DOCKET NO.: 50-352
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LIMERICK GENERATING STATION
Units 1 and 2

Regional Radiological Environmental
Monitoring Program
Report #1

22 December through 31 December 1984

Prepared for

PHILADELPHIA ELECTRIC COMPANY
2301 Market Street
Philadelphia, Pennsylvania 19101

By

TELEDYNE ISOTOPES
50 Van Buren Avenue
Westwood, NJ 07675

And

RADIATION MANAGEMENT CORPORATION
Fricks Lock Road, R.D. 1
Pottstown, PA 19464

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SUMMARY AND CONCLUSIONS

I. Summary and Conclusions

This report on the Radiological Environmental Monitoring Program conducted at the Limerick Generating Station for Philadelphia Electric Company covers the period December 22, 1984 through December 31, 1984. During that time period, 152 analyses were performed on 108 samples.

The ten day period that this report covers represents the portion of 1984 after which Limerick Generating Station achieved initial criticality. Consequently, only data from samples collected during this time period are included in the report.

Surface and drinking (potable) water samples were analyzed for concentrations of gross beta (soluble and insoluble fractions), tritium, and gamma emitting nuclides. Concentrations detected were consistent with those observed in other years.

High sensitivity I-131 analyses were performed on weekly air samples. All results were less than the minimium detectable level.

Air particulate samples were analyzed for concentrations of gross beta and gamma emitting nuclides. Concentrations detected were consistent with those observed in other years.

Environmental gamma radiation measurements were made monthly using thermoluminescent dosimeters. Levels detected were consistent with those observed in other years.

In assessing all the data gathered for this report and comparing these results with preoperational data, it was evident that the operation of the Limerick Generating Station resulted in no significant radiological impact on the environment.

INTRODUCTION

LIMERICK GENERATING STATION

Radiological Environmental Monitoring Program

II. Introduction

The Limerick Generating Station (LGS), consisting of two 1055 MWe boiling water reactors owned and operated by Philadelphia Electric Company (PECo), is located adjacent to the Schuylkill River in Montgomery County, Pennsylvania. Unit No. 1 went critical on 22 December 1984 and Unit No. 2 is under construction. The site is located in Piedmont countryside, transversed by numerous valleys containing small tributaries which feed into the Schuylkill River. On the eastern river bank elevation rises from approximately 110 to 300 feet mean sea level (MSL). On the western river bank elevation rises approximately 50 feet MSL to the western site boundary.

A Radiological Environmental Monitoring Program (REMP) for LGS was initiated in 1971. Review of the 1971 through 1977 REMP data resulted in the modification of the program to comply with changes in the Environmental Report Operating License Stage (EROL)[1] and the current revision of the Branch Technical Position Paper.[2] The preoperational period for most media covers the periods 1 January 1982 through 21 December 1984. The results of this period will be summarized in a separate report. This operational report covers those analyses performed by Teledyne Isotopes (TI) on samples collected during the period 22 December 1984 through 31 December 1984.

A. Objectives

The objectives of the Radiological Environmental Monitoring Program are:

1. To provide data on measurable levels of radiation and radioactive materials in the site environs.

2. To evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure.

B. Implementation

Implementation of the stated objectives is accomplished by identifying significant exposure pathways, establishing baseline radiological data of media within those pathways, and continuously monitoring those media before and during plant operation to assess plant effects (if any) on man and the environment.

In order to achieve the stated objectives, the current program includes the following analyses on samples collected:

1. Concentrations of tritium in surface water, drinking (potable) water, and well water.

2. Concentrations of beta emitters in surface water, drinking (potable) water, and air particulates.

3. Concentrations of gamma emitters in surface, drinking (potable), and well water, air particulates, milk, vegetation, game, fish, and sediment.

4. Concentrations of I-131 in air and milk.

5. Ambient gamma radiation levels at various site environs.

PROGRAM DESCRIPTION

III. Program Description

A. Sample Collection

This section describes the collection methods used to obtain environmental samples for the LGS REMP in 1984, including those media that were not sampled during the time period covered by this report.

Aquatic Environment The aquatic environment was examined by analyzing samples of surface water, drinking water, fish, and sediment. Two gallon water samples were collected monthly from continuous samplers located at five surface water locations (10F2, 15F5, 16B2, 24S1, and 24S2) and four drinking water locations (15F4, 15F7, 16C2, and 28F3). One additional drinking water location (13H2) was sampled monthly by a hand composite. Control locations were 10F2, 24S1, 24S2, and 28F3. All containers used were new unused plastic bottles, which were rinsed at least twice with source water prior to collection. Fish samples comprising the flesh of two groups, catfish/bullhead (bottom feeder) and sunfish (predator), were collected semi-annually at three locations: 16C5 and 20S1 (indicators) and 29C1 (control). Sediment samples composed of recently deposited substrate were collected at three locations semi-annually: 16B2 and 16C4, (indicators) and 33A2 (control).

Atmospheric Environment The atmospheric environment was examined by analyzing samples of air particulates, airborne iodine, milk, well water, food products and game. Air particulate and airborne iodine samples were collected weekly at seventeen locations (2B1, 6C1, 9C1, 10S3, 11S1, 13C1, 13H4, 14S1, 15D1, 17B1, 20D1, 22G1, 26B1, 29B1, 31D1, 34S2, and 35B1). Of the airborne iodine samples at these seventeen locations, eight (10S3, 11S1, 13C1, 13H4, 14S1, 22G1, 31D1, and 35B1) were analyzed for I-131. The remaining nine samples were collected and retained for analysis if necessary. Control locations were 13H4 and 22G1. Air particulate and airborne iodine samples were obtained using a vacuum sampler, glass fiber and charcoal filters, respectively. The filters were replaced weekly and sent to the laboratory for analysis. The vacuum samplers were run continuously at approximately 1 cubic foot per minute.

Milk samples were collected bi-weekly at four locations (5C1, 10B1, 22F1, and 25B1) and monthly at eight locations (36E1, 9E1, 9G1, 11D1, 11E1, 17C2, 18C1, and 21B1) during April through November, and monthly at all locations during December through March. Locations 9G1 and 22F1 were controls. Samples were collected in new unused two gallon plastic bottles from the bulk tank at each location, refrigerated, and shipped promptly to the laboratory. No preservative was added.

Well water samples were collected semi-annually from two locations 11S1 (indicator) and 18A1 (control) in new unused two gallon plastic bottles. Food product samples composed of broad leafy vegetation and root crops were collected monthly from one location (11S1) during the growing season (May through September). A game sample was collected annually from one location (26S5) by hunting.

Ambient Gamma Radiation Direct radiation measurements were made using thermoluminescent dosimeters (TLD) consisting of calcium sulfate ($CaSO_4$) doped with Thalium (Tm). The TLD locations were placed on and around the LGS site using a "three ring concept" consisting of:

A site boundary ring consisting of sixteen locations (36S1, 3S1, 5S1, 7S1, 10S3, 11S1, 14S1, 16S2, 18S1, 21S1, 23S2, 25S1, 26S3, 29S1, 32S1 and 34S2) near and within the site perimeter representing fencepost doses (i.e., at locations where the doses will be greater than maximum annual off-site doses) from LGS releases;

A middle ring consisting of twenty seven locations (2B1, 2E1, 4E1, 6C1, 7E1, 9C1, 10E1, 10F3, 13C1, 13E1, 15D1, 16F1, 17B1, 19D1, 20D1, 20F1, 24D1, 25D1, 26B1, 28D2, 29B1, 29E1, 31D1, 31D2, 34E1, 35B1 and 35F1) extending to approximately 5 miles from the site designed to measure possible exposures to close-in population;

And an outer ring consisting of five locations (5H1, 13H3, 18G1, 22G1 and 32G1) extending from approximately 12 to 30 miles from the site and considered to be unaffected by LGS releases.

The specific TLD locations were determined by the following criteria:

1. The presence of relatively dense population;

2. Site meteorological data taking into account distance and elevation for each of the 16 22-1/2-degree sectors around the site, where estimated annual dose from LGS, if any, would be most significant;

3. On hills free from local obstructions and within sight of the vents (where practical);

4. And near the closest dwelling to the vents in the prevailing downwind direction.

One TLD set - comprising four thermoluminescent dosimeters sealed in plastic to maintain integrity - was placed at each location in a PVC conduit located approximately three feet above ground level. The TLD set was exchanged monthly and sent to the laboratory for analysis.

B. Data Interpretation

The radioanalytical and direct radiation data collected prior to LGS becoming operational will be used as a baseline with which operational data may be compared. For the purpose of this report, LGS was considered operational at initial criticality. Several factors are important in the interpretation of the data. These factors are discussed here to avoid undue repetition in the discussion of the results.

The minimum detectable level (MDL) was defined as the two sigma counting statistic. It represents the range of values into which 95% of repeated counts of the same aliquot would fall. For all analyses (gross beta, I-131, H-3 and gamma) an activity that was greater than or equal to the MDL was reported as "activity plus/minus the MDL value". For nongamma analyses (gross beta, I-131 and H-3) when an activity was less than the MDL, the result was reported as the "< the MDL value". When an activity from a gamma isotopic analysis was less than the MDL value it was reported as "< MDL" for the specific nuclide searched for unless a positive occurrence had been found in other samples. In those cases the actual MDL values were listed.

The lower limit of detection (LLD) was defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD was intended as a before the fact estimate of a system (including instrumentation, procedure and sample type) and not as an after the fact criteria for the presence of activity. All analyses were designed to achieve the required LGS detection capabilities for environmental sample analysis. For a more detailed description of the results calculation, see Appendix D.

Results for each type of sample were grouped according to the analyses performed. Means and standard deviations of these results were calculated. These standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty. For these calculations, all results below the MDL were considered to be at the MDL. As a result, the means were biased high, and the standard deviations were generally biased low.

C. Program Exceptions

Surface water and drinking water samples were composited for tritium analysis during October and November for the preoperational period and December's samples were analyzed for tritium for the operational period. This report spans only a ten day period, resulting in some additional exceptions to the program. The LGS annual surveys (nearest farm, nearest residence, and nearest garden), included in the environmental program, were not required for the time period of this report. In addition to this, well water, milk, sediment, game, and food product samples were not scheduled for collection during the reporting period. Consequently, data from these media were not available for this report. Due to a pump malfunction, the surface water sample collected from location 10F2 was a grab sample.

D. Program Changes

None

RESULTS AND DISCUSSION

IV. Results and Discussion

A. Aquatic Environment

1. Surface Water

Samples were taken from five locations on a monthly schedule. Samples were collected from a continuous sampler at all five locations (10F2, 15F5, 16B2, 24S1, and 24S2). Of these locations, two (15F5 and 16B2) could be affected by Station discharge. The following analyses were performed.

Gross Beta

Samples from all locations were analyzed for concentrations of gross beta in the soluble and insoluble fractions (Tables C-I and C-II, Appendix C). Detectable activity was observed in the soluble and insoluble fraction of the surface water samples. The values were constant with previous years (Figures C-1 and C-2, Appendix C) and ranged from 3 to 4 pCi/l for the soluble fraction and from < .4 to 2.0 for the insoluble fraction. No difference in activity levels was observed between indicator and control locations for the soluble fraction. The insoluble fraction of the sample from the downstream location, 15F5, did not show significantly higher activity than the control locations. However, the same fraction of downstream sample location 16B2 showed a higher activity (2 pCi/l) than the control locations. This higher activity is attributable to the elevated sediment content of the sample. An activity of 2 pCi/l is still below the required sensitivity for this analysis and therefore this activity is not considered significant.

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C-III, Appendix C). All nuclides searched for were below the minimum detectable level, with the exception of naturally occurring K-40 which was detected at location 24S2 (30 pCi/l).

Tritium

Samples from locations 10F2, 16B2, and 24S1 were analyzed for aqueous tritium activity (Table C-IV, Appendix C). Positive tritium activity (130 pCi/l) was observed only at location 24S1 (control).

2. Drinking (Potable) Water

Monthly samples were taken from five locations. A hand composited sample was collected from location 13H2. Samples from locations 15F4, 15F7, 16C2 and 28F3 were collected from a continuous water sampler. Four stations (13H2, 15F4, 15F7 and

16C2) could be affected by Station discharge. The following analyses were performed:

Gross Beta

Samples from all stations were analyzed for concentrations of gross beta in the soluble and insoluble fractions (Tables C-V and C-VI, Appendix C). The values ranged from 3 to 5 pCi/l for the soluble fraction and from <.4 to .5 pCi/l for the insoluble fraction. No significant difference in activity levels was observed between indicator and control locations for both the soluble and insoluble fractions. In addition, concentrations detected in both fractions were consistent with those observed in previous years (Figures C-3 and C-4, Appendix C).

Gamma Spectrometry

Samples from all locations were analyzed for gamma emitting nuclides (Table C-VII, Appendix C). All nuclides searched for were below the minimum detectable level, except naturally occurring K-40, which was detected (30 pCi/l and 20 pCi/l respectively) at locations 15F7 and 13H2.

Tritium

Samples from locations 15F4, 15F7, 16C2 and 28F3 were analyzed for aqueous tritium activity (Table C-VIII, Appendix C). Positive tritium activity was observed in 3 of 4 samples with activities ranging from 100 to 240 pCi/l. No significant difference in tritium activity was observed between the control and indicator locations.

3. Fish

No fish samples were collected from any of the three locations during the period of this report.

4. Sediment

No sediment samples were collected from any of the three locations during the period of this report.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from seventeen locations on a weekly basis. The seventeen locations are separated into three groups: Group I represents locations within the LGS site boundary (10S3, 11S1, 14S1 and 34S2), Group II represents locations near the LGS site (2B1, 6C1, 9C1, 13C1, 15D1, 17B1, 20D1, 26B1, 29B1, 31D1, 35B1),

and Group III represents control locations at remote distances from LGS (13H4 and 22G1). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Table C-IX, Appendix C). Detectable activity was observed at all locations. The values ranged from .015 to .028 pCi/m^3. No significant difference in activity was observed between the control and indicator stations. In addition, concentrations detected were consistent with those observed in previous years (Figure C-5, Appendix C).

Gamma Spectrometry

Weekly samples were composited and analyzed monthly for gamma-emitting nuclides (Table C-X, Appendix C). Naturally occurring Be-7 was detected in all samples, due to cosmic ray activity. These values ranged from .08 to .15 pCi/m^3. K-40, also naturally occurring, was found in five of seventeen samples. These values ranged from .02 to .09 pCi/m^3. All other nuclides searched for were below the minimum detectable levels. No significant difference in activity was observed between the control and indicator stations.

b. Airborne Iodine

Continuous air samples were collected from the same seventeen locations as the air particulate samples. However, of the seventeen locations, eight (10S3, 11S1, 13C1, 13H4, 14S1, 22G1, 31D1, 35B1) were analyzed weekly for I-131. The remaining nine samples were held and analysis was not necessary. Results of the I-131 analysis are found in Table C-XI, Appendix C. All results were less than the minimum detectable level.

2. Terrestrial

a. Milk

No samples were collected from any of the milk farms during the period of this report.

b. Well Water

No samples were collected from either of the well water locations during the period of this report.

c. Food Products

No samples were collected from the vegetation location during the period of this report.

d. Game

No Game sample was collected during the period of this report.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing $CaSO_4$: Tm thermoluminescent dosimeters. Forty-eight TLD locations were established around the site in a three ring concept for comparison purposes: an "inner ring" of sixteen locations around the site boundary; a "middle ring" of twenty-seven locations within a ten mile radius of the site; and an "outer ring" of five locations at distances outside the ten mile radius of the site. Results of TLD measurements are listed in Table C-XII, Appendix C. All TLD measurements were below 10 mrad/std. month, with a range of 5.26 to 9.66 mrads/std. month. No significant differences were observed among the results from the site, middle, and outer rings (Table C-XIII, Appendix C). In addition, levels measured were consistent with those observed in previous years (Figure C-6, Appendix C).

REFERENCES

V. References

1. Environmental Report Operating License Stage, Limerick Generating Station, Units 1 and 2, Volumes 1-5 Philadelphia Electric Company.

2. Branch Technical Position Paper, Regulatory Guide 4.8, Revision 1, November 1979.

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

APPENDIX A
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

NAME OF FACILITY: LIMERICK GENERATING STATION
LOCATION OF FACILITY: MONTGOMERY COUNTY, PA

DOCKET NO.: 50-352
50-353
REPORTING PERIOD: 12/22-12/31/84

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	TYPE OF ANALYSES PERFORMED	NUMBER OF ANALYSES PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	INDICATOR LOCATIONS MEAN (F) RANGE	CONTROL LOCATIONS MEAN (F) RANGE	LOCATION WITH HIGHEST MEAN MEAN (F) RANGE	LOCATION WITH HIGHEST MEAN STATION # NAME DISTANCE & DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE (PC/CU. METER)	GROSS BETA	34	0.01	.021 (30/30) (.015-.028)	.022 (4/4) (.021-.026)	.023 (2/2) (.021-.025)	10S3 (INDICATOR) KEEN ROAD 0.5 MILES E OF SITE	0
	GAMMA	17						
	BE-7		N/A	.11 (15/15) (.08-.15)	.10 (2/2) (.10-.10)	.15 (1/1) (.15)	9C1 (INDICATOR) REED ROAD 2.2 MILES E OF SITE	0
	K-40		N/A	.05 (5/15) (.02-.09)	< LLD	.09 (1/1) (.09)	35B1 (INDICATOR) PLEASANTVIEW ROAD 1.9 MILES NNW OF SITE	0
	CS-134		0.05	< LLD	< LLD	< LLD		0
	CS-137		0.06	< LLD	< LLD	< LLD		0
AIR IODINE (PC/CU. METER)	I-131	16	0.07	< LLD	< LLD	< LLD		0
SURFACE WATER (PC/LITER)	GROSS BETA INSOLUBLE	5	4	1.4 (2/2) (.8-2.0)	< LLD	2.0 (1/1) (2.0-2.0)	16B2 (INDICATOR) LINFIELD BRIDGE 1.1 MILES SSE OF SITE	0
	GROSS BETA SOLUBLE	5	4	4 (2/2) (3-4)	3 (3/3) (3-3)	4 (1/1) (4-4)	15F5 (INDICATOR) PHILADELPHIA SUBURBAN WATER COMPANY 7.8 MILES SSE OF SITE	0
	AQUEOUS H3 TOTAL	3	2000	< LLD	130 (1/2) (130-130)	130 (1/1) (130-130)	24S1 (CONTROL) LIMERICK INTAKE 0.3 MILES WSW OF SITE	0

MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)

APPENDIX A (CONTINUED)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

NAME OF FACILITY: LIMERICK GENERATING STATION
LOCATION OF FACILITY: MONTGOMERY COUNTY, PA

DOCKET NO.: 50-352
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SURFACE WATER (PCI/LITER)	GAMMA TOTAL	5						
	K-40		N/A	< LLD	30 (1/3) (30)	30 (1/1) (30)	24S2 (CONTROL) FRICKS LOCK BOAT HOUSE 0.3 MILES WSW	0
	MN-54		15	< LLD	< LLD	< LLD		0
	FE-59		30	< LLD	< LLD	< LLD		0
	CO-58		15	< LLD	< LLD	< LLD		0
	CO-60		15	< LLD	< LLD	< LLD		0
	ZN-65		30	< LLD	< LLD	< LLD		0
	ZR-95		30	< LLD	< LLD	< LLD		0
	NB-95		15	< LLD	< LLD	< LLD		0
	CS-134		15	< LLD	< LLD	< LLD		0
	CS-137		18	< LLD	< LLD	< LLD		0
	BA-140		60	< LLD	< LLD	< LLD		0
	LA-140		15	< LLD	< LLD	< LLD		0
DRINKING WATER (PC/LITER)	GROSS BETA INSOLUBLE	5	4	.5 (2/4) (.4-.5)	< LLD	.5 (1/1) (.5-.5)	13H2 (INDICATOR) BELMONT WATER WORKS (PHILA.) 25.5 MILES SE OF SITE	0
	GROSS BETA SOLUBLE	5	4	4 (4/4) (3-5)	3 (1/1) (3-3)	5 (1/1) (5-5)	15F4 (INDICATOR) PHILADELPHIA SUBURBAN WATER COMPANY 7.8 MILES SSE OF SITE	0
	AQUEOUS H3 TOTAL	4	2000	170 (2/3) (100-240)	150 (1/1) (150-150)	240 (1/1) (240-240)	16C2 (INDICATOR) CITIZENS HOME WATER COMPANY 2.4 MILES SSE OF SITE	0

MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)

APPENDIX A (CONTINUED)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

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LOCATION OF FACILITY: MONTGOMERY COUNTY, PA

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50-353
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DRINKING WATER (PCI/LITER)	GAMMA TOTAL	5						
	K-40		N/A	25 (2/3) (20-30)	< LLD	30 (1/1) (30)	15F7 (INDICATOR) PHOENIXVILLE WATER WORKS 5.2 MILES SSE OF SITE	0
	MN-54		15	< LLD	< LLD	< LLD		0
	FE-59		30	< LLD	< LLD	< LLD		0
	CO-58		15	< LLD	< LLD	< LLD		0
	CO-60		15	< LLD	< LLD	< LLD		0
	ZN-65		30	< LLD	< LLD	< LLD		0
	ZR-95		30	< LLD	< LLD	< LLD		0
	NB-95		15	< LLD	< LLD	< LLD		0
	CS-134		15	< LLD	< LLD	< LLD		0
	CS-137		18	< LLD	< LLD	< LLD		0
	BA-140		60	< LLD	< LLD	< LLD		0
	LA-140		15	< LLD	< LLD	< LLD		0
DIRECT RADIATION MRAD/STD. MONTH	TLD	48	N/A	(7.58) (43/43) (5.26-9.66)	(7.50) (5/5) (6.70-7.50)	(9.66) (1/1) (9.66)	31D1 (INDICATOR) LINCOLN SUBSTATION 3.0 MILES NW OF SITE	0

MEAN AND RANGE BASED UPON DETECTABLE MEASUREMENTS ONLY. FRACTION OF DETECTABLE MEASUREMENTS AT SPECIFIED LOCATIONS IS INDICATED IN PARENTHESES. (F)

SAMPLE DESIGNATION
AND LOCATIONS

APPENDIX B: SAMPLE DESIGNATION AND LOCATIONS

LIST OF TABLES AND FIGURES

TABLES

FIGURES

TABLE B-I: Location Designation and Identification System for the Limerick Generating Station

XXYZ General code for identification of locations, where:

XX - Angular Sector of Sampling Location
The compass is divided into 36 sectors of 10 degrees each with center at Limerick off-gas vent. Sector 36 is centered due North, and others are numbered in a clockwise direction.

Y - Radial Zone of Sampling Location (In this report, the radial distance from the Limerick vent for all regional stations).

S	: on-site location	E	: 4-5 miles off-site
A	: 0-1 mile 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	: 20-100 miles off-site
D	: 3-4 miles off-site		

Z - Station's Numerical Designation within sector and zone, using 1, 2, 3... in each sector and zone.

TABLE B-II SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
A. Surface Water				
10F2	Perkiomen Pumping Station (control)	7.1 miles E	Two gallon sample collected from a continuous water sampler, monthly	G. Beta (S&I)-monthly Gamma Spec-monthly Tritium-quarterly composite
15F5	Philadelphia Suburban Water Company (indicator)	7.8 miles SE	Same as 10F2	G. Beta (S&I)-monthly Gamma Spec-monthly
16B2	Linfield Bridge (indicator)	1.1 miles SSE	Same as 10F2	Same as 10F2
24S1	Limerick Intake (control)	0.3 miles SSW	Same as 10F2	Same as 10F2
24S2	Fricks Lock Boat House (control)	0.3 miles WSW	Same as 10F2	Same as 15F5
B. Drinking (Potable) Water				
13H2	Belmont Water Works (indicator)	25.5 miles SE	Two gallon hand composited sample, collected monthly	G. Beta (S&I)-monthly Gamma Spec-monthly
15F4	Philadelphia Suburban Water Company (indicator)	7.8 miles SE	Two gallon composite sample collected from a continuous water sampler, monthly	G. Beta (S&I)-monthly Gamma Spec-monthly Tritium-quarterly composite
15F7	Phoenixville Water Works (indicator)	3.2 miles SSE	Same as 15F4	Same as 15F4
16C2	Citizens Home Water Company (indicator)	2.4 miles SSE	Same as 15F4	Same as 15F4
28F3	Pottstown Water Authority (control)	5.9 miles WNW	Same as 15F4	Same as 15F4

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
C. Well Water				
11S1	LGS Information Center	0.5 miles ESE	Two gallon grab taken from faucet semi-annually	Tritium-semi-annually Gamma Spec-semi-annually
18A1	Control	1.0 miles S	Two gallon grab taken from faucet semi-annually	Tritium-semi-annually Gamma Spec-semi-annually
D. Cow's Milk				
36E1		4.7 miles N	Two gallon grab sample collected from bulk tank at farm monthly	I-131-monthly Gamma Spec-quarterly
5C1		2.6 miles NE	Bi-weekly during grazing season (April through November); monthly otherwise	I-131-bi-weekly/monthly Gamma Spec-monthly
9E1		4.1 miles E	Same as 36E1	Same as 36E1
9G1	Control	11.4 miles E	Same as 36E1	Same as 36E1
11D1		3.8 miles ESE	Same as 36E1	Same as 36E1
11E1		4.9 miles ESE	Same as 36E1	Same as 36E1
17C2		2.5 miles S	Same as 36E1	Same as 36E1
18C1		1.9 miles S	Same as 36E1	Same as 36E1
21B1		1.7 miles SW	Same as 36E1	Same as 36E1
22F1	Control	9.8 miles SW	Same as 5C1	Same as 5C1
25B1		1.3 miles WSW	Same as 5C1	Same as 5C1

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
E. Goat's Milk				
10B1		1.1 mile ESE	Two gallon grab sample collected from bulk tank at farm, bi-weekly during grazing season (April through November); monthly otherwise	I-131-bi-weekly/monthly Gamma Spec-monthly
F. Air Particulates/Air Iodine				
2B1	Sanatoga Substation	1.5 miles NNE	pproximately 1 cfm continuous flow through glass fiber and charcoal filters (approx. 2" diameter) which are installed for one week and replaced	G. Beta-weekly Gamma Spec-monthly composite I-131-if necessary
6C1	Pottstown Landing Field	2.1 miles ENE	Same as 2B1	Same as 2B1
9C1	Reed Road	2.2 miles E	Same as 2B1	Same as 2B1
10S3	Keen Road	0.5 miles E	same as 2B1	G. Beta-weekly Gamma Spec-monthly composite I-131-weekly
11S1	LGS Information Center	0.5 miles ESE	Same as 2B1	Same as 10S3
13C1	King Road	2.9 miles SE	Same as 2B1	Same as 10S3
13H4	2301 Market Street, Philadelphia (control)	28.8 miles SE	Same as 2B1	Same as 10S3
14S1	Longview Road	0.6 miles SE	Same as 2B1	Same as 10S3
15D1	Spring City Substation	3.2 miles SE	Same as 2B1	Same as 2B1

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
F. Air Particulates/Air Iodine (contd.)				
17B1	Linfield Substation	1.6 miles S	Same as 2B1	Same as 2B1
20D1	Ellis Wood Road	3.1 miles SSW	Same as 2B1	Same as 2B1
22G1	Manor Substation (control)	17.6 miles SW	Same as 2B1	Same as 10S3
26B1	Old Schuylkill Road	1.7 miles W	Same as 2B1	Same as 2B1
29B1	Yost Road	1.8 miles NW	Same as 2B1	Same as 2B1
31D1	Lincoln Substation	3.0 miles NW	Same as 2B1	Same as 10S3
34S2	Met. Tower #1	0.6 miles NNW	Same as 2B1	Same as 2B1
35B1	Pleasantview Road	1.9 miles NNW	Same as 2B1	Same as 10S3
G. Fish				
16C5	Vincent Pool (indicator)	Downstream of Discharge	Fish flesh from two groups representing predator and bottom feeder species collected by electrofisher or other appropriate fishery gear, semi-annually	Gamma Spec-Semi-annually
20S1	Discharge Area (indicator)	Downstream of Discharge	Same as 16C5	Same as 16C5
29C1	Pottstown Vicinity (control)	Upstream of Intake	Same as 16C5	Same as 16C5

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
H. Sediment				
16B2	Linfield Bridge (indicator)	Downstream of Discharge	Recently deposited sediment collected below the waterline, semi-annually	Gamma Spec-Semi-annually
16C4	Vincent Dam (indicator)	Downstream of Discharge	Same as 16B2	Same as 16B2
33A2	Control	Upstream of Discharge	Same as 16B2	Same as 16B2
I. Game				
26S5	Fricks Lock Area	Site Vicinity	Game animal collected by hunting annually	Gamma Spec-annually
J. Vegetation				
11S1	LGS Information Center	0.5 miles ESE	Broad leafy vegetation and root crops, monthly during the growing season (May-September)	Gamma Spec-monthly
K. Environmental Dosimetry-TLD				
36S1	Evergreen & Sanatoga Road	0.6 miles N	Collection method and frequency is described in placement procedure, Section III, A.	TLD-monthly
2B1	Sanatoga Substation	1.5 miles NNE	Same as 36S1	Same as 36S1
2E1	Laughing Waters GSC	5.1 miles NNE	Same as 36S1	Same as 36S1
3S1	Sanatoga Road	0.6 miles NNE	Same as 36S1	Same as 36S1
4E1	Neiffer Road	4.6 miles NE	Same as 36S1	Same as 36S1
5S1	Possum Hollow Road	0.4 miles NE	Same as 36S1	Same as 36S1

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

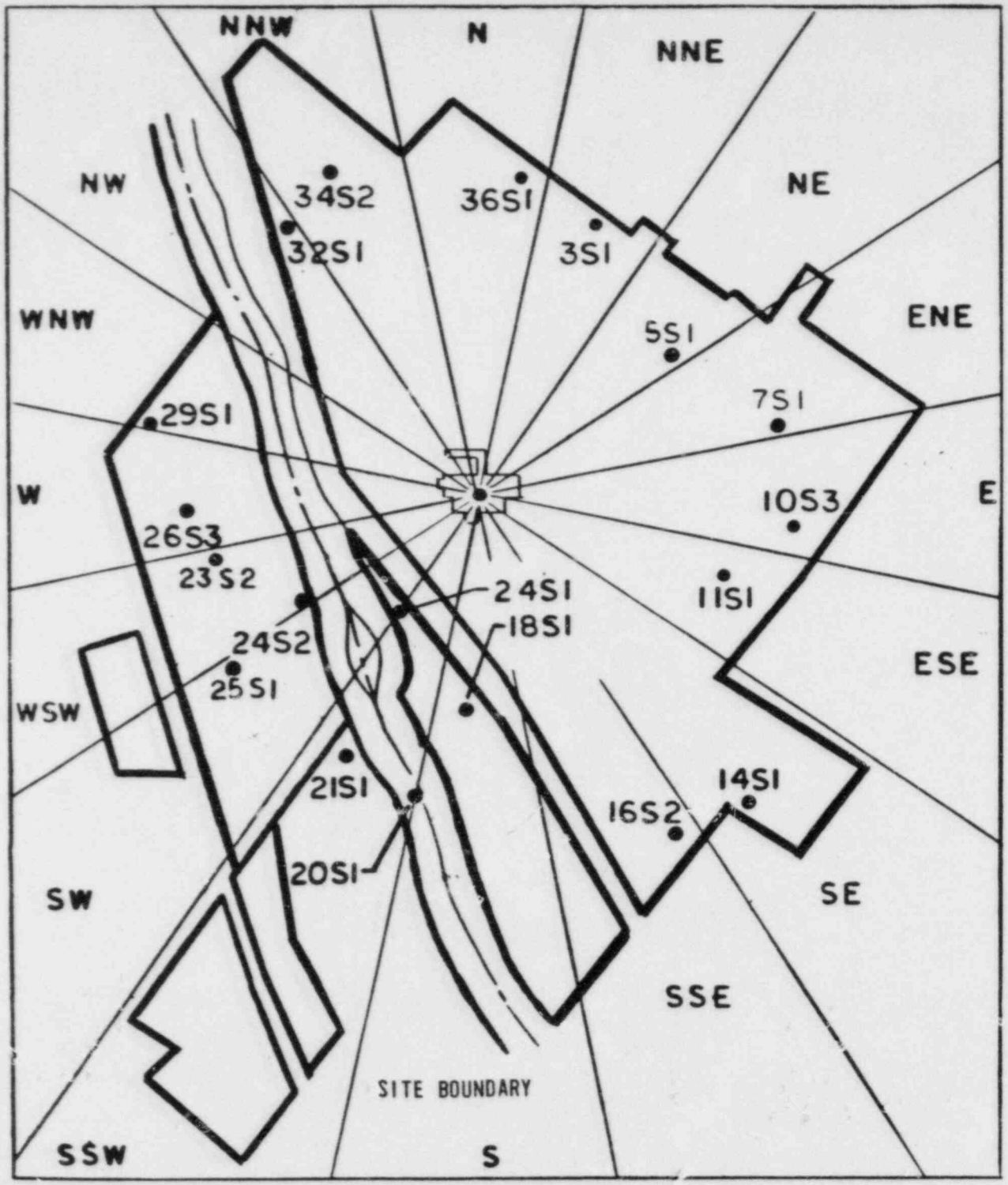
ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
K. Environmental Dosimetry-TLD (contd.)				
5H1	Birch Substation	25.8 miles NE	Same as 36S1	Same as 36S1
6C1	Pottstown Landing Field	2.1 miles ENE	Same as 36S1	Same as 36S1
7S1	LGS Training Center	0.5 miles ENE	Same as 36S1	Same as 36S1
7E1	Pheasant Road	4.2 miles ENE	Same as 36S1	Same as 36S1
9C1	Reed Road	2.2 miles E	Same as 36S1	Same as 36S1
10S3	Keen Road	0.5 miles E	Same as 36S1	Same as 36S1
10E1	Royersford Road	3.9 miles E	Same as 36S1	Same as 36S1
10F3	Trappe Substation	5.5 miles ESE	Same as 36S1	Same as 36S1
11S1	LGS Information Center	0.5 miles ESE	Same as 36S1	Same as 36S1
13C1	King Road	2.9 miles SE	Same as 36S1	Same as 36S1
13E1	Vaughn Substation	4.3 miles SE	Same as 36S1	Same as 36S1
13H3	3508 Market Street, Philadelphia (control)	28.2 miles SE	Same as 36S1	Same as 36S1
14S1	Longview Road, SE Sector	0.6 miles SE	Same as 36S1	Same as 36S1
15D1	Spring City Substation	3.2 miles SE	Same as 36S1	Same as 36S1
16S2	Longview Road, SSE Sector	0.6 miles SSE	Same as 36S1	Same as 36S1
16F1	Pikeland Substation	4.9 miles SSE	Same as 36S1	Same as 36S1
17B1	Linfield Substation	1.6 miles S	Same as 36S1	Same as 36S1
18S1	Rail Line along Longview Road	0.3 miles S	Same as 36S1	Same as 36S1
18G1	Planebrook Substation	12.9 miles S	Same as 36S1	Same as 36S1

TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
K. Environmental Dosimetery-TLD (contd.)				
34E1	Yarnell Road	4.6 miles NNW	Same as 36S1	Same as 36S1
35B1	Pleasantville Road	1.9 miles NNW	Same as 36S1	Same as 36S1
35F1	Ringing Rock Substation	4.2 miles N	Same as 36S1	Same as 36S1

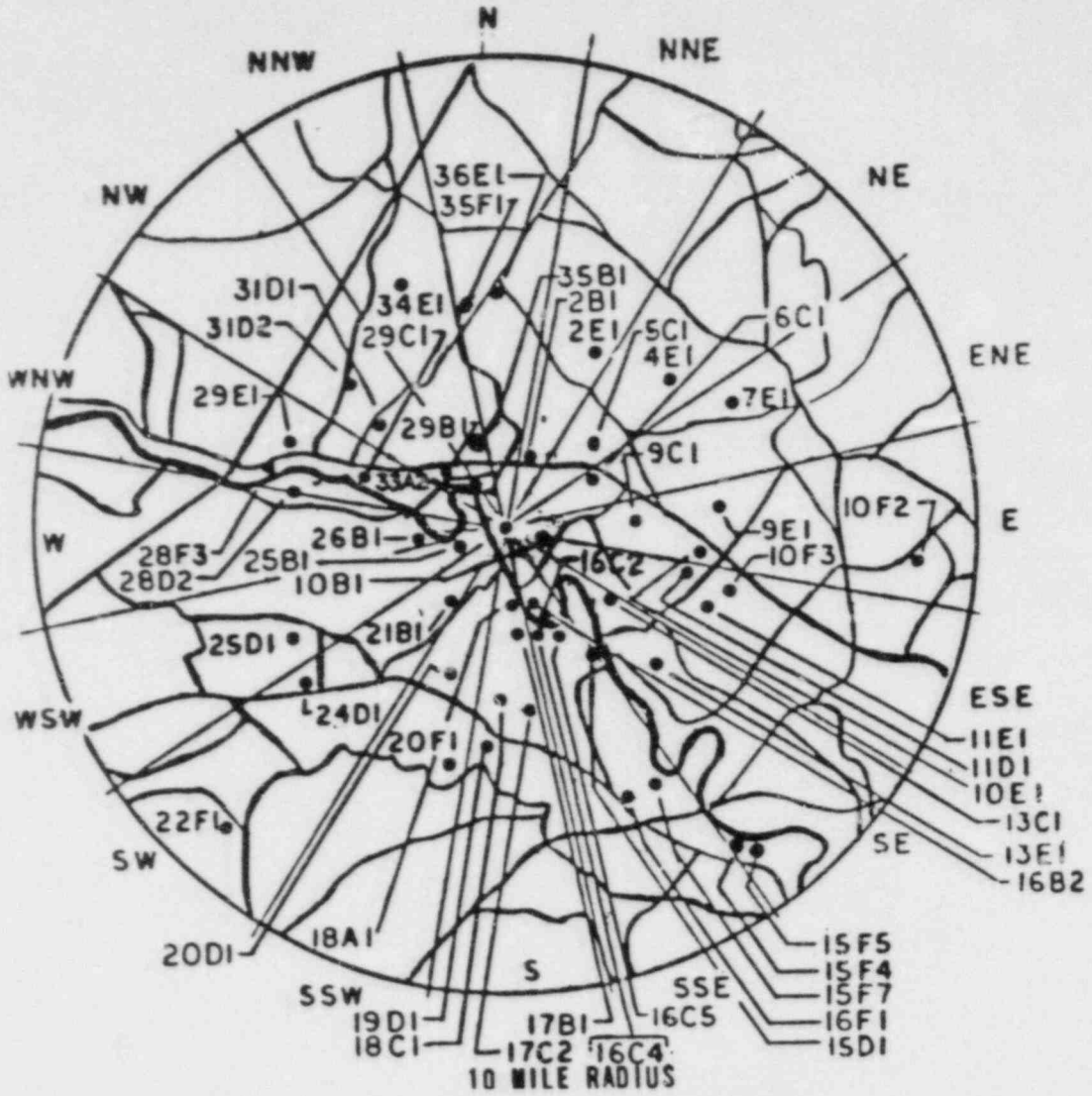
TABLE B-II (cont.) SAMPLE COLLECTION AND ANALYSIS PROGRAM FOR THE OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM, LIMERICK GENERATING STATION

ENVIRONMENTAL STATION	LOCATION DESCRIPTION	DISTANCE & DIRECTION FROM LGS VENT	COLLECTION METHOD & FREQUENCY	ANALYSIS & FREQUENCY PERFORMED
K. Environmental Dosimetry-TLD (contd.)				
19D1	Snowden Substation	3.6 miles S	Same as 36S1	Same as 36S1
20D1	Ellis Woods Road	3.1 miles SSW	Same as 36S1	Same as 36S1
20F1	Sheeder Substation	5.2 miles SSW	Same as 36S1	Same as 36S1
21S1	Impound Basin	0.5 miles SSW	Same as 36S1	Same as 36S1
22G1	Manor Substation	17.6 miles SW	Same as 36S1	Same as 36S1
23S2	Transmission Tower	0.5 miles WSW	Same as 36S1	Same as 36S1
24D1	Porters Mill Substation	3.9 miles SW	Same as 36S1	Same as 36S1
25S1	Sector Site Boundary	0.5 miles SW	Same as 36S1	Same as 36S1
25D1	Hoffecker & Keim Streets	4.0 miles WSW	Same as 36S1	Same as 36S1
26S3	Met. Tower #2	0.4 miles W	Same as 36S1	Same as 36S1
26B1	Old Schuylkill Road	1.7 miles W	Same as 36S1	Same as 36S1
28D2	W. Cedarville Road	3.8 miles W	Same as 36S1	Same as 36S1
29S1	Sector Site Boundary	0.5 miles WNW	Same as 36S1	Same as 36S1
29B1	Yost Road	1.8 miles NW	Same as 36S1	Same as 36S1
29E1	Prince Street	4.9 miles WNW	Same as 36S1	Same as 36S1
31D1	Lincoln Substation	3.0 miles NW	Same as 36S1	Same as 36S1
31D2	Poplar Substation	3.9 miles NW	Same as 36S1	Same as 36S1
32S1	Sector Site Boundary	0.6 miles NW	Same as 36S1	Same as 36S1
32G1	Friedensburg Substation	15.6 miles NW	Same as 36S1	Same as 36S1
34S2	Met. Tower #1	0.6 miles NNW	Same as 36S1	Same as 36S1



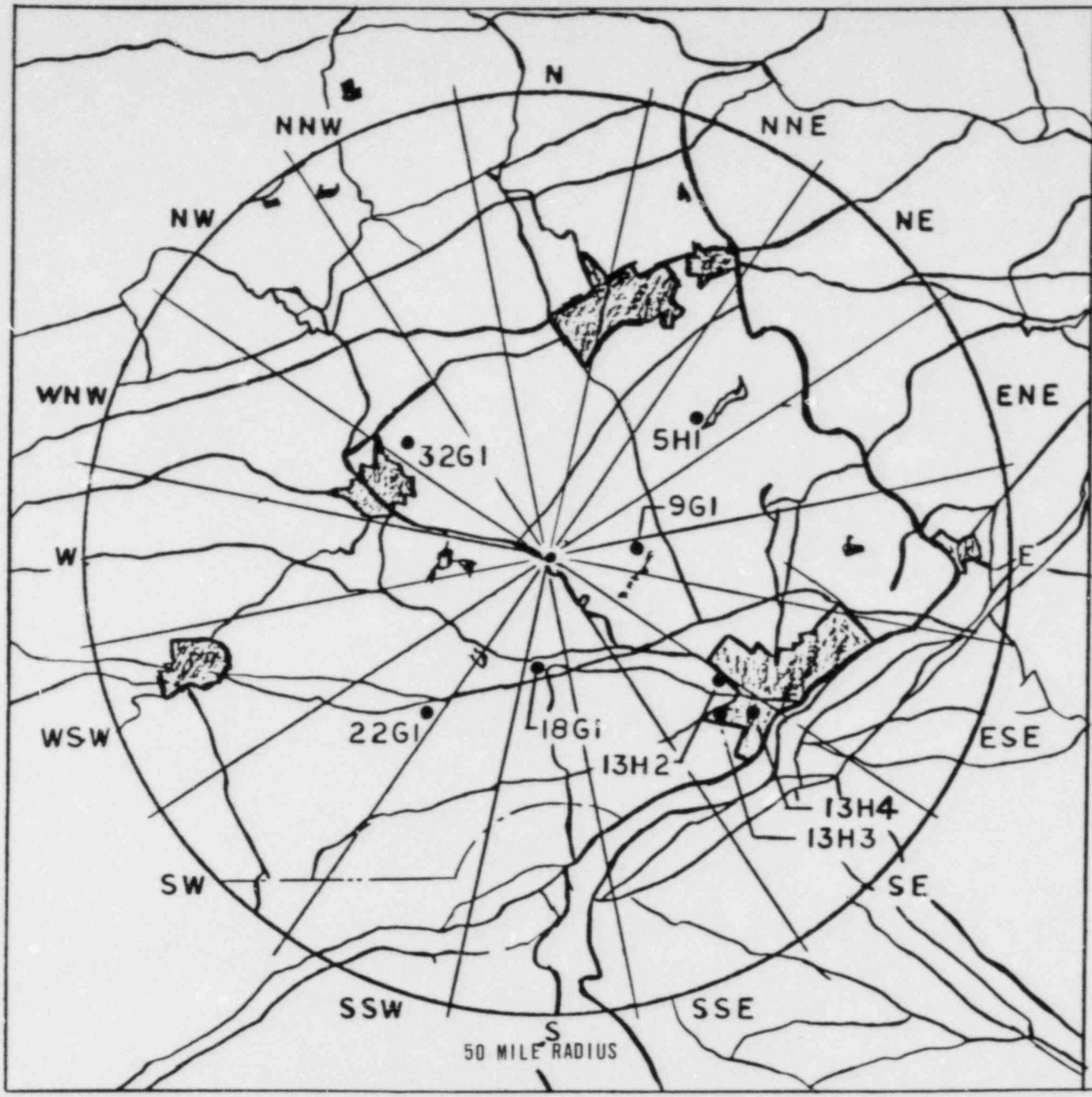
36S1	EVERGREEN & SANATOGA RDS.
3S1	SANATOGA ROAD
5S1	POSSUM HOLLOW ROAD
7S1	LGS TRAINING CENTER
10S3	KEEN ROAD
11S1	LGS INFORMATION CENTER
14S1	LONGVIEW ROAD
16S2	LONGVIEW ROAD
18S1	RAILROAD TRACKS/LONGVIEW RD.
20S1	LGS DISCHARGE AREA
21S1	IMPOUNDING BASIN
23S2	TRANSMISSION TOWER
24S1	LGS INTAKE
24S2	FRICKS LOCK
25S1	SW SECTOR
26S3	MET. TOWER #2
29S1	WNW SECTOR
32S1	NW SECTOR
34S2	MET. TOWER #1

FIGURE B-1
ENVIRONMENTAL SAMPLING LOCATIONS
ON-SITE OR NEAR THE LIMERICK
GENERATING STATION



36E1	FARM IN N SECTOR
2B1	SANATOGA SUBSTATION
2E1	LAUGHING WATERS
4E1	NEIFFER ROAD
5C1	FARM IN NE SECTOR
6C1	POTTSTOWN AIRPORT
7E1	GAME FARM
9C1	REED ROAD
9E1	FARM IN E SECTOR
10B1	FARM IN ESE SECTOR
10E1	ROYERSFORD ROAD
10F2	PERKIOMEN CREEK
10F3	TRAPPE SUBSTATION
11D1	FARM IN ESE SECTOR
11E1	FARM IN ESE SECTOR
13C1	KING ROAD
13F1	VAUGHN ROAD
15D1	SPRING CITY SUBSTATION
15F4	PHIL. SUBURBAN WATER CO.
15F5	PHIL. SUBURBAN WATER CO.
15F7	PHOENIXVILLE WATER CO.
16B2	LINFIELD BRIDGE
16C2	CITIZENS HOME WATER CO.
16C4	VINCENT POOL
16C5	VINCENT POOL
16F1	PIKELAND SUBSTATION
17B1	LINFIELD SUBSTATION
17C2	FARM IN S SECTOR
18A1	ANDERSON ROAD
18C1	FARM IN S SECTOR
19D1	SNOWDEN SUBSTATION
20D1	ELLIS WOODS ROAD
20F1	SHEEDER SUBSTATION
21B1	FARM IN SW SECTOR
22F1	FARM IN SW SECTOR
24D1	PORTERS MILL SUBSTATION
25B1	FARM IN WSW SECTOR
25D1	HOFFECKER & KEIM ST.
26B1	OLD. SCHUYLKILL ROAD
28D2	W. CEDARVILLE ROAD
28F3	POTTSTOWN WATER AUTHORITY
29B1	YOST ROAD
29C1	VINCENT POOL
29E1	HIGH SUBSTATION
31D1	LINCOLN SUBSTATION
31D2	POPLAR SUBSTATION
33A2	UPSTREAM OF DISCHARGE
34E1	YARNELL ROAD
35B1	PLEASANTVIEW ROAD
35F1	RINGING ROCKS SUBSTATION

FIGURE B-2
ENVIRONMENTAL SAMPLING STATIONS AT INTERMEDIATE DISTANCES FROM THE LIMERICK GENERATING STATION



5H1	BIRCH SUBSTATION
9G1	FARM IN E SECTOR
13H2	BELMONT WATER WORKS
13H3	3508 MARKET ST PHIL.
13H4	2301 MARKET ST PHIL.
18G1	PLANEBROOK SUBSTATION
22G1	MANOR SUBSTATION
32G1	FRIEDENBERG SUBSTATION

FIGURE B-3
ENVIRONMENTAL SAMPLING STATIONS AT REMOTE DISTANCES FROM THE LIMERICK GENERATING STATION

DATA TABLES

APPENDIX C: DATA TABLES

LIST OF TABLES AND FIGURES

TABLES

Figures

TABLE C-I CONCENTRATIONS OF GROSS BETA (SOLUBLE) IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	10F2	15F5	16B2	24S1	24S2	MEAN
DEC 84	3 ± 1	4 ± 1	3 ± 1	3 ± 1	3 ± 1	3 ± 1

TABLE C-II CONCENTRATIONS OF GROSS BETA (INSOLUBLE) IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	10F2	15F5	16B2	24S1	24S2	MEAN
DEC 84	< .4	.8 ± .4	2.0 ± .5	< .4	< .4	.8 ± 1.4

TABLE C-III CONCENTRATIONS OF GAMMA EMITTERS* IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	NUCLIDE	10F2	15F5	16B2	24S1	24S2	MEAN
DEC 84	K-40	< 5	< 5	< 6	< 10	30 ± 10	10 ± 20
	OTHERS	< MDL	< MDL	< MDL	< MDL	< MDL	

* FOR TYPICAL MINIMUM DETECTABLE LEVELS OF NUCLIDES SEARCHED FOR AND NOT FOUND, SEE TABLE C-XV.

TABLE C-IV CONCENTRATIONS OF AQUEOUS TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	10F2	15F5	16B2	24S1	24S2	MEAN
DEC 84	< 200		< 100	130 ± 70		140 ± 100

TABLE C-V CONCENTRATIONS OF GROSS BETA (SOLUBLE) IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	13H2	15F4	15F7	16C2	28F3	MEAN
DEC 84	4 ± 1	5 ± 1	4 ± 1	3 ± 1	3 ± 1	4 ± 2

TABLE C-VI CONCENTRATIONS OF GROSS BETA (INSOLUBLE) IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	13H2	15F4	15F7	16C2	28F3	MEAN
DEC 84	.5 ± .4	< .4	< .4	.4 ± .4	< .4	.4 ± .1

TABLE C-VII CONCENTRATIONS OF GAMMA EMITTERS* IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	NUCLIDE	13H2	15F4	15F7	16C2	28F3	MEAN
DEC 84	K-40	20 ± 10	< 8	30 ± 10	< 8	< 20	20 ± 20
	OTHERS	< MDL	< MDL	< MDL	< MDL	< MDL	

* FOR TYPICAL MINIMUM DETECTABLE LEVELS OF NUCLIDES SEARCHED FOR AND NOT FOUND, SEE TABLE C-XV.

TABLE C-VIII CONCENTRATIONS OF AQUEOUS TRITIUM IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/L ± 2 SIGMA

COLLECTION PERIOD	13H2	15F4	15F7	16C2	28F3	MEAN
DEC 84		< 100	100 ± 100	240 ± 90	150 ± 70	150 ± 130

TABLE C-IX CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER 1984
RESULTS IN UNITS OF PCI/CU. M ± 2 SIGMA

1984 GROUP I - LIMERICK SITE BOUNDARY LOCATIONS

WEEK #	10S3	11S1	14S1	34S2
51	.025 ± .004	.021 ± .006	.023 ± .004	.024 ± .004
52	.021 ± .004	.016 ± .003	.018 ± .004	.017 ± .003
MEAN	.023 ± .006	.019 ± .007	.021 ± .007	.021 ± .010

1984 GROUP II - NEAR SITE LOCATIONS

WEEK #	2B1	6C1	9C1	13C1	15D1	17B1
51	.026 ± .004	.022 ± .004	.023 ± .004	.024 ± .004	.023 ± .004	.019 ± .004
52	.020 ± .004	.017 ± .003	.018 ± .003	.019 ± .004	.019 ± .004	.018 ± .003
MEAN	.023 ± .008	.020 ± .007	.021 ± .007	.022 ± .007	.021 ± .006	.019 ± .001

WEEK #	20D1	26B1	29B1	31D1	35B1
51	.028 ± .004	.022 ± .004	.020 ± .004	.024 ± .004	.022 ± .004
52	.018 ± .004	.015 ± .003	.018 ± .003	.019 ± .004	.017 ± .003
MEAN	.023 ± .014	.019 ± .010	.019 ± .003	.022 ± .007	.020 ± .007

1984 GROUP III - CONTROL LOCATIONS

WEEK #	13H4	22G1
51	.026 ± .004	.021 ± .004
52	.021 ± .003	.021 ± .004
MEAN	.023 ± .008	.021 ± .000

TABLE C-X CONCENTRATIONS OF GAMMA EMITTERS* IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984 RESULTS IN UNITS OF PCI/CU. M ± 2 SIGMA

1984 GROUP I - LIMERICK SITE BOUNDARY LOCATIONS

COLLECTION PERIOD	NUCLIDE	10S3	11S1	14S1	34S2	MEAN
DEC 84	BE-7	.11 ± .02	.10 ± .02	.10 ± .02	.10 ± .03	.10 ± .01
	K-40	< .01	.02 ± .01	< .01	.06 ± .02	.03 ± .05
	OTHERS	< MDL	< MDL	< MDL	< MDL	

1984 GROUP II - NEAR SITE LOCATIONS

COLLECTION PERIOD	NUCLIDE	2B1	6C1	9C1	13C1	15D1	17B1
DEC 84	BE-7	.12 ± .02	.10 ± .02	.15 ± .03	.12 ± .03	.10 ± .02	.12 ± .02
	K-40	< .009	< .01	< .03	< .02	.04 ± .02	< .01
	OTHERS	< MDL	< MDL	< MDL	< MDL	< MDL	< MDL

COLLECTION PERIOD	NUCLIDE	20D1	26B1	29B1	31D1	35B1	MEAN
DEC 84	BE-7	.14 ± .03	.08 ± .01	.12 ± .02	.10 ± .03	.10 ± .03	.11 ± .04
	K-40	< .03	.03 ± .02	< .01	< .04	.09 ± .03	.03 ± .05
	OTHERS	< MDL	< MDL	< MDL	< MDL	< MDL	

1984 GROUP III - CONTROL LOCATIONS

COLLECTION PERIOD	NUCLIDE	22G1	13H4	MEAN
DEC 84	BE-7	.10 ± .02	.10 ± .03	.10 ± 0
	K-40	< .009	< .02	< .015
	OTHERS	< MDL	< MDL	

* FOR TYPICAL MINIMUM DETECTABLE LEVELS OF NUCLIDES SEARCHED FOR AND NOT FOUND, SEE TABLE C-XV.

TABLE C-XI CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF PCI/CU. M

WEEK	GROUP I			GROUP II			GROUP III	
#	10S3	11S1	14S1	13C1	31D1	35B1	13H4	22G1
51	< .02	< .03	< .02	< .01	< .02	< .02	< .01	< .02
52	< .02	< .02	< .02	< .01	< .02	< .01	< .008	< .01
MEAN	< .02	< .03	< .02	< .01	< .02	< .02	< .009	< .02

TABLE C-XII MONTHLY AMBIENT GAMMA RADIATION LEVELS IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

RESULTS IN UNITS OF MRADS/STD. MONTH ± 95% C. LIMITS

STATION CODE	EQV.MO.AVG.	12/02-01/02
2B1	7.30 ± 0	7.30±0.38
2E1	8.31 ± 0	8.31±1.13
3S1	7.32 ± 0	7.32±1.19
4E1	5.90 ± 0	5.90±0.67
5H1	8.50 ± 0	8.50±0.52
5S1	7.48 ± 0	7.48±0.52
6C1	7.84 ± 0	7.84±0.89
7E1	8.03 ± 0	8.03±0.58
7S1	8.90 ± 0	8.90±1.37
9C1	8.10 ± 0	8.10±0.47
10E1	9.05 ± 0	9.05±0.60
10F3	7.16 ± 0	7.16±0.30
10S3	8.51 ± 0	8.51±0.87
11S1	9.00 ± 0	9.00±1.67
13C1	6.00 ± 0	6.00±0.72
13E1	7.73 ± 0	7.73±0.68
14S1	7.61 ± 0	7.61±0.56
15D1	7.77 ± 0	7.77±2.24
16F1	7.76 ± 0	7.76±0.61
16S2	6.41 ± 0	6.41±0.86
17B1	7.98 ± 0	7.98±0.64
18G1	7.34 ± 0	7.34±0.89
18S1	7.14 ± 0	7.14±0.78
19D1	7.47 ± 0	7.47±0.65
20D1	7.39 ± 0	7.39±0.47
20F1	7.61 ± 0	7.61±0.39
21S1	7.10 ± 0	7.10±0.44
22G1	7.23 ± 0	7.23±1.46
23S2	6.85 ± 0	6.85±0.90
24D1	6.70 ± 0	6.70±1.21
25D1	6.54 ± 0	6.54±0.44
25S1	7.14 ± 0	7.14±0.77
26B1	7.29 ± 0	7.29±1.03
26S3	6.84 ± 0	6.34±1.28
28D2	7.49 ± 0	7.49±0.56
29B1	7.74 ± 0	7.74±0.45
29E1	6.81 ± 0	6.81±0.98
29S1	6.96 ± 0	6.96±1.15
31D1	9.66 ± 0	9.66±1.43
31D2	8.36 ± 0	8.36±1.44
32G1	7.74 ± 0	7.74±1.71
32S1	5.26 ± 0	5.26±0.52
34E1	7.35 ± 0	7.35±1.28
34S2	9.24 ± 0	9.24±0.98
35B1	8.59 ± 0	8.59±0.64
35F1	8.19 ± 0	8.19±1.29
36S1	7.96 ± 0	7.96±1.19

STATION CODE	EQV.MO.AVG.	12/03-01/04
13H3	6.70 ± 0	6.70±1.25

TABLE C-XIII MEAN MONTHLY AMBIENT GAMMA RADIATION LEVELS IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

LOCATION	NO. OF SAMPLES ANALYZED	PERIOD MINIMUM	PERIOD MAXIMUM	PERIOD MEAN ± 2 STD. DEV.	UNITS
SITE	16	5.26 ± 0.52	9.24 ± 0.98	7.48 ± 2.08	MRAD/STD. MONTH
MIDDLE RING	27	5.90 ± 0.67	9.66 ± 1.43	7.63 ± 1.66	MRAD/STD. MONTH
OUTER RING	5	6.70 ± 1.25	8.50 ± 0.52	7.50 ± 1.34	MRAD/STD. MONTH

SITE BOUNDARY RING STATIONS- 3S1, 5S1, 7S1,10S3,11S1,14S1,16S2,18S1,21S1,23S2,25S1, - 26S3,29S1,32S1,34S2,36S1.

MIDDLE RING STATIONS - 2B1, 2E1, 4E1, 6C1, 7E1, 9C1,10E1,10F3,13C1,13E1,15D1, - 16F1,17B1,19D1,20D1,20F1,24D1,25D1,26B1,28D2,29B1,29E1, - 31D1,31D2,34E1,35B1,35F1.

OUTER RING STATIONS - 5H1,13H3,18G1,22G1,32G1.

TABLE C-XIV SUMMARY OF COLLECTION DATES FOR SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

AIR PARTICULATES

GROUP I - LIMERICK SITE BOUNDARY LOCATIONS

WEEK #	10S3	11S1	14S1	34S2
51	12/17-12/24/84	12/20-12/24/84	12/17-12/24/84	12/17-12/24/84
52	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84

GROUP II - NEAR SITE LOCATIONS

WEEK #	2B1	6C1	9C1	13C1	15D1	17B1
51	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84
52	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84

WEEK #	20D1	26B1	29B1	31D1	35B1
51	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84
52	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84

GROUP III - CONTROL LOCATIONS

WEEK #	13H4	22G1
51	12/17-12/24/84	12/17-12/24/84
52	12/24-01/02/85	12/24-12/31/84

AIR IODINE

	GROUP I			GROUP II			GROUP III	
WEEK #	10S3	11S1	14S1	13C1	31D1	35B1	13H4	22G1
51	12/17-12/24/84	12/20-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84	12/17-12/24/84
52	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-12/31/84	12/24-01/02/85	12/24-12/31/84

SURFACE WATER

COLLECTION PERIOD	10F2	15F5	16B2	24S1	24S2
DEC 84	12/26/84	11/28-12/26/84	11/28-12/26/84	11/28-12/26/84	11/28-12/26/84

DRINKING WATER

COLLECTION PERIOD	13H2	15F4	15F7	16C2	28F3
DEC 84	11/28-12/26/84	11/28-12/26/84	11/28-12/26/84	11/28-12/26/84	11/28-12/26/84

TABLE C-XV TYPICAL* MINIMUM DETECTABLE LEVELS OF NUCLIDES SEARCHED FOR BUT NOT FOUND IN SAMPLES COLLECTED IN THE VICINITY OF LIMERICK GENERATING STATION, DECEMBER, 1984

NUCLIDE	AIR PARTICULATES (PCI/CU. M)	SURFACE WATER (PCI/L)	DRINKING WATER (PCI/L)
BE-7	**	8	9
K-40	.07	34	33
CR-51	.02	9	9
MN-54	.002	.9	.8
CO-57	.001	.6	.7
CO-58	.002	.9	.9
FE-59	.004	2	3
CO-60	.001	.9	.9
ZN-65	.003	2	3
ZR-95	.003	2	2
NB-95	.002	1	1
RU-103	.002	1	1
RU-106	.01	7	8
AG-110M	.002	1	1
SB-125	.004	2	3
TE-129M	.002	.9	1
I-131	.008	3	3
CS-134	.001	1	1
CS-136	.006	3	3
CS-137	.001	.9	1
BA-140	.01	4	4
LA-140	.005	1	1
CE-141	.003	1	1
CE-144	.008	4	5
RA-226	.02	12	10
TH-228	.003	1	1

* TYPICAL REFERS TO MEAN PLUS TWO STANDARD DEVIATIONS ROUNDED TO THE FIRST SIGNIFICANT FIGURE.

** A POSITIVE CONCENTRATION WAS MEASURED IN ALL SAMPLES ANALYZED.

FIGURE C-1
COMPARISON OF MEAN MONTHLY GROSS BETA(SOLUBLE) CONCENTRATIONS
IN SURFACE WATER SAMPLES COLLECTED IN THE VICINTY OF LGS

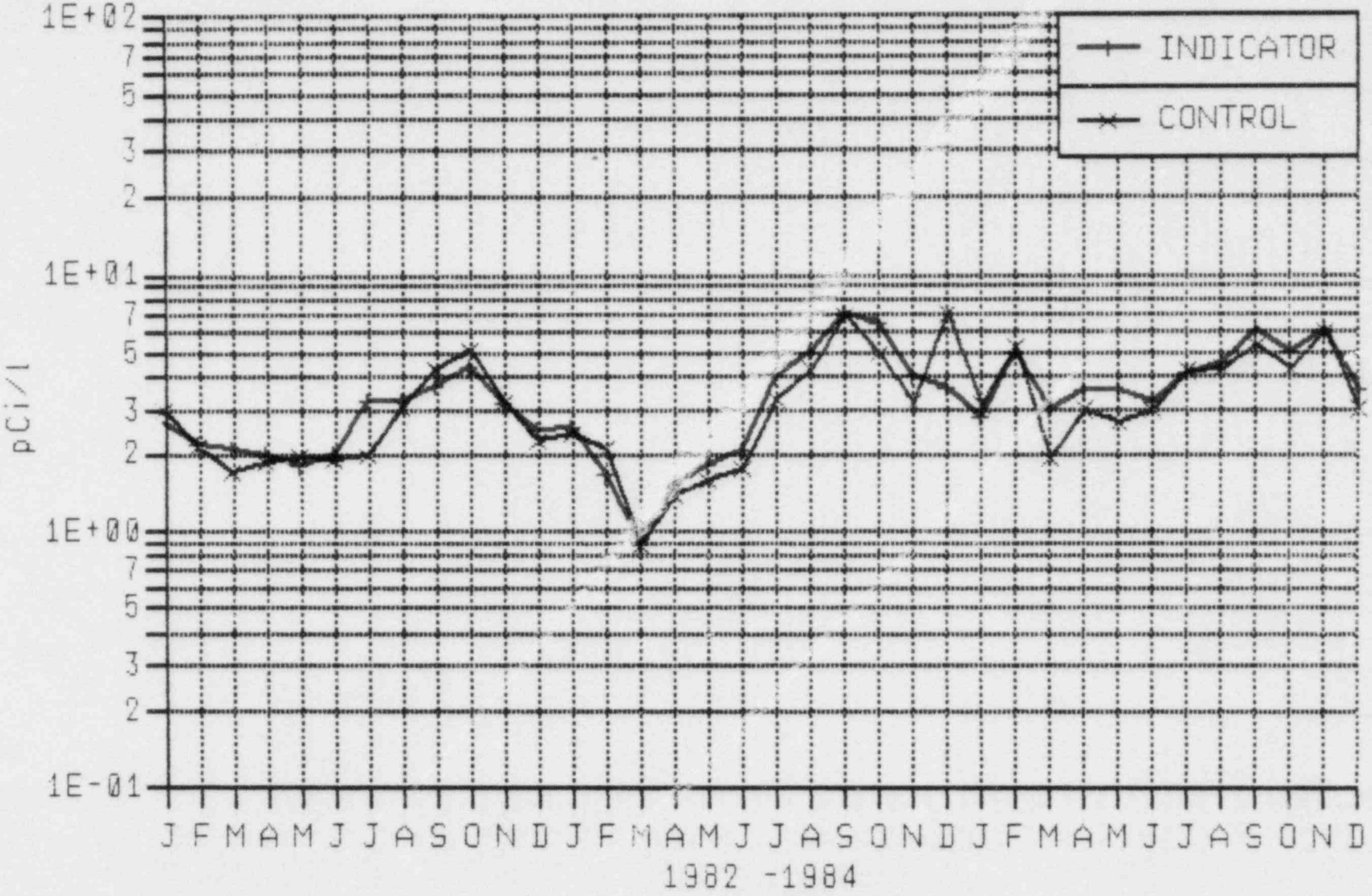


FIGURE C-2
COMPARISON OF MEAN MONTHLY GROSS BETA(INSOLUBLE) CONCENTRATIONS
IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF LGS

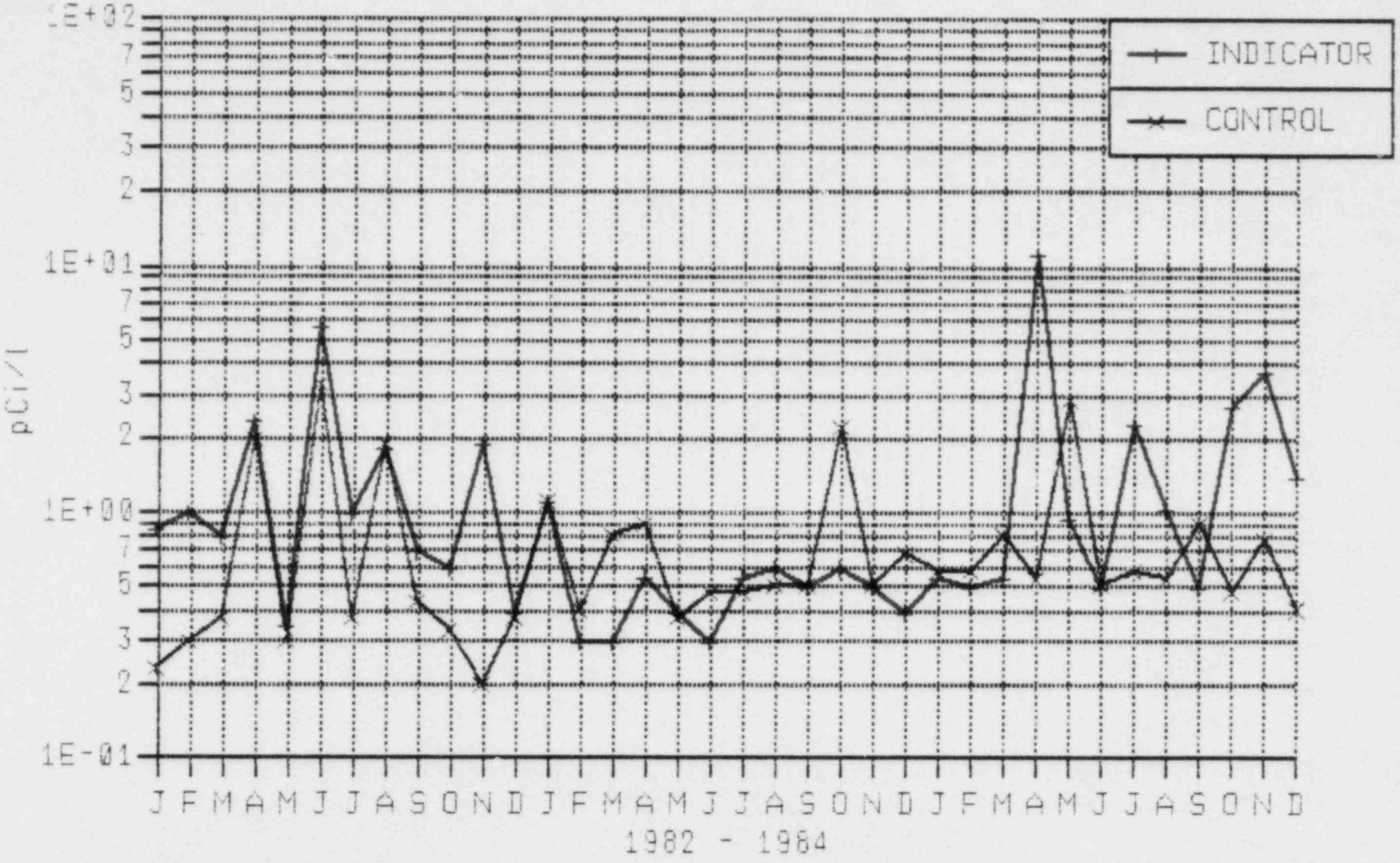


FIGURE C-3
COMPARISON OF MEAN MONTHLY GROSS BETA(SOLUBLE) CONCENTRATIONS
IN DRINKING WATER SAMPLES COLLECTED IN THE VICINTY OF LGS

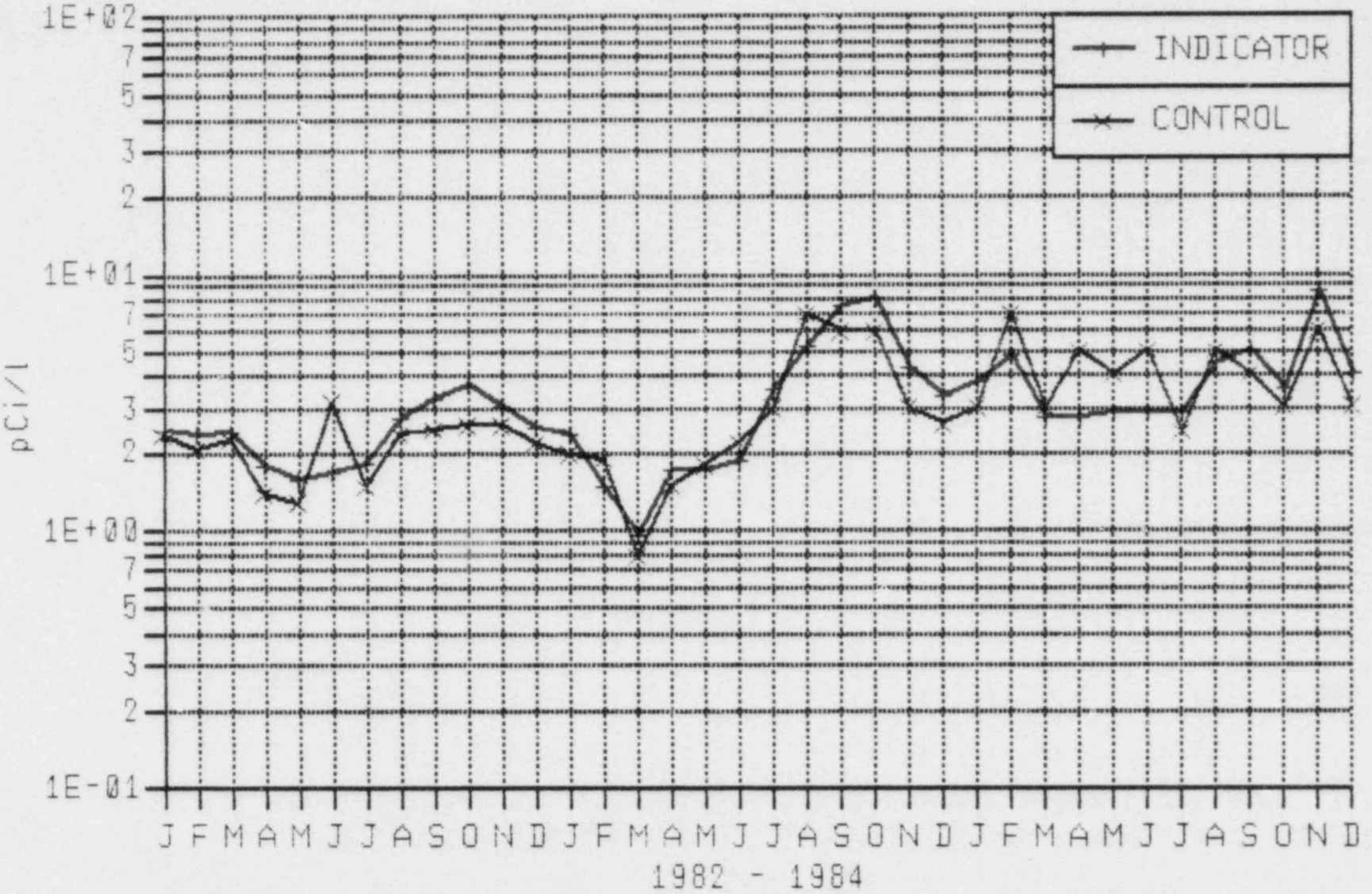


FIGURE C-4
COMPARISON OF MEAN MONTHLY GROSS BETA(INSOLUBLE)CONCENTRATIONS
IN DRINKING WATER SAMPLES COLLECTED IN THE VICINITY OF LGS

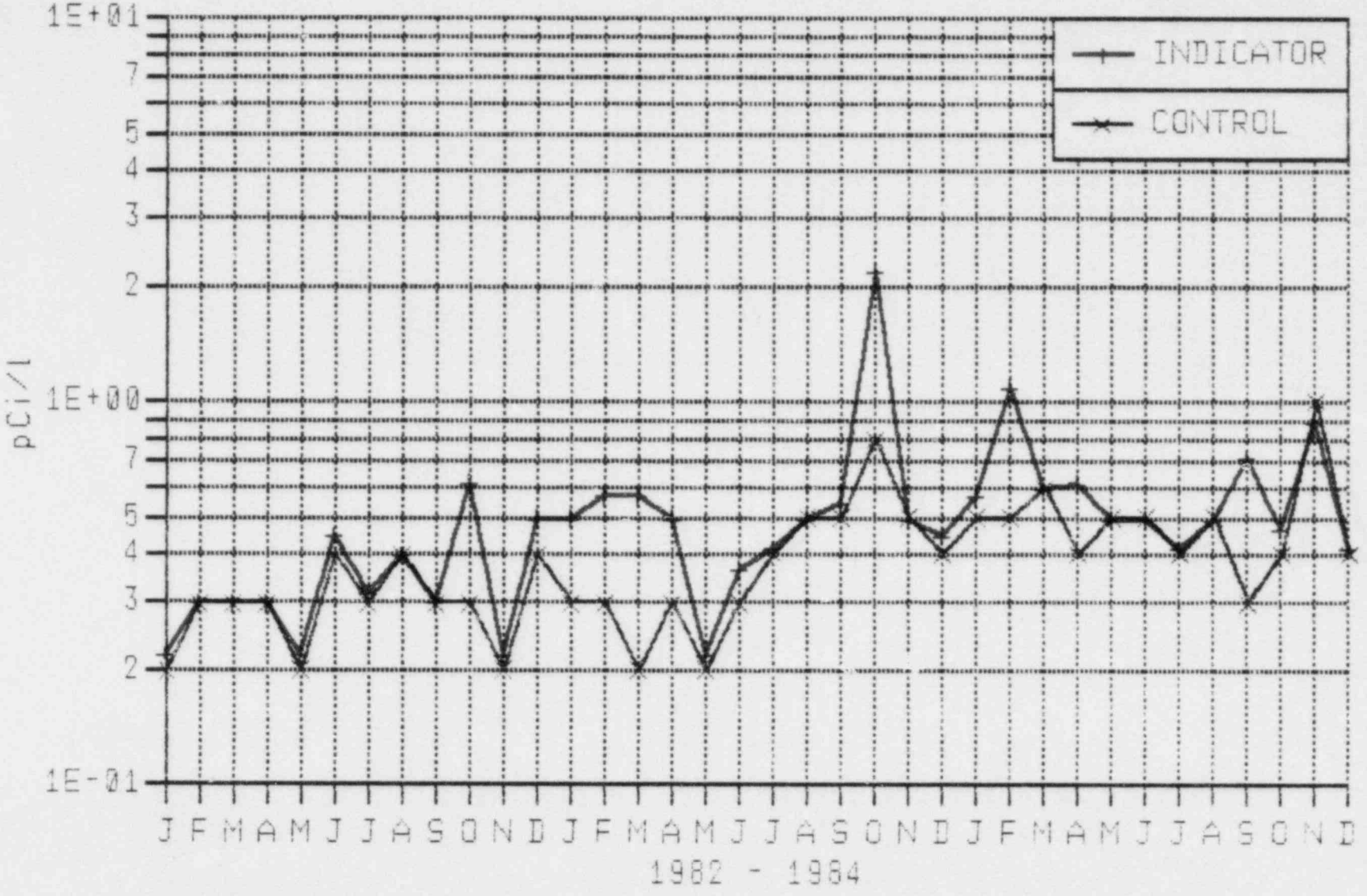


FIGURE C-5
COMPARISON OF MEAN MONTHLY GROSS BETA CONCENTRATIONS
IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF LGS

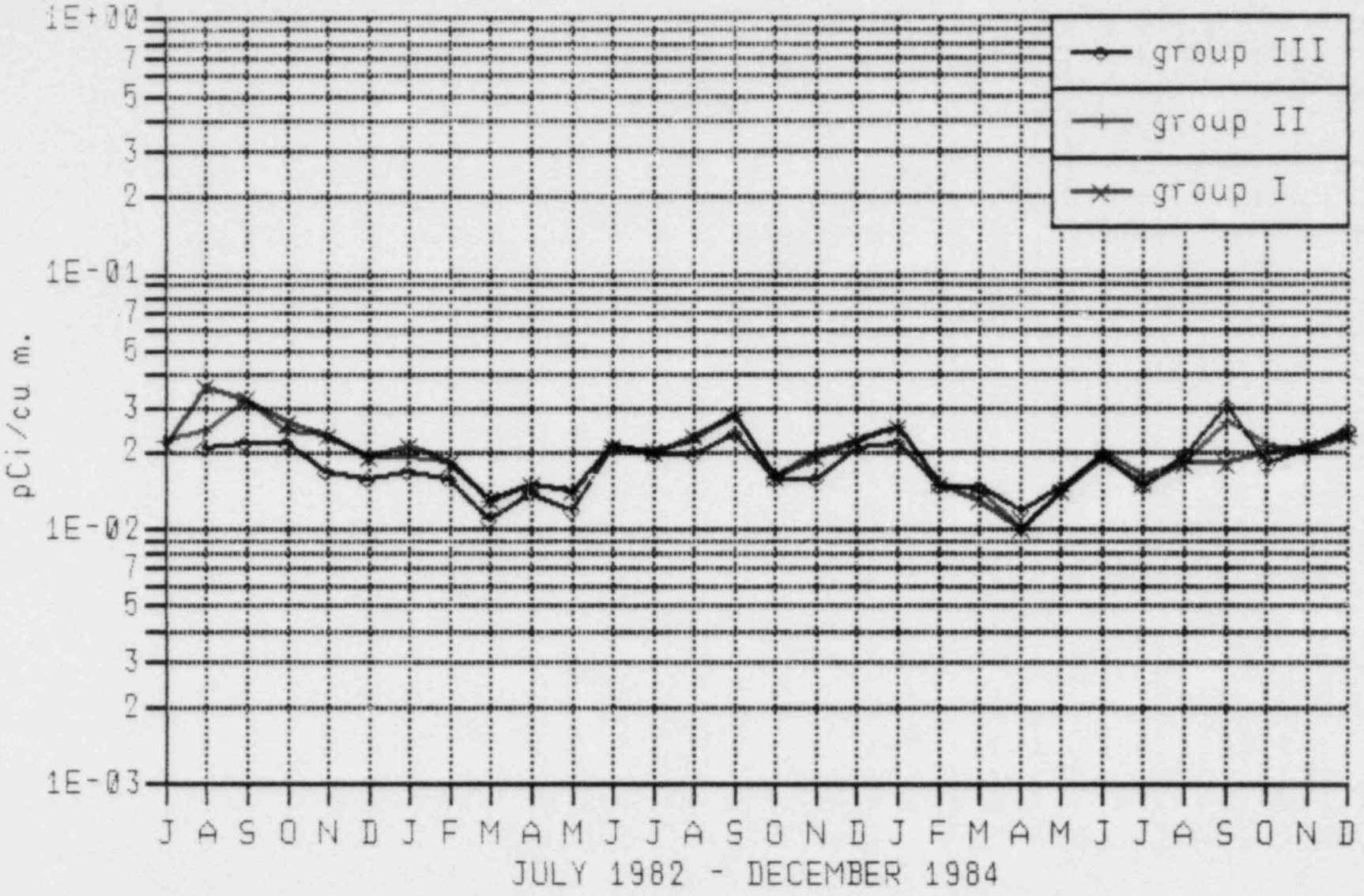
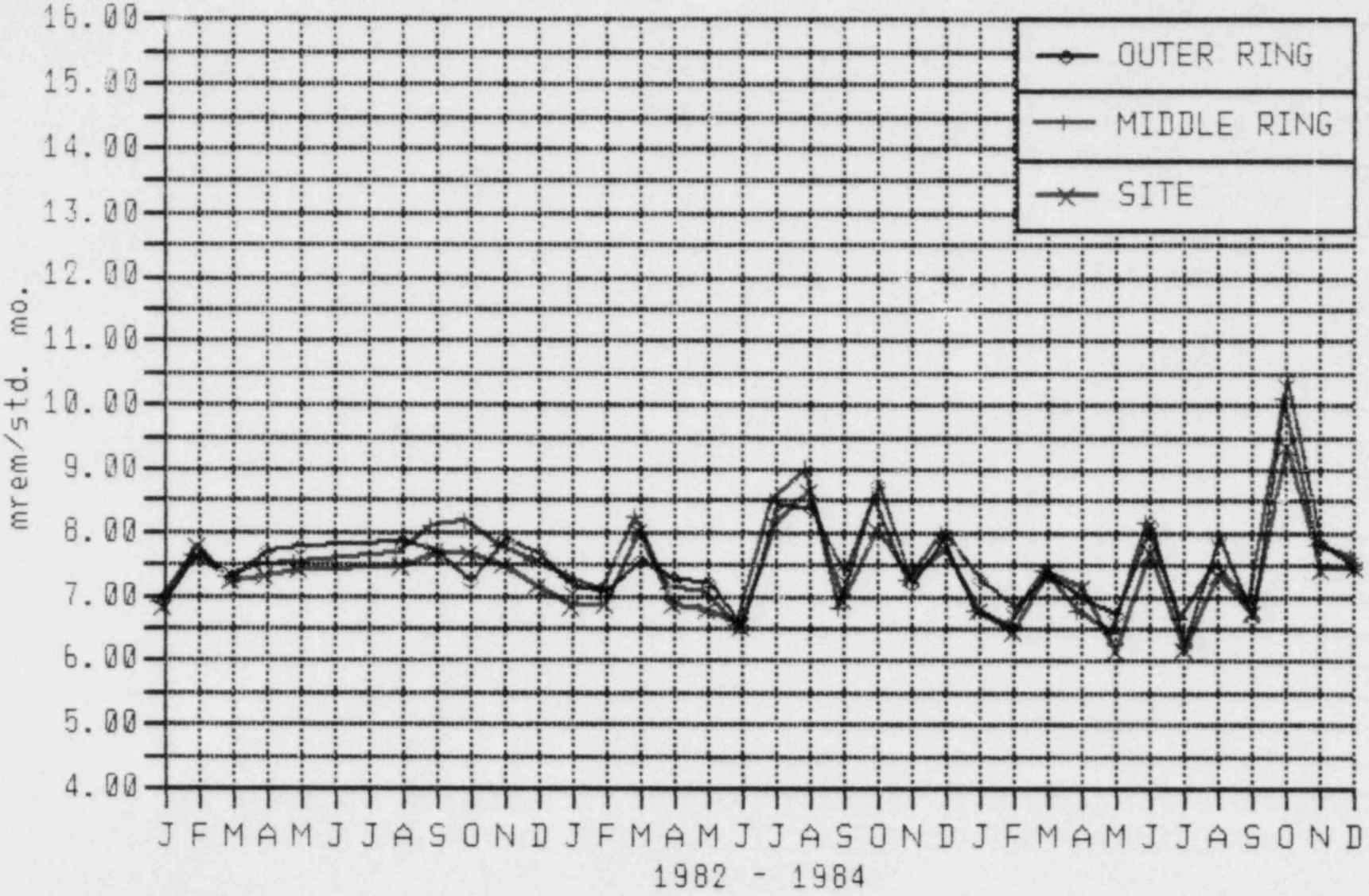


FIGURE C-6
COMPARISON OF MEAN MONTHLY AMBIENT GAMMA
RADIATION LEVELS IN THE VICINTY OF LGS



SYNOPSIS OF ANALYTICAL PROCEDURES

APPENDIX D: SYNOPSIS OF ANALYTICAL PROCEDURES

The following section contains a description of the analytical laboratory procedures along with an explanation of the analytical calculation methods used by Teledyne Isotopes for sample analysis.

Sample Preparation and Counting Procedures

Several types of liquid samples are separated by filtration prior to analysis. Resulting portions are identified as soluble and insoluble. Therefore, soluble as used in this report, is defined as that portion of a sample that passes through a No. 50 Whatman filter paper. Insoluble is defined as that portion of a sample that is collected on No. 50 Whatman filter paper.

DETERMINATION OF GROSS ALPHA AND/OR BETA ACTIVITY IN WATER SAMPLES

(SUSPENDED AND DISSOLVED FRACTIONS)

TELEDYNE ISOTOPES

This describes the process used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved. One liter of the sample is filtered under vacuum through a 0.45 μm Millipore filter. The filter is dried and mounted on a 2 inch stainless steel planchet to represent the suspended fraction of the sample. The filtrate is evaporated on a hotplate, and the residue is transferred and dried on another planchet to represent the dissolved fraction of the sample.

The planchets are counted for 50 minutes in a low-background gas flow proportional counter. Calculation of activity includes a self-adsorption correction for counter efficiency based on the weight of residue on each planchet.

CALCULATION OF THE SAMPLE ACTIVITY OR OF THE MDL

$$\frac{\text{Net pCi on collection date}}{\text{unit volume or wt.}} = \frac{\frac{N}{\Delta t} - \beta}{2.22\,(v)\,(y)\,(DF)\,(\varepsilon)} \pm \frac{\sigma m \sqrt{\frac{\frac{N}{\Delta t} + \beta}{\Delta t}}}{2.22\,(v)\,(y)\,(DF)\,(\varepsilon)}$$

net activity — counting error

where:
- N = total counts from sample (counts)
- Δt = counting time for sample (min)
- β = background rate of counter (cpm)
- 2.22 = $\frac{\text{dpm}}{\text{pCi}}$
- $v(w)$ = volume or weight of sample analyzed
- y = chemical yield of the mount or sample counted
- DF = decay factor from the collection to the counting date
- ε = efficiency of the counter
- σm = multiples of counting error

For gross alpha and gross beta calculations set y = 1 and DF = 1.

If the net activity $\left(\frac{N}{\Delta t} - \beta\right)$ is equal to or is less than the counting error, the activity on the collection date is below the limits of detection and is called "less than" (L.T.) or "minimum detectable level" (MDL).

ENVIRONMENTAL DOSIMETRY

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

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

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

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

Calculation of results and two sigma error:

Gross TLD (i) = [TLD (i)-DO(i)] x CF(i) x CF(ins) x 0.955 mrad/mRoentgen

ITD - Net (site 0) - [NET(RMC 0) (D(sta) / D(RMC 0))]

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

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

$$\text{ERROR (95\% CL)} = t(n-1) \left[\text{sigma NET TLD (i)} / \sqrt{n}\right] [D(STD) / D(EX)]$$

where: Gross TLD(1) = 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 = (6.158) $(ELS^{-1.0129})$

ELS = External light source

DO(i) = Zero for dosimeter i

CF(i) = Calibration factor for dosimeter i

ITD = in-Transit dose

NET(site)0 = Mean of n dosimeters in site lead shield

NET(RMC)0 = Mean of n dosimeters in RMC lead shield

D(sta) = Exposure period of station (SZRO)

D(RMC)0 = Exposure period of RMC 0

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(1) = Standard deviation of n readings of NET TLD (i)

ERROR = The 95% confidence limit error of AVG

DETERMINATION OF GAMMA EMITTING RADIOISOTOPES

TELEDYNE ISOTOPES

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

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

The analysis of each sample consists of calculating the specific activities of all detected radionuclides or the detection limits from a standard list of nuclides. The Ge(Li) systems are calibrated for each standard geometry using certified radionuclide standards traceable to the National Bureau of Standards.

DETERMINATION OF I-131 IN MILK AND WATER SAMPLES BY RADIOCHEMISTRY AND LIQUID PHASE BY ANALYSIS

TELEDYNE ISOTOPES

This describes the radiochemical methods for determining I-131 activity in milk and water samples by coincidence counting in the liquid phase.

Four liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodide from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, reduced with hydroxylamine hydrochloride, and extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution.

The iodide sample solution is oxidized to the free state using $NaNO_2$ reagent and is extracted several times into a total of 15 ml of toluene. A 200 μl aliquot is taken for determining chemical yield by spectrophotometer. A decolorizing agent (2-methyl-2-butene) is added to the toluene-iodine solution to form an inert molecule and to minimize liquid scintillation quenching. A toluene-based liquid scintillation counting solution is added to the sample, which is then analyzed by a beta-gated gamma-coincidence counting system.

CALCULATION OF THE SAMPLE ACTIVITY OR OF THE MDL

The Sample Activity and the 2-sigma Counting Error are Calculated as Follows:

$$\frac{\text{Net pCi on collection date}}{\text{liter}} = \frac{\frac{N}{\Delta t} - \beta}{2.22(v)(y)(DF)(\varepsilon)} \pm \frac{2\sqrt{\frac{\frac{N}{\Delta t} + \beta}{\Delta t}}}{2.22\,(v)(y)(DF)(\varepsilon)}$$

net activity **counting error**

where: N = total counts from sample (counts)
Δt = counting time for sample (min)
β = background rate of counter (cpm)
2.22 = $\frac{\text{dpm}}{\text{pCi}}$
v = volume of sample analyzed (liters)
y = chemical yield of the mount or sample counted
DF = decay factor from the collection to the mid count time
ε = efficiency of the counter for I-131

Note: Efficiency is determined by counting an I-131 standard. Consequently, the branching intensity (abundance) of the I-131 gamma does not appear in the above equation.

Calculation of the MDL

If the net activity (previously derived) is equal to or is less than a specified multiple of the background counting error, the activity on the collection date is below the limits of detection and is called "less than" (L.T.) or "minimum detectable level" (MDL).

The L.T. value can be specified by stating only the counting error at a predetermined multiple (σm) of the one sigma statistics. A sigma multiple (σm) of 4.66 is used for calculation of the L.T. values unless another multiple such as 2.83 is specified.

$$\text{thus L.T.} = \frac{\sigma m\sqrt{\frac{\beta}{\Delta t}}}{(2.22(v)(y)(DF)(\varepsilon)}$$

DETERMINATION OF TRITIUM BY GAS COUNTING

TELEDYNE ISOTOPES

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

Calculation of the sample activity or the MDL:

$$\frac{\text{Net pCi}}{\text{unit vol.}} = \frac{3.234 \times (TU)_N \times V_N}{CPM_N \times V_S} \left[(CPM)_G - BKG \pm \sigma m \sqrt{\sigma G^2 + \sigma B^2} \right]$$

where:
- $(TU)_N$ = the tritium units of the standard
- V_N = volume of the standard used to calibrate the efficiency of the detector (psia)
- V_S = volume of the sample loaded into the detector (psia)
- $(CPM)_N$ = the cpm activity of the standard of volume V
- $(CPM)_G$ = the gross activity of the sample of volume V and the detector background
- BKG = the background of the detector in cpm
- 3.234 = conversion factor changing TU to pC/l
- Δt = counting time for the sample
- σm = multiple of the counting error
- σG = standard deviation of the gross activity of the sample and the detector background, in cpm
- σB = standard deviation of the background, in cpm

If the net activity $(CPM)_G$ - BKG is equal to or is less than twice the counting error, the activity on the collection date is below the limits of detection and is called "less than" (L.T.) or "minimum detectable level" (MDL).

$$\text{thus L.T.} = \frac{2 \times 3.234 \times (TU)_N \times V_N \times \sqrt{\sigma_G^{\,2} + \sigma_B^{\,2}}}{(CPM)_N \times V_S}$$

where:
- σ_G = standard deviation of the gross activity of the sample and the detector background, in cpm
- σ_B = standard deviation of the background, in cpm

QUALITY CONTROL

APPENDIX E: INTER-LABORATORY COMPARISON PROGRAM

TI participates in the EPA radiological interlaboratory comparison (cross check) program. This participation includes a number of analyses on various sample media as found in the Limerick Generating Station REMP. As a result of this participation, an objective measurement of analytical precision and accuracy as well as, a bias estimation of the results are obtained. During the time period of this report, the one comparison sample analyzed fell within the EPA mean and standard deviations. Table E-I summarizes the results of all 1984 samples.

TABLE E-I

INTER-LABORATORY COMPARISONS, 1984

TELEDYNE ISOTOPES

Collection Date	Media	Nuclide	EPA-Results(A)	Teledyne Isotopes Results(B)	All Participants Mean ± 2 s.d.
01/06	Water	Sr-89	36. ± 8.7	29.3 ± 8.7	36. ± 9.
		Sr-90	24. ± 2.6	23. ± 3.	23. ± 3.
01/20	Water	Gross Alpha	10. ± 8.7	8. ± 3.	10. ± 3.
		Gross Beta	12. ± 8.7	12. ± 3.	13. ± 3.
01/27	Food	Sr-89	34. ± 8.7	33.3 ± 1.7	31. ± 5.
		Sr-90	20. ± 8.7	21.7 ± 1.7	21. ± 3.
		I-131	20. ± 10.4	16.3 ± 1.7	20. ± 4.
		Cs-137	20. ± 8.7	24.1 ± 0.6	21. ± 3.
		K	2720. ±235.	2503. ±555.	2665. ±246.
02/03	Water	Cr-51	40. ± 8.7	L.T. 80.	40. ± 8.
		Co-60	10. ± 8.7	15. ± 7.9	11. ± 2
		Zn-65	50. ± 8.7	53.3 ± 16.5	50. ± 8.
		Ru-106	61. ± 8.7	58.7 ± 33.	55. ± 9.
		Cs-134	31. ± 8.7	33.3 ± 3.	29. ± 3.
		Cs-137	16. ± 8.7	19.3 ± 1.7	16. ± 3.
02/10	Water	H-3	2383. ±607.	2270. ±786.	2366. ±247.
03/02	Milk	I-131	6. ± 1.6	5.7 ± 1.7	6. ± 1.
03/16	Water	Gross Alpha	5. ± 8.7	5. ± 1.3	6. ± 2.
		Gross Beta	20. ± 8.7	20. ± 3.	20. ± 3.
03/23	Air Filter	Gross Alpha	15. ± 8.7	19. ± 1.7	16. ± 3.
		Gross Beta	51. ± 8.7	45. ± 3.0	56. ± 6.
		Sr-90	21. ± 2.6	20. ± 6.0	19. ± 2.
		Cs-137	10. ± 8.7	11. ± 3.5	12. ± 3.
04/06	Water	I-131	6. ± 1.5	5.5 ± 0.4	6. ± 2.
04/13	Water	H-3	3508. ±728.	2660. ±342.	3461. ±288.

TABLE E-I (Cont.)

INTER-LABORATORY COMPARISONS, 1984

TELEDYNE ISOTOPES

Collection Date	Media	Nuclide	EPA-Results(A)	Teledyne Isotopes Results(B)	All Participants Mean ± 2 s.d.
04/20	Water (Sample A)	Gross Alpha	35. ± 15.2	22. ± 4.6	(D)
		Ra-226	4.0 ± 1.04	5.4 ± 3.3	(D)
		Ra-228	8.3 ± 2.16	2.9 ± 0.6	(D)
04/20	Water (Sample B)	Gross Beta	147. ± 12.7	117. ± 17.3	(D)
		Sr-89	23. ± 8.7	18. ± 7.5	(D)
		Sr-90	26. ± 2.6	22. ± 3.5	(D)
		Co-60	30. ± 8.7	29. ± 6.2	(D)
		Cs-134	30. ± 8.7	29. ± 4.6	(D)
		Cs-137	26. ± 8.7	29. ± 6.0	(D)
05/04	Water	Sr-89	25. ± 8.7	23. ± 5.	24. ± 4.
		Sr-90	5. ± 2.6	5.0 ± 0.5	5. ± 1.
05/18	Water	Gross Alpha	3. ± 8.7	2.7 ± 0.8	3. ± 1.
		Gross Beta	6. ± 8.7	6.9 ± 4.0	7. ± 2.
06/01	Water	Cr-51	66. ± 8.7	L.T. 90.	64. ± 13.
		Co-60	31. ± 8.7	33. ± 3.5	31. ± 4.
		Zn-65	63. ± 8.7	68. ± 15.	63. ± 9.
		Ru-106	29. ± 8.7	L.T. 50.	30. ± 11.
		Cs-134	47. ± 8.7	46. ± 5.	44. ± 6.
		Cs-137	37. ± 8.7	39. ± 1.7	37. ± 4.
06/08	Water	H-3	3051. ±622.	3210. ±834.	3039. ±235.
06/22	Milk	Sr-89	25. ± 8.7	22. ± 1.7	21. ± 5.
		Sr-90	17. ± 2.6	17. ± 4.6	15. ± 2.
		I-131	43. ± 10.4	40. ± 9.6	43. ± 4.
		Cs-137	35. ± 8.7	37. ± 3.	36. ± 3.
		K	1496. ±130.	1653. ± 46.	1560. ± 97.
07/20	Water	Gross Alpha	6. ± 8.7	3.8 ± 2.4	(D)
		Gross Beta	13. ± 8.7	11.3 ± 3.5	(D)

TABLE E-I (Cont.)

INTER-LABORATORY COMPARISONS, 1984

TELEDYNE ISOTOPES

Collection Date	Media	Nuclide	EPA-Results(A)	Teledyne Isotopes Results(B)	All Participants Mean ± 2 s.d.
07/27	Food (C)	Sr-89	25.0 ± 8.7	17. ± 9.	(D)
		Sr-90	20.0 ± 2.6	20. ± 9.	(D)
		I-131	39.0 ± 10.4	19. ± 3.5	(D)
		Cs-137	25.0 ± 8.7	26. ± 11.	(D)
		K	2605.0 ±226.0	3027. ±1183.	(D)
08/03	Water	I-131	34.0 ± 10.4	31. ± 3.0	36. ± 5.
08/10	Water	H-3	2817. ±617.	2930. ± 127.	2842. ±251.
08/24	Air Filter	Gross Alpha	17. ± 8.7	16. ± 1.7	17. ± 3.
		Gross Beta	51. ± 8.7	47. ± 3.	52. ± 6.
		Sr-90	18. ± 2.4	18. ± 1.7	17. ± 2.
		Cs-137	15. ± 8.7	17. ± 4.6	17. ± 4.
09/07	Water	Sr-89	34. ± 8.7	29. ± 4.5	30. ± 8.
		Sr-90	19. ± 2.6	19. ± 1.0	18. ± 3.
09/21	Water	Gross Alpha	5.0 ± 8.7	6. ± 0.0	5. ± 2.
		Gross Beta	16.0 ± 8.7	14. ± 3.	15. ± 3.
10/05	Water	Cr-51	40. ± 8.7	L.T. 107.	38. ± 8.
		Co-60	20. ± 8.7	23. ± 10.4	20. ± 3.
		Zn-65	147. ± 8.7	155. ± 17.6	149. ± 12.
		Ru-106	47. ± 8.7	L.T. 53.	45. ± 9.
		Cs-134	31. ± 8.7	34. ± 12.	29. ± 3.
		Cs-137	24. ± 8.7	28. ± 10.	25. ± 3.
10/12	Water	H-3	2810. ±356.	2720. ± 531.	2814. ±213.
10/22	Water (Sample A)	Gross Alpha	14. ± 8.7	11. ± 1.7	13. ± 4.
	Water (Sample B)	Gross Beta	64. ± 8.7	65. ± 10.	60. ± 7.
		Sr-89	11. ± 8.7	9. ± 3.5	11. ± 4.
		Sr-90	12. ± 2.6	13. ± 3.	13. ± 3.
		Co-60	14. ± 8.7	19. ± 3.5	16. ± 2.
		Cs-134	2 ± 8.7	L.T. 5.	3. ± 2.
		Cs-137	1 ± 8.7	17. ± 7.5	16. ± 2.

TABLE E-I (Cont.)

INTER-LABORATORY COMPARISONS, 1984

TELEDYNE ISOTOPES

Collection Date	Media	Nuclide	EPA-Results(A)	Teledyne Isotopes Results(B)	All Participants Mean ± 2 s.d.
10/26	Milk	Sr-89	22. ± 8.7	15. ± 1.7	19. ± 4.
		Sr-90	16. ± 2.6	14. ± 3.	15. ± 2.
		I-131	42. ± 10.4	34. ± 9.6	40. ± 5.
		Cs-137	32. ± 8.7	32. ± 12.	32. ± 3.
		K	1517. ±131.	1370. ± 52.7	1498. ±143.
11/16	Water	Gross Alpha	7.0 ± 8.7	7.3 ± 1.7	7. ± 2.
		Gross Beta	20.0 ± 8.7	21.7 ± 1.7	21. ± 3.
11/23	Air Filter	Gross Alpha	15. ± 8.7	15. ± 1.7	(D)
		Gross Beta	52. ± 8.7	54. ± 3.5	(D)
		Sr-90	21. ± 2.6	23. ± 3.	(D)
		Cs-137	10. ± 8.7	9. ± 4.6	(D)
12/07	Water	I-131	36. ± 10.4	36. ± 6.9	36. ± 5.
12/14	Water	H-3	3182. ±624.	3523. ±868.	3206. ±236.

Notes

(A) EPA Results-Expected laboratory precision (3 sigma). Units are pCi/ℓ for water, urine, and milk except K is in mg/l. Units are total pCi for air particulate filters.

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

(C) Units for food analysis are pCi/kg.

(D) Results were not released at time of report.

LGS SURVEY

APPENDIX F: LGS SURVEYS

The environmental program includes a requirement for three surveys to be performed during the growing season. These include a nearest farm, a nearest residence, and a nearest garden survey. The information obtained from the surveys is to be included in the annual report. However, since the time period of this report does not include the growing season, survey information is not presented here.