Units #1 and #2 had no discernable effect on the radiological characteristics of the environs of Artificial Island.

REFERENCES

(1) Radiation Management Corporation. "Salem Nuclear Generating Station - Radiological Environmental Monitoring Program - 1973." RMC-TR-74-09, 1974.

(2) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1974 Annual Report." RMC-TR-75-04, 1975.

(3) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1975 Annual Report." RMC-TR-76-04, 1976.

(4) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - Preoperational Summary - 1973 through 1976." RMC-TR-77-03, 1978.

(5) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - December 11 to December 31, 1976." RMC-TR-77-02, 1977.

(6) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1977 Annual Report." RMC-TR-78-04A, 1978.

(7) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1978 Annual Report." RMC-TR-79-03, 1979.

(8) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1979 Annual Report." RMC-TR-80-03, 1980.

(9) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - 1980 Annual Report." RMC-TR-81-03, 1981.

(10) Public Service Electric and Gas Company. "Environmental Report, Operating License Stage - Salem Nuclear Generating Station Units 1 and 2." 1971.

(11) United States Atomic Energy Commission. "Final Environmental Statement - Salem Nuclear Generating Station, Units 1 and 2." Docket No. 50-272 and 50-311, 1973.

(12) Public Service Electric and Gas Company. "Final Safety Analysis Report - Salem Nuclear Generating Station, Units 1 and 2." 1972.

(13) Public Service Electric and Gas Company. "Environmental Technical Specifications - Salem Nuclear Generating Station Units 1 and 2." 1976.

(14) Radiation Management Corporation. "Quality Control Data 1981 - Annual Report", 1982.

REFERENCES (cont.)

(15) Radiation Management Corporation. "Artificial Island Radiological Environmental Monitoring Program - Statistical Interpretation of Results of the Thermoluminescent Dosimetry Program" RMC-TR-78-11, 1978.

APPENDIX A

PROGRAM SUMMARY

ARTIFICIAL ISLAND RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

SALEM NUCLEAR GENERATING STATION DOCKET NO. 50-272

SALEM COUNTY, NEW JERSEY JANUARY 1, 1981 TO DECEMBER 31, 1981

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)*	ALL INDICATOR LOCATIONS MEAN** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (RANGE)	CONTROL LOCATION MEAN (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Air Particulates (10^{-3} pCi/m^3)	Alpha 78	0.6	1.4 (31/39) (0.6-2.7)	16E1 4.1 mi NNW	1.4 (31/39) (0.6-2.7)	1.2 (35/39) (0.6-2.1)	0
	Beta 312	-	141 (273/273) (29-471)	2F2 8.7 mi NNE	146 (39/39) (33-471)	144 (39/39) (32-386)	0
	Sr-89 24	0.8	5.4 (20/21) (0.7-9.3)	16E1 4.1 mi NNW	6.95 (2/3) (6.9-7.0)	5.8 (3/3) (1.3-8.7)	0
	Sr-90 24	0.8	0.9 (20/21) (0.3-2.2)	3H3 110 mi NE	1.3 (3/3) (0.8-2.2)	1.3 (3/3) (0.8-2.2)	0
	Gamma 24						
	Be-7	-	81 (21/21) (48-110)	2S2 0.4 mi NNE	93 (3/3) (69-110)	75 (3/3) (57-92)	0
	K-40	6.1	6.4 (6/21) (4.9-7.9)	2F2 8.7 mi NNE	7.9 (1/3) (7.9)	6.1 (1/3) (6.1)	0
	Mn-54	0.6	1.8 (10/21) (0.6-2.8)	5S1 1.0 mi E	2.2 (1/3) (2.2)	2.1 (1/3) (2.1)	0
				10D1 3.9 mi SSW	2.2 (1/3) (2.2)		
	Nb-95	-	61 (21/21) (14-120)	2S2 0.4 mi NNE	67 (3/3) (17-100)	62 (3/3) (17-110)	0
	Zr-95	-	24 (21/21) (5.1-46)	2S2 0.4 mi NNE	29 (3/3) (6.6-40)	25 (3/3) (6.4-42)	0
	Ru-103	0.9	11 (15/21) (1.1-15)	2F2 8.7 mi NNE	14 (2/3) (13-15)	9.5 (3/3) (1.4-14)	0
	Ru-106	6.1	16 (13-21) (7.4-26)	2F2 8.7 mi NNE	24 (1/3) (24)	15 (3/3) (6.6-27)	0
	Sb-125	1.7	- (0/21) -	3H3 110 mi NE	3.2 (2/3) (3.0-3.4)	3.2 (2/3) (3.0-3.4)	0
	Cs-137	-	2.8 (21/21) (0.9-5.5)	2F2 8.7 mi NNE	3.1 (3/3) (1.4-5.1)	2.5 (3/3) (0.9-4.6)	0
	Ce-141	1.0	9.3 (14/21) (6.4-12)	5S1 1.0 mi E	10 (2/3) (8.1-12)	9.9 (2/3) (8.7-11)	0
	Ce-144	-	50 (21/21) (24-110)	5D1 3.5 mi E	56 (3/3) (29-110)	52 (3/3) (25-100)	0
Air Iodine (10^{-3} pCi/m^3)	I-131 364	5.4	- (0/312) -	None Detected	-	- (0/52) -	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)*	ALL INDICATOR LOCATIONS MEAN** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (RANGE)	CONTROL LOCATION MEAN (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Precipitation (pCi/l)	Alpha 12	0.6	1.6 (3/12) (1.2-2.3)	2F2 8.7 mi NNE	1.6 (3/12) (1.2-2.3)	No Control Location	0
	Beta 12	2.3	30 (12/12) (4.7-70)	2F2 8.7 mi NNE	30 (12/12) (4.7-70)	No Control Location	0
	H-3 9	87	107 (3/9) (86-124)	2F2 8.7 mi NNE	107 (3/9) (86-124)	No Control Location	0
	Sr-89 4	0.8	3.8 (3/4) (0.6-7.5)	2F2 8.7 mi NNE	3.8 (3/4) (0.6-7.5)	No Control Location	0
	Sr-90	0.4	1.1 (2/4) (0.8-1.4)	2F2 8.7 mi NNE	1.1 (2/4) (0.8-1.4)	No Control Location	0
	Gamma 4						
	Be-7	7.6	34 (3/4) (24-44)	2F2 8.7 mi NNE	34 (3/4) (24-44)	No Control Location	0
	Zr-95	0.6	4.3 (1/4) (4.3)	2F2 8.7 mi NNE	4.3 (1/4) (4.3)	No Control Location	0
	Nb-95	0.6	11 (1/4) (11)	2F2 8.7 mi NNE	11 (1/4) (11)	No Control Location	0
	Ru-103	(1)	4.7 (1/4) (4.7)	2F2 8.7 mi NNE	4.7 (1/4) (4.7)	No Control Location	0
	Ce-141	(1)	3.4 (1/4) (3.4)	2F2 8.7 mi NNE	3.4 (1/4) (3.4)	No Control Location	0
Direct Radiation (mrad/std. month)	Gamma 288 Dose (monthly)	-	5.40 (240/240) (3.28-16.51)	11S1 0.09 mi SW	7.84 (12/12) (4.64-16.51)	5.84 (48/48) (4.97-7.14)	0
	Gamma 96 Dose (quarterly)	-	5.31 (80/80) (3.31-14.45)	11S1 0.09 mi SW	8.18 (4/4) (4.94-14.45)	5.64 (16/16) (4.90-6.58)	0
	Gamma 34 Dose (semi-annual)	-	5.46 (28/28) (4.40-6.43)	11E2 5.0 mi SW	6.12 (2/2) (5.81-6.43)	5.92 (6/6) (5.55-6.30)	0
Surface Water (pCi/l)	H-3 46	87	178 (15/35) (77-412)	11A1 0.2 mi SW	277 (3/8) (97-412)	125 (8/11) (58-246)	0
	Alpha 55	0.2	0.4 (8/44) (0.2-0.8)	11A1 0.2 mi SW	0.5 (3/11) (0.3-0.8)	0.3 (3/11) (0.2-0.4)	0
	Beta 55	-	50 (44/44) (10-129)	7E1 4.5 mi SE	66 (11/11) (33-122)	54 (11/11) (10-129)	0
	Sr-89 17	0.6	0.9 (3/13) (0.5-1.5)	1F2 7.1 mi N	1.1 (2/3) (0.7-1.5)	0.6 (1/4) (0.6)	0
	Sr-90 17	0.3	0.8 (4/13) (0.4-1.3)	11A1 0.2 mi SW	1.3 (1/3) (1.3)	- (0/4) -	0
	Gamma 55						
	K-40	11	60 (42/44) (20-120)	7E1 4.5 mi SE	88 (11/11) (49-120)	54 (11/11) (22-85)	0

ARTIFICIAL ISLAND RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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SALEM COUNTY, NEW JERSEY JANUARY 1, 1981 TO DECEMBER 31, 1981

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD)*	ALL INDICATOR LOCATIONS MEAN** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (RANGE)	CONTROL LOCATION MEAN (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Well Water (pCi/l)	H-3	27	88	106 (1/18) (106)	3E1 4.1 mi NE	106 (1/18) (106)	268 (1/9) (268)	0
	Alpha	36	0.8	2.2 (1/24) (2.2)	4S1 Site Well #5 ENE	2.2 (1/24) (2.2)	1.7 (1/12) (1.7)	0
	Beta	36	-	12 (24/24) (2.6-16)	4S1 Site Well #5 ENE	13 (12/12) (2.6-14)	9.2 (12/12) (7.6-12)	0
	K-40	36	-	9.1 (24/24) (2.2-14)	4S1 Site Well #5 ENE	10 (12/12) (2.6-14)	7.3 (12/12) (1.7-9.6)	0
	Sr-89	9	0.6	- (0/3) -	None Detected	-	- (0/6) -	0
	Sr-90	9	0.4	0.4 (1/3) (0.4)	4S1 Site Well #5 ENE	0.4 (1/3) (0.4)	- (0/6) -	0
	Gamma K-40	12	9.3	22 (1/4) (22)	4S1 Site Well #5 ENE	22 (1/4) (22)	20 (2/8) (19-20)	0
Potable Water Raw-Treated	H-3	21	82	104 (5/21) (74-151)	2F3 8.0 mi NNE	104 (5/21) (74-151)	No Control Location	0
	Alpha	24	0.4	0.99 (15/24) (0.5-1.8)	2F3 8.0 mi NNE	0.99 (15/24) (0.5-1.8)	No Control Location	0
	Beta	24	-	3.3 (24/24) (1.4-6.2)	2F3 8.0 mi NNE	3.3 (24/24) (1.4-6.2)	No Control Location	0
	Sr-89	7	0.7	0.6 (2/7) (0.5-0.7)	2F3 8.0 mi NNE	0.6 (2/7) (0.5-0.7)	No Control Location	0
	Sr-90	7	0.5	0.7 (4/7) (0.3-1.1)	2F3 8.0 mi NNE	0.7 (4/7) (0.3-1.1)	No Control Location	0
	K-40	24	-	1.4 (24/24) (0.9-3.0)	2F3 8.0 mi NNE	1.4 (24/24) (0.9-3.0)	No Control Location	0
	Gamma	8		- (0/8) -	None Detected	- (0/8) -	No Control Location	0
Benthos (pCi/g-dry)	Sr-89	8	0.2	- (0/6) -	None Detected		- (0/2) -	0
	Sr-90	8	0.8	1.2 (3/6) (0.2-3.0)	16F1 6.9 mi NNW	3.0 (1/2) (3.0)	- (0/2) -	0

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MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED		LOWER LIMIT OF DETECTION (LLD)*	ALL INDICATOR LOCATIONS MEAN** (RANGE)	LOCATION WITH HIGHEST MEAN NAME DISTANCE AND DIRECTION	LOCATION WITH HIGHEST MEAN MEAN (RANGE)	CONTROL LOCATION MEAN (RANGE)	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
Sediment (pCi/g-dry)	Sr-90	8	0.04	0.04 (1/6) (0.04)	12C1 2.5 mi. WSW	0.04 (1/2) (0.04)	- (0/2) -	0
	Gamma	8						
	K-40		-	14 (6/6) (13-18)	12C1 2.5 mi. WSW	16 (2/2) (16)	16 (2/2) (16)	0
	Co-60		0.03	0.19 (1/6) (0.19)	11A1 0.2 mi. SW	0.19 (1/2) (0.19)	- (0/2) -	0
	Zr-95		0.06	0.17 (1/6) (0.17)	16F1 6.9 mi. NNW	0.17 (1/2) (0.17)	- (0/2) -	0
	Nb-95		0.06	0.2 (3/6) (0.08-0.44)	16F1 6.9 mi. NNW	0.44 (1/2) (0.44)	- (0/2) -	0
	Cs-137		0.04	0.1 (4/6) (0.04-0.17)	11A1 0.2 mi. SW	0.15 (2/2) (0.13-0.17)	- (0/2) -	0
	Ra-226		-	0.54 (6/6) (0.46-0.65)	11A1 0.2 mi. SW	0.61 (2/2) (0.57-0.65)	0.54 (2/2) (0.48-0.60)	0
	Th-232		-	0.78 (6/6) (0.47-1.0)	16F1 6.9 mi. NNW	1.0 (2/2) (1.0)	0.88 (2/2) (0.86-0.9)	0
Fruits & Vegetables (pCi/g-wet)	Sr-89	14	0.006	- (0/7) -	None Detected	-	- (0/7) -	0
	Sr-90	14	0.003	0.009 (3/7) (0.004-0.015)	1F3 5.9 mi. N	0.015 (1/1) (0.015)	0.005 (5/7) (0.003-0.013)	0
	Gamma	14						
	K-40		-	2.2 (7/7) (1.5-2.8)	3H4 88 mi. NE	3.1 (4/4) (1.5-5.9)	2.8 (7/7) (1.5-5.9)	0
Game (pCi/g-dry)	Sr-89 (bones)	2	0.2	- (0/1) -	None Detected	-	- (0/1) -	0
	Sr-90 (bones)	2	-	0.50 (1/1) (0.50)	3E1 4.1 mi. NE	0.05 (1/1) (0.05)	0.5 (1/1) (0.5)	0
					11E1 4-5 mi. SW	0.5 (1/1) (0.5)		
(pCi/g-wet)	Gamma (flesh)	2						
	K-40		-	2.4 (1/1) (2.4)	11E1 4-5 mi. SW	3.1 (1/1) (3.1)	3.1 (1/1) (3.1)	0

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Milk (pCi/l)	I-131	144	0.04	- (0/120) -	None Detected	-	- (0/24) -	0
	Sr-89	60	1.8	3.8 (8/48) (1.8-8.5)	15F1 5.2 mi NW	6.6 (2/12) (4.7-8.5)	3.9 (4/12) (3.0-4.9)	0
	Sr-90	60	0.7	3.4 (42/48) (0.6-6.8)	5F2 7.0 mi E	4.9 (8/9) (0.6-6.8)	4.0 (11/12) (2.9-5.3)	0
	Gamma	72						
	K-40		-	1472 (60/60) (1200-2000)	2F4 6.3 mi NNE	1533 (12/12) (1300-1900)	1375 (12/12) (1100-1700)	0
	Cs-137		1.2	2.8 (31/60) (1.4-6.4)	5F2 7.0 mi E	3.5 (8/12) (1.4-6.4)	3.2 (5/12) (1.5-4.4)	0
Edible Fish (pCi/l)	H-3 (aqueous)	6	86	82.5 (2/4) (82-83)	7E1 4.5 mi SE	83 (1/2) (83)	- (0/2) -	0
	H-3 (organic)	6	112	200 (3/4) (126-317)	11A1 0.2 mi SW	317 (1/2) (317)	- (0/2) -	0
(pCi/g-dry)	Sr-89 (bones)	6	0.06	- (0/4) -	None Detected	-	- (0/2) -	0
	Sr-90 (bones)	6	0.04	0.05 (1/4) (0.05)	7E1 4.5 mi SE	0.05 (1/2) (0.05)	0.04 (1/2) (0.04)	0
(pCi/g-wet)	Gamma	6						
	K-40		-	3.6 (4/4) (2.9-4.6)	7E1 4.5 mi SE	4.0 (2/2) (3.3-4.6)	3.5 (2/2) (3.2-3.8)	0
	Cs-137		0.008	0.016 (1/4) (0.016)	7E1 4.5 mi SE	0.016 (1/2) (0.016)	- (0/2) -	0
Blue Crab (pCi/g-dry)	Sr-89 (shells)	4	0.08	0.8 (1/2) (0.8)	12C1 2.5 mi WSW	1.7 (1/2) (1.7)	1.7 (1/2) (1.7)	0
	Sr-90 (shells)	4	-	0.59 (2/2) (0.24-0.94)	12C1 2.5 mi WSW	0.64 (2/2) (0.28-1.0)	0.64 (2/2) (0.28-1.0)	0
(pCi/l)	H-3 (flesh)	4	86	123 (1/2) (123)	11A1 0.2 mi SW	123 (1/2) (123)	- (0/2) -	0
(pCi/g-wet)	Sr-89 (flesh)	4	0.01	- (0/2) -	None Detected	-	- (0/2) -	0
	Sr-90 (flesh)	4	0.007	0.07 (1/2) (0.07)	11A1 0.2 mi SW	0.07 (1/2) (0.07)	0.02 (2/2) (0.02)	0
	Gamma	4						
	K-40		-	1.9 (2/2) (1.7-2.1)	12C1 2.5 mi WSW	2.3 (2/2) (2.3)	2.3 (2/2) (2.3)	0

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Beef (pCi/g-wet)	Gamma 3 K-40	-	2.2 (2/2) (1.7-2.7)	3E1 4.1 mi. NE	2.2 (2/2) (1.7-2.7)	1.7 (1/1) (1.7)	0
Beef Thyroid (pCi/g-wet)	Gamma 3 K-40	0.6	1.3 (1/2) (1.3)	3E1 4.1 mi. NE	1.3 (1/2) (1.3)	- (0/1) -	0
Fodder Crops (pCi/g-dry)	Gamma 9 Be-7	0.1	2.3 (1/7) (2.3)	15F1 5.2 mi. NW	2.3 (1/3) (2.3)	- (0/2) -	0
	K-40	-	9.9 (7/7) (5.2-16)	3E1 4.1 mi. NE	16 (1/1) (16)	15 (2/2) (8.7-21)	0
	Cs-137	0.2	0.04 (1/7) (0.04)	3E1 4.1 mi. NE	0.04 (1/1) (0.04)	- (0/2) -	0

* LLD listed is the lowest calculated LLD during reporting period. Strontium-89 and -90 detection levels are Minimum Detectable Levels (MDLs).

** Mean calculated using values above LLD or MDL only. Fraction of measurements above LLD or MDL are in parentheses.

(1) Indicates that no LLD was calculated for that nuclide in that media.

APPENDIX B

SAMPLE DESIGNATION

AND

LOCATIONS

APPENDIX B

Sample Designation

RMC identifies samples by a three part code. The first two letters are the power station identification code, in this case "SA". The next three letters are for the media sampled.

AIO	= Air Iodine		GAM	= Game	
APT	= Air Particulates		GAD	= Deer	
ECH	= Hard Shell Blue Crab		IDM	= Immersion Dose (TLD)	
ESB	= Benthos		MLK	= Milk	
ESF	= Edible Fish		PWA	= Potable Water; (PWR = raw, PWT = treated)	
ESS	= Sediment		RWA	= Rain Water	
FPB	= Beef		SWA	= Surface Water	
FPV	= Food Products, Various		THB	= Bovine Thyroid	
FPG	= Corn		VGT	= Fodder Crops	
FPL	= Green Leafy Vegetables		WWA	= Well Water	

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 sixteen angular sectors of 22.5 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 plant:

S	= On-site 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, . . . For example, the designation SA-WWA-5D1 would indicate a sample in the SNGS program SA, consisting of well water (WWA), which had been collected in the 22.5 degree sector centered on each axis (5), at a distance of 3 to 4 miles off-site (D). The number 1 indicates that this is sampling station #1 in the designated area.

Sampling Locations

All sampling locations and specific information about the individual locations are given in Table B-1. Maps B-1 and B-2 show the locations of sampling stations with respect to the site.

TABLE B-1

STATION CODE	STATION LOCATION	SAMPLE TYPES
1F1	5.8 mi. N of vent; Fort Elfsborg	APT,IDM
1F2	7.1 mi. N of vent; midpoint of Delaware River	SWA
1F3	5.9 mi. N of vent; local farm	FPL
1G1	13 mi. N of vent; local farm	FPG
1G3	19 mi. N of vent; Wilmington, Delaware	IDM
2S2	0.4 mi. NNE of vent	APT,AIO,IDM
2E1	4.4 mi. NNE of vent; local farm	IDM,FPV
2F2	8.7 mi. NNE of vent; Salem Substation	APT,AIO,RWA,IDM
2F3	8.0 mi. NNE of vent; Salem Water Company	PWR,PWT
2F4	6.3 mi. NNE of vent; local farm	MLK,VGT
2F5	7.4 mi. NNE of vent; Salem High School	IDM
2H1	34 mi. NNE of vent; RMC, Phila.	IDM
3E1	4.1 mi. NE of vent; local farm	IDM,WWA,THB, FPV,FPG,GAM, FPB
3F2	5.1 mi. NE of vent; Hancocks Bridge Municipal Bldg.	IDM
3F3	8.6 mi. NE of vent; Quinton Township School	IDM
3G1	17 mi. NE of vent; local farm	IDM,MLK,FPG,VGT
3H1	32 mi. NE of vent; National Park, N.J.	IDM
3H3	110 mi. NE of vent; Maplewood Laboratories	APT,AIO,IDM
3H4	88 mi. NE of vent; local farm	FPV,FPG
4S1	1400 ft. ENE of vent; site well #5	WWA
4D2	3.7 mi. ENE of vent; Alloway Creek Neck Road	IDM

TABLE B-1 (CONT.)

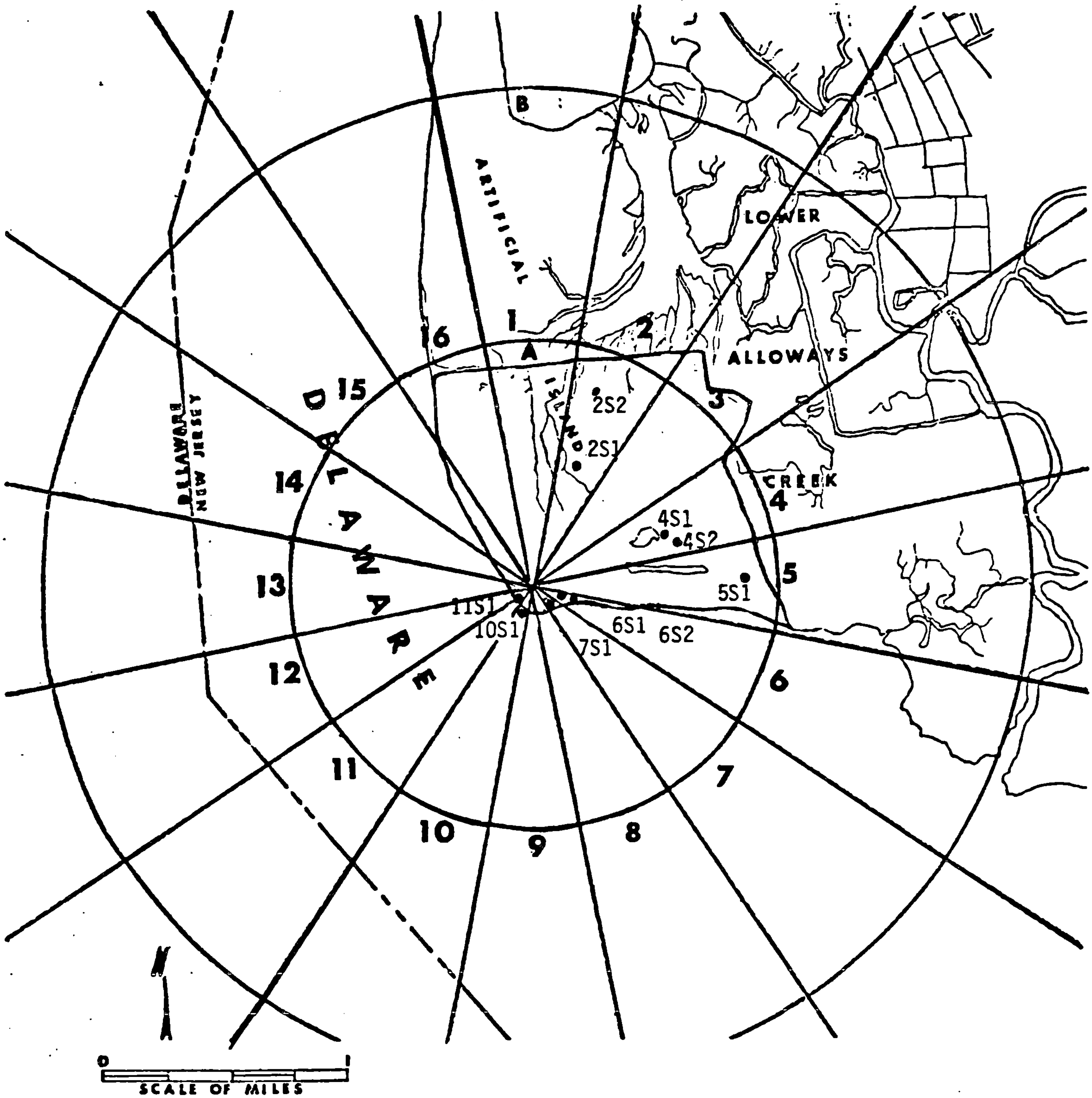
STATION CODE	STATION LOCATION	SAMPLE TYPES
5S1	1.0 mi. E of vent; site access road	APT,AIO,IDM
5D1	3.5 mi. E of vent; local farm	APT,AIO,IDM WWA,FPV
5F1	8.0 mi. E of vent	IDM,FPV
5F2	7.0 mi. E of vent; local farm	MLK
6S2	0.2 mi. ESE of vent; observation bldg.	IDM
6F1	6.4 mi. ESE of vent; Stow Neck Road	IDM
7S1	0.12 mi. SE of vent; station personnel gate	IDM
7E1	4.5 mi. SE of vent; 1 mi. W of Mad Horse Creek	SWA,ESB,ESS,ESF
7F2	9.1 mi. SE of vent; Bayside, New Jersey	IDM
9E1	4.2 mi. S of vent	IDM
10S1	0.14 mi. SSW of vent; site shoreline	IDM
10D1	3.9 mi. SSW of vent; Taylor's Bridge Spur	APT,AIO,IDM
10F2	5.8 mi. SSW of vent	IDM
10G1	12 mi. SSW of vent; Smyrna, Delaware	IDM
11S1	0.09 mi. SW of vent; site shoreline	IDM
11A1	0.2 mi. SW of vent; outfall area	SWA,ESB,ESS, ESF,ECH
11D1	3.5 mi. SW of vent	GAM
11E1	4-5 mi. SW of vent	GAM
11E2	5.0 mi. SW of vent	IDM
11F1	5.2 mi. SW of vent; Taylor's Bridge, Delaware	IDM
12C1	2.5 mi. WSW of vent; west bank of Delaware river	SWA,ESF,ECH, ESB,ESS

TABLE B-1 (CONT.)

STATION CODE	STATION LOCATION	SAMPLE TYPES
12E1	4.4 mi. WSW of vent; Thomas Landing	IDM
12F1	9.4 mi. WSW of vent; Townsend Elementary School	IDM
13E1	4.2 mi. W of vent; Diehl House Lab	IDM
13E3	4.9 mi. W of vent; local farm	MLK,VGT
13F1	9.8 mi. W of vent; Middletown, Delaware	IDM
13F2	6.5 mi. W of vent; Odessa, Delaware	IDM
13F3	9.3 mi. W of vent; Redding Middle School, Middletown, DE	IDM
14D1	3.4 mi. WNW of vent; Bay View, Delaware	IDM
14F1	5.5 mi. WNW of vent; local farm	MLK,FPB,THB,VGT
14F2	6.6 mi. WNW of vent; Boyds Corner	IDM
14F3	5.0 mi. WNW of vent; local farm	FPV,FPG
15F1	5.2 mi. NW of vent; local farm	MLK,FPG,VGT
15F3	5.4 mi. NW of vent	IDM
16E1	4.1 mi. NNW of vent; Port Penn	APT,AIO,IDM
16F1	6.9 mi. NNW of vent; C & D Canal	SWA,ESB,ESS
16F2	8.1 mi. NNW of vent; Delaware City Public School	IDM
16G1	15 mi. NNW of vent; Greater Wilmington Airport	IDM

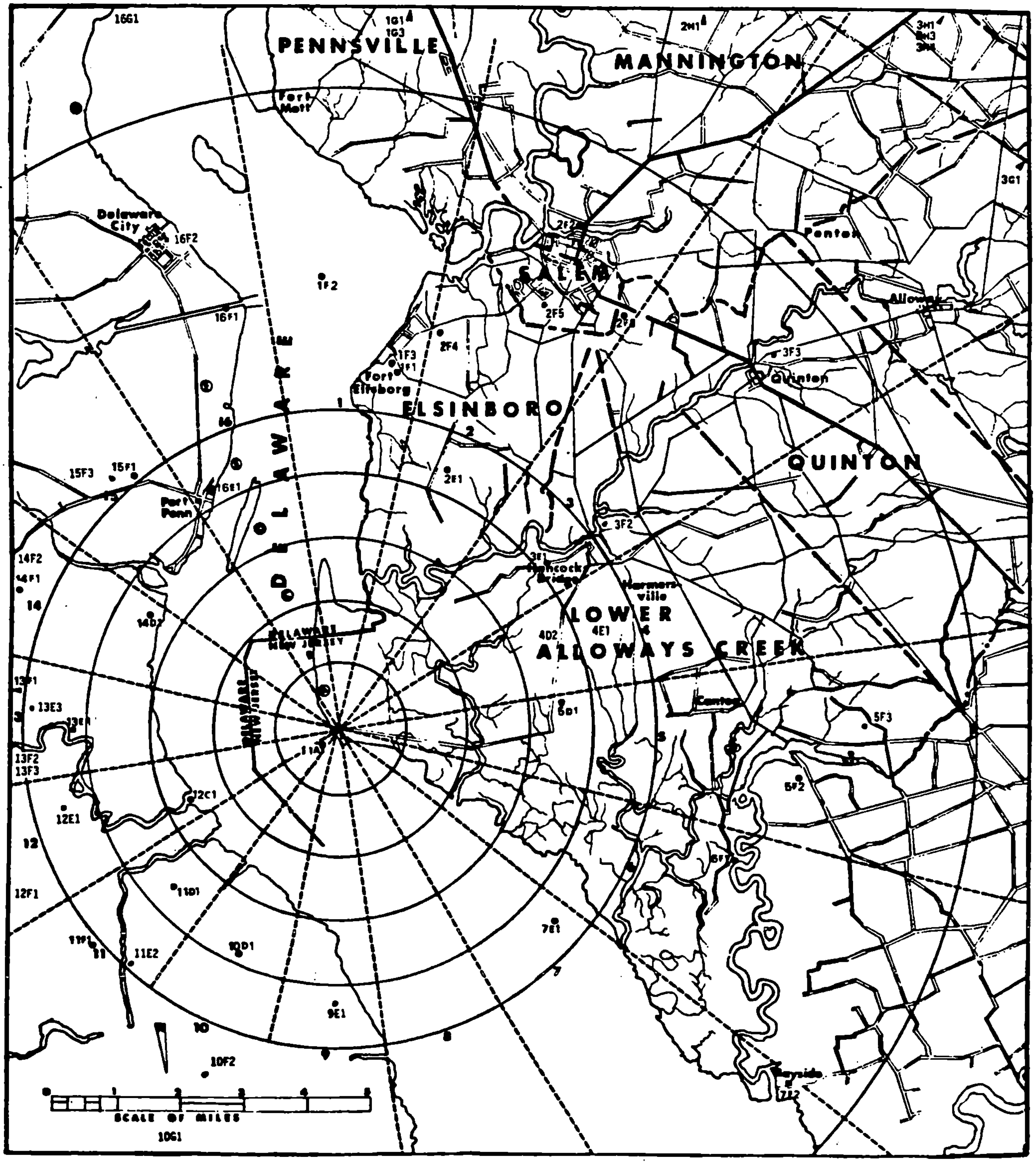
MAP B-1

ON SITE SAMPLING LOCATIONS
ARTIFICIAL ISLAND



MAP B-2

OFF SITE SAMPLING LOCATIONS
ARTIFICIAL ISLAND



APPENDIX C

1981 DATA TABLES

DATA TABLES

Appendix C presents the analytical results of the 1981 Artificial Island Radiological Environmental Monitoring Program for the period of January 1 to December 31.

DATA TABLES (cont.)

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TABLE C-1

CONCENTRATIONS OF GROSS ALPHA EMITTERS IN AIR PARTICULATES

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

STATION NUMBER	JANUARY*	FEBRUARY	MARCH	APRIL	MAY
SA-APT-16E1	1.5±0.8	1.9±0.7	<0.7	1.2±0.7	<1.1
	1.7±0.7	1.3±0.5	2.0±0.9	1.1±0.6	0.9±0.6
	1.6±0.9	1.1±0.6	1.4±0.6	1.0±0.6	0.9±0.8
	1.1±0.6	1.1±0.8	2.7±0.8	0.9±0.6	1.4±0.6
	0.6±0.6				<1.2
SA-APT-3H3 (Control Station)	1.4±0.8	1.3±0.7	0.6±0.6	0.9±0.6	<1.1
	1.2±0.7	1.2±0.4	1.2±0.6	1.8±0.7	<0.6
	1.5±0.9	1.3±0.7	1.1±0.6	1.3±0.6	0.9±0.7
	1.2±0.7	1.0±0.7	2.1±0.7	0.9±0.6	1.2±0.6
	1.6±0.7				<1.0

STATION NUMBER	JUNE	JULY	AUGUST	SEPTEMBER**	AVERAGE
SA-APT-16E1	0.9±0.6	<0.8	1.2±0.6	1.3±0.7	
	<0.9	1.5±0.6	1.6±0.7	1.9±0.8	
	1.5±0.6	1.4±0.7	<0.7	1.3±0.8	
	1.7±0.8	<0.7	0.9±0.7	1.2±0.4	1.3±0.9
		<1.2			
SA-APT-3H3 (Control Station)	1.4±0.7	0.7±0.6	1.2±0.7	1.5±0.7	
	1.0±0.6	1.2±0.6	1.4±0.6	1.4±0.8	
	1.1±0.6	1.1±0.6	1.1±0.6	1.2±0.7	
	0.7±0.6	0.8±0.5	1.5±0.7	1.0±0.4	1.2±0.6
		<1.1			

* Sampling dates can be found on Table C-6.

** Program discontinued by RMC after the third quarter.

#1/1 rec. 1/20/82

TABLE C-2

CONCENTRATIONS OF BETA EMITTERS IN AIR PARTICULATES

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

MONTH	STATION NO. SA-APT-2S2	SA-APT-5S1	SA-APT-5D1	SA-APT-10D1	SA-APT-16E1	SA-APT-1F1	SA-APT-2F2	SA-APT-3H3	AVERAGE
JANUARY*	76±8	62±6	84±8	79±8	72±7	82±8	83±8	103±10	80±23
	51±6	52±6	59±7	53±6	52±6	74±7	62±7	62±7	58±16
	91±9	99±10	102±10	113±11	107±11	94±9	97±10	95±10	100±15
	138±14	128±13	157±16	157±16	132±13	142±14	146±15	129±13	141±23
	210±21	134±13	142±14	100±10	93±9	115±12	116±12	114±11	128±74
FEBRUARY	219±22	97±10	103±10	89±9	87±9	101±10	101±10	106±11	113±87
	109±11	88±9	106±11	101±10	85±9	123±12	117±12	117±12	106±28
	145±14	110±11	135±13	132±13	128±13	117±12	130±13	136±14	129±22
	122±12	152±15	102±10	92±9	101±10	109±11	123±12	114±11	114±37
MARCH	113±11	78±8	79±8	90±9	86±9	109±11	83±8	84±8	90±27
	201±20	201±20	204±20	208±21	253±25	231±23	202±20	154±15	207±57
	196±20	136±14	140±14	154±15	136±14	162±16	128±13	159±16	151±44
	238±24	237±24	234±23	234±23	205±20	218±22	243±24	254±25	233±30
APRIL	383±38	331±33	376±38	427±43	381±38	363±46	471±47	373±37	388±85
	239±24	237±24	229±23	249±25	243±24	233±23	260±26	263±26	244±25
	233±23	268±27	250±25	267±27	283±28	283±28	249±25	269±27	263±35
	224±22	232±23	252±25	209±21	211±21	229±23	224±22	179±18	220±43
MAY	221±22	219±22	229±23	219±22	244±24	237±24	251±25	266±27	236±34
	172±17	184±18	183±18	201±20	163±16	199±20	184±18	196±20	185±27
	285±28	282±28	287±29	294±29	285±29	287±29	321±32	271±27	289±29
	345±35	360±36	394±39	359±36	352±35	4000±2300(1)	338±34	386±39	362±41
	200±20	190±19	198±20	184±18	185±19	183±18	210±21	200±20	194±19
JUNE	158±16	156±16	157±16	149±15	162±16	159±16	165±16	180±18	161±18
	144±14	124±12	138±14	134±13	135±13	129±13	148±15	173±17	141±30
	113±11	99±10	98±10	124±12	116±12	112±11	109±11	106±11	110±17
	138±14	146±15	164±16	142±14	131±13	134±13	150±15	119±12	141±27
JULY	94±9	95±10	96±10	84±9	87±9	86±9	95±10	100±10	92±11
	190±19	194±19	192±19	179±18	175±17	203±20	208±21	204±20	193±24
	109±11	112±11	123±12	95±10	94±9	115±11	108±11	127±13	110±24
	91±9	95±10	101±10	96±10	100±10	113±11	101±10	94±9	99±14
	69±7	67±7	75±8	67±8	69±8	67±8	78±8	86±9	72±14
AUGUST	40±5	46±6	42±6	42±6	39±5	50±7	51±7	65±7	47±17
	51±6	61±7	59±7	58±7	58±7	63±8	66±8	63±7	60±9
	61±6	67±7	70±7	70±7	69±7	80±8	68±7	69±7	69±10
	37±5	52±7	43±7	40±6	42±6	46±6	48±6	46±6	44±9
SEPTEMBER**	40±5	36±6	46±6	42±6	41±5	41±6	37±5	49±6	42±9
	47±6	52±8	42±8	57±7	44±6	46±7	57±8	42±6	48±12
	35±5	37±7	33±6	29±6	34±6	37±6	33±6	38±6	35±6
	34±5	33±6	35±7	40±6	37±6	29±6	35±6	32±5	34±7
AVERAGE	145±175	137±169	143±179	140±183	136±178	137±159	146±191	144±177	141±175

* Sampling dates can be found on Table C-6.
** Program discontinued by RMC after the third quarter.
(1) High result due to low sample volume. This result was not included in the averages.

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TABLE C-3

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATES

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

STATION NUMBER AND DATE	Be-7	K-40	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Sb-125	Cs-137	Ce-141	Ce-144
SA-APT-2S2											
12-29-80 to 3-30-81	69±7	6.6±5.2	0.6±0.3	85±9	40±4	15±2	8.1±4.0	<2.3	1.2±0.4	11±1	31±3
3-30-81 to 6-29-81	99±10	<7.2	2.3±0.5	100±10	39±4	13±1	26±5	<2.3	4.6±0.5	7.9±1.2	89±9
6-29-81** to 9-28-81	110±11	<11	<0.9	17±2	6.6±0.9	1.1±0.7	9.7±4.4	<2.0	1.9±0.5	<1.7	30±3
SA-APT-5S1											
12-29-80 to 3-30-81	67±7	4.9±4.3	<0.7	63±6	29±3	13±1	<6.1	<2.1	1.1±0.4	12±1	28±3
3-30-81 to 6-29-81	83±9	<13	2.2±0.6	110±11	39±4	11±1	23±6	<2.9	4.7±0.6	8.1±1.4	95±10
6-29-81** to 9-28-81	92±9	<15	<0.9	17±2	6.0±1.1	<1.4	<11	<2.5	2.0±0.6	<1.9	29±4
SA-APT-5D1											
12-29-80 to 3-30-81	65±7	5.0±4.7	<0.6	61±6	27±3	12±1	<8.3	<2.2	0.9±0.5	11±1	30±3
3-30-81 to 6-29-81	91±10	<9.1	2.1±0.5	120±12	46±5	13±2	24±7	<3.2	5.1±0.7	8.3±1.4	110±11
6-29-81** to 9-28-81	87±9	<15	<1.0	14±1	7.2±1.2	<1.4	7.4±4.8	<2.8	2.5±0.6	<1.9	29±4

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TABLE C-3 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATES

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

STATION NUMBER AND DATE	Be-7	K-40	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Sb-125	Cs-137	Ce-141	Ce-144
SA-APT-10D1											
12-29-80 to 3-31-81	48±6	<8.8	<0.6	52±5	21±2	10±1	8.4±4.1	<1.9	1.1±0.4	10±1	24±2
3-31-81 to 6-30-81	84±9	<13	2.2±0.6	100±10	40±4	11±1	20±6	<3.0	4.9±0.6	6.4±1.4	95±10
6-30-81** to 9-28-81	88±9	<13	<0.9	15±2	5.1±1.0	<1.3	<8.4	<2.4	2.4±0.6	<2.1	30±4
SA-APT-16E1											
12-29-80 to 3-31-81	65±7	6.9±5.2	<0.6	60±6	26±3	12±1	7.6±4.1	<2.2	1.4±0.5	11±1	29±3
3-31-81 to 6-30-81	78±10	<15	2.0±0.6	100±10	38±4	9.8±1.3	17±6	<3.3	5.5±0.8	6.7±1.5	83±8
6-30-81** to 9-28-81	88±9	<8.2	<0.6	16±2	5.9±0.8	<0.9	13±5	<1.7	2.1±0.5	<1.8	34±4
SA-APT-1F1											
12-29-80 to 3-30-81	49±8	<9.7	<0.9	60±6	25±3	11±1	<8.4	<2.2	1.2±0.5	12±1	29±3
3-30-81 to 6-29-81	74±9	<9.8	2.8±0.6	89±9	33±3	8.8±1.3	19±5	<2.8	4.2±0.7	6.8±1.6	86±9
6-29-81** to 9-28-81	95±10	6.9±5.5	0.9±0.5	16±2	6.5±0.9	<0.9	<9.2	<2.0	2.2±0.5	<1.9	34±4

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TABLE C-3 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* IN QUARTERLY COMPOSITES OF AIR PARTICULATES

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

STATION NUMBER AND DATE	Be-7	K-40	Mn-54	Nb-95	Zr-95	Ru-103	Ru-106	Sb-125	Cs-137	Ce-141	Ce-144
SA-APT-2F2											
12-29-80 to 3-30-81	78±8	7.9±4.9	<0.6	63±6	27±3	15±2	<8.0	<2.2	1.4±0.5	12±1	26±3
3-30-81 to 6-29-81	78±11	<10	2.1±0.6	110±11	40±4	13±1	24±6	<2.7	5.1±0.6	6.6±1.0	85±9
6-29-81** to 9-28-81	110±11	<13	0.9±0.5	18±2	6.4±1.0	<1.2	<7.0	<2.3	2.7±0.6	<1.9	33±4
SA-APT-3H3 (Control Station)											
12-29-80 to 3-30-81	57±7	6.1±4.4	<0.6	59±6	27±3	14±1	6.6±3.7	<2.2	0.9±0.4	11±1	25±3
3-30-81 to 6-29-81	92±9	<7.9	2.1±0.5	110±11	42±4	13±1	27±6	3.4±1.4	4.6±0.5	8.7±1.4	100±10
6-29-81** to 9-28-81	77±8	<6.1	<0.9	17±2	6.4±1.0	1.4±0.6	10±4	3.0±1.1	2.1±0.4	<1.0	31±3

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

** Program discontinued by RMC after the third quarter.

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TABLE C-4

CONCENTRATIONS OF STRONTIUM-89* AND -90 IN QUARTERLY COMPOSITES OF AIR PARTICULATE SAMPLES

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

STATION NUMBER	January to March		April to June		July to September**	
	Sr-89	Sr-90	Sr-89	Sr-90	Sr-89	Sr-90
SA-APT-2S2	7.5±0.8	0.4±0.3	6.5±0.8	2.2±0.3	0.8±0.5	0.5±0.2
SA-APT-5S1	7.0±0.8	0.4±0.3	7.6±0.9	1.7±0.4	1.0±0.5	0.5±0.2
SA-APT-5D1	9.3±1.3	<0.8	5.9±1.8	1.2±0.7	0.7±0.6	0.6±0.2
SA-APT-10D1	7.3±0.8	0.5±0.3	7.8±1.0	1.4±0.4	0.7±0.5	0.4±0.2
SA-APT-16E1	6.9±0.8	0.4±0.4	7.0±1.0	1.7±0.4	<0.8	0.6±0.2
SA-APT-1F1	6.9±0.9	0.6±0.4	8.3±1.0	0.8±0.4	1.3±0.6	0.3±0.2
SA-APT-2F2	6.6±1.0	0.7±0.4	7.2±0.9	1.6±0.4	0.8±0.6	0.7±0.3
SA-APT-3H3 (Control Station)	7.3±1.0	0.8±0.4	8.7±0.9	2.2±0.4	1.3±0.5	0.8±0.2
Average	7.4±1.7	0.6±0.4	7.4±1.8	1.6±1.0	0.9±0.5	0.6±0.3

* Strontium-89 results are corrected for decay to sample stop date.
** Program discontinued by RMC after the third quarter.

#13/1 rec. 1/20/82

TABLE C-5

CONCENTRATIONS OF IODINE-131* IN FILTERED AIR

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

MONTH	STATION NO. SA-AIO-2S2	SA-AIO-5S1	SA-AIO-5D1	SA-AIO-10D1	SA-AIO-16E1	SA-AIO-2F2	SA-AIO-3H3 (Control Station)
JANUARY**	<12	<9.1	<12	<9.9	<11	<11	<12
	<11	<9.0	<11	<8.1	<9.1	<11	<11
	<12	<9.2	<12	<12	<14	<11	<13
	<12	<9.6	<12	<8.3	<9.7	<11	<11
	<12	<8.6	<11	<11	<13	<10	<11
FEBRUARY	<11	<9.3	<11	<8.2	<9.4	<11	<11
	<9.9	<8.0	<9.6	<9.5	<12	<9.4	<9.9
	<13	<13	<13	<10	<10	<12	<14
	<12	<8.9	<12	<12	<14	<10	<11
MARCH	<11	<11	<11	<8.8	<8.7	<10	<12
	<12	<9.5	<12	<12	<13	<9.8	<10
	<11	<9.8	<11	<8.5	<9.0	<9.6	<10
	<11	<11	<11	<11	<10	<10	<11
APRIL	<12	<12	<13	<13	<12	<13	<12
	<16	<15	<20	<14	<16	<17	<17
	<10	<12	<12	<14	<13	<10	<12
	<13	<13	<15	<15	<14	<12	<14
MAY	<9.1	<10	<11	<11	<9.7	<9.9	<11
	<6.2	<6.5	<7.0	<5.6	<5.4	<6.2	<6.4
	<10	<11	<11	<13	<12	<11	<12
	<8.8	<10	<11	<8.6	<7.9	<8.8	<9.8
	<11	<14	<14	<15	<15	<11	<33
JUNE	<15	<15	<21	<14	<15	<17	<17
	<11	<11	<14	<13	<14	<12	<12
	<9.1	<11	<12	<9.3	<8.8	<9.7	<11
	<11	<14	<12	<11	<9.7	<12	<11

#14/1 rec. 2/16/82

TABLE C-5 (cont.)

CONCENTRATIONS OF IODINE-131* IN FILTERED AIR

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

MONTH	SA-AIO-2S2	SA-AIO-5S1	SA-AIO-5D1	SA-AIO-10D1	SA-AIO-16E1	SA-AIO-2F2	SA-AIO-3H3 (Control Station)
	STATION NO.						
JULY	<12	<15	<14	<15	<13	<11	<12
	<12	<16	<14	<10	<9.3	<14	<12
	<11	<14	<13	<11	<9.8	<12	<11
	<12	<16	<13	<12	<11	<12	<13
	<11	<13	<13	<14	<12	<13	<12
AUGUST	<11	<15	<13	<10	<9.4	<12	<13
	<11	<14	<13	<11	<10	<13	<12
	<11	<15	<12	<11	<11	<12	<12
	<11	<16	<14	<13	<13	<12	<11
SEPTEMBER	<9.2	<14	<11	<10	<9.3	<10	<11
	<19	<26	<25	<17	<16	<20	<19
	<11	<16	<14	<15	<14	<13	<12
	<11	<15	<16	<13	<12	<11	<12
OCTOBER	<10	<86 (1)	<12	<14	<12	<11	<12
	<9.1	<14	<12	<11	<9.5	<10	<9.8
	<18	<23	<16	<15	<15	<14	<16
	<8.3	<13	<12	<8.5	<8.8	<9.1	<9.9
	<9.7	<17	<14	<15	<16	<8.8	<13
NOVEMBER	<11	<14	<13	<9.9	<10	<11	<12
	<9.3	<14	<12	<12	<13	<11	<11
	<9.1	<13	<13	<8.9	<11	<11	<10
	<16	<22	<18	<18	<19	<17	<21
DECEMBER	<14	<15	<13	<13	<18	<9.7	<14
	<26	<16	<12	<12	<12	<1210 (2)	<13
	<9.9	<12	<12	<9.7	<12	<11	<11
	<9.0	<14	<10	<9.6	<11	<9.6	<13

* I-131 results are corrected for decay to sample stop date.
** Actual sampling dates can be found on Table C-6.
(1) High LLD due to low sample volume resulting from a power outage.
(2) High LLD due to low sample volume caused by an obstruction in the air filter line.

#8/1 rec. 1/20/82

TABLE C-6

SAMPLING DATES FOR AIR SAMPLES

MONTH	STATION NO. 2S2	5S1	5D1	10D1	16E1	1F1	2F2	3H3
JANUARY	12-29-80 to 1-05-81	12-29-80 to 1-05-81	12-29-80 to 1-05-81	12-29-80 to 1-05-81	12-29-80 to 1-05-81	1-29-80 to 1-05-81	12-29-80 to 1-05-81	12-29-80 to 1-05-81
	1-05-81 to 1-12-81	1-05-81 to 1-12-81	1-05-81 to 1-12-81	1-05-81 to 1-13-81	1-05-81 to 1-13-81	1-05-81 to 1-12-81	1-05-81 to 1-12-81	1-05-81 to 1-12-81
	1-12-81 to 1-19-81	1-12-81 to 1-19-81	1-12-81 to 1-19-81	1-13-81 to 1-19-81	1-13-81 to 1-19-81	1-12-81 to 1-19-81	1-12-81 to 1-19-81	1-12-81 to 1-19-81
	1-19-81 to 1-26-81	1-19-81 to 1-26-81	1-19-81 to 1-26-81	1-19-81 to 1-27-81	1-19-81 to 1-27-81	1-19-81 to 1-26-81	1-19-81 to 1-26-81	1-19-81 to 1-26-81
	1-26-81 to 2-02-81	1-26-81 to 2-02-81	1-26-81 to 2-02-81	1-27-81 to 2-02-81	1-27-81 to 2-02-81	1-26-81 to 2-02-81	1-26-81 to 2-02-81	1-26-81 to 2-02-81
FEBRUARY	2-02-81 to 2-09-81	2-02-81 to 2-09-81	2-02-81 to 2-09-81	2-02-81 to 2-10-81	2-02-81 to 2-10-81	2-02-81 to 2-09-81	2-02-81 to 2-09-81	2-02-81 to 2-09-81
	2-09-81 to 2-17-81	2-09-81 to 2-17-81	2-09-81 to 2-17-81	2-10-81 to 2-17-81	2-10-81 to 2-17-81	2-09-81 to 2-17-81	2-09-81 to 2-17-81	2-09-81 to 2-17-81
	2-17-81 to 2-23-81	2-17-81 to 2-23-81	2-17-81 to 2-23-81	2-17-81 to 2-24-81	2-17-81 to 2-24-81	2-17-81 to 2-23-81	2-17-81 to 2-23-81	2-17-81 to 2-23-81
	2-23-81 to 3-02-81	2-23-81 to 3-02-81	2-23-81 to 3-02-81	2-24-81 to 3-02-81	2-24-81 to 3-02-81	2-23-81 to 3-02-81	2-23-81 to 3-02-81	2-23-81 to 3-02-81
MARCH	3-02-81 to 3-09-81	3-02-81 to 3-09-81	3-02-81 to 3-09-81	3-02-81 to 3-10-81	3-02-81 to 3-10-81	3-02-81 to 3-09-81	3-02-81 to 3-09-81	3-02-81 to 3-09-81
	3-09-81 to 3-16-81	3-09-81 to 3-16-81	3-09-81 to 3-16-81	3-10-81 to 3-16-81	3-10-81 to 3-16-81	3-09-81 to 3-16-81	3-09-81 to 3-16-81	3-09-81 to 3-16-81

#9/1 rec. 1/20/82

TABLE C-6 (cont.)

SAMPLING DATES FOR AIR SAMPLES

MONTH	2S2	5S1	5D1	STATION NO. 10D1	16E1	1F1	2F2	3H3
MARCH	3-16-81 to 3-23-81	3-16-81 to 3-23-81	3-16-81 to 3-23-81	3-16-81 to 3-24-81	3-16-81 to 3-24-81	3-16-81 to 3-23-81	3-16-81 to 3-23-81	3-16-81 to 3-23-81
	3-23-81 to 3-30-81	3-23-81 to 3-30-81	3-23-81 to 3-30-81	3-24-81 to 3-31-81	3-24-81 to 3-31-81	3-23-81 to 3-30-81	3-23-81 to 3-30-81	3-23-81 to 3-30-81
APRIL	3-30-81 to 4-06-81	3-30-81 to 4-06-81	3-30-81 to 4-06-81	3-31-81 to 4-06-81	3-31-81 to 4-06-81	3-30-81 to 4-06-81	3-30-81 to 4-06-81	3-30-81 to 4-06-81
	4-06-81 to 4-13-81	4-06-81 to 4-13-81	4-06-81 to 4-13-81	4-06-81 to 4-14-81	4-06-81 to 4-14-81	4-06-81 to 4-13-81	4-06-81 to 4-13-81	4-06-81 to 4-13-81
	4-13-81 to 4-20-81	4-13-81 to 4-20-81	4-13-81 to 4-20-81	4-14-81 to 4-20-81	4-14-81 to 4-20-81	4-13-81 to 4-20-81	4-13-81 to 4-20-81	4-13-81 to 4-20-81
	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81	4-20-81 to 4-27-81
MAY	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81	4-27-81 to 5-04-81
	5-04-81 to 5-11-81	5-04-81 to 5-11-81	5-04-81 to 5-11-81	5-04-81 to 5-12-81	5-04-81 to 5-12-81	5-04-81 to 5-11-81	5-04-81 to 5-11-81	5-04-81 to 5-11-81
	5-11-81 to 5-18-81	5-11-81 to 5-18-81	5-11-81 to 5-18-81	5-12-81 to 5-18-81	5-12-81 to 5-18-81	5-11-81 to 5-18-81	5-11-81 to 5-18-81	5-11-81 to 5-18-81
	5-18-81 to 5-26-81	5-18-81 to 5-26-81	5-18-81 to 5-26-81	5-18-81 to 5-27-81	5-18-81 to 5-27-81	5-18-81 to 5-26-81	5-18-81 to 5-26-81	5-18-81 to 5-26-81
	5-26-81 to 6-01-81	5-26-81 to 6-01-81	5-26-81 to 6-01-81	5-27-81 to 6-01-81	5-27-81 to 6-01-81	5-26-81 to 6-01-81	5-26-81 to 6-01-81	5-26-81 to 6-01-81

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TABLE C-6 (cont.)

SAMPLING DATES FOR AIR SAMPLES

	STATION NO.							
MONTH	2S2	5S1	5D1	10D1	16E1	1F1	2F2	3H3
JUNE	6-01-81 to 6-08-81	6-01-81 to 6-08-81	6-01-81 to 6-08-81	6-01-81 to 6-09-81	6-01-81 to 6-09-81	6-01-81 to 6-08-81	6-01-81 to 6-08-81	6-01-81 to 6-08-81
	6-08-81 to 6-15-81	6-08-81 to 6-15-81	6-08-81 to 6-15-81	6-09-81 to 6-15-81	6-09-81 to 6-15-81	6-08-81 to 6-15-81	6-08-81 to 6-15-81	6-08-81 to 6-15-81
	6-15-81 to 6-22-81	6-15-81 to 6-22-81	6-15-81 to 6-22-81	6-15-81 to 6-23-81	6-15-81 to 6-23-81	6-15-81 to 6-22-81	6-15-81 to 6-22-81	6-15-81 to 6-22-81
	6-22-81 to 6-29-81	6-22-81 to 6-29-81	6-22-81 to 6-29-81	6-23-81 to 6-30-81	6-23-81 to 6-30-81	6-22-81 to 6-29-81	6-22-81 to 6-29-81	6-22-81 to 6-29-81
JULY	6-29-81 to 7-06-81	6-29-81 to 7-06-81	6-29-81 to 7-06-81	6-30-81 to 7-06-81	6-30-81 to 7-06-81	6-29-81 to 7-06-81	6-29-81 to 7-07-81	6-29-81 to 7-06-81
	7-06-81 to 7-13-81	7-06-81 to 7-13-81	7-06-81 to 7-13-81	7-06-81 to 7-14-81	7-06-81 to 7-14-81	7-06-81 to 7-13-81	7-07-81 to 7-13-81	7-06-81 to 7-13-81
	7-13-81 to 7-20-81	7-13-81 to 7-20-81	7-13-81 to 7-20-81	7-14-81 to 7-21-81	7-14-81 to 7-21-81	7-13-81 to 7-20-81	7-13-81 to 7-20-81	7-13-81 to 7-20-81
	7-20-81 to 7-27-81	7-20-81 to 7-27-81	7-20-81 to 7-27-81	7-21-81 to 7-28-81	7-21-81 to 7-28-81	7-20-81 to 7-27-81	7-20-81 to 7-27-81	7-20-81 to 7-27-81
	7-27-81 to 8-03-81	7-27-81 to 8-03-81	7-27-81 to 8-03-81	7-28-81 to 8-03-81	7-28-81 to 8-03-81	7-27-81 to 8-03-81	7-27-81 to 8-03-81	7-27-81 to 8-03-81
AUGUST	8-03-81 to 8-10-81	8-03-81 to 8-10-81	8-03-81 to 8-10-81	8-03-81 to 8-11-81	8-03-81 to 8-11-81	8-03-81 to 8-10-81	8-03-81 to 8-10-81	8-03-81 to 8-10-81
	8-10-81 to 8-17-81	8-10-81 to 8-17-81	8-10-81 to 8-17-81	8-11-81 to 8-18-81	8-11-81 to 8-18-81	8-10-81 to 8-17-81	8-10-81 to 8-17-81	8-10-81 to 8-17-81

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TABLE C-6 (cont.)

SAMPLING DATES FOR AIR SAMPLES

MONTH	STATION NO. 2S2	5S1	5D1	10D1	16E1	1F1	2F2	3H3
AUGUST	8-17-81 to 8-24-81	8-17-81 to 8-24-81	8-17-81 to 8-24-81	8-18-81 to 8-25-81	8-18-81 to 8-25-81	8-17-81 to 8-24-81	8-17-81 to 8-24-81	8-17-81 to 8-24-81
	8-24-81 to 8-31-81	8-24-81 to 8-31-81	8-24-81 to 8-31-81	8-25-81 to 8-31-81	8-25-81 to 8-31-81	8-24-81 to 8-31-81	8-24-81 to 8-31-81	8-24-81 to 8-31-81
SEPTEMBER	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81	8-31-81 to 9-08-81
	9-08-81 to 9-14-81	9-08-81 to 9-14-81	9-08-81 to 9-14-81	9-08-81 to 9-15-81	9-08-81 to 9-15-81	9-08-81 to 9-14-81	9-08-81 to 9-14-81	9-08-81 to 9-14-81
	9-14-81 to 9-21-81	9-14-81 to 9-21-81	9-14-81 to 9-21-81	9-15-81 to 9-21-81	9-15-81 to 9-21-81	9-14-81 to 9-21-81	9-14-81 to 9-21-81	9-14-81 to 9-21-81
	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81	9-21-81 to 9-28-81
OCTOBER*	9-28-81 to 10-05-81	9-28-81 to 10-05-81	9-28-81 to 10-05-81	9-28-81 to 10-05-81	9-28-81 to 10-05-81		9-28-81 to 10-05-81	9-28-81 to 10-05-81
	10-05-81 to 10-13-81	10-05-81 to 10-13-81	10-05-81 to 10-13-81	10-05-81 to 10-13-81	10-05-81 to 10-13-81		10-05-81 to 10-13-81	10-05-81 to 10-13-81
	10-13-81 to 10-19-81	10-13-81 to 10-19-81	10-13-81 to 10-19-81	10-13-81 to 10-19-81	10-13-81 to 10-19-81		10-13-81 to 10-19-81	10-13-81 to 10-19-81
	10-19-81 to 10-26-81	10-19-81 to 10-26-81	10-19-81 to 10-26-81	10-19-81 to 10-27-81	10-19-81 to 10-27-81		10-19-81 to 10-26-81	10-19-81 to 10-26-81
	10-26-81 to 11-02-81	10-26-81 to 11-02-81	10-26-81 to 11-02-81	10-27-81 to 11-02-81	10-27-81 to 11-02-81		10-26-81 to 11-02-81	10-26-81 to 11-02-81

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TABLE C-6 (cont.)

SAMPLING DATES FOR AIR SAMPLES

MONTH	STATION NO. 2S2	5S1	5D1	10D1	16E1	1F1	2F2	3H3
NOVEMBER	11-02-81 to 11-09-81	11-02-81 to 11-09-81	11-02-81 to 11-09-81	11-02-81 to 11-10-81	11-02-81 to 11-10-81		11-02-81 to 11-09-81	11-02-81 to 11-09-81
	11-09-81 to 11-16-81	11-09-81 to 11-16-81	11-09-81 to 11-16-81	11-10-81 to 11-16-81	11-10-81 to 11-16-81		11-09-81 to 11-16-81	11-09-81 to 11-16-81
	11-16-81 to 11-23-81	11-16-81 to 11-23-81	11-16-81 to 11-23-81	11-16-81 to 11-24-81	11-16-81 to 11-24-81		11-16-81 to 11-23-81	11-16-81 to 11-23-81
	11-23-81 to 11-30-81	11-23-81 to 11-30-81	11-23-81 to 11-30-81	11-24-81 to 12-01-81	11-24-81 to 12-01-81		11-23-81 to 11-30-81	11-23-81 to 11-30-81
DECEMBER	11-30-81 to 12-07-81	11-30-81 to 12-07-81	11-30-81 to 12-07-81	12-01-81 to 12-07-81	12-01-81 to 12-07-81		11-30-81 to 12-08-81	11-30-81 to 12-07-81
	12-07-81 to 12-14-81	12-07-81 to 12-14-81	12-07-81 to 12-14-81	12-07-81 to 12-14-81	12-07-81 to 12-15-81		12-08-81 to 12-14-81	12-07-81 to 12-14-81
	12-14-81 to 12-21-81	12-14-81 to 12-21-81	12-14-81 to 12-21-81	12-14-81 to 12-22-81	12-15-81 to 12-22-81		12-14-81 to 12-21-81	12-14-81 to 12-21-81
	12-21-81 to 12-28-81	12-21-81 to 12-28-81	12-21-81 to 12-28-81	12-22-81 to 12-29-81	12-22-81 to 12-29-81		12-21-81 to 12-28-81	12-21-81 to 12-28-81

* Air Particulate program discontinued by RMC after the third quarter.

TABLE C-7

CONCENTRATIONS OF TRITIUM, GROSS ALPHA AND GROSS BETA EMITTERS IN PRECIPITATION

STATION SA-RWA-2F2

Results in Units of pCi/l ± 2 sigma

COLLECTION PERIOD	H-3*	ALPHA	BETA
12-29-80 to 2-02-81	<123	<1.1	46±5
2-02-81 to 3-03-81	<113	<0.7	35±4
3-03-81 to 3-30-81	124±59	2.3±1.2	67±7
3-30-81 to 4-28-81	<100	<0.6	70±7
4-28-81 to 6-01-81	<87	<0.9	51±5
6-01-81 to 6-29-81	86±68	<0.8	19±2
6-29-81 to 8-03-81	<109	1.2±0.8	30±4
8-03-81 to 9-01-81	111±74	<0.9	9.1±1.6
9-01-81 to 9-28-81	<124	<1.2	8.1±1.6
9-28-81 to 11-02-81		<0.7	5.9±1.9
11-02-81 to 11-30-81		1.2±0.8	14±3
11-30-81 to 12-29-81		<0.6	4.7±1.8
Average	-	-	30±48

* Program discontinued by RMC after the third quarter.

TABLE C-8

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND GAMMA EMITTERS** IN QUARTERLY COMPOSITES OF PRECIPITATION

STATION: SA-RWA-2F2

Results in Units of pCi/l ± 2 sigma

NUCLIDE	12-29-80 to 3-30-81	3-30-80 to 6-29-81	6-29-81 to 9-28-81	9-28-81 to 12-29-81
Sr-89	7.5±0.9	3.4±0.7	0.6±0.4	<0.8
Sr-90	<0.9	0.8±0.4	<0.4	1.4±0.3
Be-7	35±10	44±8	24±8	<7.6
Zr-95	4.3±1.3	<0.8+	<0.8+	<0.6+
Nb-95	11±1	<0.8+	<0.8+	<0.6+
Ru-103	4.7±1.2	-	-	-
Ce-141	3.4±1.7	-	-	-

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

** All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33. Nuclides not routinely searched for are indicated by a dash (-).

\+ LLD for Zr-95 and Nb-95 is that of ZrNb-95.

TABLE C-9

DIRECT RADIATION MEASUREMENTS - MONTHLY TLD RESULTS

mrad/standard month*

STATION NUMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
SA-IDM-2S2	5.00±0.43	6.38±0.52	5.83±0.14	5.08±0.68	4.82±0.13	5.18±0.30
SA-IDM-5S1	4.53±0.24	5.33±0.94	5.15±0.34	4.58±0.77	3.65±0.34	4.44±0.39
SA-IDM-6S2	5.11±0.34	6.02±0.36	5.65±0.37	4.77±0.75	4.16±0.14	4.33±0.58
SA-IDM-7S1	6.18±0.67	7.43±0.41	7.35±0.96	5.63±1.31	5.34±0.18	5.28±0.73
SA-IDM-10S1	8.25±0.48	8.31±0.69	7.92±1.38	5.97±0.89	5.78±0.46	6.00±0.87
SA-IDM-11S1	16.51±0.93	12.02±0.59	9.00±0.52	7.80±0.82	6.98±1.19	5.74±0.31
SA-IDM-5D1	4.77±0.50	5.81±0.33	5.45±1.10	4.61±0.74	4.31±0.16	4.67±0.53
SA-IDM-10D1	5.69±0.42	6.42±0.56	6.26±0.66	6.10±0.36	4.73±0.69	5.58±0.54
SA-IDM-14D1	5.64±0.24	6.64±0.33	6.42±0.70	5.56±0.31	4.87±0.29	4.96±0.43
SA-IDM-2E1	5.13±0.10	6.25±0.63	6.43±1.28	5.48±0.62	4.39±0.65	5.17±0.19
SA-IDM-3E1	4.75±0.17	6.09±0.84	5.89±0.89	5.04±0.14	4.28±0.23	4.87±0.59
SA-IDM-13E1	4.93±0.37	6.16±0.92	6.18±0.54	5.26±0.54	4.35±0.16	4.61±0.57
SA-IDM-16E1	5.39±0.26	6.86±0.52	6.75±0.75	5.46±0.38	4.95±0.58	4.93±0.32
SA-IDM-1F1	5.30±0.35	6.55±0.59	6.29±0.06	5.31±0.66	4.94±0.59	5.39±0.44
SA-IDM-2F2	4.40±0.21	5.10±0.32	5.07±0.65	4.39±0.16	3.63±0.69	4.24±0.57
SA-IDM-5F1	4.80±0.14	6.17±1.02	6.45±0.30	4.65±0.13	4.55±0.87	4.99±0.48
SA-IDM-6F1	4.22±0.16	5.24±0.41	5.26±0.78	4.36±0.33	3.60±0.30	4.13±0.56
SA-IDM-7F2	3.61±0.22	4.49±0.41	4.77±0.51	3.87±0.20	3.28±0.61	4.21±0.28
SA-IDM-11F1	5.62±0.31	6.99±0.88	6.64±0.25	5.77±0.79	4.87±0.36	5.66±1.10
SA-IDM-13F1	5.01±0.53	6.02±0.18	5.98±0.26	5.15±0.41	4.73±0.31	4.88±0.36
SA-IDM-3G1	5.69±0.43	6.87±0.53	6.63±0.80	5.71±0.22	4.97±0.67	5.96±0.51
SA-IDM-2H1	5.61±0.23	6.92±0.77	7.14±0.92	5.46±0.64	5.91±0.93	5.23±0.72
SA-IDM-3H1	5.58±0.84	6.87±0.22	6.65±0.88	5.73±0.85	5.08±0.81	5.86±0.25
SA-IDM-3H3	5.23±0.38	6.50±0.58	6.52±0.70	5.84±0.18	5.01±0.58	5.55±0.49
AVERAGE	5.71±4.91	6.56±2.82	6.32±1.88	5.32±1.56	4.72±1.62	5.08±1.14

STATION NUMBER	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	AVERAGE
SA-IDM-2S2	4.71±0.57	4.75±0.17	5.54±0.31	4.89±0.33	4.88±0.57	5.72±1.06	5.23±1.05
SA-IDM-5S1	4.61±0.30	4.05±0.25	4.56±0.28	4.65±0.78	4.25±0.23	4.97±0.38	4.56±0.92
SA-IDM-6S2	5.62±0.42	4.60±0.27	4.96±0.20	5.60±0.47	5.16±0.39	5.73±0.39	5.14±1.19
SA-IDM-7S1	5.42±0.64	5.28±0.45	6.10±0.91	6.29±0.70	5.61±0.38	6.13±0.41	6.00±1.49
SA-IDM-10S1	6.35±1.13	5.34±0.49	6.29±0.38	6.06±0.21	6.81±0.64	6.48±0.49	6.63±1.99
SA-IDM-11S1	5.53±1.07	4.64±0.27	5.07±0.56	5.78±0.54	9.24±0.90	5.73±0.46	7.84±6.96
SA-IDM-5D1	4.64±0.39	4.66±0.18	4.99±0.26	5.31±1.29	4.83±0.63	5.51±0.19	4.96±0.91
SA-IDM-10D1	6.13±1.03	5.43±0.41	5.91±0.51	5.94±0.29	5.37±0.61	5.66±0.30	5.77±0.93
SA-IDM-14D1	7.27±3.21	5.54±0.60	5.74±0.90	5.68±0.30	5.26±0.77	5.98±0.80	5.80±1.39
SA-IDM-2E1	5.29±0.22	4.88±0.32	5.74±0.25	5.39±0.80	5.08±0.79	5.71±0.24	5.41±1.13
SA-IDM-3E1	5.65±0.61	4.87±0.81	5.43±0.48	5.26±0.31	4.71±0.19	5.50±0.45	5.20±1.07
SA-IDM-13E1	5.02±0.54	4.80±0.89	4.91±0.56	5.49±0.15	4.81±0.56	5.25±0.43	5.15±1.13
SA-IDM-16E1	5.85±0.71	4.83±0.48	5.84±0.79	5.14±1.25	5.09±0.40	5.47±0.23	5.55±1.35
SA-IDM-1F1	5.20±0.38	5.00±0.47	5.35±0.91	5.68±0.25	5.68±0.64	5.80±0.20	5.54±0.98
SA-IDM-2F2	4.02±0.23	3.95±0.51	4.35±0.38	4.37±0.55	4.22±0.25	4.56±0.77	4.36±0.84
SA-IDM-5F1	4.85±0.47	4.84±0.64	5.10±0.25	5.73±0.46	5.26±0.48	5.26±0.88	5.22±1.20
SA-IDM-6F1	4.10±0.20	3.96±0.76	4.52±0.64	4.68±0.91	4.15±0.34	5.14±0.75	4.45±1.07
SA-IDM-7F2	3.59±0.43	3.77±0.23	3.99±0.40	4.26±0.46	3.93±0.37	4.87±0.30	4.05±0.97
SA-IDM-11F1	5.74±0.44	5.24±0.83	6.29±0.73	6.32±0.86	5.66±0.81	6.04±0.58	5.90±1.18
SA-IDM-13F1	4.91±0.28	4.86±0.83	5.65±0.21	5.37±0.64	5.22±0.65	5.78±0.47	5.30±0.91
SA-IDM-3G1	6.04±1.05	5.31±0.41	5.84±0.61	5.95±0.92	5.56±0.45	5.80±0.36	5.86±1.03
SA-IDM-2H1	5.90±0.91	5.27±0.86	5.78±0.42	5.94±0.96	5.63±0.32	6.29±0.56	5.92±1.20
SA-IDM-3H1	5.21±0.63	5.19±0.40	5.92±0.51	5.97±0.28	5.10±0.54	6.51±0.56	5.81±1.24
SA-IDM-3H3	5.15±0.61	5.29±0.58	5.97±0.76	5.86±0.71	5.88±0.73	6.20±0.46	5.75±1.02
AVERAGE	5.28±1.62	4.85±0.99	5.41±1.26	5.48±1.15	5.31±2.10	5.67±0.99	5.47±2.32

* The standard month = 30.4 days.

TABLE C-10

DIRECT RADIATION MEASUREMENTS - QUARTERLY TLD RESULTS

mrad/standard month*

STATION NUMBER	JANUARY to MARCH	APRIL to JUNE	JULY to SEPTEMBER	OCTOBER to DECEMBER	AVERAGE
SA-IDM-2S2	5.67±0.18	4.70±0.40	4.09±0.68	4.93±0.73	4.85±1.31
SA-IDM-5S1	5.06±0.23	3.93±0.43	4.32±0.19	4.28±0.61	4.40±0.95
SA-IDM-6S2	6.00±0.82	4.73±0.39	4.74±0.11	5.02±0.62	5.12±1.20
SA-IDM-7S1	6.77±1.01	5.53±0.29	5.82±0.41	5.99±0.14	6.03±1.06
SA-IDM-10S1	8.93±0.44	6.26±0.49	5.32±0.46	5.85±0.60	6.59±3.21
SA-IDM-11S1	14.45±1.57	6.29±0.80	4.94±0.78	7.03±0.93	8.18±8.54
SA-IDM-5D1	5.31±0.48	4.59±0.64	4.68±0.31	5.11±0.51	4.92±0.69
SA-IDM-10D1	6.29±0.41	5.25±0.37	5.36±0.56	5.49±0.36	5.60±0.94
SA-IDM-14D1	6.14±0.58	4.92±0.52	5.13±0.31	5.71±0.22	5.48±1.11
SA-IDM-2E1	6.41±0.29	4.87±0.30	4.97±0.41	5.30±0.45	5.39±1.41
SA-IDM-3E1	5.95±0.18	4.60±0.43	4.83±0.34	5.10±0.22	5.12±1.18
SA-IDM-13E1	5.62±0.26	4.43±0.15	4.81±0.40	5.10±0.36	4.99±1.00
SA-IDM-16E1	6.18±0.52	4.97±0.37	5.16±0.20	5.65±0.26	5.49±1.08
SA-IDM-1F1	6.41±0.46	4.89±0.17	5.02±0.33	5.46±0.18	5.45±1.38
SA-IDM-2F2	5.15±0.45	3.92±0.22	3.87±0.32	4.01±0.44	4.24±1.22
SA-IDM-5F1	5.76±0.81	4.69±0.25	4.67±0.90	4.72±1.15	4.96±1.07
SA-IDM-6F1	4.82±0.30	3.94±0.03	4.11±0.12	4.75±0.39	4.41±0.89
SA-IDM-7F2	4.39±0.30	3.31±0.79	3.51±0.32	4.03±0.28	3.81±0.98
SA-IDM-11F1	6.35±0.99	5.71±0.53	5.81±0.16	5.65±0.37	5.88±0.64
SA-IDM-13F1	6.26±0.54	4.95±0.18	5.11±0.43	4.97±0.36	5.32±1.26
SA-IDM-3G1	6.45±0.84	5.12±0.24	5.33±0.09	5.42±0.30	5.58±1.19
SA-IDM-2H1	6.58±0.49	4.90±0.15	5.29±0.52	5.83±0.33	5.65±1.46
SA-IDM-3H1	6.57±0.58	5.46±0.97	5.67±0.46	5.75±0.67	5.86±0.97
SA-IDM-3H3	5.97±0.82	5.03±0.30	5.14±0.48	5.73±0.48	5.47±0.91
AVERAGE	6.40±3.84	4.87±1.40	4.90±1.18	5.29±1.34	5.37±2.52

* The standard month = 30.4 days.

TABLE C-11

DIRECT RADIATION MEASUREMENTS - SEMI-ANNUAL TLD RESULTS

mrad/standard month*

STATION NO.	SEPTEMBER TO MARCH	APRIL TO SEPTEMBER	AVERAGE
SA-IDM-4D2	5.91±0.45	4.97±0.46	5.44±1.33
SA-IDM-9E1	6.13±0.90	5.52±0.74	5.83±0.86
SA-IDM-11E2	6.43±0.57	5.81±0.68	6.12±0.88
SA-IDM-12E1	6.12±0.33	5.77±0.27	5.95±0.49
SA-IDM-2F5	5.28±0.19	4.98±0.32	5.13±0.42
SA-IDM-3F2	5.27±0.24	4.61±0.32	4.94±0.93
SA-IDM-3F3	4.92±0.31	4.40±0.26	4.66±0.74
SA-IDM-10F2	5.83±0.70	5.50±0.13	5.67±0.47
SA-IDM-12F1	5.88±0.90	5.34±0.33	5.61±0.76
SA-IDM-13F2	5.76±0.87	5.12±0.21	5.44±0.91
SA-IDM-13F3	5.80±0.93	5.11±0.33	5.46±0.98
SA-IDM-14F2	5.58±1.06	5.02±0.33	5.30±0.79
SA-IDM-15F3	6.11±0.59	5.84±0.39	5.98±0.38
SA-IDM-16F2	4.88±0.33	4.95±0.74	4.92±0.10
SA-IDM-1G3	5.91±0.09	6.30±0.74	6.11±0.55
SA-IDM-10G1	5.55±0.18	5.71±0.51	5.63±0.23
SA-IDM-16G1	5.84±0.22	6.23±0.81	6.04±0.55
AVERAGE	5.72±0.85	5.36±1.07	5.54±1.02

* The standard month = 30.4 days.

TABLE C-12

CONCENTRATIONS OF TRITIUM IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	2-17-81*	3-04-81	4-10-81	5-06-81	6-01-81	7-08-81
SA-SWA-11A1	412±79	<102	<103	<89	97±62	<115
SA-SWA-12C1	99±76	75±65	206±63	58±54	<100	<115
SA-SWA-7E1	102±76	<102	<103	<94	<100	<115
SA-SWA-1F2	123±76	<102	<103	77±58	<87	<115
SA-SWA-16F1	<123	77±65	238±63	<89	<100	128±64
Average	172±270	92±29	151±132	81±29	97±11	118±12

STATION NO.	8-05-81	9-08-81	10-07-81**	11-03-81	12-14-81	AVERAGE
SA-SWA-11A1	<130	322±70				171±248
SA-SWA-12C1	<131	246±69	113±73	113±64	93±71	123±111
SA-SWA-7E1	133±80	279±69				129±124
SA-SWA-1F2	<130	301±69				130±143
SA-SWA-16F1	<131	82±65	195±74	<102	104±71	124±100
Average	131±2	246±192	154±116	108±16	99±16	134±146

* No surface water samples were collected in January.

** Program was reduced after the third quarter. Station SWA-12C1 continues to be analyzed for tritium on a monthly basis by RMC; in addition, one station a quarter is selected by PSE&G to receive a monthly tritium analysis.

TABLE C-13

CONCENTRATIONS OF GROSS ALPHA EMITTERS IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	2-17-81*	3-04-81	4-10-81	5-06-81	6-01-81	7-08-81
SA-SWA-11A1	<0.3	<0.4	<0.3	<0.6	<0.5	<0.5
SA-SWA-12C1	<0.3	<0.4	0.2±0.2	<0.6	<0.3	<0.5
SA-SWA-7E1	<0.3	<0.4	<0.3	<0.5	<0.5	<0.5
SA-SWA-1F2	<0.3	<0.4	<0.3	<0.6	<0.5	<0.5
SA-SWA-16F1	<0.4	<0.4	<0.3	<0.6	<0.8	<0.5

STATION NO.	8-05-81	9-08-81	10-05-81	11-03-81	12-14-81
SA-SWA-11A1	<0.4	<0.4	0.8±0.4	0.3±0.2	0.3±0.2
SA-SWA-12C1	<0.4	<0.4	0.4±0.3	0.2±0.2	<0.2
SA-SWA-7E1	<0.4	<0.4	<0.5	0.3±0.3	<0.2
SA-SWA-1F2	<0.4	<0.4	<0.4	0.2±0.2	0.2±0.1
SA-SWA-16F1	<0.4	0.3±0.3	0.4±0.3	<0.5	<1.3

* No surface water samples were collected in January.

TABLE C-14

CONCENTRATIONS OF GROSS BETA EMITTERS IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	2-17-81*	3-04-81	4-10-81	5-06-81	6-01-81	7-08-81
SA-SWA-11A1	76±8	78±8	49±6	76±8	26±4	37±5
SA-SWA-12C1	39±4	42±4	39±5	54±6	25±4	40±4
SA-SWA-7E1	37±4	38±4	60±7	85±9	41±5	33±3
SA-SWA-1F2	34±3	20±2	23±4	32±4	16±3	22±2
SA-SWA-16F1	32±3	43±4	27±4	42±5	24±3	33±3
Average	44±37	44±42	40±31	58±45	26±18	33±14

STATION NO.	8-05-81	9-08-81	10-05-81	11-03-81	12-14-81	AVERAGE
SA-SWA-11A1	59±6	13±3	96±10	83±8	55±6	59±52
SA-SWA-12C1	66±7	18±4	129±13	76±8	69±7	54±61
SA-SWA-7E1	122±12	114±11	82±8	68±7	50±6	66±62
SA-SWA-1F2	20±3	10±3	97±10	46±5	46±5	33±48
SA-SWA-16F1	68±7	16±4	72±7	48±5	57±6	42±36
Average	67±73	34±89	95±43	64±33	55±17	51±56

* No surface water samples were collected in January.

TABLE C-15

CONCENTRATIONS OF GAMMA EMITTERS* IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NO.	NUCLIDE	2-17-81**	3-04-81	4-10-81	5-06-81	6-01-81	7-08-81
SA-SWA-11A1	K-40	84±10	78±9 (1)	<11	66±9	45±8	33±10
SA-SWA-12C1	K-40	45±9	46±8	39±8	56±9	22±8	47±10
SA-SWA-7E1	K-40	85±9	77±9	71±9	120±12	76±10	83±10
SA-SWA-1F2	K-40	30±8	<11	20±8	27±7	24±9	23±9
SA-SWA-16F1	K-40	33±9	36±8	37±10	38±8	22±8	26±10
Average		55±54	50±57	36±46	61±72	38±47	42±49

STATION NO.	NUCLIDE	8-05-81	9-08-81	10-05-81	11-03-81	12-14-81	AVERAGE
SA-SWA-11A1	K-40	43±12	67±9	74±9	68±8	100±10	61±51
SA-SWA-12C1	K-40	59±9	72±9	50±10	85±9	69±10	54±35
SA-SWA-7E1	K-40	120±13	99±10	49±10	95±10	89±9	88±42
SA-SWA-1F2	K-40	27±10	68±9	90±17	50±9	68±9	40±51
SA-SWA-16F1	K-40	70±9	58±9	34±10	36±8	99±11	44±45
Average		64±71	73±31	59±45	67±49	85±31	57±55

* By gamma spectrometry, all other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

** No surface water samples were collected in January.

(1) ZrNb-95 was also observed in this sample with a concentration of 1.8±0.8 pCi/l.

TABLE C-16

CONCENTRATIONS OF STRONTIUM-89* AND -90 IN SURFACE WATER

Results in Units of pCi/l ± 2 sigma

STATION NUMBER	2-17-81** to 3-04-81		4-10-81 to 6-01-81		7-08-81 to 9-08-81		10-05-81*** to 12-14-81	
	Sr-89	Sr-90	Sr-89	Sr-90	Sr-89	Sr-90	Sr-89	Sr-90
SA-SWA-11A1	<0.6	<0.3	<0.9	1.3±0.4	<1.6	<0.9		
SA-SWA-12C1	<0.8	<0.4	0.6±0.6	<0.5	<1.1	<0.6	<0.8	<0.5
SA-SWA-7E1	0.5±0.5	<0.4	<0.8	<0.5	<1.4	<0.7		
SA-SWA-1F2	<0.7	0.4±0.2	0.7±0.5	<0.5	1.5±1.2	<0.4		
SA-SWA-16F1	<0.8	0.5±0.3	<1.0	<0.6	<2.3	1.1±0.8	<0.8	<0.5

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

** No surface water samples were collected in January.

*** Strontium program was reduced after the third quarter. Station 12C1 continues to be analyzed for Sr-89 and -90 on a quarterly basis by RMC; in addition, one station a quarter is selected by PSE&G to receive a quarterly composite Sr-89 and -90 analysis.

TABLE C-17

CONCENTRATIONS OF TRITIUM, GROSS ALPHA AND GROSS BETA EMITTERS, AND POTASSIUM-40 IN WELL WATER

Results in Units of pCi/l ± 2 sigma

STATION NO. RADIOACTIVITY	1-12-81	2-09-81	3-09-81	4-13-81	5-11-81	6-08-81
SA-WWA-4S1						
H-3	<105	<122	<102	<103	<94	<158
Alpha	<2.5	2.2±1.6	<2.4	<2.8	<2.2	<3.6
Beta	11±3	15±2	11±2	12±3	13±3	13±2
K-40	12±1	9.7±1.0	9.5±1.0	9.5±1.0	9.2±0.9	13±1
SA-WWA-5D1						
H-3	<88	<122	<102	<103	<94	<174
Alpha	<1.8	<1.1	<1.8	<2.2	<1.8	<2.9
Beta	3.8±2.3	3.9±1.3	2.6±1.2	14±3	14±3	15±2
K-40	2.9±0.3	2.4±0.2	2.2±0.2	10±1	10±1	14±1
SA-WWA-3E1						
H-3	<88	<122	<102	<103	<94	<174
Alpha	<2.1	1.7±1.4	<2.2	<2.4	<1.9	<2.9
Beta	9.2±2.6	8.4±2.3	7.6±1.5	8.6±2.2	8.8±2.4	9.3±1.6
K-40	8.2±0.8	8.2±0.8	9.2±0.9	7.2±0.7	6.8±0.7	9.6±1.0

STATION NO. RADIOACTIVITY	7-13-81	8-10-81	9-14-81	10-13-81*	11-09-81	12-14-81
SA-WWA-4S1						
H-3	<91	<130	106±74 (1)			
Alpha	<1.9	<3.1	<1.6	<1.1	<2.1	<2.8
Beta	15±3	16±3	13±2	12±2	13±3	14±3
K-40	14±1	2.6±0.3	11±1	11±1	9.6±1.0	8.5±0.9
SA-WWA-5D1						
H-3	<91	<130	<120			
Alpha	<1.6	<2.4	<1.2	<0.8	<1.7	<2.0
Beta	12±2	15±3	12±2	15±3	16±3	16±3
K-40	13±1	2.6±0.3	11±1	12±1	11±1	8.5±0.9
SA-WWA-3E1						
H-3	<91	268±82	<120			
Alpha	<1.0	<2.5	<1.3	<0.9	<1.6	<2.0
Beta	9.8±1.5	12±2	9.0±1.7	10±2	8.8±2.4	8.8±2.5
K-40	9.5±1.0	1.7±0.2	7.8±0.8	7.8±0.8	5.8±0.6	5.4±0.5

* Tritium program was discontinued by RMC after the third quarter.
(1) Station WWA-4S1 was collected on 9-24-81.

TABLE C-18

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND GAMMA EMITTERS** IN QUARTERLY COMPOSITES OF WELL WATER

Results in Units of pCi/l ± 2 sigma

STATION NUMBER RADIOACTIVITY	1-12-81 to 3-09-81	4-13-81 to 6-08-81	7-13-81 to 9-14-81	10-13-81*** to 12-14-81
SA-WWA-4S1				
Sr-89	<0.6	<2.2	<0.7(1)	
Sr-90	<0.4	<1.1	0.4±0.3	
K-40	<9.3	<9.3	22±8	<9.3
SA-WWA-5D1				
Sr-89	<0.6	<0.8	<0.8	
Sr-90	<0.4	<0.4	<0.4	
K-40	<9.3	19±7	20±10	<9.3
SA-WWA-3E1				
Sr-89	<0.8	<1.2	<0.7	
Sr-90	<0.6	<0.6	<0.4	
K-40	<9.3	<9.3	<9.3	<9.3

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

** All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

*** Sr-89 and -90 program was discontinued by RMC after the third quarter.

(1) Stop date for station WWA-4S1 was 9-24-81.

TABLE C-19

CONCENTRATIONS OF TRITIUM, GROSS ALPHA AND GROSS BETA EMITTERS, AND POTASSIUM-40
IN RAW AND TREATED POTABLE WATER

STATION SA-PWA-2F3

Results in Units of pCi/l ± 2 sigma

RADIOACTIVITY		JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
H-3	(Raw)	<123	<82	<95	<100	<87	<110
	(Treated)	<123	<113	<95	<100	<87	134±69
Alpha	(Raw)	0.8±0.4	1.2±0.5	0.6±0.6	1.8±0.7	1.3±0.7	1.2±0.7
	(Treated)	0.9±0.6	0.6±0.4	<1.0	0.9±0.7	0.6±0.6	<0.8
Beta	(Raw)	2.4±0.4	4.3±0.5	3.8±0.5	3.6±0.4	6.2±0.6	5.2±0.5
	(Treated)	2.6±0.4	2.9±0.4	2.9±0.4	3.1±0.4	3.7±0.5	3.1±0.4
K-40	(Raw)	1.0±0.1	0.90±0.09	1.1±0.1	1.0±0.1	1.1±0.1	1.7±0.2
	(Treated)	1.1±0.1	1.0±0.1	1.1±0.1	1.0±0.1	1.2±0.1	1.7±0.2

RADIOACTIVITY		JULY	AUGUST	SEPTEMBER	OCTOBER*	NOVEMBER	DECEMBER	AVERAGE
H-3	(Raw)	85±67	<120	74±73				-
	(Treated)	74±67	<120	<119	151±77	<116	<122	-
Alpha	(Raw)	<0.8	<0.6	1.0±0.5	<0.4	0.5±0.4	1.5±0.6	1.0±0.9
	(Treated)	<1.1	0.8±0.7	<0.5	<0.4	<0.6	1.1±0.6	0.8±0.5
Beta	(Raw)	5.2±0.5	3.4±0.5	3.1±0.5	2.9±0.4	2.6±0.5	4.0±0.5	3.9±2.3
	(Treated)	3.4±0.5	2.7±0.4	2.3±0.4	1.4±0.4	1.9±0.5	2.6±0.5	2.7±1.3
K-40	(Raw)	1.7±0.2	2.2±0.2	1.1±0.1	1.1±0.1	1.4±0.1	2.0±0.2	1.4±0.9
	(Treated)	2.1±0.2	3.0±0.3	1.2±0.1	1.2±0.1	1.4±0.1	1.7±0.2	1.5±1.2

* Tritium program for raw potable water samples was discontinued by RMC after the third quarter.

TABLE C-20

CONCENTRATIONS OF STRONTIUM-89* AND -90, AND GAMMA EMITTERS** IN QUARTERLY COMPOSITES OF POTABLE WATER

STATION SA-PWA-2F3

Results in Units of pCi/l ± 2 sigma

SAMPLE	1-01-81 to 3-31-81	4-01-81 to 6-30-81	7-01-81 to 9-30-81	10-01-81*** to 12-31-81
Raw				
Sr-89	0.7±0.5	<0.8	<0.8	
Sr-90	<0.5	0.6±0.3	0.7±0.3	
Gamma Emitters	<LLD	<LLD	<LLD	<LLD
Treated				
Sr-89	0.5±0.5	<0.9	<0.7	<0.7
Sr-90	<0.5	1.1±0.3	0.3±0.3	<0.5
Gamma Emitters	<LLD	<LLD	<LLD	<LLD

* Sr-89 results are corrected for decay to sample stop date.
** All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.
*** Strontium program for raw potable water samples was discontinued by RMC after the third quarter.

TABLE C-21

CONCENTRATIONS OF Sr-89* AND -90 IN BENTHOS

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

STATION NUMBER	DATE	Sr-89	Sr-90
SA-ESB-11A1	6-02-81	<0.5	0.2±0.1
	9-09-81	<0.2	0.36±0.09
SA-ESB-12C1(C)	6-02-81	<23	<6.9
	9-09-81	<1.6	<0.8
SA-ESB-7E1	6-02-81	<2.7	<0.8
	9-09-81	<2.1	<1.1
SA-ESB-16F1	6-02-81	<14	3.0±2.8
	9-09-81	<169**	<86**

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

** High MDL due to small sample size.

TABLE C-22

CONCENTRATIONS OF STRONTIUM-90 AND GAMMA* EMITTERS IN SEDIMENT**

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

STATION NO.	SA-ESS-11A1		SA-ESS-12C1		SA-ESS-7E1		SA-ESS-16F1	
DATE	6-01-81	9-09-81	6-01-81	9-09-81	6-01-81	9-09-81	6-01-81	9-09-81
Sr-90	0.04±0.04	<0.05	<0.1	<0.04	<0.05	<0.04	<0.06	<0.05
K-40	13±1	15±2	16±2	16±2	13±1	13±1	13±1	18±2
Co-60	<0.06	0.19±0.05	<0.04	<0.04	<0.03	<0.05	<0.06	<0.05
Zr-95	<0.08	<0.1	<0.09	<0.09	<0.06	<0.07	0.17±0.05	<0.08
Nb-95	<0.06	<0.09	<0.07	<0.07	0.09±0.03	0.08±0.04	0.44±0.05	<0.07
Cs-137	0.13±0.03	0.17±0.03	<0.04	<0.04	0.07±0.02	0.04±0.02	<0.04	<0.04
Ra-226	0.57±0.06	0.65±0.08	0.60±0.06	0.48±0.06	0.49±0.05	0.46±0.05	0.51±0.08	0.57±0.07
Th-232	0.7±0.1	0.9±0.1	0.86±0.09	0.9±0.1	0.58±0.07	0.47±0.08	1.0±0.1	1.0±0.1

* All other gamma emitters <LLD; typical LLDs are given in Table C-33.
** Sediment samples included associated benthic organisms.

TABLE C-23

CONCENTRATIONS OF IODINE-131 IN MILK

Results* in Units of pCi/l

STATION NO.	JANUARY**	FEBRUARY	MARCH	APRIL	MAY	JUNE
SA-MLK-13E3	<0.1 <0.1	<0.1 <0.08	<0.07 <0.07	<0.09 <0.08	<0.07 <0.07	<0.09 <0.07
SA-MLK-2F4	<0.09 <0.09	<0.09 <0.08	<0.07 <0.07	<0.1 <0.08	<0.07 <0.08	<0.08 <0.07
SA-MLK-5F2	<0.1 <0.1	<0.1 <0.08	<0.08 <0.09	<0.09 <0.07	<0.06 <0.09	<0.08 <0.08
SA-MLK-14F1	<0.1 <0.1	<0.1 <0.07	<0.08 <0.07	<0.09 <0.08	<0.07 <0.08	<0.09 <0.08
SA-MLK-15F1	<0.1 <0.1	<0.1 <0.07	<0.08 <0.07	<0.09 <0.09	<0.07 <0.09	<0.09 <0.08
SA-MLK-3G1	<0.2 <0.09	<0.1 <0.07	<0.09 <0.08	<0.1 <0.07	<0.06 <0.08	<0.07 <0.07

STATION NO.	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
SA-MLK-13E3	<0.1 <0.08	<0.07 <0.05	<0.09 <0.07	<0.1 <0.09	<0.07 <0.07	<0.08 <0.06
SA-MLK-2F4	<0.09 <0.07	<0.07 <0.04	<0.08 <0.07	<0.07 <0.08	<0.08 <0.09	<0.1 <0.07
SA-MLK-5F2	<0.09 <0.1	<0.07 <0.05	<0.09 <0.09	<0.09 <0.1	<0.08 <0.08	<0.08 <0.07
SA-MLK-14F1	<0.1 <0.1	<0.08 <0.04	<0.09 <0.08	<0.1 <0.1	<0.09 <0.1	<0.09 <0.08
SA-MLK-15F1	<0.1 <0.08	<0.08 <0.05	<0.09 <0.09	<0.2 <0.1	<0.1 <0.1	<0.09 <0.08
SA-MLK-3G1	<0.09 <0.09	<0.08 <0.04	<0.09 <0.07	<0.07 <0.08	<0.09 <0.09	<0.1 <0.07

* I-131 results decay corrected to sample stop date.

** Sampling dates can be found on Table C-25.

TABLE C-24

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN MILK

Results in Units of pCi/l ± 2 sigma

STATION NO.	NUCLIDE	JANUARY***	FEBRUARY	MARCH	APRIL	MAY	JUNE
SA-MLK-13E3	K-40	1400±140	2000±200	1500±150	1400±140	1500±150	1300±130
	Cs-137	<1.2	<1.2	<1.4	1.5±1.2	1.8±1.2	1.4±1.0
	Sr-89	<3.3	<5.2	<3.1	<37 (1)	<11 (2)	<9.6 (2)
	Sr-90	<1.0	<1.7	4.6±1.4	<8.9 (1)	2.5±0.8	2.8±0.9
SA-MLK-2F4	K-40	1600±160	1900±190	1400±140	1300±130	1500±150	1800±180
	Cs-137	<1.4	1.5±1.2	3.8±1.4	1.7±1.2	1.7±1.2	2.3±1.1
	Sr-89	<2.5	<13 (2)	<4.8	<6.5	<1.9	<12 (2)
	Sr-90	0.6±0.5	2.0±0.9	3.5±2.0	4.2±2.3	2.3±0.8	2.4±1.1
SA-MLK-5F2	K-40	1500±150	1500±150	1300±130	1700±170	1300±130	1400±140
	Cs-137	<1.2	1.5±1.1	1.4±0.9	1.5±1.0	3.8±1.1	6.4±1.3
	Sr-89	<2.7	<9.0	4.1±3.1	<5.4	<14 (2)	2.7±2.5
	Sr-90	0.6±0.5	3.9±1.8	6.3±2.1	6.8±2.0	6.6±1.1	<2.2

STATION NO.	NUCLIDE	JULY	AUGUST	SEPTEMBER	OCTOBER****	NOVEMBER	DECEMBER
SA-MLK-13E3	K-40	1300±130	1500±150	1400±140	1500±150	1600±160	1400±140
	Cs-137	<1.6	2.6±1.1	5.6±1.3	<1.4	<1.2	2.0±1.1
	Sr-89	<3.8	<2.9	<2.1			<4.3
	Sr-90	1.7±1.2	6.1±1.0	4.4±0.8			4.2±1.5
SA-MLK-2F4	K-40	1400±140	1300±130	1400±140	1500±150	1400±140	1900±190
	Cs-137	2.7±1.2	<1.4	<1.2	3.0±1.3	2.5±1.2	<1.2
	Sr-89	<3.6	<2.6	<6.6	1.8±1.5		
	Sr-90	<1.8	2.6±0.9	2.8±1.5	1.7±0.9		
SA-MLK-5F2	K-40	1500±150	1400±140	1400±140	1500±150	1400±140	1600±160
	Cs-137	6.1±1.4	3.1±1.2	3.9±1.4	<1.4	<1.2	<1.2
	Sr-89	<5.1	<2.8	2.0±1.4			
	Sr-90	5.4±1.6	5.6±1.0	4.1±0.8			

TABLE C-24 (cont.)

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN MILK

Results in Units of pCi/l ± 2 sigma

STATION NO.	NUCLIDE	JANUARY***	FEBRUARY	MARCH	APRIL	MAY	JUNE
SA-MLK-14F1	K-40	1500±150	1600±160	1400±140	1400±140	1400±140	1400±140
	Cs-137	<1.2	<1.2	<1.2	<1.4	2.6±1.1	5.0±1.3
	Sr-89	<2.7	<9.8 (2)	<3.2	<4.8	3.5±1.6	2.9±1.6
	Sr-90	<1.0	2.9±0.8	2.9±1.3	2.7±1.7	3.1±1.0	3.4±0.9
SA-MLK-15F1	K-40	1600±160	1600±160	1600±160	1400±140	1200±120	1400±140
	Cs-137	<1.4	<1.2	<1.4	2.1±1.3	3.1±1.0	3.5±1.3
	Sr-89	<12 (2)	8.5±5.0	<3.4	<25 (2)	4.7±2.7	<2.7
	Sr-90	2.8±1.0	4.7±2.4	4.0±1.4	3.0±1.2	3.0±1.5	2.7±1.0
SA-MLK-3G1	K-40	1500±150	1400±140	1400±140	1300±130	1700±170	1400±140
	Cs-137	<1.4	1.5±1.1	<1.4	<1.2	4.4±1.3	4.0±1.2
	Sr-89	<2.4	<6.9	<48 (2)	3.0±2.8	4.9±2.1	4.2±2.3
	Sr-90	<0.7	4.4±1.4	3.9±1.4	4.1±1.6	4.9±1.3	5.3±1.5

STATION NO.	NUCLIDE	JULY	AUGUST	SEPTEMBER	OCTOBER****	NOVEMBER	DECEMBER
SA-MLK-14F1	K-40	1300±130	1400±140	1300±130	1600±160	1500±150	1600±160
	Cs-137	<1.6	<1.4	2.6±1.4	<1.4	<1.4	<1.4
	Sr-89	<3.5	<2.8	<4.4		<2.5	
	Sr-90	2.0±1.1	3.6±0.9	2.7±1.5		3.1±1.0	
SA-MLK-15F1	K-40	1400±140	1400±140	1300±130	1300±130	1600±160	1400±140
	Cs-137	1.6±1.1	<1.2	2.6±1.3	2.7±1.4	<1.4	<1.2
	Sr-89	<6.0	<3.0	<2.8			
	Sr-90	2.9±0.8	4.1±1.0	2.9±1.0			
SA-MLK-3G1	K-40	1500±150	1200±120	1100±110	1300±130	1300±130	1400±140
	Cs-137	2.8±1.5	<1.4	<1.4	3.1±1.2	<1.4	<1.4
	Sr-89	<4.2	<2.4	3.3±1.7	<3.4	<5.2	<1.8
	Sr-90	3.6±1.4	5.2±0.9	2.9±1.0	2.9±1.2	3.4±1.9	3.7±0.7

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

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

*** Sampling dates can be found on Table C-25.

**** Strontium program was reduced after the third quarter. Station MLK-3G1 continues to be analyzed for Sr-89 and -90 on a monthly basis by RMC; in addition, one station a month is selected by PSE&G to be analyzed for Sr-89 and -90.

(1) High MDL due to low chemical yield.

(2) High MDL due to long decay period.

TABLE C-25

SAMPLING DATES FOR MILK SAMPLES

MONTH	13E3	2F4	5F2	14F1	15F1	3G1
JANUARY	1-05-81 to 1-06-81	1-05-81 to 1-06-81	1-04-81 to 1-05-81	1-04-81 to 1-05-81	1-04-81 to 1-05-81	1-04-81 to 1-05-81
	1-19-81 to 1-20-81	1-19-81 to 1-20-81	1-16-81 to 1-19-81	1-18-81 to 1-19-81	1-18-81 to 1-19-81	1-18-81 to 1-19-81
FEBRUARY	2-02-81 to 2-03-81	2-02-81 to 2-03-81	1-31-81 to 2-02-81	2-01-81 to 2-02-81	2-01-81 to 2-02-81	2-01-81 to 2-02-81
	2-17-81 to 2-18-81	2-16-81 to 2-17-81	2-14-81 to 2-17-81	2-17-81 to 2-18-81	2-17-81 to 2-18-81	2-17-81 to 2-18-81
MARCH	3-02-81 to 3-03-81	3-02-81 to 3-03-81	3-02-81 to 3-03-81	3-01-81 to 3-02-81	3-01-81 to 3-02-81	3-01-81 to 3-02-81
	3-16-81 to 3-17-81	3-16-81 to 3-17-81	3-15-81 to 3-16-81	3-15-81 to 3-16-81	3-15-81 to 3-16-81	3-15-81 to 3-16-81
APRIL	4-06-81 to 4-07-81	4-05-81 to 4-06-81	4-06-81 to 4-07-81	4-06-81 to 4-07-81	4-05-81 to 4-07-81	4-06-81 to 4-07-81
	4-20-81 to 4-21-81	4-19-81 to 4-20-81	4-20-81 to 4-21-81	4-21-81 to 4-21-81	4-19-81 to 4-20-81	4-20-81 to 4-21-81
MAY	5-04-81 to 5-05-81	5-03-81 to 5-04-81	5-04-81 to 5-05-81	5-05-81 to 5-05-81	5-03-81 to 5-05-81	5-04-81 to 5-05-81
	5-18-81 to 5-19-81	5-17-81 to 5-18-81	5-17-81 to 5-18-81	5-17-81 to 5-18-81	5-17-81 to 5-18-81	5-18-81 to 5-19-81
JUNE	6-01-81 to 6-02-81	5-31-81 to 6-01-81	5-31-81 to 6-02-81	5-31-81 to 6-01-81	5-31-81 to 6-01-81	6-01-81 to 6-02-81
	6-15-81 to 6-16-81	6-14-81 to 6-15-81	6-13-81 to 6-15-81	6-14-81 to 6-15-81	6-14-81 to 6-15-81	6-15-81 to 6-16-81

TABLE C-25 (cont.)

SAMPLING DATES FOR MILK SAMPLES

MONTH	13E3	2F4	5F2	14F1	15F1	3G1
JULY	7-06-81 to 7-07-81	7-06-81 to 7-07-81	7-05-81 to 7-06-81	7-06-81 to 7-07-81	7-06-81 to 7-07-81	7-05-81 to 7-06-81
	7-20-81 to 7-21-81	7-20-81 to 7-21-81	7-18-81 to 7-20-81	7-20-81 to 7-21-81	7-20-81 to 7-21-81	7-19-81 to 7-20-81
AUGUST	8-03-81 to 8-04-81	8-03-81 to 8-04-81	8-03-81 to 8-04-81	8-03-81 to 8-04-81	8-03-81 to 8-04-81	8-02-81 to 8-03-81
	8-17-81 to 8-18-81	8-17-81 to 8-18-81	8-16-81 to 8-17-81	8-17-81 to 8-18-81	8-17-81 to 8-18-81	8-16-81 to 8-17-81
SEPTEMBER	9-07-81 to 9-09-81	9-08-81 to 9-09-81	9-07-81 to 9-08-81	9-08-81 to 9-09-81	9-08-81 to 9-09-81	9-07-81 to 9-08-81
	9-21-81 to 9-22-81	9-20-81 to 9-21-81	9-19-81 to 9-21-81	9-21-81 to 9-22-81	9-20-81 to 9-21-81	9-21-81 to 9-22-81
OCTOBER	10-05-81 to 10-06-81	10-04-81 to 10-05-81	10-05-81 to 10-06-81	10-04-81 to 10-05-81	10-04-81 to 10-05-81	10-05-81 to 10-06-81
	10-19-81 to 10-20-81	10-18-81 to 10-19-81	10-17-81 to 10-19-81	10-19-81 to 10-20-81	10-18-81 to 10-19-81	10-19-81 to 10-20-81
NOVEMBER	11-01-81 to 11-02-81	11-01-81 to 11-02-81	10-31-81 to 11-02-81	11-01-81 to 11-02-81	11-01-81 to 11-02-81	10-31-81 to 11-02-81
	11-16-81 to 11-17-81	11-15-81 to 11-16-81	11-16-81 to 11-17-81	11-15-81 to 11-16-81	11-15-81 to 11-16-81	11-16-81 to 11-17-81
DECEMBER	12-06-81 to 12-08-81	12-07-81 to 12-08-81	12-07-81 to 12-07-81	12-07-81 to 12-08-81	12-07-81 to 12-08-81	12-06-81 to 12-07-81
	12-14-81 to 12-15-81	12-13-81 to 12-14-81	12-13-81 to 12-14-81	12-13-81 to 12-14-81	12-13-81 to 12-14-81	12-14-81 to 12-15-81

TABLE C-26

CONCENTRATIONS OF GAMMA EMITTERS* IN EDIBLE FISH

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

STATION NUMBER	SAMPLING DATE	K-40	Cs-137
SA-ESF-11A1	6-01-81 to 7-02-81	2.9±0.3	<0.008
	8-27-81 to 9-18-81	3.5±0.4	<0.009
SA-ESF-12C1	6-01-81 to 7-02-81	3.2±0.3	<0.009
	8-27-81 to 9-18-81	3.8±0.4	<0.01
SA-ESF-7E1	6-01-81 to 7-02-81	3.3±0.3	0.016±0.009
	8-27-81 to 9-18-81	4.6±0.5	<0.009

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

TABLE C-27

CONCENTRATIONS OF STRONTIUM-89* AND -90, AND TRITIUM IN EDIBLE FISH SAMPLES

STATION	DATE	Bones (pCi/g(dry) ± 2 sigma) Sr-89	Bones (pCi/g(dry) ± 2 sigma) Sr-90	Flesh Aqueous Fraction (pCi/l ± 2 sigma) H-3	Flesh Organic Fraction (pCi/l ± 2 sigma) H-3
SA-ESF-11A1	6-01-81 to 7-02-81	<0.2	<0.08	82±63	317±72
	8-27-81 to 9-18-81	<0.08	<0.05	<110	<112
SA-ESF-12C1	6-01-81 to 7-02-81	<0.09	0.04±0.03	<86	<112
	8-27-81 to 9-18-81	<0.06	<0.04	<110	<112
SA-ESF-7E1	6-01-81 to 7-02-81	<0.09	0.05±0.03	<86	156±70
	8-27-81 to 9-18-81	<0.07	<0.04	83±68	126±69

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

TABLE C-28

CONCENTRATIONS OF GAMMA EMITTERS* IN BLUE CRAB SAMPLES

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

STATION NUMBER	DATE	SAMPLE TYPE	K-40
SA-ECH-11A1	6-01-81 to 7-02-81	Flesh	1.7±0.2
	8-27-81 to 9-18-81	Flesh	2.1±0.2
SA-ECH-12C1	6-01-81 to 7-02-81	Flesh	2.5±0.3
	8-27-81 to 9-18-81	Flesh	2.1±0.2

* All other gamma emitters <LLD; typical LLDs are given in Table C-33.

TABLE C-29

CONCENTRATIONS OF STRONTIUM-89* AND -90 AND TRITIUM IN BLUE CRAB SAMPLES

STATION NUMBER	DATE	SAMPLE	Sr-89 pCi/g ± 2 sigma	Sr-90 pCi/g ± 2 sigma	H-3 (Edible Portion) pCi/l ± 2 sigma
SA-ECH-11A1	6-01-81 to 7-02-81	Flesh	<0.02	<0.007	<86
		Shell	0.8±0.2	0.94±0.09	-
	8-27-81 to 9-18-81	Flesh	<0.08	0.07±0.02	123±68
		Shell	<0.1	0.24±0.04	-
SA-ECH-12C1	6-01-81 to 7-02-81	Flesh	<0.01	0.007±0.004	<86
		Shell	1.7±0.2	1.0±0.1	-
	8-27-81 to 9-18-81	Flesh	<0.06	0.03±0.02	<110
		Shell	<0.08	0.28±0.04	-

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

\- Indicates tritium analysis not performed on shells.

TABLE C-30

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89** AND -90 IN FOOD PRODUCTS

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

STATION NO.	DATE	SAMPLE TYPE	K-40	Sr-89	Sr-90
SA-FPV-2E1	5-03-81	Asparagus	2.2±0.2	<0.01	<0.007
SA-FPV-2E1	7-27-81	Peppers	2.0±0.2	<0.006	<0.003
SA-FPL-1F3	7-27-81	Cabbage	2.4±0.2	<0.02	0.015±0.006
SA-FPV-5F1	7-27-81	Tomatoes	2.8±0.3	<0.008	0.004±0.002
SA-FPG-1G1	7-27-81	Corn	2.8±0.3	<0.008	0.003±0.002
SA-FPV-1G1	7-27-81	Tomatoes	2.5±0.3	<0.006	0.004±0.002
SA-FPG-3H4	7-27-81	Corn	5.9±0.6	<0.008	<0.004
SA-FPV-3H4	7-27-81	Cucumbers	1.5±0.2	<0.008	0.003±0.003
SA-FPV-3H4	7-27-81	Peppers	1.7±0.2	<0.02	0.013±0.007
SA-FPV-3H4	7-27-81	Tomatoes	3.1±0.3	<0.006	<0.003
SA-FPV-5D1	7-28-81	Squash	1.5±0.2	<0.01	0.008±0.003
SA-FPV-1G1	7-28-81	Peppers	2.0±0.2	<0.009	0.004±0.002
SA-FPV-14F3	8-08-81 to 8-10-81	Tomatoes	2.1±0.2	<0.008	<0.004
SA-FPG-14F3	8-11-81	Corn	2.1±0.2	<0.009	<0.004

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

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

TABLE C-31

CONCENTRATIONS OF GAMMA EMITTERS* AND STRONTIUM-89 AND -90** IN MEAT, GAME, AND BOVINE THYROID

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

STATION NO.	DATE	SAMPLE TYPE	K-40	Sr-89	Sr-90
				pCi/g(dry)±2 sigma	
SA-GAM-3E1	1-08-81 to 1-09-81	Muskrat	2.4±0.2	<0.2	0.50±0.05
SA-GAM-11E1	3-05-81 to 3-06-81	Muskrat	3.1±0.3	<0.9	0.5±0.3
SA-FPB-3E1	3-09-81	Beef	2.7±0.3	-	-
SA-THB-3E1	3-09-81	Bovine Thyroid	1.3±0.7	-	-
SA-FPB-3E1	11-02-81	Beef	1.7±0.2	-	-
SA-THB-3E1	11-02-81	Bovine Thyroid	<0.6	-	-
SA-FPB-14F1	12-08-81	Beef	1.7±0.2	-	-
SA-THB-14F1	12-08-81	Bovine Thyroid	<1.1	-	-

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

** Radiostrontium performed on muskrat only. Sr-89 results are corrected for decay to sample stop date.

TABLE C-32

CONCENTRATIONS OF GAMMA EMITTERS* IN FODDER CROP SAMPLES

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

STATION NUMBER	DATE	SAMPLE TYPE	Be-7	K-40	Cs-137
SA-VGT-3G1	8-01-81 to 8-31-81	Silage	<1.2	8.7±1.8	<0.1
SA-VGT-2F4	9-08-81	Green Chop	<1.1	12±2	<0.1
SA-VGT-14F1	9-08-81	Green Chop	<0.4	5.6±0.6	<0.05
SA-VGT-13E3	9-21-81	Green Chop	<0.5	5.2±0.8	<0.06
SA-VGT-15F1	9-21-81	Weed Chop	2.3±0.7	10±1	<0.08
SA-VGT-15F1	10-05-81	Corn Silage	<1.3	7.5±1.4	<0.1
SA-FPG-3E1	10-14-81	Soybeans	<0.3	16±2	0.04±0.03
SA-FPG-3G1	11-17-81	Soybeans	<0.5	21±2	<0.05
SA-FPG-15F1	11-30-81	Soybeans	<0.2	13±1	<0.03

* All other gamma emitters searched for were <LLD; typical LLDs are given in Table C-33.

TABLE C-33

LLDs FOR GAMMA SPECTROMETRY

NUCLIDES	SURFACE WATER (pCi/l)	FISH (pCi/g-wet)	SEDIMENT (pCi/g-dry)	AIR PARTICULATES (10^{-3}pCi/m^3)	PRECIPITATION (pCi/l)	WELL/POTABLE WATER (pCi/l)
Be-7	5.2	0.07	0.3	-	7.6	7.0
Na-22	0.8	0.009	*	*	0.6	0.6
K-40	11	-	-	7.2	7.8	7.8
Cr-51	5.3	0.06	0.4	7.6	5.9	5.8
Mn-54	0.6	0.008	0.03	0.6	0.6	0.6
Co-57	*	*	0.02	0.3	1.0	*
Co-58	0.7	0.009	0.03	0.5	0.7	0.7
Fe-59	1.5	0.02	0.09	1.1	1.6	1.4
Co-60	0.8	0.009	0.03	0.5	0.8	0.8
Zn-65	1.4	0.02	0.08	0.9	1.5	1.4
Zr-95	*	*	0.06	-	*	*
Nb-95	*	*	0.06	-	*	*
ZrNb-95	0.6	0.008	*	*	0.6	0.6
Mo-99	18	1.1	*	39	51	40
Ru-103	*	*	0.04	0.9	*	*
Ru-106	6.3	0.08	0.02	6.1	13	6.3
Ag-110m	0.6	0.008	0.03	0.6	0.8	0.6
Sb-125	*	*	0.07	1.7	*	*
Te-129m	12	0.2	1.4	28	13	13
I-131	1.0	0.02	0.2	3.4	1.4	1.3
Te-132	1.5	0.07	*	*	3.6	3.0
I-133	*	*	*	*		*
Cs-134	0.6	0.008	0.03	0.5	0.8	0.6
Cs-136	1.2	0.02	0.1	1.2	1.6	1.5
Cs-137	0.6	0.008	0.04	-	0.8	0.6
Ba-140	*	*	0.5	9.7	9.8	*
La-140	*	*	0.1	1.6	2.8	*
BaLa-140	1.0	0.02	*	*	1.3	1.2
Ce-141	*	*	0.07	1.0	*	*
Ce-144	1.6	0.03	0.2	*	3.2	1.6
Ra-226	1.1	0.01	-	1.1	1.2	1.2
Th-232	3.1	0.03	-	1.8	3.1	3.1

TABLE C-33 (cont.)

LLDs FOR GAMMA SPECTROMETRY

NUCLIDES	MILK (pCi/l)	FOOD PRODUCTS (pCi/g-wet)	FODDER CROPS (pCi/g-dry)	GAME (pCi/g-wet)	SHELLFISH (pCi/g-wet)
Be-7	9.4	0.02	0.3	0.7	0.09
Na-22	1.3	0.003	0.03	0.008	0.01
K-40	-	-	-	-	-
Cr-51	6.7	0.02	0.2	0.06	0.1
Mn-54	1.0	0.003	0.03	0.008	0.01
Co-57	*	*	*	*	*
Co-58	1.1	0.003	0.03	0.008	0.01
Fe-59	3.7	0.007	0.09	0.02	0.02
Co-60	1.2	0.003	0.03	0.008	0.01
Zn-65	3.2	0.008	0.08	0.02	0.03
Zr-95	*	*	*	*	*
Nb-95	*	*	*	*	*
ZrNb-95	1.2	0.003	0.03	0.008	0.009
Mo-99	130	0.08	0.9	0.2	1.9
Ru-103	*	*	*	*	*
Ru-106	8.0	0.03	0.3	0.08	0.1
Ag-110m	1.0	0.003	0.03	0.008	0.01
Sb-125	*	*	*	*	*
Te-129m	19	0.06	0.5	0.2	0.2
I-131	2.3	0.004	0.06	0.01	0.03
Te-132	6.1	0.004	0.07	0.02	0.1
I-133	*	0.09	3.1	0.4	*
Cs-134	0.9	0.003	0.03	0.008	0.01
Cs-136	2.7	0.007	0.07	0.02	0.03
Cs-137	1.2	0.003	0.05	0.009	0.01
Ba-140	*	*	*	*	*
La-140	*	*	*	*	*
BaLa-140	1.7	0.004	0.05	0.01	0.02
Ce-141	*	*	*	*	*
Ce-144	3.2	0.01	0.01	0.03	0.03
Ra-226	1.6	0.005	0.06	0.01	0.02
Th-232	4.7	0.01	0.1	0.03	0.05

- Indicates a positive concentration was measured in all samples analyzed.
* Indicates that no LLD was calculated for that nuclide in that media.

APPENDIX D

SYNOPSIS OF ANALYTICAL PROCEDURES

GROSS ALPHA ANALYSIS OF SAMPLES

Total Water (AØ, A1)

A 250 ml (AØ) or one l (A1) aliquot of the sample is evaporated to dryness on a hot plate in a preweighed, 2" X 1/4" ringed planchet, allowed to cool, and reweighed. The planchet is counted in a low-background, gas flow proportional counter. Self-absorption corrections are made based on the measured sample weight and calculated thickness. The calibration standard used is Pu-239. A 250 ml or one l sample of distilled water is evaporated in the same manner and used as a blank.

Total Salt Water (AA)

Alpha emitters are concentrated initially from a liter aliquot of water sample by coprecipitation with magnesium hydroxide. The precipitate is then dissolved in hydrochloric acid and titanium trichloride is added to the solution. The alpha emitters are coprecipitated by adding barium chloride and sulfuric acid to precipitate barium sulfate. The precipitate is transferred to a tared stainless steel planchet and dried. The planchet is reweighed and counted in a low background gas-flow proportional counter. Self-absorption corrections are made on the basis of the weight of the precipitate.

Calculations are made utilizing the following equations:

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

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

where:

S = Gross counts of sample
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 = Sample aliquot size (liters)
TF = Transmission factor (based on net weight of sample in counting planchet)

Calculation of lower limit of detection (LLD)

The detection limit is assumed to be exceeded when the counting result is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

where:

- B = Counts of blank
- E = Fractional Pu-239 counting efficiency
- t = Number of minutes blank was counted
- V = Volume of aliquot (liters)
- TF = Transmission factor (based on net weight of sample in counting planchet)

Air Particulates (AD)

After a decay period of three to seven days, to allow for the decay of short lived radium and thorium daughter products, the filters are counted in a gas-flow proportional counter. The alpha activity per unit volume is calculated from the volume of air filtered. An unused filter is used as a blank.

Calculations are made utilizing the following equations:

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

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

where:

- S = Gross counts of sample
- 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 (cubic meters)

Calculation of lower limit of detection (LLD)

The detection limit is assumed to be exceeded when the counting result is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

where:

- B = Counts of blank
- E = Fractional Pu-239 counting efficiency
- t = Number of minutes blank was counted
- V = Volume of aliquot (cubic meters)

GROSS BETA ANALYSIS OF SAMPLES

Total Water (BØ, B1)

A 250 ml (BØ) or one l (B1) aliquot is evaporated to dryness on a hot plate in 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 or one l sample of distilled water is evaporated in the same manner and used as a blank.

Calculations are made utilizing the following equations:

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

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

where:

- S = Gross counts of sample
- 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 = Volume of aliquot (liters)
- TF = Transmission factor (based on net weight of sample in counting planchet)

Calculation of lower limit of detection (LLD)

The detection limit is assumed to be exceeded when the counting result for the sample is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

where:

- B = Counts of blank
- E = Fractional Sr-90-Y-90 counting efficiency
- t = Number of minutes blank was counted
- V = Volume of aliquot (liters)
- TF = Transmission factor (based on net weight of sample in counting planchet)

Air Particulates (BD)

After a decay period of three to seven days, to allow for the decay of short lived radium and thorium daughter products, the filters are counted in a gas-flow proportional counter. The beta activity is calculated from the volume of air filtered. An unused filter paper is used as a blank.

Calculations are made utilizing the following equations:

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

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

where:

- S = Gross counts of sample
- 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 = Volume of sample (cubic meters)

Calculation of lower limit of detection (LLD)

The detection limit is assumed to be exceeded when the counting result for the sample is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

where:

- B = Counts of blank
- E = Fractional Sr-90-Y-90 counting efficiency
- t = Number of minutes blank was counted
- V = Volume of sample (cubic meters)

GAMMA SPECTROMETRY OF SAMPLES

Water (N1)

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

Milk (N7)

A 4 liter aliquot is dried at 175°C, ashed at 500°C until no carbon residue is present, compressed and sealed in a standard container, and then counted with a NaI(Tl) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Dried Solids (N8, 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, sealed in a standard container, and counted with a NaI(Tl) or Ge(Li) detector, coupled to a multi-channel pulse-height analyzer. The counting time is 50,000 seconds.

Air Dried Solids (NA)

A large quantity of sample is air dried. A 100 gram aliquot (or the total sample if less than 100 grams) is taken, compressed to unit density, sealed in a standard container and counted with a NaI(Tl) 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, compressed, and sealed in the standard container, and counted with the high resolution Ge(Li) detector, coupled to a multi-channel pulse-height analyzer.

Calculation of result and two sigma error

The spectrum obtained is smoothed to eliminate spurious statistical noise. Peaks are identified by changes in the slope of the gross spectrum. The net counting rate above the baseline is calculated. This counting rate is converted to activity in curie units, making allowance for counting efficiency and gamma ray abundance. A PDP-11 computer program was introduced for spectrum analysis.

Calculations are made utilizing the following equations:

$$\text{Result (pCi/l, g or m}^3) = ((S/T) - (B/t)) / (2.22\ V\ E\ F)$$

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

where:

S = Sample counts in energy channels for peak being quantitated
B = Background counts in energy channels for peak being quantitated
T = Number of minutes sample was counted
E = Detector efficiency for energy of interest
V = Sample aliquot size
F = Fractional gamma abundance

Calculation of lower limit of detection (LLD) for G8 and GB

LLD (pCi/l, g or m^3) $= 4.66\ (6\ S)^{1/2}\ /\ (2.22\ V\ E\ F\ T)$

where:

S = Sample counts in energy channels for peak being quantitated
T = Number of minutes sample was counted
E = Detector efficiency for energy of interest
V = Sample aliquot size
F = Fractional gamma abundance

Calculation of lower limit of detection (LLD) for N1, N7, N8 and NA

LLD (pCi/l, g or m^3) $= 4.66\ (.63\ 6\ S)^{1/2}\ /\ (2.22\ V\ E\ F\ T)$

where:

S = Sample counts in energy channels for peak being quantitated
T = Number of minutes sample was counted
E = Detector efficiency for energy of interest
V = Sample aliquot size
F = Fractional gamma abundance

ANALYSIS OF WATER SAMPLES FOR POTASSIUM-40 BY AA (EØ)

Sample Preparation

An aliquot sample size of 100 ml is filtered. The concentration of potassium is determined spectrophotometrically on a Perkin Elmer Model 373 atomic absorption unit. The result obtained, in micrograms per milliliter, is multiplied by the specific activity of 0.12% for natural potassium to determine the amount of potassium-40 present in the sample. The error reported is 10% of KCl are determined with each sample set.

Calculations are made using the following equations:

$$\text{K-40 (pCi/l)} = Cs\ D\ (C/S)\ K\ 10^3$$

$$\text{LLD (pCi/l)} = Cs\ D\ (.1/S)\ K\ 10^3$$

where:

Cs = Concentration of Standard (μg K/ml)
C = Sample reading
S = Standard reading
D = Dilution factor
K = Specific activity of K-40 per unit weight of potassium
= .852 pCi/mg

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 are made utilizing the following equations:

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

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

where:

- S = Total gross counts of sample
- 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 = Aliquot volume (liters)

Gross counts of sample may be corrected for the blank activity. If the collection container is rinsed with distilled water and the rinse is added to the sample, the rinse plus sample and a separate aliquot of the distilled water are counted. The corrected gross counts for the sample only are calculated using the following equations:

$$S = ((s-b)v) / G$$

$$s = (c(G+H)) / V$$

$$b = (d(H)) / V$$

$$V = ((G+H)\ V) / G$$

where:

- S = Gross counts of sample
- G = Volume of sample
- H = Volume of rinse
- s = Volume corrected gross counts of sample plus rinse
- b = Volume corrected gross counts of rinse
- v = Corrected aliquot volume
- c = Uncorrected gross counts of sample plus rinse
- d = Uncorrected gross counts of rinse

Calculation of lower limit detection (LLD)

The detection limit is assumed to be exceeded when the counting result is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

where:

B = Counts of blank
E = Fractional H-3 counting efficiency
t = Number of minutes blank was counted
V = Aliquot volume (liters)

Aqueous and Organic Fraction of Milk or Organic Solids (H3, H4, H9)

A carefully measured aliquot of a food product, such as milk or fish, is dried in a rotating vacuum flash evaporator. During the evaporation process, the evaporated water fraction is trapped out by a dry ice isopropanol mixture for counting as in (a) below. The dried residue is reserved for (b). The wet sample is analyzed as in (c).

a. Aqueous H-3 in Food Products

An eight (8) ml aliquot of the cold-trapped water is counted in a liquid scintillation counter in the same manner as surface water samples are counted.

b. Organic Bound H-3 in Food Products

The dried residue is combusted in an RMC designed oxidizer. The collected water - organic fraction is measured and vacuum distilled to remove any impurities. Permanganate in KOH solution is added to remove impurities which may cause quenching. An eight (8) ml aliquot is counted in a liquid scintillation counter. If less than eight (8) ml are collected, the entire portion collected is carefully measured with a 10 ml pipette and then counted. A sample of deep well water is counted as a blank.

c. Aqueous and organic Bound H-3 in Food Products

A wet weight aliquot is combusted in an RMC designed oxidizer. The collected water fraction is measured and vacuum distilled to remove any impurities. Permanganate in KOH solution is added to remove impurities which may cause quenching. An eight (8) ml aliquot is counted in a liquid scintillation counter. If less than eight (8) ml are collected, the entire portion collected is carefully measured with a 10 ml pipette and then counted. A sample of deep well water is counted as a blank.

Calculations are made utilizing the following equations:

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

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

Result (pCi/g of freeze dried sample) = A (YI)

2 sigma error (pCi/g of freeze dried sample) = C (YI)

Result (pCi/g or l of original sample) = A (YF)

2 sigma error (pCi/g or l of original sample) = C (YF)

where:

S = Gross counts of sample
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 = Volume of distillate counted
YI = Liters of water-organic recovered/ g of freeze dried sample
YF = Liters of water recovered/ (l or g) of sample aliquot taken
A = Result in pCi/l of distillate
C = 2 sigma error in pCi/l of distillate

Calculation of lower limit detection (LLD)

The detection limit is assumed to be exceeded when the counting result is different from the blank reading by at least 4.66 times the standard deviation of that background.

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

LLD (pCi/g of freeze dried sample) = F (YI)

LLD (pCi/l or g) = F (YF)
of original sample

where:

B = Counts of blank
E = Fractional H-3 counting efficiency
t = Number of minutes blank was counted
V = Volume of distillate counted
YI = Liters of water-organic recovered/g of freeze dried sample
YF = Liters of water recovered/(l or g) of sample aliquot taken
F = LLD in pCi/l of distillate

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.

Calculations are made utilizing the following equations:

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

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

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

where:

- S = Gross counts of sample in channels containing I-131 peak
- B = Background counts in channels containing I-131 peak
- T = Number of minutes sample was counted
- t = Number of minutes background was counted
- E = Iodine-131 counting efficiency
- V = Sample aliquot size
- F = Fractional gamma abundance
- Y = Chemical yield of iodine

Air Cartridges (I1)

An iodine absorber 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.

Calculation of results and two sigma error

Peaks are identified by changes in the slope of the spectrum. If peaks are identified the spectrum obtained is smoothed to eliminate spurious statistical noise. The presence of iodine-131 is identified by the presence of a 364 Kev peak. The net counting rate above the baseline is calculated. This counting rate is converted to activity in curie units, making allowance for counting efficiency and gamma ray abundance. A PDP-11 computer program is used for spectrum analysis. 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.

Calculations are made utilizing the following equations:

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

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

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

where:

- S = Gross counts of sample in channels containing I-131 peak
- B = Background counts in channels containing I-131 peak
- t = Number of minutes background was counted
- E = Iodine-131 counting efficiency
- V = Sample aliquot size
- F = Fractional gamma abundance

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 scavenging 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 dissolved ash to facilitate chemical separation of Sr-89 and -90, and to determine the strontium recovery. Strontium concentrations and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron rare earth scavenging 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.

Bones and Shells (S5, T5)

A large quantity of the sample is dried, ashed and a 25 g portion is then dissolved in concentrated acid. Stable strontium carrier is added to the dissolved sample to facilitate chemical separations 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 scavenging 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.

Soil and Sediment (S6, T6)

A large quantity of sample is dried, and a 25 g portion is then leached with concentrated HCl before drying. Stable strontium carrier is added to the sample to facilitate isolation of the strontium and to determine the strontium recovery. Strontium concentrations and purification is ultimately realized by at least two precipitations of strontium nitrate in concentrated nitric acid. Additional iron rare earth scavenging and barium chromate separations are performed to remove suspected interfering nuclides. The purified strontium is converted to a carbonate for weighing and counting. Within 8 hours 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 processed with each batch of samples.

Organic Solids (S8, T8)

A 250 g portion of the sample is ashed and then dissolved in concentrated 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 rare earth iron hydroxide scavenging 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.

Air Particulates (SA, TA)

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 concentrations 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 7-14 day interval and Sr-90 and Sr-89 activities are calculated on the basis of appropriate Sr-89 decay and Y-90 ingrowth equations.

Calculations are made using the following equations:

$$\text{Result Sr-90 } (\text{pCi/l, g or m}^3) = ((Z(S1-B1)) - (S2-B2)) / (2.22\ K\ V\ E9\ Y\ T)$$

$$\text{2 sigma error Sr-90 } (\text{pCi/l, g or m}^3) = 2\ (Z^2(S1+B1) + S2+B2)^{1/2} / (2.22\ (K^2)^{1/2}\ V\ E9\ Y\ T)$$

$$\text{MDL } (\text{pCi/l, g or m}^3) = (-9 -6(2\ B2+Z(S1-B1))^{1/2} + 2.25 + Z^2(S1+B1))/(4.44\ V\ E9\ Y\ T)$$

$$\text{Result Sr-89 } (\text{pCi/l, g or m}^3) = (F(S1-B1) + H(S2-B2)) / (2.22\ V\ E8\ Y\ T\ \exp(-.693t4/52.7))$$

$$\text{2 sigma error Sr-89 } (\text{pCi/l, g or m}^3) = 2(F^2(S1+B1) + H^2(S2+B2))^{1/2} / (2.22\ V\ E8\ Y\ T\ \exp(-.693t4/52.7))$$

$$\text{MDL } (\text{pCi/l, g or m}^3) = (F(X-B1) + H\ (S2-B2)) / (2.22\ V\ E8\ Y\ T\ \exp(-.693t4/52.7))$$

where:

Sr-89(1)	=	Sr-89 counts on first 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	=	Blank counts in first count
B2	=	Blank 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	=	$(-9\ F^2\ B1) - 9\ H^2\ (S2+B2)+(F\ B1)^2 - 2\ F\ H\ B2\ S2+2\ F\ H\ B1\ B2 + (H(S2-B2))^2$
B	=	$2\ F^2 H\ (S2-B2) - 2\ F^2\ B1 - 9\ F^2$
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

Calculation of minimum detectable levels (MDLs)

Due to the method of calculating the activity of Sr-90 in the presence of Sr-89, the form used in the NBS Handbook 80 for calculating minimum detectable activities is not applicable.

ENVIRONMENTAL DOSIMETRY (DØ, D1, D2)

Measurement Techniques

Each dosimeter utilized is a capillary tube containing calcium sulfate. (Tm) powder as the thermoluminescent dosimeter (TLD) material. This was chosen primarily for its high light output, minimal thermally induced signal loss (fading), and lack of self-dosing. The energy response curve has been flattened by a complex multiple element energy compensation shield supplied by Panasonic Corporation, manufacturer of the TLD reader. The four dosimeters per station are sealed in a polyethylene bag to demonstrate integrity at time of measurement. Visible through the bag are the sample placement instructions. One set of TLDs is placed in a lead shield at RMC and represents a zero dose. The TLDs are then taken and placed in the field stations; one field TLD set is placed in a field lead shield at station 18 and is used in calculating the in-transit dose.

Following the pre-designated exposure period the TLD is heated with hot gas and the luminescence measured with a TLD reader. Data are normalized to standard machine conditions by correcting machine settings to zero before readout. Data are corrected for in-transit dose using a set of TLDs which is kept in a lead shield in the field and only exposed during transit. Average dose per exposure period, and its error, are calculated.

The basic calibration is in mR exposure to a standard Cs-137 source. This is converted to absorbed dose in tissue by the factor : 0.955 rad/Roentgen and to dose equivalent by using a quality factor of 1.

Calculation of results and two sigma error

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

ITD = NET(siteØ) - (NET(RMCØ) (D(sta) / D(RMCØ)))

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

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

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

ENVIRONMENTAL DOSIMETRY (cont.)

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 = $(6.21)\cdot(ELS^{-0.95})$
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

APPENDIX E

SUMMARY OF INTERLABORATORY COMPARISONS

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	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	54±5	64±10
July 1981	57789	Water	α	19±3	22±6	18±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

TABLE E-2

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-3

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 Sr-90	24±11 27±7	16±5 34±2	15±5 32±5
Jan 1981	43514	Milk	Sr-89 Sr-90	<8 22±3	0 20±3	29±37 19±3
March 1981	44815	Food	Sr-89 Sr-90	74±13 32±2	47±5 29±2	43±18 27±8
March 1981	53663	APT	Sr-90	16±2	18±1.5	17±3
Apr 1981	54841	Water	Sr-89 Sr-90	32±6 29±5	38±5 28±1.5	34±9 26±7
May 1981	54879	Water	Sr-89 Sr-90	51±2 26±10	36±5 22±1.5	32±10 22±6
May 1981	55248	Milk	Sr-89 Sr-90	9±2 9±1	25±5 11±1.5	22±6 10±3
June 1981	56994	APT	Sr-90	18±2	19±2	19±3
July 1981	57331	Food	Sr-89 Sr-90	36±14 23±1	44±5 31±2	44±9 29±3
July 1981	57812	Milk	Sr-89 Sr-90	20±7 16±0	25±5 17±2	24±6 16±2
Sept 1981	59585	Water	Sr-89 Sr-90	21±5 6±2	23±5 11±2	22±3 11±2
Sept 1981	60776	APT	Sr-90	16±1	16±2	17±3
Oct 1981	62491	Water	Sr-89 Sr-90	24±7 9±6	21±5 14±2	22±6 13±3
Oct 1981	62547	Milk	Sr-89 Sr-90	26±2 17±2	23±5 18±2	22±5 18±3
Nov 1981	63205	Food	Sr-89 Sr-90	31±6 21±2	38±5 23±2	35±6 23±4

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

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	69±10

TABLE E-5

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	48±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	0
			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-5 (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.

APPENDIX F

SYNOPSIS OF DAIRY & VEGETABLE GARDEN SURVEY

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SYNOPSIS OF DAIRY & VEGETABLE GARDEN SURVEY

A door-to-door survey of dairy farms within 5 miles of SNGS was performed in April and July. The results of the April survey were as follows:

> One dairy farm, located 4.9 miles from SNGS in the west sector was located.

The results of the July survey were as follows:

> No change from April survey.

Since a dairy farm was located within 5 miles of the site, the vegetable garden survey was performed to a distance of one mile. No vegetable gardens were found in this area.