NUS-4514

ANNUAL REPORT FOR 1983

OF THE

PREOPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM AT THE PERRY NUCLEAR POWER PLANT

Prepared for
The Cleveland Electric Illuminating Company

by
Carl R. Yates

July 1984

Environmental Services Division
NUS Corporation
5350 Campbells Run Road
Pittsburgh, Pennsylvania 15205

A. Edgar Mitchell, Jr.
Project Manager

Charles J. Marcinkiewicz
Manager
Radiological Laboratory

IE25

Table of Contents

LIST OF TABLES
(Page 1 of 2)

LIST OF TABLES
(Page 2 of 2)

LIST OF FIGURES

I. INTRODUCTION

The preoperational radiological environmental monitoring program for Perry Nuclear Power Plant (PNPP) was initiated in March 1981 and will continue until fuel loading, presently scheduled for December 01, 1984. This program is being conducted by NUS Corporation under contract with The Cleveland Electric Illuminating Company (CEI). This is the third Annual Report for the radiological environmental monitoring program being conducted under the contract. This report covers the period December 28, 1982 through January 4, 1984 and summarizes the results of measurements and analyses of data obtained from samples collected during this interval.

A. Site and Station Description

PNPP will consist of two BWR units, each designed to operate at a power level of about 1205 megawatts with the main condenser circulating water cooled by a system of closed-loop natural draft cooling towers. The plant is located on Lake Erie, on approximately 1100 acres, about thirty-five (35) miles northeast of Cleveland, Ohio and about seven (7) miles northeast of Painesville, Ohio. PNPP is situated in North Perry Village in northeastern Lake County, Ohio.

B. Objectives and Overview of PNPP Monitoring Program

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

In-plant monitoring will be used to assure that these predetermined release limits are not exceeded. However, as a precaution against unexpected and undefined processes which might allow undue accumulation of radioactivity in any sector of man's environment, a program for monitoring the plant environs is also included.

The regulations governing the quantities of radioactivity in reactor effluents allow nuclear power plants to contribute, at most, only a few percent increase above normal background radioactivity. Background levels at any one location are not constant but vary with time as they are influenced by external events such as cosmic ray bombardment, weapons test fallout, and seasonal variations. These levels also can vary spatially within relatively short distances reflecting variations in geological composition. Because of these spatial and temporal variations, the radiological surveys of the plant environs are divided into preoperational and operational phases. The preoperational phase of the program of sampling and measuring radioactivity in various media permits a general characterization of the radiation levels and concentrations prevailing prior to plant operation along with an indication of the degree of natural variation to be expected. The operational phase of the program obtains data which, when considered along with the data obtained in the preoperational phase, assist in the evaluation of the radiological impact of plant operation.

Implementation of the preoperational monitoring program fulfills the following objectives:

1. Evaluation of procedures, equipment and techniques.

2. Identification of potentially important pathways to be monitored after the plant is in operation.

3. Measurement of background levels and their variations along potentially important pathways in the area surrounding the plant.

4. Provision of baseline data for statistical comparison with future operational analytical results.

Sampling locations were selected on the basis of local ecology, meteorology, physical characteristics of the region, and demographic and land use features of the site vicinity. The preoperational program was designed on the basis of the USNRC Radiological Assessment Branch Technical Position on radiological environmental monitoring as revised in Revision 1 November 1979.[1]

In 1983 the radiological monitoring program included the measurement of ambient gamma radiation by thermoluminescent dosimetry, the determination of gamma emitters in shoreline sediments and fish, the determination of gross beta and gamma emitters in airborne particulates, the measurement of airborne iodine-131, the measurement of gross beta, tritium, and gamma emitters in water, the measurement of iodine-131 and gamma emitters in milk, and the determination of gamma emitters in silage and food products (vegetables). The measurement of strontium-89 and strontium-90 in milk, water, and sediment was initiated during the third quarter of 1983.

II. PROGRAM DESCRIPTION

Thirty-nine locations within a radius of about 15 miles from the PNPP site were included in the monitoring program for 1983. The number and locations of monitoring points were determined by considering the locations where the highest off-site environmental concentrations have been predicted from plant effluent source terms, site hydrology, and site meteorological conditions. Other factors considered were applicable regulations, population distribution, ease of access to sampling stations, security and future program integrity.

The preoperational environmental radiological program for Perry is summarized in Table 1. Table 2 describes sample locations, associated media, and approximate distance and direction from the site. Figures 1 and 2 illustrate the locations of sampling stations relative to PNPP.

In addition to the described analytical program, a milk animal, vegetable garden, and residence survey was performed in 1983. This survey located the nearest milk animal, garden and residence in each sector (out to 5 miles) and will be updated annually.

III. SAMPLING METHODS AND PROCEDURES

To derive meaningful and useful data from the radiological environmental monitoring program, sampling methods and procedures are required which will provide samples representative of potential pathways of the area. During the preoperational phase of the program, samples are collected and analyzed not only to obtain background radiological levels, but at the same time to acquire experience with the sampling methodology and procedural format dictated by site specific requirements.[2]

A. Direct Radiation

Thermoluminescent dosimeters (TLDs) were used to determine the direct (ambient) radiation levels at twenty-five (25) monitoring points as described in Tables 1 and 2. Sampling locations were chosen according to the criteria given in the USNRC Branch Technical Position on Radiological Monitoring (Revision 1, November 1979).[1] TLDs were located in two rings around the station. An inner ring was located at the site boundary and an outer ring was located at an approximate distance of 4 to 5 miles from the station.

The area around the station was divided into 16 radial sectors of 22 1/2 degrees each. TLDs were placed in all sectors except those which radiated from the site directly out over the lake without intersecting any unrestricted areas. Additional TLDs were located at three nearby communities and two control locations.

For routine TLD measurements, two dosimeters of $CaSO_4$:Dy in teflon cards were deployed at each selected location. One set of dosimeters were exchanged on a monthly basis and the second set was exchanged on an annual basis. Additional sets of dosimeters were shipped with each exchange cycle to serve as in-transit controls. For routine exchanges TLDs were shipped by overnight Greyhound one evening, picked up and exchanged the following day, and returned by overnight Greyhound on the second evening. This was done to maintain the minimum possible in-transit dose. Due to a Greyhound employee's strike, the October and November TLD shipments were made by Federal Express.

Individual dosimeters were calibrated by exposure to an accurately known radiation field from a calibrated Cs-137 source.

B. Fish

The results of gamma spectrometric analyses of fish samples collected during 1983 are presented in Table 5. The averages, fraction of detectables, and range of radionuclide concentrations are summarized in Table 19. A total of 23 samples were analyzed; 12 from the indicator location (#25) and 11 from the control location (#32). Sampling efforts concentrated on the larger edible species of commercial and/or recreational importance. Results are presented from 11 of 12 samples from station #25, since one sample was destroyed in analysis.

As expected, naturally occurring K-40 was the major detectable activity in the edible portions of the fish. Cs-137 was detected in 6 of 11 samples from station #25 and 4 of 11 samples from station #32, with activities ranging from 6.1 to 46 picoCuries per kilogram (wet). This isotope has previously been reported in fish flesh in the Perry Power Nuclear Plant environmental monitoring program and other monitoring programs. Since it is present in global fallout, the occasional detection of Cs-137 in environmental media is not unusual.

C. Sediment

The processes by which radionuclides and stable elements are concentrated in bottom sediments are complex, involving physicochemical interaction in the environment between the various organic and inorganic materials from the watershed. These interactions can proceed by a myriad of steps in which the elements are adsorbed on or displaced from the surfaces of colloidal particles enriched with chelating organic materials. Biological action of bacteria and other benthic organisms also contribute to the concentration of certain elements and in the acceleration of the sedimentation process.

D. Airborne Particulates/Air Iodine-131

Research Appliance Company continuous low volume air sampler units (Model #209088-2) were used to collect air particulates and airborne iodine-131. Airborne particulates were collected by drawing air through a 47-millimeter diameter glass fiber filter. Air iodine-131 was collected by drawing air through a 57 millimeter diameter TEDA impregnated charcoal cartridge (F & J Specialty Products, Inc.). The sampling units are housed in ventilated metal cabinets bolted to utility poles.

The air sampling network consists of six (6) stations; one is located in Redbird (#1) approximately 3.4 miles ENE of the Perry plant and four are located at the site boundary (#3,4,5 and 35). The control location is located at the Concord Service Center(#6), approximately 11 miles SSW of the plant. These locations are identified in Figures 1 and 2 and described in Tables 1 and 2.

The samplers were run continuously and the filter and charcoal cartridge exchanged weekly. The elapsed time of sampling was recorded on an elapsed-time meter. Total air volume was calculated and recorded by the site technician from the initial and final volumes as registered on the dry gas meter.

E. Water

The water sampling network consists of four (4) stations as identified in Figures 1 and 2 and described in Tables 1 and 2. Stations 28 and 34 utilize Horizon Interval Samplers, which collect a small volume of water at short intervals, nominally 15 minutes. Stations 36 and 37 utilize an interval timer (Dayton #2E357) to control a solenoid valve (Dayton #6X230) on a pressurized sampling line. This arrangement draws small aliquots at the periodic intervals. The small volumes are automatically composited into a five-gallon container. Monthly grab samples had been taken at station 36 until November, 1983. Samples from the four (4) stations are collected monthly by the site technician.

F. Milk/Silage

Milk samples were collected monthly during the months of January, February, March, November and December, and semi-monthly during the remaining months. The control location, Brookglen Farm (station 33), is located approximately 10.2 miles south of the Perry plant. Sampling from station 29 (1.4 miles ESE) was initiated February 28, 1983. Sampling from station 30 (2.3 miles SSW) was begun on March 28, 1983. As a preservative, formalin was added to each sample at the time of collection. The annual feed/silage sample from stations 29,30 and 33 were taken on August 29, 1983.

A third indicator location (#31) will be initiated during the first quarter of 1984.

G. Vegetables and Food Products

The annual collection of food products was conducted on September 20, 1983. Various fruits and vegetables were collected from Stations 38 (1.1 miles E), 39 (1.8 miles SSW), and 40 (1.1 miles E).

IV. SUMMARY AND DISCUSSION OF 1983 ANALYTICAL RESULTS

Data from the radiological analyses of environmental media collected during the report period are tabulated and discussed below. The procedures and specification followed in the laboratory for these analyses are as required in Section 5.0 of the NUS Environmental Services Division Quality Assurance Manual, 9019xx-2, and are detailed in the NUS Radiological Laboratory Work Instructions.

Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods.[2] The use of "LT" in the data tables is the equivalent of the less than symbol (<) and is consistent with the NUS Radiological Laboratory practice of data reporting. The number following the "LT" is a result of the lower limit of detection (LLD) calculation as defined in Appendix B. "ND" (Not Detected) is used periodically in the tables presenting gamma analysis results for various media. It primarily appears under the "Others" column, and indicates that no other detectable gamma emitting nuclides were identified. NUS analytical methods meet the " a priori" LLD requirements addressed in Table 2 of the USNRC Branch Technical Position on Radiological Monitoring (November 1979, Revision 1).[1]

Tables 3 through 18 give the radioanalytical results for individual samples. A statistical summary of the results appears in Table 19. The reported averages are based only on concentrations above the limit of detection. In Table 19, the fraction (f) of the total number of analyses which were detectable follows in parentheses. Also given in parentheses are the minimum and maximum values of detectable activity during the report period.

A. Direct Radiation

Environmental radiation dose rates determined by thermoluminescent dosimeters (TLDs) are given in Table 3. Average monthly dose rates are plotted in Figure 3. TLD badges of four readout areas each were deployed at each location on monthly and annual cycles. The "annual" cycle covers the period January through December. The mean values of four readings (corrected individually for response to a known dose and for in-transit exposure) are reported.

A statistical summary of the 1983 data is included in Table 19. Individual measurements of external radiation levels in the environs of the PNPP site ranged from 0.15 to 0.33 mR/day. Table 4 compares the data from the annual cycle TLDs with the annual averages of the monthly cycle TLDs. Agreement between the two types of data is generally quite good.

Annual averages (from the monthly cycles) ranged from 0.19 to 0.30 mR/day or 69 to 110 mR/year.

Oakley[3] calculates an ionizing radiation dose equivalent of 82.2 mR/year for Ohio including a terrestrial component of 45.6 mR/year and an ionizing cosmic ray component of 36.6 mR/year (excludes neutron component). Since Oakley's values represent averages covering wide geographical areas, the measured ambient radiation average of 80.3 mR/year for the immediate locale of Perry is not inconsistent with Oakley's observations. Significant variations occur between geographical areas as a result of geological composition and altitude differences. Temporal variations result from changes in cosmic ray intensity, local human activities, and factors such as ground cover and soil moisture.

B. Fish

The results of gamma spectrometric analyses of fish samples collected during 1983 are presented in Table 5. The averages, fraction of detectables, and range of radionuclide concentrations are summarized in Table 19. A total of 23 samples were analyzed; 12 from the indicator location (#25) and 11 from the control location (#32). Sampling efforts concentrated on the larger edible species of commercial and/or recreational importance. Results are presented from 11 of 12 samples from station #25, since one sample was destroyed in analysis.

As expected, naturally occurring K-40 was the major detectable activity in the edible portions of the fish. Cs-137 was detected in 6 of 11 samples from station #25 and 4 of 11 samples from station #32, with activities ranging from 6.1 to 46 picoCuries per kilogram (wet). This isotope has previously been reported in fish flesh in the Perry Power Nuclear Plant environmental monitoring program and other monitoring programs. Since it is present in global fallout, the occasional detection of Cs-137 in environmental media is not unusual.

C. Sediment

The processes by which radionuclides and stable elements are concentrated in bottom sediments are complex, involving physicochemical interaction in the environment between the various organic and inorganic materials from the watershed. These interactions can proceed by a myriad of steps in which the elements are adsorbed on or displaced from the surfaces of colloidal particles enriched with chelating organic materials. Biological action of bacteria and other benthic organisms also contribute to the concentration of certain elements and in the acceleration of the sedimentation process.

Results of the gamma isotopic and strontium analyses of the sediments sampled from the PNPP environment are given in Table 6 A and 6 B respectively. The average, fraction of detectables, and range of radionuclide concentrations are summarized in Table 19.

Most of the observed gamma emitters were naturally occurring members of the uranium and thorium decay chains. These were detected in their expected concentrations. Similarly, K-40 was observed in all samples at its expected range of activities. The predominant man-made radionuclide observed in the sediment samples was Cs-137 which was detected in 4 of 8 samples. Because of its presence in global fallout, the detection of this isotope is neither unexpected nor unusual. The activity levels reported (150 to 310 picoCuries per kilogram (dry)) are within the range of observed values for other environmental monitoring programs. Due to the inhomogeneity typical of sediment samples, wide variations between samples are expected even when the samples are taken relatively near each other.

Strontium-89 and strontium-90 results are presented in Table 6B. There was no detectable strontium-89 or strontium-90 activity in the samples.

D. Air Particulates/Air Iodine

The results of the gross beta analyses on air particulate filters are presented in Table 7. Average weekly gross beta results are plotted in Figure 4. A total of 311 analyses were performed; 259 from the indicator locations and 52 from the control location. Both the indicator and control locations had mean gross beta activities of 19 E-03 pCi/m^3. The range of gross beta activity for the indicator and control locations was 5.7 to 41 E-03 pCi/m^3 and 7.7 to 34 E-03 pCi/m^3, respectively.

Air filters were composited quarterly and analyzed by gamma spectrometry. The gamma spectrometry results are presented in Table 8. A total of 24 composite analyses were performed; 20 from the indicator locations and 4 from the control location. Cosmogenic beryllium-7 was the only isotope detected. Be-7 was found in 18 of 24 samples analyzed.

Airborne iodine-131 analyses on charcoal cartridges were also performed and the results are presented in Table 9. Iodine-131 was not detected in any of the samples.

E. Water

The results of the gamma spectrometric analyses of water samples are presented in Table 10. There were 48 analyses performed; 36 from the indicator locations and 12 from the control location. There was no detectable activity in any of the samples analyzed.

The 48 water samples were also analyzed for gross beta activity. The average gross beta activity for the indicator and control locations was 4.2 pCi/l. Results of gross beta analyses are given in Table 11.

Water samples were also composited quarterly for the tritium analysis. The quarterly results are presented in Table 12. Positive tritium activity was detected in 4 out of 16 samples. These activities (pCi/l) were well below the LLD as defined in the USNRC Branch Technical Position on Radiological Monitoring (November 1979, Revision 1).

Strontium-89 and strontium-90 analyses were performed on August and November, 1983 water samples. Positive strontium-90 activity (0.62 ± 0.61 pCi/l) was detected in one August sample from station 28. Results are presented in Table 13.

F. Milk/Silage

Milk samples were analyzed by gamma spectrometry and the results are presented in Table 14. Two indicator locations and one control station were sampled during 1983. There were 54 analyses performed, and as expected, K-40 was the major detectable activity. Cesium-137 was detected in 8 of 35 samples from the indicator locations. Its a activity ranged from 1.4 to 3.5 pCi/l. Because of its presence on global fallout, Cs-137 is often observed in milk samples at these activity levels. None of the samples fron the control location contained detectable activity of Cs-137.

The milk samples were also analyzed for Iodine-131 and, as expected, there was no detectable activity. The I-131 results are presented in Table 15.

Strontium-89 and strontium-90 analyses were performed on August and November, 1983 milk samples. Results are presented in Table 16. There were no results available for 1 of the 3 August samples and 2 of the 3 November samples due to depletion of the samples during re-analysis. There was no strontium-89 detected in the milk samples. Strontium-90 was detected in one August milk sample (station 33, 1.8 $\pm$ 0.9 pCi/l), and one November milk sample (station 30, 3.5 $\pm$ 1.5 pCi/l).

Feed/Silage samples were collected in August from the 3 milk stations and analyzed by gamma spectrometry. These results are presented in Table 17. Naturally occurring K-40 was observed in all of the samples. Cosmogenic Be-7 was observed in both pasture grass samples due to its deposition as stratospheric fallout.

G. Vegetables and Food Products

Vegetables and fruits were collected in September from 3 indicator locations and analyzed by gamma spectrometry. The results are presented in Table 18. Naturally occurring K-40 was the only nuclide detected in the vegetation samples. K-40 was found in all of the vegetation samples at its expected range of activity.

V. LAND USE CENSUS

A land use survey was performed in the environs of the Perry NPP on August 10th and August 11th 1983. The purpose of this survey was to identify the potential indicator milk sampling locations as well as the nearest vegetable garden and residence in each of the sixteen standard sampling sectors around the plant. The outer bound of the survey for identifying the "nearest" or potential indicator locations was 5 miles. In addition, candidate "control" milk sampling locations were verified. Table 20 identifies the nearest garden and residence in each sector for which one could be identified within the 5 mile radius. Table 21 identifies all the potential indicator milk sampling locations within 5 miles of the plant. Control milk sampling locations are given in Table 22.

VI. REFERENCES

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

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

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

TABLE 1
(Page 1 of 2)

PNPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Media	Locations	Sampling Frequency	Analysis Type	Analysis Frequency
Airborne Radioiodine and Particulates	1, 3, 4, 5, 6, 35	Continuous sampler operation with collection weekly or as required by dust loading, whichever is more frequent	Radioiodine I-131 Particulates Gross Beta[d]	Weekly following canister change Weekly following filter change
			Gamma Isotopic[e]	Composite, by location quarterly
Direct Radiation (2 TLDs/location)	1 through 24 plus 35	Continuous sampling, one TLD exchanged monthly	Gamma Dose	Monthly
		Continuous sampling, one TLD exchanged annually	Gamma Dose	Annually
Waterborne surface drinking	28, 34, 36, 37	Monthly Composite[e]	Gross Beta Gamma Isotopic H-3	Monthly Monthly Composite, by location, quarterly
			Sr-89,-90	Quarterly(analyses performed on one monthly sample per station per quarter)
Sediment from shoreline	25, 26, 27, 32	Semiannually--spring and fall as weather permits	Gamma Isotopic Strontium-89, 90	Semiannually Semiannually
Ingestion Milk[a, b, f]	29, 30, 31, 33	Monthly when animals are not on pasture	I-131, Gamma Isotopic	Monthly
		Semimonthly when animals are on pasture	I-131, Gamma Isotopic	Semimonthly
			Sr-89,-90	Quarterly(analyses performed on one monthly sample per station per quarter)

TABLE 1
(Page 2 of 2)

PNPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Sample Media	Locations	Sampling Frequency	Analysis Type	Analysis Frequency
Fish	25, 32	Semiannually--spring and fall as weather permits	Gamma Isotopic (edible portion)	Semiannually
Silage[f]	29, 30, 33	Annually	Gamma Isotopic	Annually
Food Products[f]	38, 39, 40	Annually	Gamma Isotopic	Annually

(a) Sampling begins at least one year prior to PNPP operation. Sampling at station 29 was initiated on February 28, 1983. Sampling at station 30 was initiated on March 28, 1983.

(b) I-131 to be performed at least for 6 months of the last full pasture season prior to operation.

(c) Particulate sample filters will be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air is greater than ten times the mean of the control samples for any medium, gamma isotopic analysis will be performed on the individual samples.

(d) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

(e) Composite samples will be collected with equipment that is capable of collecting an aliquot at time intervals that are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

(f) Definitive sampling locations will be determined by a milk-animal and garden census to be performed annually.

TABLE 2
Page 1 of 3

Sample Locations and Media for the Perry
Radiological Environmental Monitoring Program

Location No.	Description	Distance (Miles)	Direction	Media (1)
1	Redbird (Haines Road, North of West Chapel Road) On pole 3303609; first pole south of first driveway on left	3.4	ENE	APT,AI,TLD
2	Site boundary; tree line Ash tree 1000 feet NNW of second transmission tower from road	0.7	E	TLD
3	Meteorological tower On fence surrounding the equipment shelter	1.0	SE	APT,AI,TLD
4	Site Boundary On pole #W79/SPG5-30; inside auxiliary road gate off Parmly Rd.	0.7	S	APT,AI,TLD
5	Site Boundary, Quincy Substation On pole #L1283/9300; east side of substation	0.6	SW	APT,AI,TLD
6	Concord Service Center (Control) Auburn Road south of Rt. 90; on inside rear fence next to gate	11.0	SSW	APT,AI,TLD
7	Site Boundary; Lockwood Road Bus Turnaround On tree on right, 100 feet past the turnaround	0.6	NE	TLD
8	Site Boundary; Tree Line 1000 feet N of location #2 on tree near rusted manure spreader	0.8	ENE	TLD
9	Site Boundary; Transmission Line Tower Third tower from Antioch Road toward the plant	0.7	ESE	TLD
10	Site Boundary; Southsoutheast Corner Security Fence On pole at turn in the fence	0.8	SSE	TLD
11	Site Boundary; Transmission Line Tower On tower at SW corner of Center and Parmly Roads	0.6	SSW	TLD
12	Site Boundary; Transmission Line Tower Access road from N side of Parmly just W of location #5, left at first turn after 90 degree left; TLD on tower to right	0.6	WSW	TLD
13	Madison-on-the-Lake At end of Whitewood Drive, N of Chapel Road, NW side of turnaround on pole #835803	4.7	ENE	TLD

TABLE 2
Page 2 of 3

Sample Locations and Media for the Perry
Radiological Environmental Monitoring Program

Location No.	Description	Distance (Miles)	Direction	Media (1)
14	Hubbard Road (South of North Ridge Road) On pole #28974 on W side of road, S side of McMackin Creek	4.9	E	TLD
15	Madison Substation (Eagle Street) First pole next to substation near railroad tracks	5.1	ESE	TLD
16	Dayton Road (North of Interstate 90) On pole #572203 on left after dirt driveway which is just after the sharp left on Dayton after crossing I-90	5.0	SE	TLD
17	Chadwick Road (Cul de Sac South of Interstate 90) On pole #276222/1122011; last pole on left	5.2	SSE	TLD
18	Blair Road On pole on left just after road makes 90 degree left curve from south to east heading toward Grand River Bridge.	5.0	S	TLD
19	Lane Road and South Ridge Road On pole #PC5648, 100 feet north of intersection	5.3	SSW	TLD
20	Nursery Road at Route 2 Overpass On pole #828976, across from entrance to Rt. 2	5.3	SW	TLD
21	Hardy Road at Painesville Township Park On pole #378345, east of park entrance	5.1	WSW	TLD
22	Painesville On S side of Main Street across from Evergreen Cemetery entrance, on tree 50 feet west of pole #DBPG296	6.9	SW	TLD
23	Fairport Harbor (High Street and New Street) On pole on street side of substation	7.9	WSW	TLD
24	St. Clair Avenue Substation (Control) In Mentor; on rear fence corner near railroad tracks	15.1	SW	TLD
25	PNPP Discharge	0.6	NNW	SED, FSH
26	Offshore at Redbird, vicinty of Ohio Water Service Company Intake	4.2	ENE	SED
27	Offshore, vicinty of Fairport Harbor Water Supply System Intake	7.9	WSW	SED
28	Ashtabula (Control), CEI Generating Station Intake	22.0	ENE	WTR

TABLE 2
Page 3 of 3

Sample Locations and Media for the Perry
Radiological Environmental Monitoring Program

Location No.	Description	Distance (Miles)	Direction	Media (1)
29	Milk Farm, J. Waites, Antioch Road	1.4	ESE	MLK
30	Milk Farm, E. Manley, North Ridge Road	2.3	SSW	MLK
31	Milk Farm, to be selected in first quarter 1984	-	- (2)	MLK
32	Mentor-on-the-Lake (Control)	15.8	WSW	SED, FSH
33	Brookglen Farm (Control), Callow Road	10.2	S	MLK
34	PNPP Intake	0.7	NW	WTR
35	Site Boundary, Center of Sector, follow tree line around fields south and west of Locat on #2	0.6	E	APT,AI,TLD
36	Painesville Water Supply Intake	3.9	WSW	WTR
37	Ohio Water Service Company, Lake Erie East, Madison; at end of Green Road in Redbird	4.1	ENE	WTR
38	Farm at site boundary, off Antioch Road	1.1	E	FP
39	Goldings, N. Ridge Road	1.8	SSW	FP
40	Antioch Road	1.1	E	FP

(1) APT = Air particulate
AI = Air iodine
TLD = Ambient gamma dose rate
SED = Sediment
WTR = Water
FSH = Fish
MLK = Milk
FP = Food Products

(2) This location to be determined in the annual milk animal survey

Table 3
(Page 1 of 4)

Direct Radiation - Thermoluminescent Dosimetry
Results for Monthly Exchange Cycles

PNPP REMP-1983
(Results in Units of mR/day ± 2s)[1]

Location	January	February	March
1	0.22 ± 0.04	0.20 ± 0.03	0.22 ± 0.05
2	0.23 ± 0.06	0.20 ± 0.03	0.22 ± 0.04
3	0.22 ± 0.04	0.21 ± 0.03	0.21 ± 0.03
4	0.22 ± 0.05	0.21 ± 0.03	0.23 ± 0.04
5	0.21 ± 0.04	0.21 ± 0.03	0.22 ± 0.04
6	0.21 ± 0.06	0.21 ± 0.03	0.22 ± 0.04
7	0.22 ± 0.04	0.19 ± 0.03	0.20 ± 0.04
8	0.20 ± 0.05	0.18 ± 0.03	0.20 ± 0.04
9	0.20 ± 0.04	0.19 ± 0.03	0.23 ± 0.04
10	0.20 ± 0.05	0.21 ± 0.03	0.23 ± 0.04
11	0.23 ± 0.04	0.19 ± 0.03	0.20 ± 0.05
12	0.20 ± 0.04	0.19 ± 0.03	0.21 ± 0.05
13	0.22 ± 0.05	0.21 ± 0.03	0.20 ± 0.04
14	0.20 ± 0.05	0.19 ± 0.03	0.18 ± 0.04
15	0.21 ± 0.04	0.22 ± 0.03	0.23 ± 0.04
16	0.26 ± 0.04	0.26 ± 0.03	0.27 ± 0.04
17	0.24 ± 0.06	0.22 ± 0.03	0.23 ± 0.04
18	0.32 ± 0.06	0.28 ± 0.03	0.28 ± 0.03
19	0.20 ± 0.04	0.21 ± 0.03	0.20 ± 0.04
20	0.25 ± 0.08	0.23 ± 0.03	0.20 ± 0.04
21	0.24 ± 0.05	0.22 ± 0.03	0.20 ± 0.03
22	0.24 ± 0.10	0.21 ± 0.03	0.23 ± 0.09
23	0.25 ± 0.05	0.22 ± 0.03	0.22 ± 0.04
24	0.24 ± 0.04	0.18 ± 0.03	0.21 ± 0.05
35	0.19 ± 0.05	0.17 ± 0.03	0.19 ± 0.03
Average ± 2s[2]	0.22 ± 0.06	0.21 ± 0.05	0.22 ± 0.04

Note: See footnote at end of table.

Table 3
(Page 2 of 4)

Direct Radiation - Thermoluminescent Dosimetry
Results for Monthly Exchange Cycles

PNPP REMP-1983
(Results in Units of mR/day ± 2s)[1]

Location	April	May	June
1	0.25 ± 0.03	0.23 ± 0.03	0.25 ± 0.03
2	0.20 ± 0.04	0.21 ± 0.04	0.20 ± 0.03
3	0.21 ± 0.04	0.21 ± 0.05	0.24 ± 0.05
4	0.23 ± 0.03	0.22 ± 0.03	0.23 ± 0.03
5	0.19 ± 0.04	0.20 ± 0.04	0.21 ± 0.04
6	0.18 ± 0.03	0.23 ± 0.03	0.19 ± 0.03
7	0.22 ± 0.04	0.24 ± 0.05	0.22 ± 0.04
8	0.15 ± 0.04	0.23 ± 0.04	0.17 ± 0.03
9	0.17 ± 0.04	0.25 ± 0.03	0.18 ± 0.03
10	0.18 ± 0.04	0.17 ± 0.05	0.18 ± 0.03
11	0.20 ± 0.04	0.20 ± 0.04	0.20 ± 0.03
12	0.24 ± 0.03	0.18 ± 0.03	0.18 ± 0.03
13	0.19 ± 0.04	0.21 ± 0.04	0.19 ± 0.03
14	0.21 ± 0.03	0.22 ± 0.04	0.17 ± 0.03
15	0.21 ± 0.04	0.23 ± 0.04	(*)
16	0.22 ± 0.04	0.26 ± 0.05	0.28 ± 0.03
17	0.23 ± 0.04	0.22 ± 0.04	0.25 ± 0.04
18	0.29 ± 0.04	0.30 ± 0.04	0.28 ± 0.03
19	0.19 ± 0.03	0.21 ± 0.03	0.20 ± 0.03
20	0.22 ± 0.03	0.21 ± 0.03	0.22 ± 0.03
21	0.23 ± 0.04	0.23 ± 0.03	0.21 ± 0.03
22	0.25 ± 0.05	0.23 ± 0.03	0.26 ± 0.07
23	0.27 ± 0.05	0.25 ± 0.05	0.23 ± 0.03
24	0.24 ± 0.03	0.23 ± 0.04	0.20 ± 0.03
35	0.21 ± 0.04	0.20 ± 0.03	0.20 ± 0.04
Average ± 2s[2]	0.22 ± 0.06	0.22 ± 0.05	0.21 ± 0.06

Note: See footnote at end of table.

Table 3
(Page 3 of 4)

Direct Radiation - Thermoluminescent Dosimetry
Results for Monthly Exchange Cycles

PNPP REMP-1983
(Results in Units of mR/day ± 2s)[1]

Location	July	August	September
1	0.24 ± 0.05	0.24 ± 0.03	0.23 ± 0.03
2	0.23 ± 0.06	0.28 ± 0.08	0.24 ± 0.03
3	0.20 ± 0.03	0.24 ± 0.03	0.23 ± 0.04
4	0.27 ± 0.03	0.25 ± 0.03	0.28 ± 0.06
5	0.23 ± 0.04	0.23 ± 0.03	0.27 ± 0.07
6	0.24 ± 0.05	0.24 ± 0.03	0.23 ± 0.03
7	0.27 ± 0.06	0.27 ± 0.08	0.28 ± 0.04
8	0.18 ± 0.03	0.24 ± 0.03	(*)
9	0.20 ± 0.04	0.22 ± 0.03	0.21 ± 0.03
10	0.20 ± 0.03	0.23 ± 0.03	0.21 ± 0.03
11	0.22 ± 0.04	0.25 ± 0.03	0.22 ± 0.03
12	0.22 ± 0.04	0.20 ± 0.03	0.22 ± 0.04
13	0.23 ± 0.04	0.21 ± 0.03	0.30 ± 0.04
14	0.23 ± 0.05	0.21 ± 0.03	0.23 ± 0.04
15	0.24 ± 0.03	0.21 ± 0.03	0.22 ± 0.03
16	0.28 ± 0.03	0.29 ± 0.03	0.27 ± 0.03
17	0.24 ± 0.04	0.27 ± 0.03	0.25 ± 0.04
18	0.31 ± 0.04	0.32 ± 0.03	0.33 ± 0.03
19	0.24 ± 0.04	0.22 ± 0.03	0.26 ± 0.04
20	0.24 ± 0.04	0.22 ± 0.03	0.24 ± 0.03
21	0.25 ± 0.04	0.27 ± 0.03	0.22 ± 0.03
22	0.25 ± 0.05	0.21 ± 0.03	0.25 ± 0.04
23	0.24 ± 0.03	0.24 ± 0.03	0.24 ± 0.03
24	0.28 ± 0.05	0.22 ± 0.03	0.23 ± 0.04
35	0.20 ± 0.03	0.21 ± 0.03	0.20 ± 0.03
Average ± 2s[2]	0.24 ± 0.06	0.24 ± 0.06	0.24 ± 0.06

Note: See footnote at end of table.

Table 3
(Page 4 of 4)

Direct Radiation - Thermoluminescent Dosimetry
Results for Monthly Exchange Cycles

PNPP REMP-1983
(Results in Units of mR/day ± 2s)[1]

Location	October	November	December	Average ± 2s
1	0.20 ± 0.04	0.20 ± 0.03	0.23 ± 0.03	0.23 ± 0.04
2	0.20 ± 0.03	0.19 ± 0.04	(*)	0.22 ± 0.05
3	0.20 ± 0.03	0.20 ± 0.03	0.24 ± 0.04	0.22 ± 0.03
4	0.21 ± 0.04	0.20 ± 0.03	0.23 ± 0.04	0.23 ± 0.05
5	0.21 ± 0.03	0.18 ± 0.02	0.21 ± 0.03	0.21 ± 0.05
6	0.21 ± 0.04	0.18 ± 0.02	0.24 ± 0.04	0.22 ± 0.04
7	0.20 ± 0.03	0.19 ± 0.02	0.22 ± 0.03	0.23 ± 0.06
8	0.17 ± 0.03	0.17 ± 0.03	0.19 ± 0.03	0.19 ± 0.05
9	0.21 ± 0.05	0.19 ± 0.03	0.20 ± 0.04	0.20 ± 0.04
10	0.19 ± 0.03	0.19 ± 0.02	0.19 ± 0.03	0.20 ± 0.04
11	0.18 ± 0.04	0.20 ± 0.03	0.22 ± 0.04	0.21 ± 0.04
12	0.19 ± 0.03	0.18 ± 0.03	0.20 ± 0.03	0.20 ± 0.04
13	0.22 ± 0.04	0.20 ± 0.03	0.21 ± 0.03	0.22 ± 0.06
14	0.19 ± 0.04	0.21 ± 0.03	0.21 ± 0.03	0.20 ± 0.04
15	0.22 ± 0.03	0.22 ± 0.03	0.22 ± 0.03	0.22 ± 0.02
16	0.25 ± 0.03	0.31 ± 0.04	0.25 ± 0.03	0.27 ± 0.05
17	0.22 ± 0.03	0.25 ± 0.02	0.24 ± 0.03	0.24 ± 0.03
18	0.31 ± 0.03	0.30 ± 0.03	0.29 ± 0.03	0.30 ± 0.03
19	0.23 ± 0.03	0.22 ± 0.02	0.22 ± 0.03	0.22 ± 0.04
20	0.21 ± 0.03	0.24 ± 0.03	0.22 ± 0.03	0.23 ± 0.03
21	0.22 ± 0.03	(*)	0.23 ± 0.03	0.23 ± 0.04
22	0.23 ± 0.03	0.22 ± 0.02	0.23 ± 0.03	0.23 ± 0.03
23	0.23 ± 0.03	0.24 ± 0.03	0.23 ± 0.03	0.24 ± 0.03
24	0.21 ± 0.03	0.21 ± 0.03	0.23 ± 0.04	0.22 ± 0.05
35	0.21 ± 0.03	0.20 ± 0.03	0.20 ± 0.03	0.20 ± 0.02
Average ± 2s[2]	0.21 ± 0.05	0.21 ± 0.07	0.22 ± 0.04	0.22 ± 0.05

(*) TLD vandalized in field

(1) Errors for individual measurements are two standard deviations of the average of four readings per dosimeter.

(2) Errors of row and column averages are two standard deviations calculated from the same row or column data used to generate the average.

Table 4

Comparison of Annual and Average-Monthly
Direct Radiation Measurements
PNPP REMP 1983

(Results in Units of mR/day ± 2s) (1)

Sampling Period: 12/28/82 to 12/28/83

Station Number	Annual Cycle TLD	Average of Monthly Cycle
1	0.19 ± 0.01	0.23 ± 0.04
2	0.15 ± 0.01	0.22 ± 0.05
3	0.17 ± 0.01	0.22 ± 0.03
4	0.18 ± 0.02	0.23 ± 0.06
5	0.16 ± 0.01	0.21 ± 0.05
6	0.16 ± 0.02	0.22 ± 0.04
7	0.17 ± 0.01	0.23 ± 0.06
8	0.17 ± 0.01	0.19 ± 0.05
9	0.15 ± 0.01	0.20 ± 0.04
10	0.16 ± 0.01	0.20 ± 0.04
11	0.16 ± 0.01	0.21 ± 0.04
12	0.18 ± 0.01	0.20 ± 0.04
13	0.16 ± 0.01	0.22 ± 0.06
14	0.19 ± 0.01	0.20 ± 0.04
15	0.21 ± 0.01	0.22 ± 0.02
16	0.21 ± 0.01	0.27 ± 0.05
17	0.22 ± 0.02	0.24 ± 0.03
18	0.30 ± 0.01	0.30 ± 0.03
19	0.21 ± 0.02	0.22 ± 0.04
20	0.23 ± 0.01	0.23 ± 0.03
21	*	0.23 ± 0.04
22	0.22 ± 0.02	0.23 ± 0.03
23	0.22 ± 0.01	0.24 ± 0.03
24	0.21 ± 0.01	0.22 ± 0.05
35	0.17 ± 0.01	0.20 ± 0.02

* TLD lost due to vandalism

(1) Errors of annual TLDs are two standard deviations of the four readout areas on each TLD; errors of monthly averages are two standard deviations of the average of the individual monthly results.

Table 5
(Page 1 of 2)

Gamma Spectrometry of Fish Samples

PNPP REMP 1983
(Results in pCi/kg (wet) ± 2s)

Location	Fish Species	Collection Date	Co-58	Co-60	Cs-134	Cs-137	Fe-59	K-40	Mn-54	Zn-65
25	Smallmouth Bass	05/24/83	LT 30[1]	LT 30	LT 20	36 ± 15	LT 110	4300 ± 600	LT 30	LT 70
25	Rock Bass	05/24/83	LT 80	LT 80	LT 70	LT 80	LT 200	3900 ± 900	LT 70	LT 140
25	Freshwater Drum	05/24/83	LT 15	LT 18	LT 13	38 ± 10	LT 60	3400 ± 400	LT 15	LT 50
25	White Sucker	05/24/83	LT 20	LT 20	LT 15	LT 20	LT 70	4400 ± 500	LT 20	LT 50
25	Walleye	05/24/83	LT 9	LT 11	LT 7	LT 8	LT 40	2200 ± 300	LT 10	LT 30
25	White Bass	05/24/83	LT 30	LT 30	LT 30	25 ± 15	LT 110	8500 ± 900	LT 30	LT 80
25	Yellow Perch[2]	05/24/83	-	-	-	-	-	-	-	-
32	White Bass	05/24/83	LT 19	LT 20	LT 12	43 ± 10	LT 60	5100 ± 600	LT 18	LT 50
32	White Sucker	05/24/83	LT 20	LT 20	LT 19	LT 20	LT 80	3600 ± 400	LT 30	LT 60
32	Yellow Perch	05/24/83	LT 40	LT 40	LT 30	LT 40	LT 110	2000 ± 300	LT 30	LT 90
32	Freshwater Drum	05/24/83	LT 30	LT 40	LT 30	46 ± 18	LT 110	3500 ± 600	LT 30	LT 80
32	Walleye	05/24/83	LT 30	LT 40	LT 30	LT 50	LT 140	3100 ± 400	LT 30	LT 90

Note: See footnote at end of table.

Table 5
(Page 2 of 2)

Gamma Spectrometry of Fish Samples

PNPP REMP 1983
(Results in pCi/kg (wet) ± 2s)

Location	Fish Species	Collection Date	Co-58	Co-60	Cs-134	Cs-137	Fe-59	K-40	Mn-54	Zn-65
25	White Sucker	10/19/83	LT 6	LT 6	LT 4	6.1 ± 3.0	LT 20	3700 ± 400	LT 5	LT 18
25	Freshwater Drum	10/19/83	LT 50	LT 60	LT 50	LT 50	LT 140	3100 ± 700	LT 50	LT 120
25	Carp	10/19/83	LT 80	LT 100	LT 60	LT 60	LT 200	4600 ± 1000	LT 70	LT 140
25	White Bass	10/19/83	LT 17	LT 18	LT 13	24 ± 9	LT 50	3600 ± 400	LT 15	LT 40
25	Yellow Perch	10/19/83	LT 20	LT 20	LT 16	20 ± 11	LT 60	4300 ± 500	LT 18	LT 50
32	White Bass	10/19/83	LT 20	LT 20	LT 18	LT 20	LT 60	4100 ± 500	LT 18	LT 50
32	Freshwater Drum	10/19/83	LT 9	LT 9	LT 7	23 ± 5	LT 30	2800 ± 300	LT 8	LT 20
32	White Sucker	10/19/83	LT 50	LT 40	LT 40	LT 40	LT 110	4700 ± 500	LT 40	LT 100
32	Yellow Perch	10/19/83	LT 40	LT 30	LT 30	LT 30	LT 110	3900 ± 500	LT 30	LT 80
32	Walleye	10/19/83	LT 9	LT 9	LT 7	18 ± 5	LT 20	3700 ± 400	LT 8	LT 20
32	Carp	10/19/83	LT 7	LT 8	LT 5	LT 7	LT 20	3300 ± 400	LT 6	LT 180

(1) LT = Less Than
(2) Sample was destroyed in analysis.

Table 6a

Gamma Spectrometry of Sediment Samples
PNPP REMP 1983

(Results in pCi/kg (dry) ± 2s)

Sampling Location	Collection Date	Ac-228	Bi-214	Cs-134	Cs-137	K-40	Pb-212	Pb-214	Ra-226	Tl-208	Others
25	05/23/83	ND(1)	1000 ± 200	LT 150(2)	LT 150	12000 ± 2000	580 ± 120	1100 ± 200	1100 ± 200	740 ± 260	ND
26	05/23/83	850 ± 290	1000 ± 200	LT 140	150 ± 70	15000 ± 2000	890 ± 100	1300 ± 200	1100 ± 200	920 ± 270	Bi-212: @ 880 ± 800
27	05/23/83	620 ± 240	560 ± 160	LT 130	LT 100	13000 ± 2000	ND	700 ± 100	630 ± 150	590 ± 170	ND
32	05/23/83	1000 ± 300	980 ± 180	LT 120	160 ± 80	15000 ± 2000	680 ± 130	970 ± 170	980 ± 180	880 ± 200	ND
25	10/18/83	620 ± 130	660 ± 90	LT 70	310 ± 40	9600 ± 1000	470 ± 100	680 ± 90	670 ± 90	620 ± 100	ND
26	10/18/83	1100 ± 300	1100 ± 200	LT 120	190 ± 70	18000 ± 2000	790 ± 190	1100 ± 200	1100 ± 200	940 ± 200	Bi-212:@ 1000 ± 700
27	10/18/83	380 ± 140	540 ± 80	LT 50	LT 60	10000 ± 1000	310 ± 60	590 ± 80	570 ± 80	430 ± 90	ND
32	10/18/83	580 ± 170	560 ± 100	LT 80	LT 80	11000 ± 2000	380 ± 80	720 ± 120	640 ± 110	570 ± 130	ND

(1) ND = Not detected
(2) LT = Less than

Table 6b

Strontium-89 and -90 in Sediment Samples
PNPP REMP 1983

(Results in pCi/kg (dry) ± 2s)

Sampling Location	Collection Date	Sr-89	Sr-90
25	10/18/83	LT 2	LT 0.08
26	10/18/83	LT 2	LT 0.08
27	10/18/83	LT 1.7	LT 0.06
32	10/18/83	LT 3	LT 0.10

(1) LT = Less Than

Table 7
(Page 1 of 4)

Gross Beta in Air Particulate Filters
PNPP REMP 1983

(Results in E-03 pCi/m^3 ± 2s)

Month	Collection Period	Station Location 1	3	4	5	6	35
January	01/04/83 to 01/11/83	20 ± 7	16 ± 7	18 ± 7	16 ± 7	14 ± 7	16 ± 7
	01/11/83 to 01/18/83	19 ± 6	10 ± 6	16 ± 6	16 ± 6	21 ± 6	16 ± 6
	01/18/83 to 01/25/83	19 ± 6	20 ± 6	17 ± 6	16 ± 6	17 ± 6	16 ± 6
	01/25/83 to 02/01/83	19 ± 7	15 ± 7	15 ± 7	23 ± 7	23 ± 7	19 ± 7
February	02/01/83 to 02/08/83	15 ± 7	13 ± 6	11 ± 6	12 ± 6	15 ± 7	12 ± 6
	02/08/83 to 02/15/83	31 ± 6	29 ± 6	35 ± 6	35 ± 6	34 ± 6	34 ± 6
	02/15/83 to 02/22/83	28 ± 7	23 ± 7	24 ± 7	16 ± 7	18 ± 7	21 ± 7
	02/22/83 to 03/01/83	12 ± 7	13 ± 7	15 ± 7	14 ± 7	13 ± 7	16 ± 6
March	03/01/83 to 03/08/83	17 ± 7	21 ± 7	15 ± 7	NS (1)	20 ± 7	20 ± 7
	03/08/83 to 03/15/83	18 ± 7	18 ± 7	13 ± 7	14 ± 9 (2)	8.7 ± 6.4	15 ± 7
	03/15/83 to 03/22/83	7.2 ± 6.1	11 ± 6	8.2 ± 6.0	LT 9 (3)	LT 9	5.7 ± 5.7
	03/22/83 to 03/29/83	8.1 ± 6.7	13 ± 7	12 ± 7	11 ± 5 (4)	12 ± 7	8.7 ± 6.3

Note: See footnote at end of table.

Table 7
(Page 2 of 4)

Gross Beta in Air Particulate Filters
PNPP REMP 1983

(Results in E-03 pCi/m^3 ± 2s)

Month	Collection Period	Station Location 1	3	4	5	6	35
April	03/29/83 to 04/05/83	15 ± 7	14 ± 7	10 ± 6	12 ± 7	15 ± 6	17 ± 7
	04/05/83 to 04/12/83	LT 9	9.1 ± 6.2	LT 9	LT 9	LT 10(5)	LT 9
	04/12/83 to 04/19/83	12 ± 7	8.1 ± 6.1	15 ± 7	12 ± 6	9.3 ± 6.1	9.2 ± 6.0
	04/19/83 to 04/26/83	9.6 ± 6.4	16 ± 7	18 ± 7	22 ± 7	13 ± 7	12 ± 6
	04/26/83 to 05/03/83	13 ± 6	14 ± 6	16 ± 6	14 ± 6	17 ± 6	12 ± 6
May	05/03/83 to 05/10/83	15 ± 7	13 ± 7	17 ± 7	12 ± 7	13 ± 6	11 ± 6
	05/10/83 to 05/17/83	LT 8	LT 8	7.2 ± 5.7	8.4 ± 6.0	11 ± 6	11 ± 6
	05/17/83 to 05/24/83	11 ± 6	9.7 ± 5.9	11 ± 6	18 ± 6	19 ± 7	12 ± 6
	05/24/83 to 05/31/83	LT 10	8.0 ± 6.6	8.6 ± 6.5	LT 10	7.7 ± 6.4	LT 10
June	05/31/83 to 06/07/83	LT 10	LT 10	LT 9	LT 10	8.4 ± 6.3	LT 9
	06/07/83 to 06/14/83	27 ± 7	22 ± 7	20 ± 7	26 ± 7	26 ± 7	30 ± 7
	06/14/83 to 06/21/83	34 ± 7	41 ± 8	29 ± 7	40 ± 8	34 ± 7	24 ± 6
	06/21/83 to 06/28/83	14 ± 7	6.6 ± 6.1	10 ± 6	9.8 ± 6.2	9.9 ± 6.4	13 ± 6

Note: See footnote at end of table.

Table 7
(Page 3 of 4)

Gross Beta in Air Particulate Filters
PNPP REMP 1983

(Results in E-03 pCi/m^3 ± 2s)

Month	Collection Period	Station Location					
		1	3	4	5	6	35
July	06/28/83 to 07/05/83	11 ± 6	14 ± 6	11 ± 6	12 ± 6	12 ± 6	10 ± 6
	07/05/83 to 07/12/83	16 ± 7	12 ± 6	14 ± 6	LT 9	15 ± 6	11 ± 6
	07/12/83 to 07/19/83	35 ± 8	28 ± 7	23 ± 7	32 ± 7	25 ± 7	22 ± 7
	07/19/83 to 07/26/83	12 ± 7	LT 10	14 ± 7	12 ± 7	11 ± 7	LT 10
	07/26/83 to 08/02/83	27 ± 7	29 ± 7	25 ± 7	24 ± 7	20 ± 6	26 ± 7
August	08/02/83 to 08/09/83	24 ± 7	21 ± 7	17 ± 6	16 ± 6	19 ± 7	21 ± 7
	08/09/83 to 08/16/83	11 ± 6	LT 9	LT 9	9.8 ± 6.2	11 ± 6	10 ± 6
	08/16/83 to 08/23/83	25 ± 7	24 ± 7	23 ± 7	22 ± 7	26 ± 7	25 ± 7
	08/23/83 to 08/30/83	31 ± 7	34 ± 7	31 ± 7	33 ± 7	29 ± 7	29 ± 7
September	08/30/83 to 09/06/83	19 ± 7	22 ± 7	18 ± 7	20 ± 7	25 ± 7	22 ± 7
	09/06/83 to 09/13/83	18 ± 7	17 ± 7	14 ± 6	22 ± 7	19 ± 6	20 ± 6
	09/13/83 to 09/20/83	19 ± 7	23 ± 7	23 ± 7	16 ± 7	25 ± 7	23 ± 7
	09/20/83 to 09/27/83	15 ± 7	21 ± 7	15 ± 6	17 ± 7	25 ± 7	19 ± 6

Note: See footnote at end of table.

Table 7
(Page 4 of 4)

Gross Beta in Air Particulate Filters
PNPP REMP 1983

(Results in E-03 pCi/m^3 ± 2s)

Month	Collection Period	Station Location 1	3	4	5	6	35
October	09/27/83 to 10/04/83	32 ± 8	33 ± 8	30 ± 7	32 ± 8	27 ± 7	30 ± 7
	10/04/83 to 10/11/83	13 ± 5	9.6 ± 5.3	13 ± 5	13 ± 5	16 ± 5	12 ± 5
	10/11/83 to 10/18/83	25 ± 6	27 ± 6	21 ± 5	23 ± 6	29 ± 6	26 ± 6
	10/18/83 to 10/25/83	9.9 ± 4.5	11 ± 5	11 ± 4	13 ± 5	13 ± 5	11 ± 4
	10/25/83 to 11/02/83	16 ± 4	18 ± 5	16 ± 4	13 ± 4	14 ± 4	15 ± 4
November	11/02/83 to 11/09/83	21 ± 5	21 ± 5	17 ± 5	21 ± 5	21 ± 5	17 ± 5
	11/09/83 to 11/16/83	17 ± 5	16 ± 5	17 ± 5	18 ± 5	16 ± 5	17 ± 5
	11/16/83 to 11/23/83	15 ± 5	17 ± 5	16 ± 5	15 ± 5	18 ± 5	15 ± 5
	11/23/83 to 11/30/83	26 ± 5	24 ± 5	26 ± 5	28 ± 5	22 ± 5	21 ± 5
December	11/30/83 to 12/07/83	19 ± 5	20 ± 5	17 ± 5	15 ± 5	16 ± 5	17 ± 5
	12/07/83 to 12/14/83	24 ± 5	26 ± 6	24 ± 5	23 ± 5	23 ± 5	26 ± 5
	12/14/83 to 12/21/83	23 ± 5	22 ± 5	20 ± 5	29 ± 6	22 ± 5	24 ± 5
	12/21/83 to 12/27/83	24 ± 6	31 ± 6	25 ± 6	29 ± 6	24 ± 6	29 ± 6
	12/27/83 to 01/04/84	25 ± 5	27 ± 5	25 ± 5	31 ± 5	29 ± 5	24 ± 5

(1) NS = No Sample
(2) Collection start date is 03/10/83.
(3) LT = Less Than
(4) Collection start date is 03/23/83.
(5) Collection start date is 04/06/83.

TABLE 8
(Page 1 of 2)

Gamma Spectrometry of Composited Air Particulate Filters
PNPP REMP 1983

(Results in Units of E-03 pCi/m^3 $\pm$ 2s)

Location	Collection Period	Be-7	Ce-144	Cs-134	Cs-137	Nb-95	Zr-95
1	01/04/83 to 04/05/83	57 ± 15	LT 4[1]	LT 1.4	LT 1.2	LT 1.7	LT 3
3	01/04/83 to 04/05/83	57 ± 15	LT 5	LT 1.5	LT 1.6	LT 1.7	LT 2
4	01/04/83 to 04/05/83	44 ± 15	LT 5	LT 1.6	LT 1.6	LT 2	LT 4
5	01/04/83 to 04/05/83	46 ± 18	LT 7	LT 1.9	LT 2	LT 2	LT 3
6	01/04/83 to 04/05/83	52 ± 16	LT 5	LT 2	LT 2	LT 2	LT 4
35	01/04/83 to 04/05/83	39 ± 19	LT 7	LT 1.9	LT 2	LT 2	LT 4
1	04/05/83 to 07/05/83	LT 80	LT 12	LT 3	LT 5	LT 4	LT 8
3	04/05/83 to 07/05/83	59 ± 36	LT 12	LT 3	LT 5	LT 4	LT 12
4	04/05/83 to 07/05/83	47 ± 30	LT 17	LT 3	LT 3	LT 4	LT 13
5	04/05/83 to 07/05/83	LT 80	LT 14	LT 4	LT 5	LT 5	LT 9
6	04/05/83 to 07/05/83	LT 100	LT 15	LT 4	LT 3	LT 4	LT 12
35	04/05/83 to 07/05/83	LT 70	LT 14	LT 19	LT 3	LT 4	LT 1.4

Note: See footnote at end of table.

TABLE 8
(Page 2 of 2)

Gamma Spectrometry of Composited Air Particulate Filters
PNPP REMP 1983

(Results in Units of E-03 pCi/m^3 ± 2s)

Location	Collection Period	Be-7	Ce-144	Cs-134	Cs-137	Nb-95	Zr-95
1	07/05/83 to 10/04/83	61 ± 24	LT 9	LT 3	LT 3	LT 4	LT 6
3	07/05/83 to 10/04/83	53 ± 26	LT 10	LT 3	LT 3	LT 5	LT 8
4	07/05/83 to 10/04/83	49 ± 23	LT 8	LT 2	LT 3	LT 4	LT 5
5	07/05/83 to 10/04/83	94 ± 28	LT 9	LT 3	LT 3	LT 4	LT 7
6	07/05/83 to 10/04/83	64 ± 24	LT 10	LT 2	LT 3	LT 4	LT 7
35	07/05/83 to 10/04/83	52 ± 26	LT 10	LT 3	LT 3	LT 4	LT 8
1	10/04/83 to 01/04/84	LT 50	LT 10	LT 3	LT 3	LT 4	LT 6
3	10/04/83 to 01/04/84	58 ± 21	LT 9	LT 2	LT 3	LT 4	LT 5
4	10/04/83 to 01/04/84	44 ± 21	LT 9	LT 3	LT 3	LT 3	LT 7
5	10/04/83 to 01/04/84	52 ± 22	LT 9	LT 2	LT 2	LT 4	LT 6
6	10/04/83 to 01/04/84	40 ± 23	LT 11	LT 3	LT 1.8	LT 3	LT 5
35	10/04/83 to 01/04/84	LT 50	LT 9	LT 3	LT 3	LT 3	LT 7

(1) LT = Less Than

Table 9
(Page 1 of 3)

Iodine-131 in Charcoal Cartridges
PNPP REMP 1983

(Results in pCi/m^3 +/- 2s)

Month	Collection Period	Station Location 1	3	4	5	6	35
January	01/04/83 to 01/11/83	LT 0.03(1)	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	01/11/83 to 01/18/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.04
	01/18/83 to 01/25/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	01/25/83 to 02/01/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
February	02/01/83 to 02/08/83	LT 0.02	LT 0.02	LT 0.02	LT 0.02	LT 0.02	LT 0.02
	02/08/83 to 02/15/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	02/15/83 to 02/22/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	02/22/83 to 03/01/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.04
March	03/01/83 to 03/08/83	LT 0.03	LT 0.03	LT 0.03	NS (2)	LT 0.03	LT 0.03
	03/08/83 to 03/15/83	LT 0.04	LT 0.03	LT 0.04	LT 0.03(3)	LT 0.05	LT 0.03
	03/15/83 to 03/22/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	03/22/83 to 03/29/83	LT 0.04	LT 0.04	LT 0.04	LT 0.05(4)	LT 0.04	LT 0.04
April	03/29/83 to 04/05/83	LT 0.04	LT 0.03	LT 0.03	LT 0.03	LT 0.03(5)	LT 0.03
	04/05/83 to 04/12/83	LT 0.02	LT 0.02	LT 0.02	LT 0.02	LT 0.03	LT 0.02
	04/12/83 to 04/19/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	04/19/83 to 04/26/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	04/26/83 to 05/03/83	LT 0.05	LT 0.03	LT 0.04	LT 0.05	LT 0.04	LT 0.04

Note : See footnote at end of table.

Table 9
(Page 2 of 3)

Iodine-131 in Charcoal Cartridges
PNPP REMP 1983

(Results in pCi/m^3 +/- 2s)

Month	Collection Period	Station Location					
		1	3	4	5	6	35
May	05/03/83 to 05/10/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	05/10/83 to 05/17/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	05/17/83 to 05/24/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	05/24/83 to 05/31/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
June	05/31/83 to 06/07/83	LT 0.04	LT 0.03	LT 0.03	LT 0.04	LT 0.03	LT 0.04
	06/07/83 to 06/14/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	06/14/83 to 06/21/83	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06
	06/21/83 to 06/28/83	LT 0.04	LT 0.04	LT 0.03	LT 0.04	LT 0.04	LT 0.03
July	06/28/83 to 07/05/83	LT 0.07	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06
	07/05/83 to 07/12/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	07/12/83 to 07/19/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	07/19/83 to 07/26/83	LT 0.05	LT 0.05	LT 0.04	LT 0.04	LT 0.05	LT 0.04
	07/26/83 to 08/02/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
August	08/02/83 to 08/09/83	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06
	08/09/83 to 08/16/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	08/16/83 to 08/23/83	LT 0.07	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	08/23/83 to 08/30/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03

Note : See footnote at end of table.

Table 9
(Page 3 of 3)

Iodine-131 in Charcoal Cartridges
PNPP REMP 1983

(Results in pCi/m^3 +/- 2s)

Month	Collection Period	Station Location					
		1	3	4	5	6	35
September	08/30/83 to 09/06/83	LT 0.03	LT 0.04	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	09/06/83 to 09/13/83	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06
	09/13/83 to 09/20/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
	09/20/83 to 09/27/83	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07
October	09/27/83 to 10/04/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	10/04/83 to 10/11/83	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07
	10/11/83 to 10/18/83	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07
	10/18/83 to 10/25/83	LT 0.07	LT 0.07	LT 0.06	LT 0.07	LT 0.07	LT 0.06
	10/25/83 to 11/02/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
November	11/02/83 to 11/09/83	LT 0.06	LT 0.06	LT 0.05	LT 0.06	LT 0.06	LT 0.05
	11/09/83 to 11/16/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	11/16/83 to 11/23/83	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04	LT 0.04
	11/23/83 to 11/30/83	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03	LT 0.03
December	11/30/83 to 12/07/83	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.07	LT 0.06
	12/07/83 to 12/14/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.04	LT 0.04
	12/14/83 to 12/21/83	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05	LT 0.05
	12/21/83 to 12/27/83	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06	LT 0.06
	12/27/83 to 01/04/84	LT 0.05	LT 0.04	LT 0.05	LT 0.05	LT 0.04	LT 0.04

(1) LT = Less Than
(2) NS = No Sample
(3) Collection start date is 03/10/83.
(4) Collection start date is 03/23/83.
(5) Collection start date is 04/06/83

Table 10
(Page 1 of 2)

Gamma Spectrometry of Water Samples
PNPP REMP 1983

(Results in pCi/l ± 2s)

Month	Location	Collection Period	Ba-140	Co-58	Co-60	Cs-134	Cs-137	Fe-59	La-140	Mn-54	Nb-95	Zn-65	Zr-95	Other
January	28	12/29/82 to 01/31/83	LT 16[1]	LT 3	LT 5	LT 4	LT 3	LT 5	LT 12	LT 4	LT 4	LT 8	LT 7	ND[2]
	34	12/29/82 to 01/31/83	LT 19	LT 6	LT 3	LT 6	LT 5	LT 12	LT 10	LT 6	LT 5	LT 13	LT 9	ND
	36	01/31/83	LT 16	LT 3	LT 4	LT 4	LT 3	LT 8	LT 9	LT 4	LT 4	LT 9	LT 6	ND
	37	12/29/82 to 01/31/83	LT 13	LT 3	LT 5	LT 3	LT 4	LT 10	LT 11	LT 4	LT 4	LT 12	LT 7	ND
February	28	01/31/83 to 02/28/83	LT 20	LT 6	LT 5	LT 7	LT 7	LT 11	LT 9	LT 6	LT 6	LT 13	LT 13	ND
	34	01/31/83 to 02/28/83	LT 30	LT 9	LT 7	LT 10	LT 11	LT 17	LT 12	LT 10	LT 10	LT 17	LT 18	ND
	36	02/28/83	LT 20	LT 6	LT 5	LT 8	LT 7	LT 11	LT 8	LT 6	LT 7	LT 11	LT 12	ND
	37	01/31/83 to 02/28/83	LT 9	LT 3	LT 5	LT 3	LT 3	LT 8	LT 6	LT 3	LT 3	LT 8	LT 5	ND
March	28	02/28/83 to 03/28/83	LT 40	LT 10	LT 8	LT 12	LT 12	LT 20	LT 10	LT 11	LT 11	LT 20	LT 18	ND
	34	02/28/83 to 03/28/83	LT 20	LT 6	LT 7	LT 6	LT 6	LT 11	LT 7	LT 6	LT 6	LT 13	LT 7	ND
	36	03/28/83	LT 17	LT 6	LT 10	LT 6	LT 6	LT 14	LT 12	LT 7	LT 7	LT 18	LT 14	ND
	37	02/28/83 to 03/28/83	LT 16	LT 5	LT 6	LT 6	LT 6	LT 10	LT 9	LT 6	LT 5	LT 14	LT 10	ND
April	28	03/28/83 to 04/25/83	LT 16	LT 6	LT 5	LT 7	LT 5	LT 11	LT 9	LT 5	LT 5	LT 14	LT 9	ND
	34	03/28/83 to 04/25/83	LT 8	LT 3	LT 3	LT 3	LT 3	LT 5	LT 5	LT 3	LT 3	LT 7	LT 5	ND
	36	04/25/83	LT 12	LT 4	LT 4	LT 3	LT 4	LT 7	LT 8	LT 3	LT 4	LT 8	LT 6	ND
	37	03/28/83 to 04/25/83	LT 10	LT 3	LT 4	LT 4	LT 4	LT 6	LT 6	LT 4	LT 3	LT 7	LT 6	ND
May	28	04/25/83 to 05/23/83	LT 15	LT 4	LT 4	LT 3	LT 4	LT 7	LT 8	LT 4	LT 4	LT 8	LT 7	ND
	34	04/25/83 to 05/23/83	LT 8	LT 2	LT 2	LT 2	LT 2	LT 4	LT 4	LT 2	LT 2	LT 4	LT 4	ND
	36	05/23/83	LT 7	LT 2	LT 3	LT 2	LT 2	LT 4	LT 5	LT 2	LT 2	LT 5	LT 4	ND
	37	04/25/83 to 05/23/83	LT 10	LT 3	LT 3	LT 3	LT 3	LT 5	LT 5	LT 3	LT 3	LT 6	LT 5	ND
June	28	05/23/83 to 06/27/83	LT 9	LT 1.5	LT 2	LT 3	LT 1.0	LT 5	LT 12	LT 1.3	LT 1.4	LT 4	LT 2	ND
	34	05/23/83 to 06/27/83	LT 8	LT 1.4	LT 2	LT 2	LT 1.0	LT 4	LT 11	LT 1.2	LT 1.3	LT 4	LT 2	ND
	36	06/27/83	LT 9	LT 2	LT 2	LT 3	LT 1.1	LT 5	LT 11	LT 1.3	LT 1.4	LT 4	LT 3	ND
	37	06/27/83	LT 9	LT 1.4	LT 2	LT 2	LT 1.0	LT 5	LT 13	LT 1.2	LT 1.3	LT 4	LT 2	ND

Note: See footnote at end of table.

Table 10
(Page 2 of 2)

Gamma Spectrometry of Water Samples
PNPP REMP 1983

(Results in pCi/l ± 2s)

Month	Location	Collection Period	Ba-140	Co-58	Co-60	Cs-134	Cs-137	Fe-59	La-140	Mn-54	Nb-95	Zn-65	Zr-95	Other
July	28	06/27/83 to 07/25/83	LT 10	LT 6	LT 4	LT 4	LT 4	LT 18	LT 10	LT 4	LT 6	LT 9	LT 11	ND
	34	06/27/83 to 07/25/83	LT 10	LT 6	LT 4	LT 4	LT 4	LT 18	LT 10	LT 4	LT 6	LT 9	LT 11	ND
	36	07/25/83	LT 11	LT 5	LT 4	LT 3	LT 4	LT 15	LT 11	LT 4	LT 5	LT 9	LT 9	ND
	37	06/27/83 to 07/25/83	LT 10	LT 6	LT 4	LT 4	LT 4	LT 18	LT 10	LT 4	LT 6	LT 9	LT 11	ND
August	28	07/25/83 to 08/29/83	LT 150(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 90(2)	LT 3	LT 5	LT 6	LT 9	ND
	34	07/25/83 to 08/29/83	LT 150(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 90(2)	LT 3	LT 5	LT 6	LT 9	ND
	36	08/29/83	LT 150(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 90(2)	LT 3	LT 5	LT 6	LT 9	ND
	37	07/25/83 to 08/29/83	LT 150(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 90(2)	LT 3	LT 5	LT 6	LT 9	ND
September	28	08/29/83 to 09/26/83	LT 200(3)	LT 5	LT 3	LT 3	LT 3	LT 15	LT 110(3)	LT 3	LT 5	LT 7	LT 8	ND
	34	08/29/83 to 09/26/83	LT 200(3)	LT 5	LT 3	LT 3	LT 3	LT 15	LT 110(3)	LT 3	LT 5	LT 7	LT 8	ND
	36	09/26/83	LT 300(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 110(3)	LT 3	LT 5	LT 6	LT 9	ND
	37	08/29/83 to 09/26/83	LT 300(3)	LT 5	LT 3	LT 3	LT 3	LT 14	LT 120(3)	LT 3	LT 5	LT 6	LT 9	ND
October	28	09/26/83 to 10/31/83	LT 100(3)	LT 3	LT 2	LT 2	LT 2	LT 8	LT 50(3)	LT 2	LT 3	LT 5	LT 5	K-40 @ LT 20
	34	09/26/83 to 10/31/83	LT 100(3)	LT 3	LT 2	LT 2	LT 2	LT 8	LT 50(3)	LT 2	LT 3	LT 5	LT 5	K-40 @ LT 20
	36	10/31/83	LT 100(3)	LT 3	LT 2	LT 2	LT 2	LT 8	LT 50(3)	LT 2	LT 3	LT 5	LT 5	K-40 @ LT 20
	37	09/26/83 to 10/31/83	LT 100(3)	LT 3	LT 2	LT 2	LT 2	LT 8	LT 50(3)	LT 2	LT 3	LT 5	LT 5	K-40 @ LT 20
November	28	11/28/83	LT 20	LT 2	LT 2	LT 1.9	LT 2	LT 5	LT 12	LT 2	LT 3	LT 4	LT 4	K-40 @ LT 20
	34	10/31/83 to 11/28/83	LT 20	LT 2	LT 2	LT 1.9	LT 2	LT 5	LT 12	LT 2	LT 3	LT 4	LT 4	K-40 @ LT 20
	36	11/01/83 to 11/28/83	LT 20	LT 2	LT 2	LT 1.9	LT 2	LT 5	LT 12	LT 2	LT 3	LT 4	LT 4	K-40 @ LT 20
	37	10/31/83 to 11/28/83	LT 20	LT 2	LT 2	LT 1.9	LT 2	LT 5	LT 12	LT 2	LT 3	LT 4	LT 4	K-40 @ LT 20
December	28	12/05/83 to 12/19/83	LT 50	LT 1.6	LT 1.1	LT 1.1	LT 1.0	LT 4	LT 20	LT 1.1	LT 1.6	LT 2	LT 3	ND
	34	11/28/83 to 12/19/83	LT 40	LT 1.6	LT 1.1	LT 1.1	LT 1.0	LT 4	LT 20	LT 1.1	LT 1.6	LT 2	LT 3	ND
	36	11/28/83 to 12/19/83	LT 40	LT 1.6	LT 1.1	LT 1.1	LT 1.0	LT 4	LT 20	LT 1.1	LT 1.6	LT 2	LT 3	ND
	37	12/19/83	LT 50	LT	LT 1.1	LT 1.1	LT 1.0	LT 4	LT 20	LT 1.1	LT 1.6	LT 2	LT 3	ND

(1) LT = Less Than
(2) ND = Not Detected
(3) Lower sensitivity due to delay in counting.

Table 11
(Page 1 of 2)

Gross Beta in Water
PNPP REMP 1983

(Results in pCi/l ± 2s)

Month	Location	Collection Period	Gross Beta
January	28	12/29/82 to 01/31/83	4.5 ± 1.3
	34	12/29/82 to 01/31/83	4.5 ± 1.3
	36	01/31/83	3.6 ± 1.4
	37	12/29/82 to 01/31/83	5.6 ± 1.6
February	28	01/31/83 to 02/28/83	3.9 ± 1.4
	34	01/31/83 to 02/28/83	2.7 ± 1.3
	36	02/28/83	2.8 ± 1.3
	37	01/31/83 to 02/28/83	2.3 ± 1.3
March	28	02/28/83 to 03/28/83	2.8 ± 1.3
	34	02/28/83 to 03/28/83	2.8 ± 1.3
	36	03/28/83	3.1 ± 1.3
	37	02/28/83 to 03/28/83	3.2 ± 1.3
April	28	03/28/83 to 04/25/83	3.3 ± 1.5
	34	03/28/83 to 04/25/83	3.0 ± 1.4
	36	04/25/83	4.1 ± 1.5
	37	03/28/83 to 04/25/83	3.5 ± 1.5
May	28	04/25/83 to 05/23/83	3.9 ± 1.3
	34	04/25/83 to 05/23/83	5.0 ± 1.3
	36	05/23/83	5.5 ± 1.3
	37	04/25/83 to 05/23/83	7.2 ± 1.4
June	28	05/23/83 to 06/27/83	6.2 ± 1.5
	34	05/23/83 to 06/27/83	7.0 ± 1.6
	36	06/27/83	3.2 ± 1.4
	37	06/27/83	9.0 ± 1.3

Table 11
(Page 2 of 2)

Gross Beta in Water
PNPP REMP 1983

(Results in pCi/l ± 2s)

Month	Location	Collection Period	Gross Beta
July	28	06/27/83 to 07/25/83	5.5 ± 1.5
	34	06/27/83 to 07/25/83	LT 2 (1)
	36	07/25/83	LT 2
	37	06/27/83 to 07/25/83	LT 2
August	28	07/25/83 to 08/29/83	6.0 ± 2.5
	34	07/25/83 to 08/29/83	6.4 ± 2.5
	36	08/29/83	3.4 ± 1.4
	37	07/25/83 to 08/29/83	4.7 ± 2.4
September	28	08/29/83 to 09/26/83	3.7 ± 1.3
	34	08/29/83 to 09/26/83	3.0 ± 1.3
	36	09/26/83	1.8 ± 1.4
	37	08/29/83 to 09/26/83	4.3 ± 1.5
October	28	09/26/83 to 10/31/83	1.6 ± 1.4
	34	09/26/83 to 10/31/83	4.3 ± 1.4
	36	10/31/83	4.7 ± 1.3
	37	09/26/83 to 10/31/83	3.2 ± 1.3
November	28	11/28/83	6.2 ± 1.9
	34	10/31/83 to 11/28/83	4.0 ± 1.3
	36	11/01/83 to 11/28/83	2.7 ± 1.3
	37	10/31/83 to 11/28/83	3.7 ± 1.3
December	28	12/05/83 to 12/19/83	3.0 ± 1.4
	34	11/28/83 to 12/19/83	3.7 ± 1.5
	36	11/28/83 to 12/19/83	2.5 ± 1.4
	37	12/19/83	7.9 ± 1.7

(1) LT = Less Than

Table 12

Tritium in Water
Quarterly Composite by Location

PNPP REMP 1983
(Results in pCi/l ± 2s)

Quarter	Location	Collection Period	Tritium
1	28	12/29/82 to 03/28/83	LT 300[1]
	34	12/29/82 to 03/28/83	LT 300
	36	01/31/83 to 03/28/83	LT 300
	37	12/29/82 to 03/28/83	LT 300
2	28	03/28/83 to 06/27/83	LT 300
	34	03/28/83 to 06/27/83	LT 300
	36	04/25/83 to 06/27/83	LT 300
	37	03/28/83 to 06/27/83	780 ± 200
3	28	06/27/83 to 09/26/83	240 ± 190
	34	06/27/83 to 09/26/83	LT 300
	36	07/25/83 to 09/26/83	310 ± 190
	37	06/27/83 to 09/26/83	360 ± 190
4	28	09/26/83 to 12/19/83	LT 300
	34	09/26/83 to 12/19/83	LT 300
	36	10/31/83 to 12/19/83	LT 300
	37	09/26/83 to 12/19/83	LT 300

(1) Less Than

Table 13

Strontium-89 and Strontium-90 in Water
PNPP REMP 1983

(Results in units of pCi/l + 2s)

Station	Collection Date	Strontium-89	Strontium-90
28	08/29/83	LT 60 (1)	0.62 + 0.61
34	08/29/83	LT 60	LT 1.4
36	08/29/83	LT 60	LT 1.3
37	08/29/83	LT 70	LT 1.6
28	11/28/83	LT 20	LT 1.6
34	11/28/83	LT 18	LT 1.4
36	11/28/83	LT 16	LT 1.3
37	11/28/83	LT 14	LT 1.1

(1) LT = Less Than

Table 14
(Page 1 of 3)

Gamma Spectrometry of Milk Samples
PNPP REMP 1983

(Results in pCi/l ± 2s)

Location	Collection Date	Ba-140	Cs-134	Cs-137	K-40	La-140
33	01/31/83	LT 14[1]	LT 4	LT 4	1300 ± 200	LT 7
29	02/28/83	LT 19	LT 6	LT 6	1300 ± 200	LT 8
33	02/28/83	LT 19	LT 6	LT 8	1200 ± 200	LT 15
29	03/28/83	LT 30	LT 8	LT 8	1500 ± 200	LT 7
30	03/28/83	LT 14	LT 4	LT 4	1600 ± 200	LT 7
33	03/28/83	LT 20	LT 6	LT 7	1300 ± 200	LT 10
29	04/11/83	LT 30	LT 11	LT 11	1500 ± 200	LT 13
30	04/11/83	LT 20	LT 9	LT 10	1800 ± 200	LT 12
33	04/11/83	LT 20	LT 9	LT 9	1100 ± 200	LT 10
29	04/25/83	LT 30	LT 6	LT 7	1600 ± 200	LT 13
30	04/25/83	LT 20	LT 6	LT 7	1600 ± 200	LT 12
33	04/25/83	LT 20	LT 8	LT 8	1300 ± 200	LT 7
29	05/09/83	LT 20	LT 7	LT 8	1400 ± 200	LT 10
30	05/09/83	LT 20	LT 7	LT 8	1200 ± 200	LT 10
33	05/09/83	LT 20	LT 8	LT 8	1200 ± 200	LT 9
29	05/23/83	LT 40	LT 12	LT 13	1800 ± 200	LT 14
30	05/23/83	LT 20	LT 8	LT 8	1400 ± 200	LT 11
33	05/23/83	LT 14	LT 5	LT 5	1400 ± 200	LT 6
29	06/13/83	LT 30	LT 10	LT 10	1700 ± 200	LT 13
30	06/13/83	LT 18	LT 4	LT 5	1500 ± 200	LT 7
33	06/13/83	LT 30	LT 9	LT 9	1300 ± 200	LT 13

Note: See footnote at end of table.

Table 14
(Page 2 of 3)

Gamma Spectrometry of Milk Samples
PNPP REMP 1983

(Results in pCi/l ± 2s)

Location	Collection Date	Ba-140	Cs-134	Cs-137	K-40	La-140
29	06/27/83	LT 40	LT 3	3.4 ± 2.0	1900 ± 200	LT 15
30	06/27/83	LT 16	LT 1.6	2.3 ± 1.1	1300 ± 200	LT 8
33	06/27/83	LT 30	LT 2	LT 3	1100 ± 200	LT 13
29	07/11/83	LT 20	LT 10	LT 10	1600 ± 200	LT 11
30	07/11/83	LT 30	LT 11	LT 14	1100 ± 200	LT 13
33	07/11/83	LT 30	LT 10	LT 13	860 ± 150	LT 15
29	07/25/83	LT 30	LT 5	LT 6	1700 ± 200	LT 15
30	07/25/83	LT 30	LT 5	LT 5	1700 ± 200	LT 15
33	07/25/83	LT 30	LT 4	LT 5	1400 ± 200	LT 15
29	08/15/83	LT 40	LT 12	LT 18	1200 ± 200	LT 13
30	08/15/83	LT 30	LT 10	LT 11	1600 ± 200	LT 15
33	08/15/83	LT 30	LT 10	LT 11	1300 ± 200	LT 15
29	08/29/83	LT 90[2]	LT 1.2	3.5 ± 0.7	1700 ± 200	LT 40[2]
30	08/29/83	LT 190[2]	LT 2	LT 3	1500 ± 200	LT 90[2]
33	08/29/83	LT 100	LT 1.4	LT 1.5	1100 ± 200	LT 50[2]
29	09/12/83	LT 100[2]	LT 2	1.4 ± 1.3	1800 ± 200	LT 40[2]
30	09/12/83	LT 110[2]	LT 2	LT 3	1900 ± 200	LT 50[2]
33	09/12/83	LT 70[2]	LT 1.6	LT 1.8	1300 ± 200	LT 30[2]
29	09/26/83	LT 70[2]	LT 1.4	1.8 ± 0.9	1800 ± 200	LT 30[2]
30	09/26/83	LT 40	LT 1.0	2.0 ± 0.6	1300 ± 200	LT 19[2]
33	09/26/83	LT 40	LT 0.9	LT 1.0	1000 ± 100	LT 18[2]

Note: See footnote at end of table.

Table 14
(Page 3 of 3)

Gamma Spectrometry of Milk Samples
PNPP REMP 1983

(Results in pCi/l ± 2s)

Location	Collection Date	Ba-140	Cs-134	Cs-137	K-40	La-140
29	10/10/83	LT 800(2)	LT 3	LT 3	2000 ± 200	LT 300(2)
30	10/10/83	LT 500(2)	LT 2	3.1 ± 1.3	1700 ± 200	LT 200(2)
33	10/10/83	LT 500(2)	LT 1.9	LT 2	1500 ± 200	LT 190(2)
29	10/31/83	LT 20	LT 2	1.6 ± 1.3	1700 ± 200	LT 11(2)
30	10/31/83	LT 70(2)	LT 4	LT 5	1600 ± 200	LT 30(2)
33	10/31/83	LT 60	LT 4	LT 4	1400 ± 200	LT 30(2)
29	11/28/83	LT 40	LT 7	LT 8	1700 ± 200	LT 20(2)
30	11/28/83	LT 30	LT 5	LT 6	1700 ± 200	LT 13
33	11/28/83	LT 80(2)	LT 9	LT 10	1500 ± 200	LT 40(2)
29	12/19/83	LT 30	LT 5	LT 5	1400 ± 200	LT 15
30	12/19/83	LT 30	LT 4	LT 5	1400 ± 200	LT 15
33	12/19/83	LT 30	LT 4	LT 5	1300 ± 200	LT 15

(1) LT = Less than
(2) Lower sensitivity due to delay in counting.

Table 15
(Page 1 of 2)

Iodine-131 in Milk
PNPP REMP - 1983

(Results in pCi/l ± 2s)

Location	Collection Date	I-131
33	01/31/83	LT 0.3[1]
29	02/28/83	LT 0.2
33	02/28/83	LT 0.2
29	03/28/83	LT 0.3
30	03/28/83	LT 0.3
33	03/28/83	LT 0.2
29	04/11/83	LT 0.2
30	04/11/83	LT 0.3
33	04/11/83	LT 0.2
29	04/25/83	LT 0.2
30	04/25/83	LT 0.3
33	04/25/83	LT 0.2
29	05/09/83	LT 0.2
30	05/09/83	LT 0.3
33	05/09/83	LT 0.2
29	05/23/83	LT 0.3
30	05/23/83	LT 0.3
33	05/23/83	LT 0.3
29	06/13/83	LT 0.10
30	06/13/83	LT 0.3
33	06/13/83	LT 0.2
29	06/27/83	LT 0.6
30	06/27/83	LT 0.6
33	06/27/83	LT 0.6
29	07/11/83	LT 0.09
30	07/11/83	LT 0.19
33	07/11/83	LT 0.14

Note: See footnote at end of table.

Table 15
(Page 2 of 2)

Iodine-131 in Milk
PNPP REMP - 1983

(Results in pCi/l ± 2s)

Location	Collection Date	I-131
29	07/25/83	LT 0.3
30	07/25/83	LT 0.3
33	07/25/83	LT 0.2
29	08/15/83	LT 0.10
30	08/15/83	LT 0.2
33	08/15/83	LT 0.19
29	08/29/83	LT 0.2
30	08/29/83	LT 0.2
33	08/29/83	LT 0.3
29	09/12/83	LT 0.4
30	09/12/83	LT 0.3
33	09/12/83	LT 0.4
29	09/26/83	LT 0.3
30	09/26/83	LT 0.3
33	09/26/83	LT 0.2
29	10/10/83	LT 0.2
30	10/10/83	LT 0.2
33	10/10/83	LT 0.2
29	10/31/83	LT 0.12
30	10/31/83	LT 0.13
33	10/31/83	LT 0.13
29	11/28/83	LT 0.13
30	11/28/83	LT 0.14
33	11/28/83	LT 0.2
29	12/19/83	LT 0.6
30	12/19/83	LT 0.3
33	12/19/83	LT 0.4

(1) LT = Less Than

Table 16

Strontium-89 and Strontium-90 in Milk
PNPP REMP 1983

(Results in units of pCi/l ± 2s)

Station	Collection Date	Strontium-89	Strontium-90
29	08/29/83	LT 50 (1)	LT 1.1
30	08/29/83	(2)	(2)
33	08/29/83	LT 90	1.8 ± 0.9
29	11/28/83	(2)	(2)
30	11/28/83	LT 50	3.5 ± 1.5
33	11/28/83	(2)	(2)

(1) LT = Less Than

(2) Sample depleted during analysis

Table 17

Gamma Spectrometry of Feed/Silage
PNPP REMP 1983

(Results in units of pCi/kg (wet) ± 2s)

Location	Collection Date	Be-7	Cs-134	Cs-137	I-131	K-40
29(1)	08/29/83	240 ± 120	LT 20(3)	LT 20	LT 50	6500 ± 700
30(1)	08/29/83	470 ± 90	LT 15	LT 18	LT 60	12000 ± 2000
29(2)	08/29/83	ND(4)	LT 40	LT 50	LT 50	6500 ± 900
30(2)	08/29/83	ND	LT 50	LT 50	LT 60	6000 ± 900
33(2)	08/29/83	ND	LT 20	LT 20	LT 30	3900 ± 400

(1) Pasture grass
(2) Grain
(3) LT = Less Than
(4) ND = Not detected

Table 18

Gamma Spectrometry of Vegetation Samples
PNPP REMP 1983

(Results in Units of pCi/kg (wet) ± 2s)

Collection Date	Location	Vegetation Type	I-131	Cs-134	Cs-137	K-40
09/20/83	38	Squash	LT 60	LT 60	LT 80	3700 ± 900
09/20/83	38	Cabbage	LT 50	LT 50	LT 50	2000 ± 600
09/20/83	39	Apples	LT 50	LT 40	LT 50	1700 ± 300
09/20/83	39	Peaches	LT 50	LT 40	LT 40	1800 ± 500
09/20/83	40	Tomatoes	LT 50	LT 40	LT 50	2400 ± 600
09/20/83	40	Cucumbers	LT 50	LT 40	LT 40	2200 ± 500
09/20/83	40	Peppers	LT 40	LT 40	LT 50	630 ± 200

LT = Less Than

TABLE 19

SUMMARY OF DATA FOR THE PERRY NPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1983
(Page 1 of 4)

Name of Facility: Perry NPP Units 1 and 2, Docket Nos. 50-440 and 50-441
Location of Facility: 35 Miles Northeast of Cleveland, Ohio (Lake County)
Reporting Period: January 04, 1983, through January 04, 1984

Medium or Pathway Sampled (Units of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection(1)	All Indicator Locations Mean (f) (Range)	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean (f)(2) (Range)	Control Location Mean (f)(2) (Range)
TLDs (mR/day)	Gamma Dose - 296		0.22 (272/272) (0.15 - 0.33)	Station 18 5.0 miles S	0.30 (12/12) (0.28 - 0.33)	0.22 (24/24) (0.18 - 0.28)
Fish (pCi/kg (wet))	Gamma Spec - 22		4200 (11/11) (2200 - 8500)	Only one indicator location sampled for this medium		3600 (11/11) (2000 - 5100)
	K-40	-				
	Mn-54	130	LLD			LLD
	Fe-59	260	LLD			LLD
	Co-58,60	130	LLD			LLD
	Zn-65	260	LLD			LLD
	Cs-134	130	LLD			LLD
	Cs-137	150	25 (6/11) (6.1 - 38)			33 (4/11) (18 - 46)
Shoreline Sediments (pCi/kg (dry))	Gamma Spec 8					
	Bi-214		810 (6/6) (540 - 1100)	Station 26 4.2 miles ENE	1100 (2/2) (1000-1100)	770 (2/2) (560-980)
	Pb-214		910 (6/6) (590 - 1300)	Station 26 4.2 miles ENE	1200 (2/2) (1100-1300)	850 (2/2) (720-970)
	Ra-226		860 (6/6) (570-1100)	Station 26 4.2 miles ENE	1100 (2/2) (1100-1100)	810 (2/2) (640-980)
	Pb-212		610 (5/6) (310-890)	Station 26 4.2 miles ENE	840 (2/2) (790-890)	530 (2/2) (380-680)
	Tl-208		710 (6/6) (430-940)	Station 26 4.2 miles ENE	930 (2/2) (920-940)	730 (2/2) (570-880)

Note: See footnotes at end of table.

TABLE 19

SUMMARY OF DATA FOR THE PERRY NPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1983
(Page 2 of 4)

Name of Facility: Perry NPP Units 1 and 2, Docket Nos. 50-440 and 50-441
Location of Facility: 35 Miles Northeast of Cleveland, Ohio (Lake County)
Reporting Period: January 04, 1983, through January 04, 1984

Medium or Pathway Sampled (Units of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection(1)	All Indicator Locations Mean (f) (Range)	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean (f)(2) (Range)	Control Location Mean (f)(2) (Range)
Shoreline Sediments (con't)	Ac-228		714 (5/6) (380-1100)	Station 26 4.2 miles ENE	980 (2/2) (850-1100)	790 (2/2) (580-1000)
	K-40		13,000 (6/6) (9600 - 18,000)	Station 26 4.2 miles ENE	17,000 (2/2) (15,000-18,000)	13,000 (2/2) (11,000-15,000)
	Cs-134	150	LLD			LLD
	Cs-137	180	220 (3/6) (150 - 310)	Station 25 0.6 miles NNW	310 (1/2) (310-310)	160 (1/2) (160-160)
	Strontium-4					
	Sr-89		LLD			LLD
	Sr-90		LLD			LLD
Airborne Particulates ($E-03$ pCi/m^3)	Gross Beta-311	10	19 (239/259) (5.7-41)	Station 5 0.6 miles SW	19 (46/52) (8.4-35)	19 (50/52) (7.7-34)
	Gamma Spec-24					
	Be-7		54 (15/20) (44-94)	Station 5 0.6 miles SW	64 (3/4) (46-94)	52 (3/4) (40-64)
	Ce-144		LLD			LLD
	Cs-134	50	LLD			LLD
	Cs-137	60	LLD			LLD
	Nb-95		LLD			LLD
	Zr-95		LLD			LLD
Air Iodine (pCi/m^3)	I-131-311	0.07	LLD			LLD

Note: See footnotes at end of table.

TABLE 19

SUMMARY OF DATA FOR THE PERRY NPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1983
(Page 3 of 4)

Name of Facility: Perry NPP Units 1 and 2, Docket Nos. 50-440 and 50-441
Location of Facility: 35 Miles Northeast of Cleveland, Ohio (Lake County)
Reporting Period: January 04, 1983, through January 04, 1984

Medium or Pathway Sampled (Units of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection(1)	All Indicator Locations Mean (f) (Range)	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean (f)(2) (Range)	Control Location Mean (f)(2) (Range)
Water (pCi/l)	Gross Beta-48	4	4.2 (33/36) (1.8-9.0)	Station 37 4.1 miles ENE	5.0 (11/12) (2.3-9.0)	4.2 (12/12) (1.6-6.2)
	Gamma Spec-48					
	Ba-140	60	LLD			LLD
	Co-58	15	LLD			LLD
	Co-60	15	LLD			LLD
	Cs-134	15	LLD			LLD
	Cs-137	18	LLD			LLD
	Fe-59	30	LLD			LLD
	La-140	15	LLD			LLD
	Mn-54	15	LLD			LLD
	Nb-95	15	LLD			LLD
	Zn-65	30	LLD			LLD
	Zr-95	30	LLD			LLD
	Tritium-16	2000	480 (3/12) (310-780)	Station 37 4.1 miles ENE	570 (2/4) (360-780)	240 (1/4) (240-240)
	Strontium-8					
	Sr-89		LLD			LLD
	Sr-90		LLD			0.62 (1/2) (0.62-0.62)
Milk (pCi/l)	Gamma Spec-54					
	Ba-140	60	LLD			LLD
	Cs-134	15	LLD			LLD
	Cs-137	18	2.4 (8/35) (1.4 - 3.5)	Station 30 2.3 miles SSW	2.5 (3/17) (2.0 - 3.1)	LLD
	K-40		1600 (35/35) (1100 - 2000)	Station 29 1.4 miles ESE	1600 (18/18) (1200-2000)	1300 (19/19) (860-1500)
	La-140	15	LLD			LLD
	I-131-54	1	LLD			LLD
	Strontium-3					
	Sr-89		LLD			LLD
	Sr-90		3.5 (1/2) (3.5 - 3.5)			1.8 (1/1) (1.8 - 1.8)

Note: See footnotes at end of table.

TABLE 19

SUMMARY OF DATA FOR THE PERRY NPP RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - 1983
(Page 4 of 4)

Name of Facility: Perry NPP Units 1 and 2, Docket Nos. 50-440 and 50-441
Location of Facility: 35 Miles Northeast of Cleveland, Ohio (Lake County)
Reporting Period: January 04, 1983, through January 04, 1984

Medium or Pathway Sampled (Units of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection(1)	All Indicator Locations Mean (f) (Range)	Location with Highest Annual Mean: Name, Distance and Direction	Location with Highest Annual Mean: Mean (f)(2) (Range)	Control Location Mean (f)(2) (Range)
Feed/Silage (pCi/kg (wet))	Gamma Spec-5					
	Be-7		360 (2/4) (240-470)	Station 30 2.3 miles SSW	470 (1/2) (470-470)	ND
	Cs-134	60	LLD			LLD
	Cs-137	80	LLD			LLD
	K-40		7800 (4/4) (6000-12,000)	Station 30 2.3 miles SSW	9000 (2/2) (6000-12,000)	3900 (1/1) (3900-3900)
	I-131	60	LLD			LLD
Vegetation (pCi/kg (wet))	Gamma Spec-7					
	I-131	60	LLD			Only indicator locations sampled for this medium
	Cs-134	60	LLD			
	Cs-137	80	LLD			
	K-40		2100 (7/7) (630-3700)	Station 38 (1.1 miles E	2900 (2/2) (2000-3700)	

(1) LLD is lower limit of detection as defined and required in USNRC Branch Technical Position on An Acceptable Radiological Environmental Monitoring Program, Revision 1, November 1979.

(2) (f) is the ratio of positive results to the number of samples analyzed for the parameter of interest

(3) Means are identical for the three locations.

Table 20

Nearest Gardens and Residences Identified
During the 1983 Perry NPP Annual Land Use Survey

Direction	Nearest Residence (Distance/Address)	Nearest Garden (Distance/Address)
NE	0.6 miles 4384 Lockwood	0.6 miles 4384 Lockwood
ENE	1.1 miles 4611 Lockwood	1.1 miles 4611 Lockwood
E	1.2 miles 2684 Antioch	1.2 miles 2674 Antioch
ESE	1.2 miles 2774 Antioch	1.2 miles 2774 Antioch
SE	1.2 miles 4495 North Ridge	1.0 mile 4495 North Ridge
SSE	0.8 miles 3119 Parmly	0.8 miles 3119 Parmly
S	0.9 miles 3121 Center	0.9 miles 3298 Center
SSW	0.9 miles 3850 Clark	1.5 miles 3787 North Ridge
SW	1.3 miles 3032 Perry Park	1.3 miles 3078 Perry Park
WSW	1.2 miles 3462 Parmly	1.2 miles 2970 Perry Park

Table 21
(Page 1 of 2)

Milk Animals Identified During 1983 Perry
NPP Annual Land Use Survey

Location	Number/Type of Animals
1 mile SSE 3291 Parmly	2 Goats (and 2 Kids)
2 miles E 2541 Townline	12 Goats
3.7 miles E Green Farm Green and North Ridge	12 or more Cows
2.6 miles SSE 3907 Call	1 Goat
2.9 miles S 4312 Call	1 Cow, 1 Goat
1.1 miles S 3830 Center	2 Goats
3.6 miles ESE 5960 Middle Ridge	Cows, number undetermined
1.4 miles SE 4776 North Ridge	2 Goats
1.4 miles ESE 2908 Antioch	2 Goats
3.1 miles E 2565 Haines	1 Cow
2.6 miles SW Blackmore Road	2 or more Cows
2.6 miles SSE 4761 Davis	4 Cows

Table 21
(Page 2 of 2)

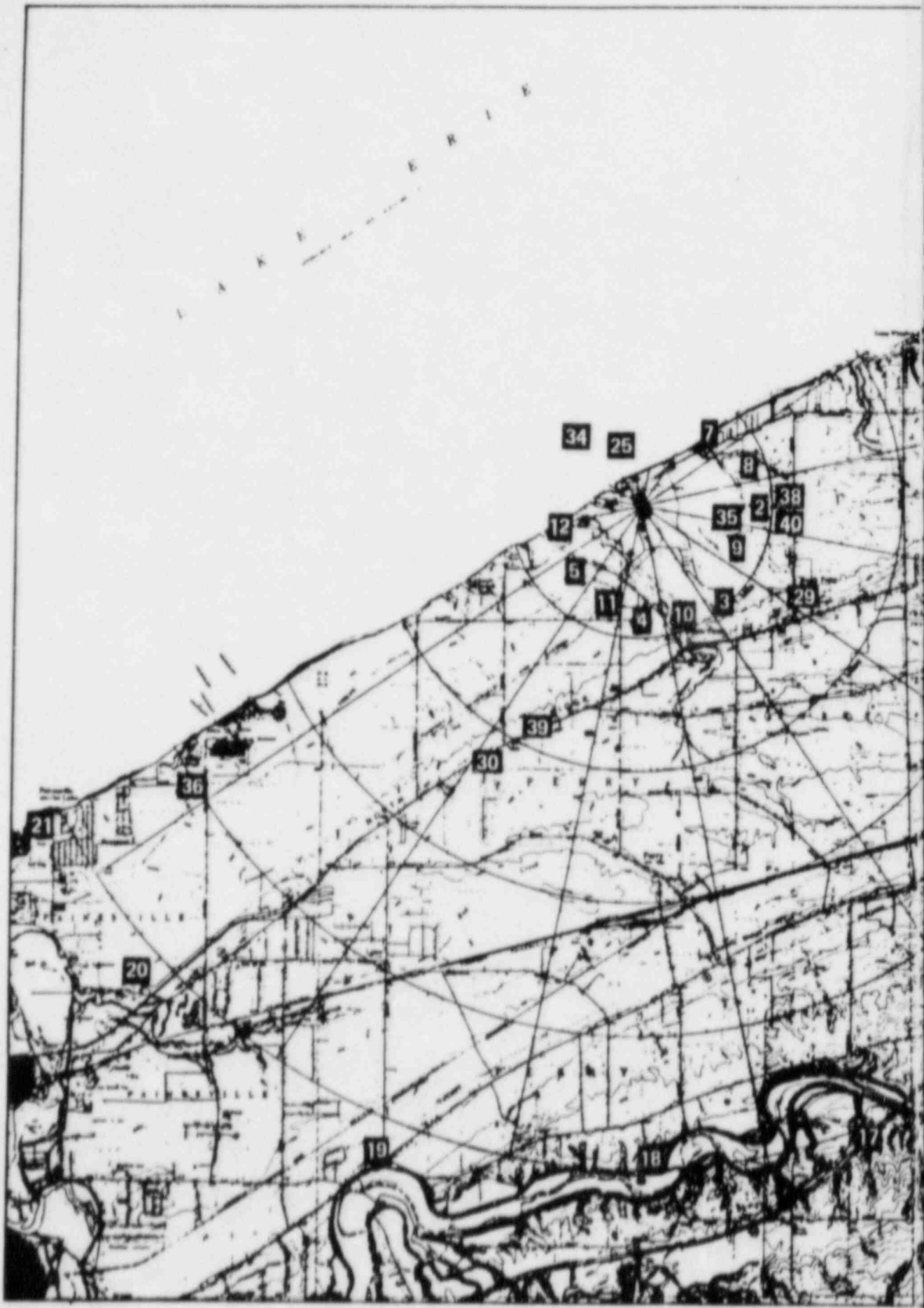
Milk Animals Identified During 1983 Perry
NPP Annual Land Use Survey

Location	Number/Type of Animals
3.7 miles SE 5378 South Ridge	3 Cows (may be heifers)
3.9 miles ESE Dayton Road next to 3352	6 Cows, also sheep
4 miles ESE 3587 Dayton	2 Cows
2.6 miles ENE 5297 Lockwood	2 Cows
4.4 miles SSE Turney and River Rd	2 Cows, 2 horses
2.3 miles SSW 3203 North Ridge	Goats

Table 22

Control Milk Sampling Locations Identified
During the 1983 Perry NPP Annual Land Use Survey

Location	Description
12 miles SSE 8187 Callow Road	Brookglen Farm Major Dairy Herd
11 miles SSE 13863 Painesville - Warren Road	Rettger Major dairy herd


34
25
7
8
38
2
35
40
12
9
5
11
4
10
3
29
39
30
36
21
20
19
18

0 1 2 3 4 Miles

LEGEND

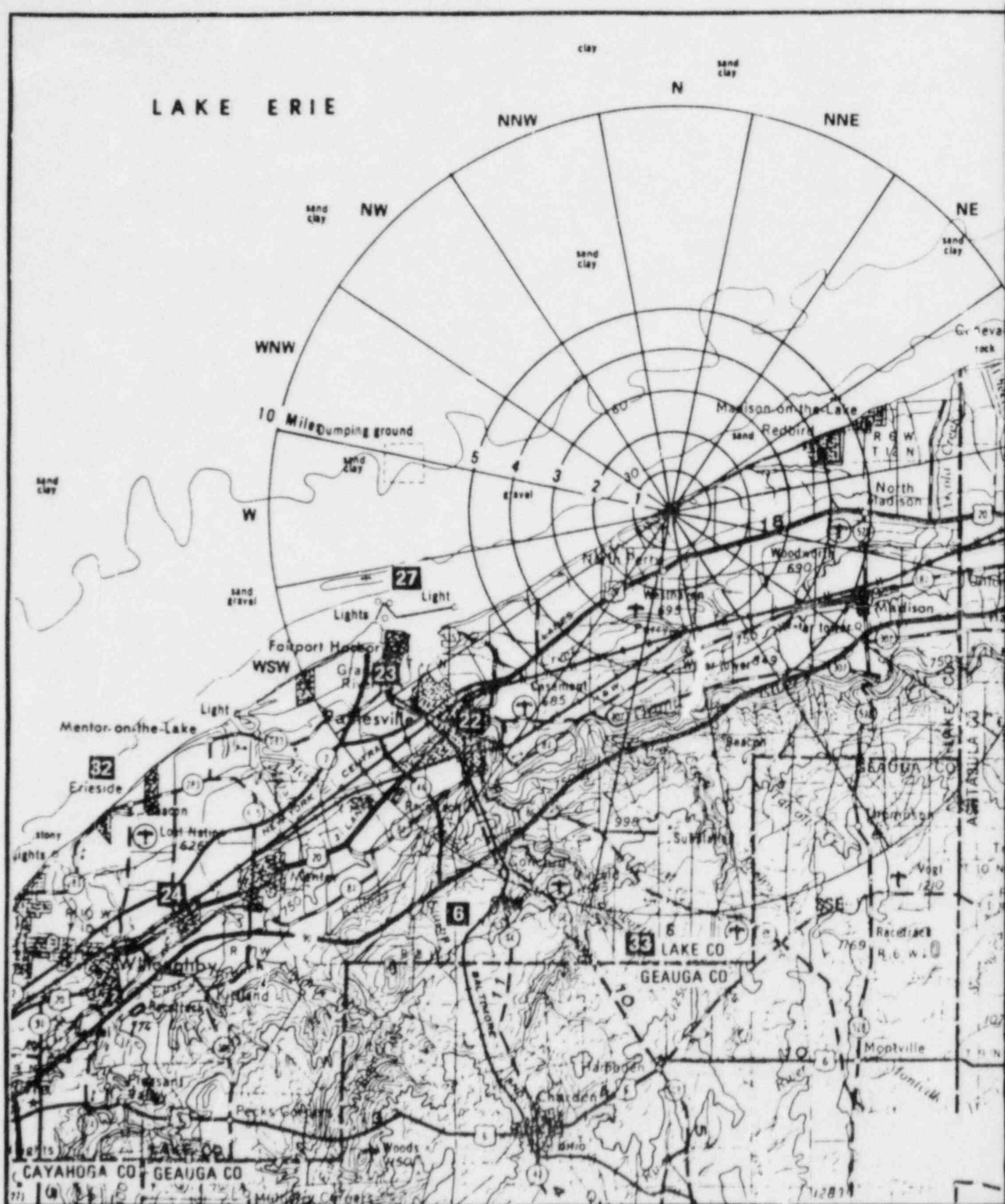
Station No.	Media	Direction
1	Air – TLD	ENE
2	TLD	E
3	Air – TLD	SE
4	Air – TLD	S
5	Air – TLD	SW
7	TLD	NE
8	TLD	ENE
9	TLD	ESE
10	TLD	SSE
11	TLD	SSW
12	TLD	WSW
13	TLD	ENE
14	TLD	E
15	TLD	ESE
16	TLD	SE
17	TLD	SSE
18	TLD	S
19	TLD	SSW
20	TLD	SW
21	TLD	WSW
25	Sediment – Fish	NNW
26	Sediment	ENE
29	Milk	ESE
30	Milk	SSW
34	Water	NW
35	Air – TLD	E
36	Water	WSW
37	Water	ENE
38	Food Products	E
39	Food Products	SSW
40	Food Products	E

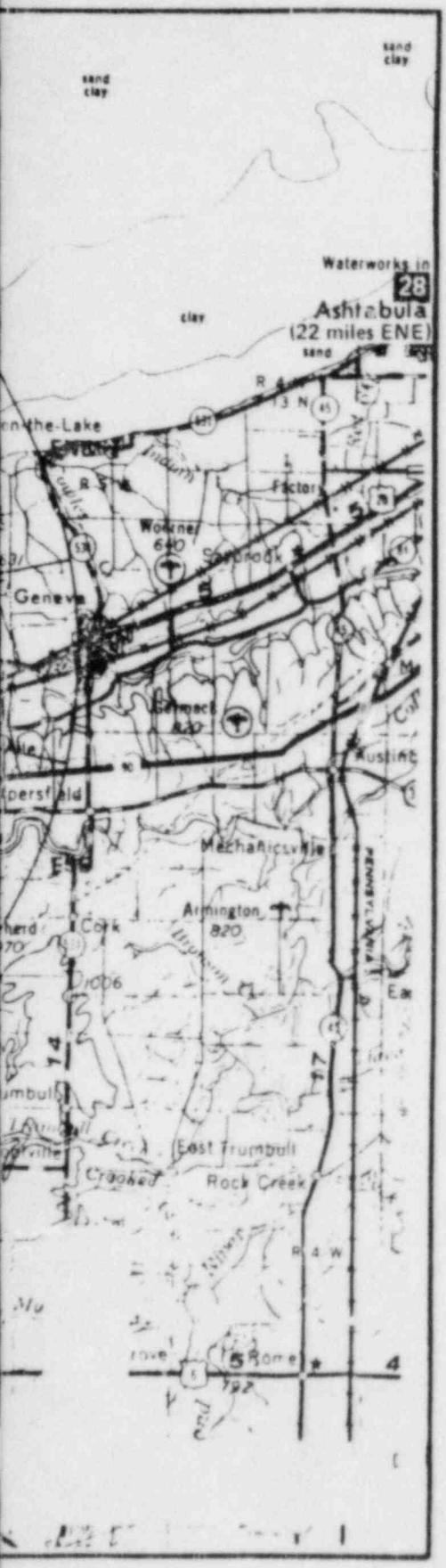
PNPP ENVIRONMENTAL
RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS WITHIN 5 MILES OF SITE

PERRY NUCLEAR POWER PLANT 1 & 2

THE CLEVELAND ELECTRIC
ILLUMINATING COMPANY

Figure 1 8508060083-01
F-1


LAKE ERIE
N
NNW
NNE
NW
NE
WNW
W
WSW
10 Miles
Dumping ground
5
4
3
2
1
Madison-on-the-Lake
Redbird
North Madison
Madison
Woodworth
Fairport Harbor
Painesville
Mentor-on-the-Lake
Erieside
Lights
Light
Willoughby
Kirtland
Chardon
Montville
LAKE CO
GEAUGA CO
CAYAHOGA CO
GEAUGA CO
ASHTABULA CO
27
23
22
32
24
6
33
18
sand clay
sand gravel
gravel
clay



LEGEND

Station No.	Media	Direction
6	Air – TLD – (Control)	SSW
22	TLD	SW
23	TLD	WSW
24	TLD (Control)	SW
27	Sediment	WSW
28	Water (Control)	ENE
32	Fish – Sediment (Control)	WSW
33	Milk (Control)	S

PNPP ENVIRONMENTAL
RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS >5 MILES FROM SITE

PERRY NUCLEAR POWER PLANT 1 & 2

THE CLEVELAND ELECTRIC
ILLUMINATING COMPANY

Figure 2

FIG. 3 AVERAGE MONTHLY AMBIENT RADIATION LEVELS
IN THE VICINITY OF THE PERRY NPP - 1983

GRAPH DEPICTS BOTH INDICATOR AND CONTROL LOCATIONS

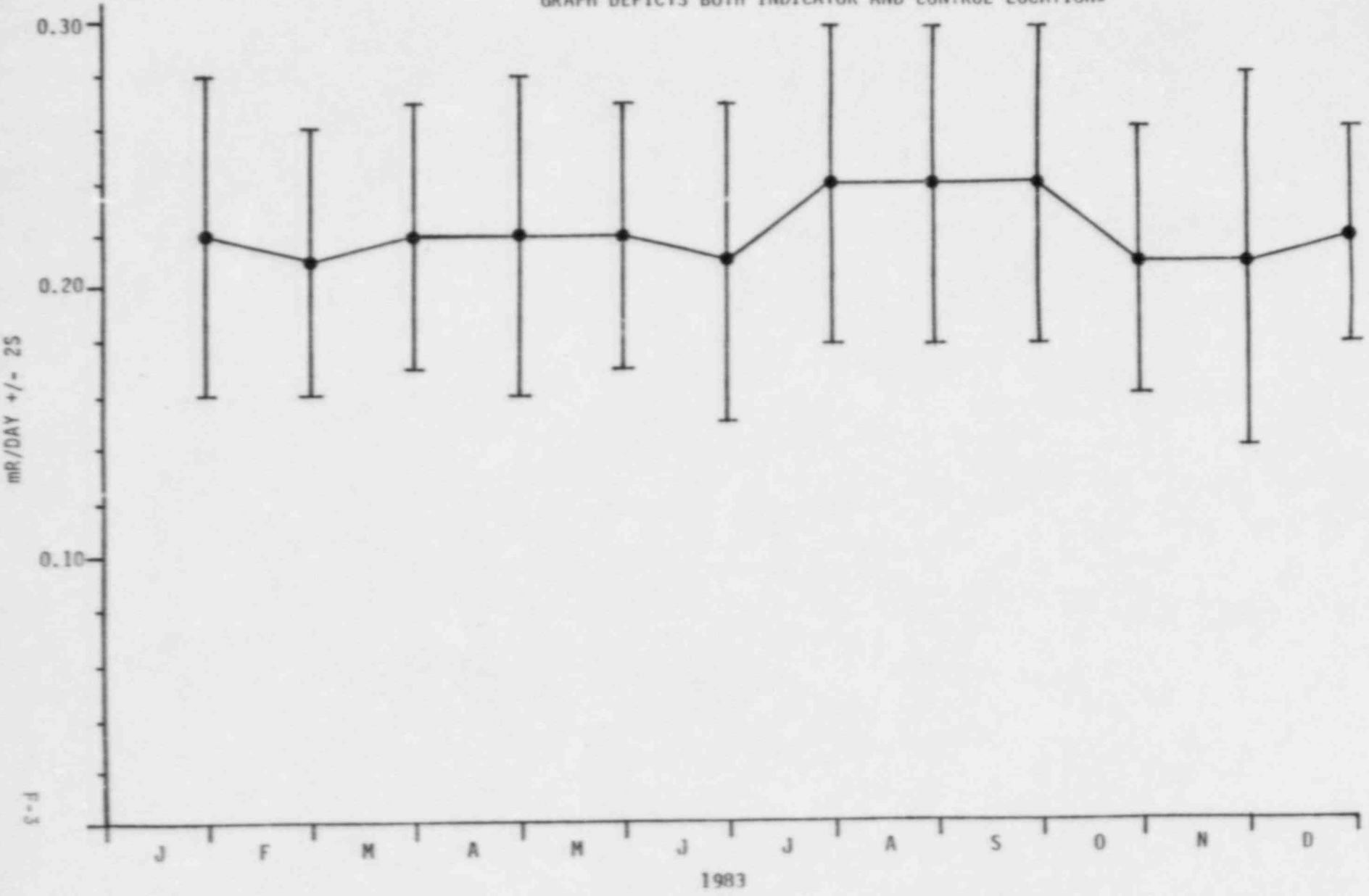
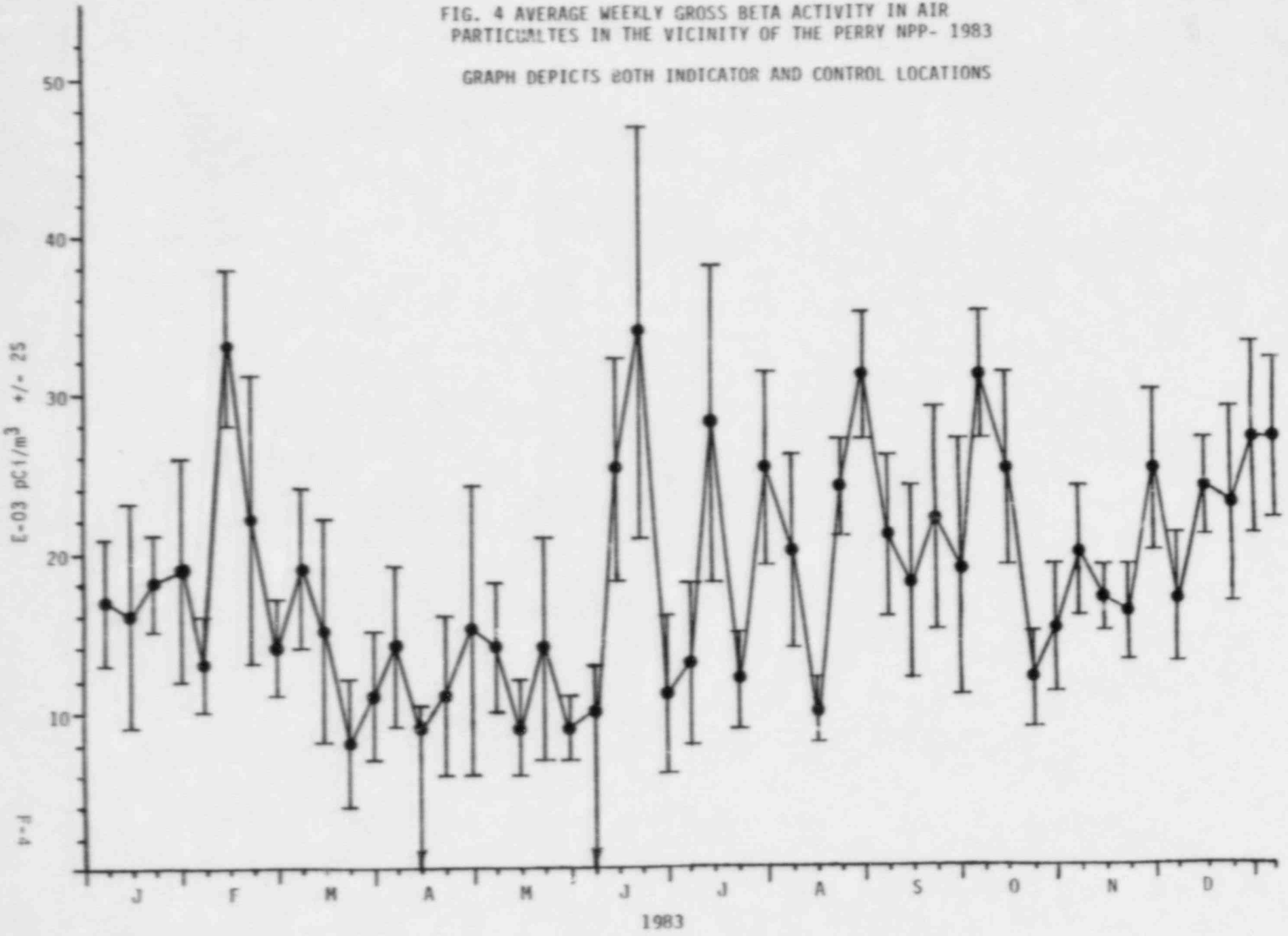


FIG. 4 AVERAGE WEEKLY GROSS BETA ACTIVITY IN AIR PARTICULATES IN THE VICINITY OF THE PERRY NPP- 1983

GRAPH DEPICTS BOTH INDICATOR AND CONTROL LOCATIONS



Appendix A

APPENDIX A

LABORATORY QUALITY ASSURANCE

1. Introduction

The quality assurance program of the Radiological Laboratory of NUS is briefly described in this appendix.

Information on each incoming sample is entered in a permanent log book. A sample number is assigned to each sample at the time of receipt. This sample number uniquely identifies each sample.

Laboratory counting instruments are calibrated, using radionuclide standards obtained from the National Bureau of Standards, the EPA, and reliable commercial suppliers, such as Amersham-Searle. Calibration of counting instruments is maintained by regular counting of radioactive reference sources. Background counting rates are measured regularly on all counting instruments. Additional performance checks for the gamma-ray scintillation spectrometer include regular checks and adjustment, when necessary, of energy calibration.

Blank samples are processed, with each group of samples analyzed for specific radionuclides, using radiochemical separation procedures. Blank, spiked (known quantities of radioactivity added), and replicate samples are processed periodically to determine analytical precision and accuracy.

2. Laboratory Analyses for Quality Assurance

The quality assurance procedures employed in the conduct of radiological monitoring programs by the Environmental Services Division Radiological Laboratory are as required in Section 5.0 of the NUS Environmental Systems Group Quality Assurance Manual and detailed in the NUS Radiological Laboratory Manual. These procedures include the requirement for (1) laboratory analysis of samples distributed by appropriate government or other standards-maintaining agencies in a laboratory intercomparison program, (2) analysis of some of the client's environmental samples split with other independent laboratories, and (3) analysis in duplicate of a specific fraction of the client's environmental samples.

The NUS Radiological Laboratory participates in the U.S. Environmental Protection Agency Radioactivity Intercomparison Studies (Cross-check) Program. The NUS results of analyses performed on samples pertinent to the Perry program and the known values are listed in Tables A-1 through A-17.

A-1
GROSS ALPHA IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
01/21/83	29 ± 4	30 ± 1
03/18/83	31 ± 4	31 ± 2
05/20/83	11 ± 3	16 ± 2
07/15/83	7.0 ± 2.9	11 ± 1
11/18/83	14 ± 5	11 ± 0 (1)

(1) Value not reported to EPA in time to be included in report.

B-1
GROSS BETA IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
01/21/83	31 ± 3	33 ± 1
03/18/83	28 ± 3	24 ± 2
05/20/83	57 ± 6	46 ± 5
07/15/83	22 ± 3	27 ± 2
11/18/83	16 ± 5	14 ± 1 (1)

(1) Value not reported to EPA in time to be included in report.

C-1
GAMMA SPECTROMETRY OF MILK

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclide	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02/25/83	Cs-137	26 ± 3.0	28 ± 1
	Ba-140	0.0 ± 0.0	LT 15
	K-40	1512 ± 40(mg/l)	1530 ± 200(mg/l)
06/10/83	Cs-137	47 ± 3	46 ± 3
	K-40	1486 ± 43(mg/l)	1500 ± 100(mg/l)
10/28/83	Cs-137	33 ± 5.8	32 ± 2
	K-40	1550 ± 90(mg/l)	1633 ± 57

LT = Less Than

C-2
GAMMA SPECTROMETRY OF WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclides	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02/04/83	Cr-51	45 ± 3	LT 40
	Co-60	22 ± 3	22 ± 2
	Zn-65	21 ± 3	19 ± 1
	Ru-106	48 ± 3	41 ± 8
	Cs-134	20 ± 3	20 ± 1
	Cs-137	19 ± 3	20 ± 0
06/03/83	Cr-51	60 ± 3	LT 80
	Co-60	13 ± 3	14 ± 1
	Zn-65	36 ± 3	37 ± 5
	Ru-106	40 ± 3	LT 50
	Cs-134	47 ± 3	42 ± 2
	Cs-137	26 ± 3	26 ± 2
10/07/83	Cr-51	51 ± 5	35 ± 6(1)
	Co-60	19 ± 5	19 ± 1
	Zn-65	40 ± 5	39 ± 1
	Ru-106	52 ± 5	40 ± 3
	Cs-134	15 ± 5	13 ± 1
	Cs-137	22 ± 5	22 ± 1

LT - Less Than

(1) Average counting error for these analyses was ± 14 which overlaps the EPA warning and control limits.

D-1
IODINE IN MILK

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02/25/83	55 ± 3	56 ± 6
06/10/83	30 ± 3	43 ± 0(1)
10/28/83	40 ± 6.93	27 ± 1.7

(1) Only one number reported due to improper preparation of sample. Insufficient data to determine statistics.

D-2
IODINE-131 IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
12/03/82	37 ± 3	35 ± 3
04/01/83	27 ± 3	25 ± 3
08/05/83	14 ± 6	11 ± 1
12/16/83	20 ± 6	16 ± 1

E-1
PLUTONIUM IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
07/08/83	8.9 ± 0.5	8.3 ± 0.9

F-1
RADIUM-226 & 228 IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclide	EPA Value ± 1s (pCi/l)	NUS Value ± 1s (pCi/l)
12/17/82	Ra-226	11.0 ± 1.0	11 ± 2
	Ra-228	0.0 ± 0.0	LT 1
03/11/83	Ra-226	12.7 ± 1.0	10 ± 1
	Ra-228	0.0 ± 0.0	LT 1
06/17/83	Ra-226	4.8 ± 0.4	6.2 ± 1.4
	Ra-228	0.0 ± 0.0	LT 1
09/09/83	Ra-226	3.1 ± 0.47	5.3 ± 0.7(1)
	Ra-228	2.0 ± 0.3	1.9 ± 0.5

LT = Less Than

(1) anomalous results under investigation.

G-1
STRONTIUM IN MILK

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclide	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02-25-83	Sr-89	37 ± 3	30 ± 6
	Sr-90	18 ± 1	16 ± 0

G-2
STRONTIUM IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclide	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
01/07/83	Sr-89	29.2 ± 2.9	29 ± 3
	Sr-90	17.2 ± 0.9	15 ± 1
05/06/83	Sr-89	57 ± 3	64 ± 5
	Sr-90	38 ± 1	42 ± 3
09/02/83	Sr-89	15 ± 5	22 ± 2
	Sr-90	10 ± 1.5	7.3 ± 0

H-1
TRITIUM IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02/11/83	2560 ± 204	2530 ± 140
04/08/83	3330 ± 210	3500 ± 0
06/10/83	1529 ± 194	1333 ± 58
08/12/83	1836 ± 198	1900 ± 200
10/14/83	1210 ± 190	1167 ± 58
12/09/83	2389 ± 203	2333 ± 58

H-2
TRITIUM IN URINE

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
03/18/83	2470 ± 210	1967 ± 404
06/10/83	1589 ± 195	1367 ± 58
11/04/83	1008 ± 338	1474 ± 320 (1)

(1) Value not reported to EPA in time for report.

J-1
URANIUM IN WATER

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	EPA Results ± 1s (pCi/l)	NUS Results ± 1s (pCi/l)
02/18/83	31 ± 3	33 ± 1
08/19/83	26 ± 3	27 ± 1

K-1
RADIONUCLIDES ON AIR FILTER

USEPA INTERCOMPARISON PROGRAM 198

Collection Date	Radionuclide	EPA Value ±1s (pCi/filter)	NUS Value ±1s (pCi/filter)	
03/25/83	Alpha	26 ± 3.7	27.3 ± 2	(1)
	Beta	68 ± 3	68 ± 1	
	Sr-90	20 ± 1	22 ± 2	
	Cs-137	27 ± 3	29 ± 6	
08/26/83	Alpha	13 ± 5	10 ± 2	
	Beta	36 ± 5	35 ± 5	
	Sr-90	10 ± 1.5	125 ± 5	(2)
	Cs-137	15 ± 5	13 ± 5	
11/25/83	Alpha	19 ± 2.9	26.7 ± 1.5	
	Beta	50 ± 2.9	53.7 ± 1.2	

(1) Value from original EPA report was incorrect. Report value is recalculated with correct efficiency. Original reported value was 79.7.

(2) Anomalous results under investigation.

L-1

EPA "Blind" Analysis (water)

USEPA INTERCOMPARISON PROGRAM 1983

Collection Date	Nuclide	EPA Value ± 1s (pCi/l)	NUS Value ± 1s (pCi/l)	
05/09/83	Alpha	64 ± 16	57 ± 4	(1)
	Beta	149 ± 7.5	123 ± 6	(1)
	Sr-89	24 ± 3	27 ± 3	
	Sr-90	13 ± 1	17 ± 1	
	Ra-226	8.5 ± 0.8	9.2 ± 0.1	
	Ra-228	4.7 ± 0.4	3.3 ± 0.4	
	Co-60	30 ± 3	31 ± 1	
	Cs-134	33 ± 3	29 ± 2	
	Cs-137	27 ± 3	25 ± 2	
	U	25 ± 3	25 ± 2	
11/14/83	Alpha	22 ± 5.5	21 ± 2	
	Beta	63 ± 5	58 ± 4	
	Sr-89	17 ± 5	25 ± 3	
	Sr-90	8 ± 1.5	10.57 ± 2.21	
	Ra-226	5.1 ± 0.8	5.5 ± 0.3	
	Ra-228	2.8 ± 0.4	1.73 ± .23	
	Co-60	11 ± 5	15.33 ± 3.1	(2)
	Cs-137	15 ± 5	9.17 ± 3.0	
	Cs-134	15 ± 5	9.9 ± 1.82	
	U	11 ± 6	12 ± 0	

(1) Original EPA report was incorrect, corrected EPA value did not include an error

(2) NUS value is average of one positive value and two LLD's which were reported.

M-1
Results of Sixth International Intercomparison
of Environmental Dosimeters

	Expected Value ±1s (mR)	NUS Value ±1s (mR)
Field Exposure	43.5 ± 2.2	51.2 ± 7.9
Field Exposure (pre-irradiated)	202 ± 10	218 ± 13
Lab Exposure	158 ± 8	161 ± 11

Appendix B

APPENDIX B

REPORTING OF ANALYTICAL RESULTS

In the tables presenting analytical measurements, the calculated value is reported with the two sigma counting error (2s) derived from a statistical analysis of both the sample and background count rates. The precision of the results is influenced by the size of the sample, the background count rate, and the method used to round off the value obtained to reflect the degree of significance of the results. For analytical results obtained from gamma spectral analysis, the precision is also influenced by the composition and concentrations of the radionuclides in the sample, the size of the sample, and the assumptions used in selecting the radionuclides to be quantitatively determined. The two sigma error for the net counting rate is:

$$2s = 2\left[\frac{R_s}{t_s} + \frac{R_b}{t_b}\right]^{1/2}$$

where:

R_s = sample counting rate

R_b = background counting rate

t_s = sample counting time

t_b = background counting time

If the measurements on the samples are not statistically significant (i.e., the two sigma count error is equal to or greater than the net measured value), then the radioactivity concentrations in the sample are considered not detected.

Results reported as less than ("LT") are below the lower limit of detection (LLD). The LLD is defined as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95 percent probability with only 5 percent probability of falsely concluding that blank observation represents a "real" signal.

For a particular measurement system (that may include radiochemical separation):

$$LLD = \frac{4.66 s_b}{E \times V \times 2.22 \times Y \times \exp(-\lambda \Delta t)}$$

where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection and counting

The following are definitions or descriptions of statistical terms used in the reporting and analysis of environmental monitoring results.

Precision relates to the reproducibility of measurements within a set, that is, to the scatter or dispersion of a set about its central value.

Measures of the Central Value of a Set. Mean (or Average or Arithmetic Mean) is the sum $\sum_{i=1}^{n} X_i$ of the values of individual results divided by the number of results in the set. The mean is given by:

$$\bar{X} = (X_1 \pm X_2 \pm \ldots X_n) / n = \sum_{i=1}^{n} X_i / n$$

Measures of Precision with a Set. Standard Deviation is the square root of the quantity (sum of squares of deviations of individual results from the mean, divided by one less than the number of results in the set). The standard deviation, s, is given by:

$$s = \sum_{i=1}^{n} (X_1 - X)^2 / (n-1)$$

Standard deviation has the same units as the measurement. It becomes a more reliable expression of precision as n becomes larger. When the measurements are independent and normally distributed, the most useful statistics are the mean for the central value and the standard deviation for the dispersion.

Note: In the USEPA Intercomparison Program, the standard deviation given by EPA is the expected laboratory result from three analyses. The standard deviation given by NUS is the standard deviation from the mean of three reported values.

Relative Standard Deviation is the standard deviation expressed as a fraction of the mean, $s/\bar{X}$. It is sometimes multiplied by 100 and expressed as a percentage.

Range is the difference in magnitude between the largest and the smallest results in a set. Instead of a single value, the actual limits are sometimes expressed (minimum value/maximum value).