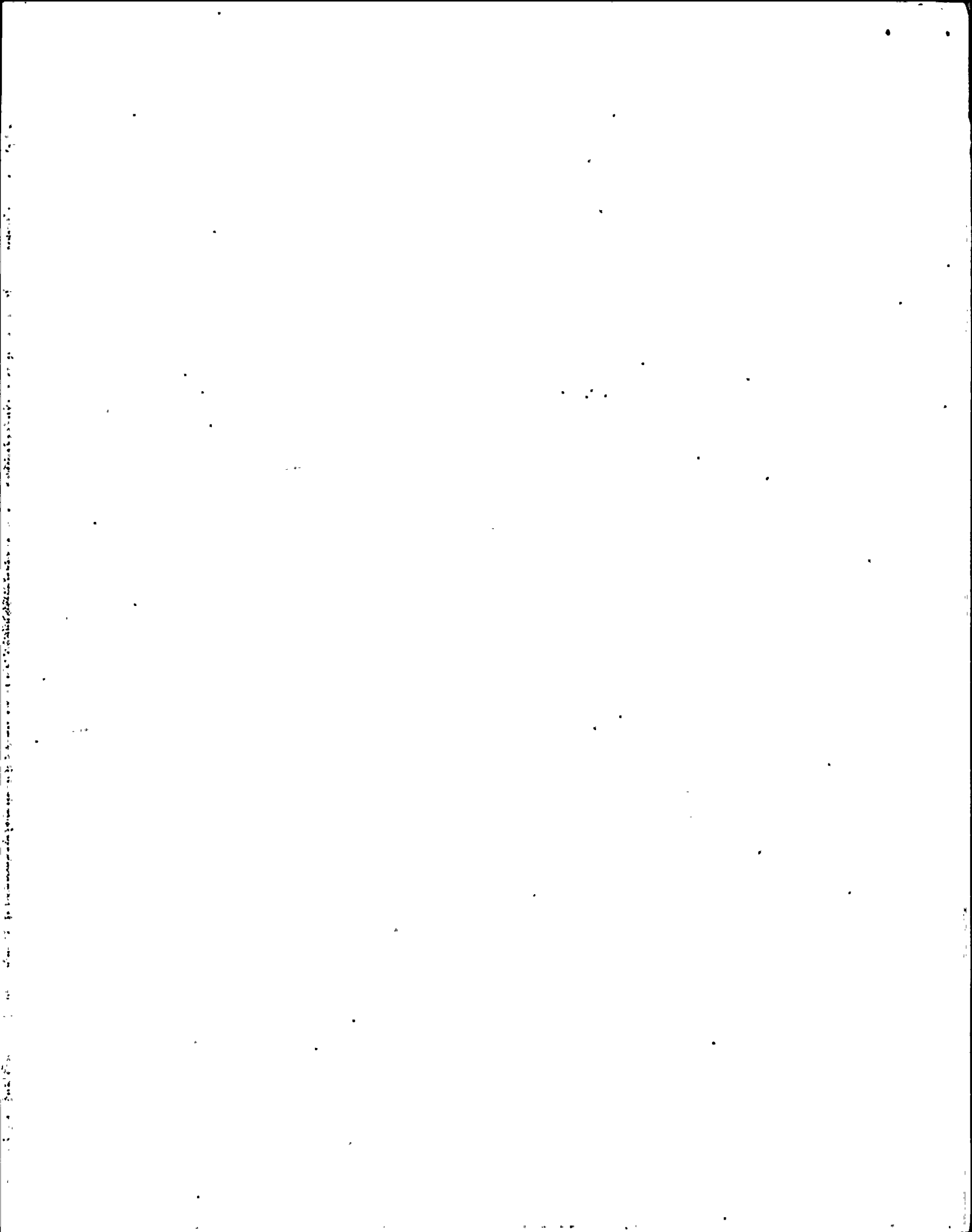


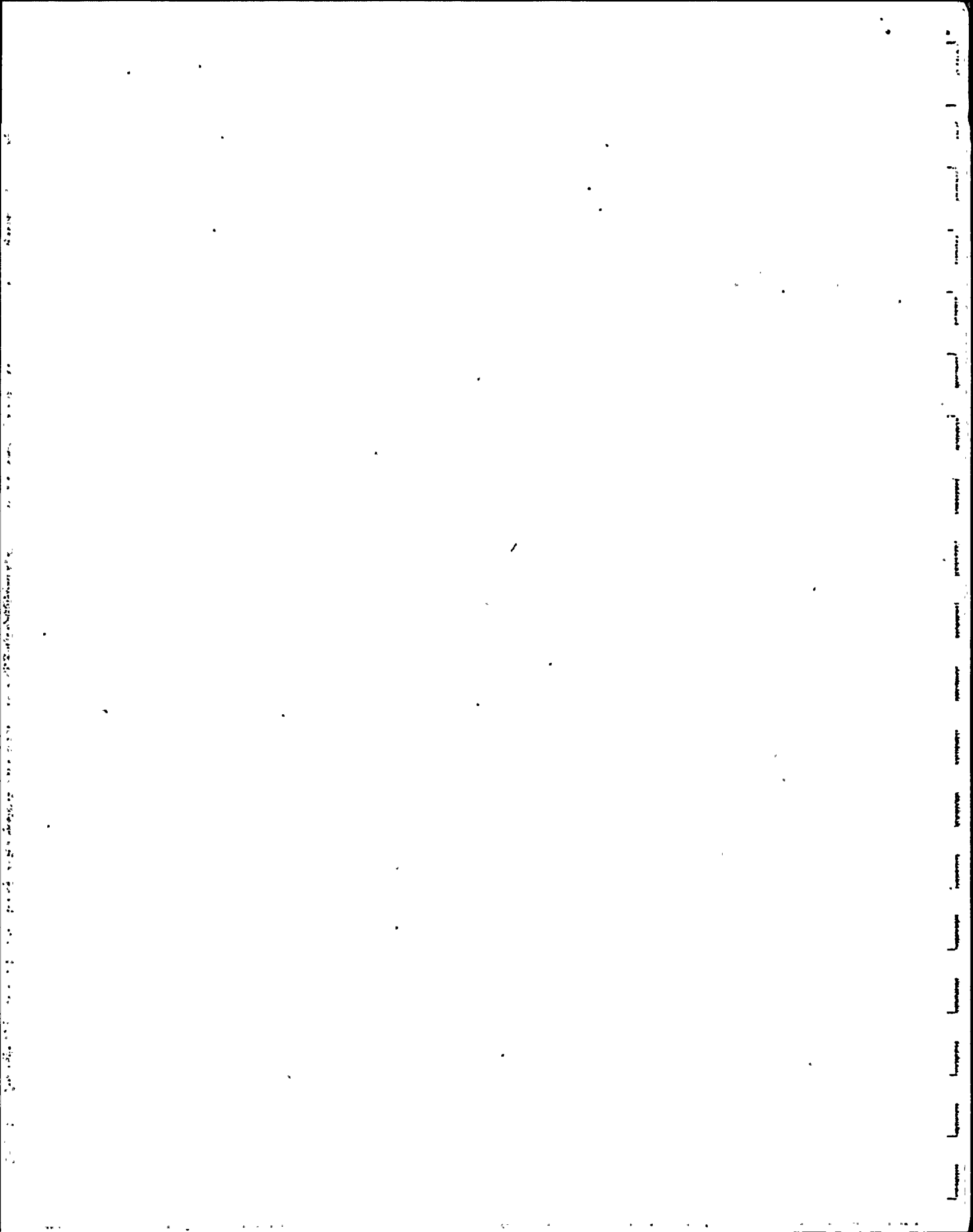
ARIZONA NUCLEAR POWER PROJECT
PALO VERDE NUCLEAR GENERATING STATION
OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
REPORT FOR 1985

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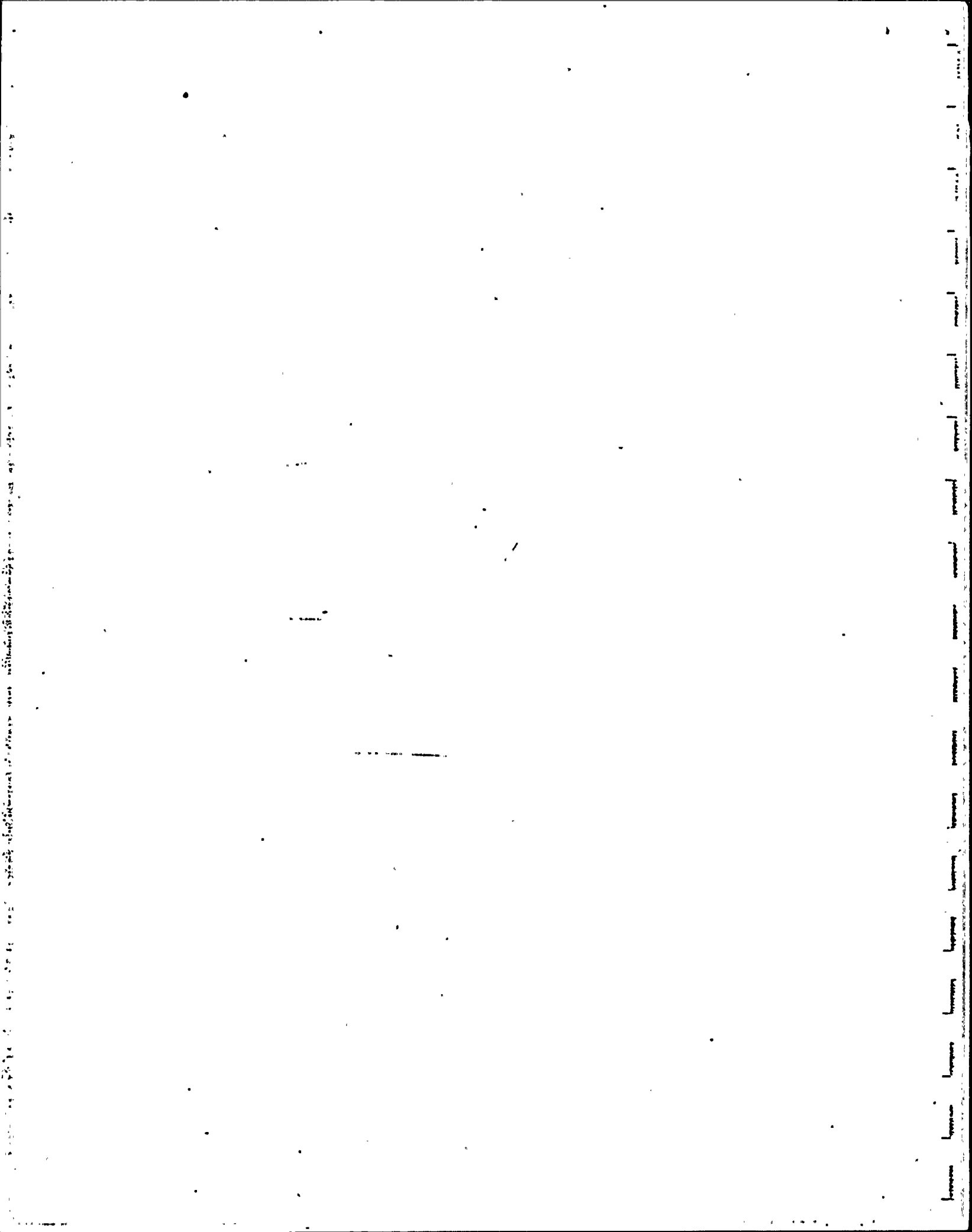
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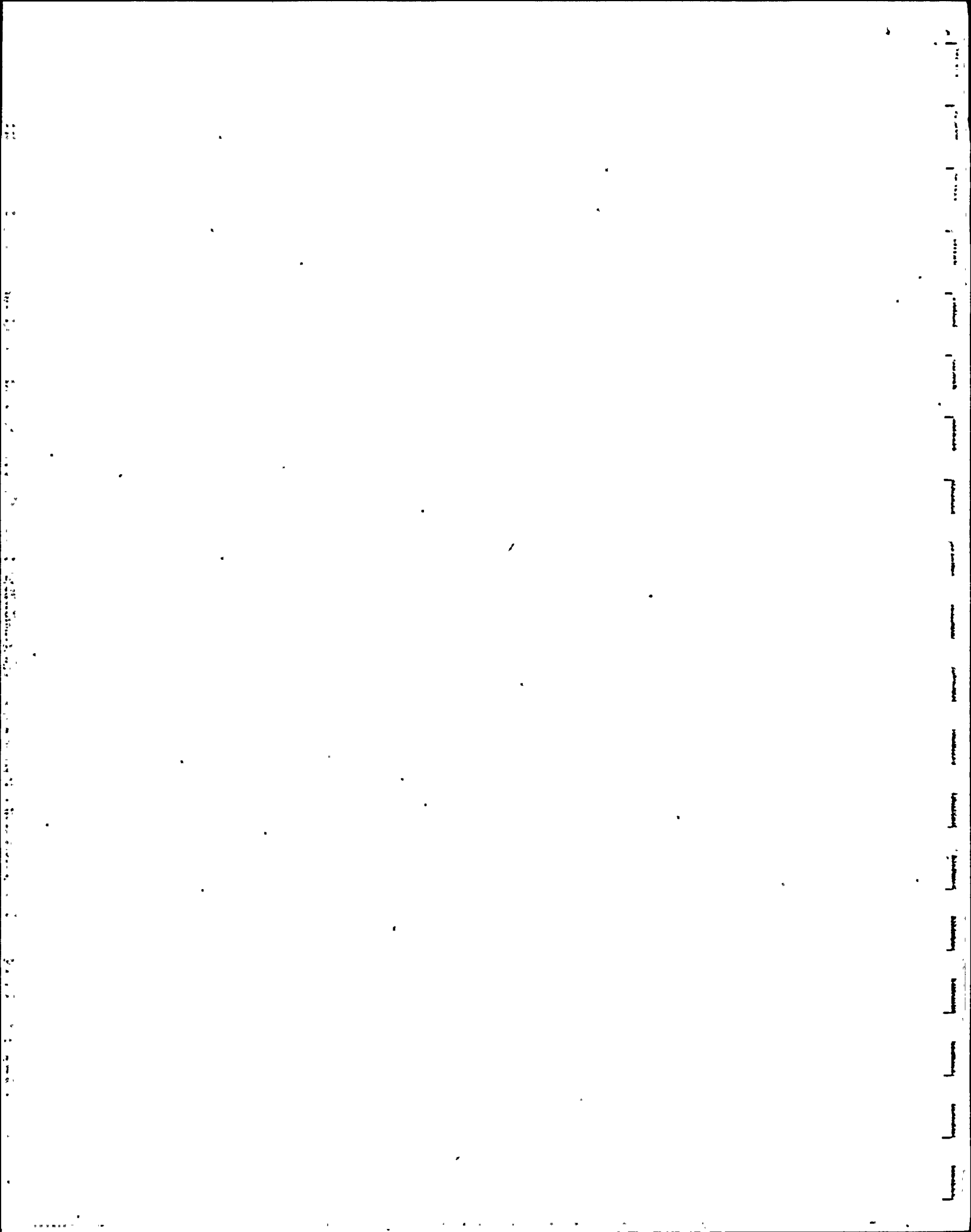
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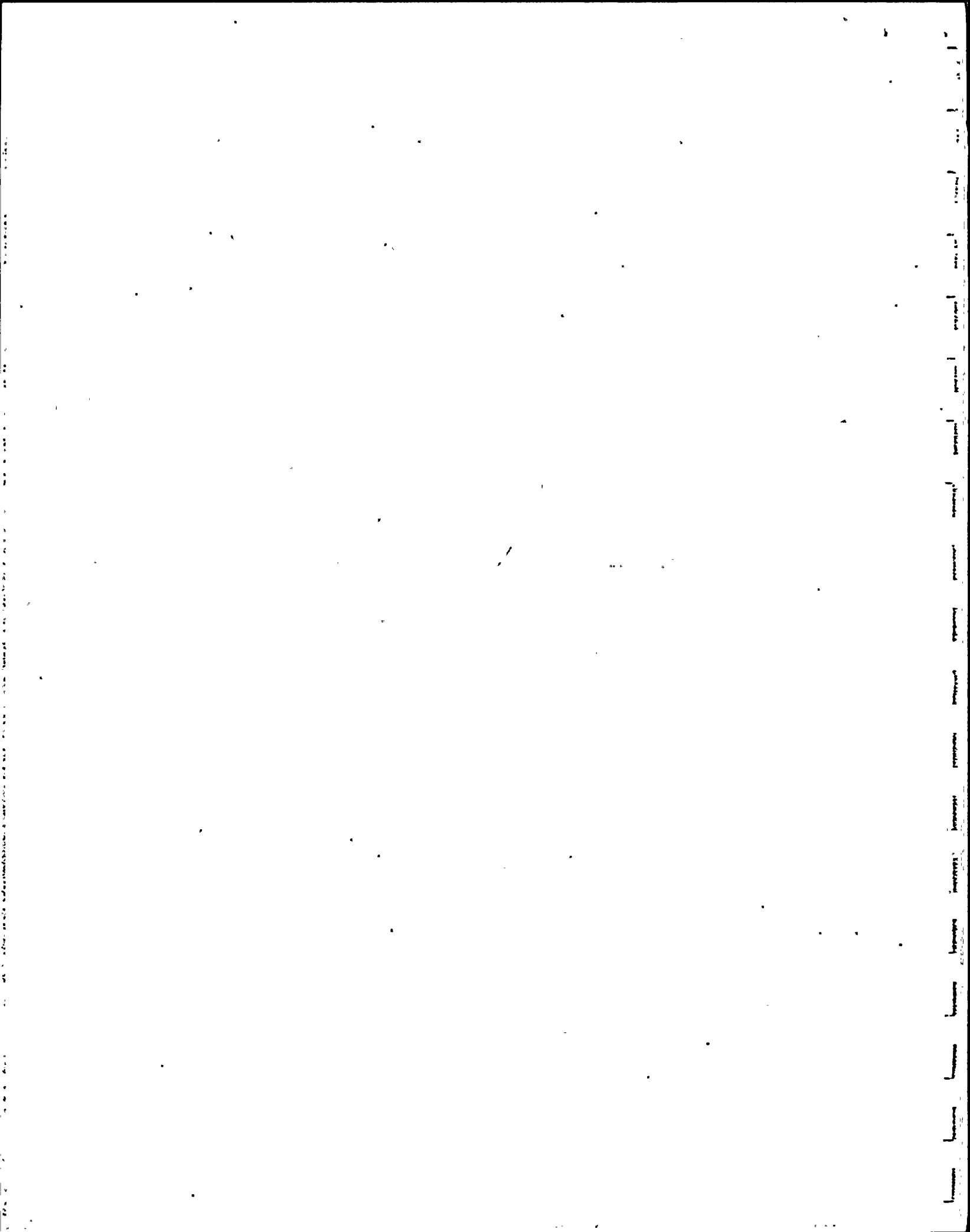
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Abstract

This operational environmental radiological monitoring program is an ongoing study conducted by Controls for Environmental Pollution, Inc. (CEP) for Arizona Nuclear Power Project (ANPP), Palo Verde Nuclear Generating Station (PVNGS). The data presented in this report were obtained from samples collected by APS personnel and analyzed by CEP during 1985, beginning May 25.

In order to determine radiation levels in the environment around the PVNGS, the following types of samples were collected: vegetation (including fruits and vegetables), fresh milk, groundwater, drinking water, surface water, airborne particulate and radioiodine.

Analytical results are presented and discussed along with other pertinent information. Possible trends and anomalous results, as interpreted by CEP are also discussed.

ARIZONA NUCLEAR POWER PROJECT
PALO VERDE NUCLEAR GENERATING STATION
OPERATIONAL RADIOLOGICAL MONITORING PROGRAM

1.0 Introduction

This report presents results of the operational environmental radiological monitoring program conducted during 1985 by Controls for Environmental Pollution, Inc. (CEP) for Arizona Nuclear Power Project (ANPP), Palo Verde Nuclear Generating Station (PVNGS).

In compliance with federal requirements to provide a complete environmental monitoring program for nuclear reactors, and in its concern for maintaining the quality of the local environment, ANPP began its pre-operational environmental monitoring program in 1979. The program complies with the requirements of the U.S. Nuclear Regulatory Commission in their Reactor Assessment Branch Technical Position, Revision 1, November, 1979. On May 25, 1985 PVNGS Unit One became operational.

The objectives of the pre-operational radiological environmental monitoring program were as follows: (1) to provide information on the concentrations of radionuclides and levels of radiation in the environs prior to reactor operations, (2) to provide the experience from which to develop a meaningful operational program of radiological assessment, and (3) to develop trip notification levels (background levels) for operational evaluation. Program modifications, should they prove necessary, will be described in each annual report.

The objectives of the operational radiological environmental monitoring program are as follows: 1) to determine radiation levels in the environs during reactor operations; 2) to monitor potential critical pathways of radioeffluent to man; 3) to determine radiological impact on the environment caused by the operation of PVNGS.

A number of techniques are used to distinguish power plant effects from other sources during the operational phase, including application of established background levels. Operational radiation levels measured in the vicinity of ANPP are compared with the pre-operational measurements at each of the sampling locations. Results of the monitoring program help to evaluate sources of elevated levels of radiation in the environment, e.g., atmospheric nuclear detonation or abnormal plant releases.

1.1 Pre-operational Radiological Monitoring Program Changes

To date, the following changes have been made in the pre-operational /operational radiological environmental monitoring program:

- 1.1.1 August 1984 - Desert Farms became the new designation for what was earlier known as 18bbb or 19bbb. The collection location changed slightly.
- 1.1.2 February 1984 - Meat samples were deleted from the sampling program. They may be collected again after PVNCS becomes operational.
- 1.1.3 February 1984 - The Adams residence replaces the Roger's residence as a vegetation and citrus collection location. The Adams residence is approximately one half mile north of the old sampling location.
- 1.1.4 February 1984 - AJM Farming, Inc. in Chandler, Arizona was added to the sampling program as the new Vegetation control site.
- 1.1.5 January 1984 - PVNCS took over the TLD program.
- 1.1.6 January 1984 -The Hamstra #2 Dairy replaced the Dan Paxton Dairy as a milk sampling location.
- 1.1.7 1983, fourth quarter - CEP purchased a Berthold (LB770) 10-Channel Low Level Planchet Counting System. This system is capable of simultaneously counting 10 planchets for gross alpha and gross beta activities alternately with proportional gas flow detectors. The system has an average background count rate of less than 1 count per minute for Beta and less than 0.05 count per minute for Alpha. The system is connected to a computer to calculate samples as pCi/unit volume.
- 1.1.8 1983, first quarter - Two new sample locations for vegetation were added to the sampling program, the Cooley Farm, located approximately 75 miles east of the PVNCS and the Rogers Residence, approximately 3 miles to the east of the PVNCS.

- 1.1.9 1983, first and second quarters - Domestic meat was collected at the Paxton Dairy during the first and second quarters of 1983.
- 1.1.10 February 1983 - Weekly airborne radioiodine sampling was re-introduced into the sampling regimen (See Section 1.1.12).
- 1.1.11 December, 1982 - A Salt Drift Monitoring Program was initiated and continued throughout 1983 at monitoring locations 14, 15, 17A, 21, 29, and 40. Since this program required air filter leachates for analysis, gamma spectral analysis was performed weekly for these sites rather than quarterly.
- 1.1.12 Mid 1982 - Thermoluminescent Dosimeter collection location number 45 was moved from the APS Deer Valley Office to PVNGS Lead Shielding.
- 1.1.13 1982 - No Groundwater samples were collected from Winter's Well or Red Quail and these locations were dropped from the program.
- 1.1.14 1982, fourth quarter - CEP purchased a Tennelec LB5100 System. This system has a two-inch detector (80 ug/cm² window) with an average of 2 cpm Beta background and 0.1 cpm Alpha background. This system has been designed for simultaneous Alpha and Beta counting and has a sample capacity of fifty samples.
- 1.1.15 1982, third quarter - Surface water samples (PVNGS Evaporation Pond and Reservoir) were included in the sampling regimen. Samples were analyzed for Iodine-131 weekly and composited monthly for Gross Alpha, Gross Beta, Strontium-89, Strontium-90, Tritium and Gamma Spectral analysis.
- 1.1.16 March, 1982 - the Hoffman and Mineso-Boers Dairies were deleted from the sampling program due to scheduling and relocation problems. At the same time, two new dairies were introduced into the sampling program, the Paul Skousen Dairy located approximately 24 miles east of the PVNGS and the Dan Paxton Dairy located in Chandler, Arizona, approximately 75 miles east of the PVNGS.
- 1.1.17 1982 - The collection of Dairy Feed, Wildlife (jack rabbit) and Poultry Products (eggs) was deleted from the sampling regimen.
- 1.1.18 1982, fourth quarter - A TLD Badge comparison was made. This was accomplished by introducing a different type of dosimeter (CaSO₄), into the field which was placed next to the LiF dosimeter in order to evaluate performance of each type of badge with respect to each other.

- 1.1.19 December 31, 1981 - Sampling for airborne radioiodine was suspended until February 1983, six months prior to the then estimated fuel load date.
- 1.1.20 1981 - changes in the method of reporting non-detectable activity levels in the annual report were made. All samples that have non-detectable activity levels are reported as less than the detection limit (i.e., less than 5 pCi/l) instead of the previously used method of reporting, (i.e., 0 ± 5 pCi/l). In addition, Tritium activities in groundwater reflect a 1000 pCi/l detection limit.
- 1.1.21 1981, fourth quarter - Sampling for airborne particulate and airborne radioiodine began.
- 1.1.22 July, 1981 - The TLD (Thermoluminescent Dosimetry) dose measurement program began.
- 1.1.23 1981 - CEP acquired a new computer-based Gamma Spectrometry System. It consists of a Tracor Northern Scientific (Model 4500) 4096 channel pulse height analyzer coupled to three intrinsic detectors and one GeLi detector. The new system has greater sensitivity and gives more detailed information about the spectrum.
- 1.1.24 January, 1980 - Due to a fire which totally destroyed Nancy's Yellow Canary, Drinking Water samples were collected from the Red Quail, a general store located directly behind what is now called "The Local". The Red Quail water comes from a well at the trailer park behind the store.
- 1.1.25 September, 1980 - The Red Quail had an extensive filtering system installed. This made samples from Red Quail non-representative of the groundwater found in the Palo Verde area. For the October 24, 1980 sampling, the second sample was taken at a faucet on the pipe, in order to obtain an unfiltered sample. All remaining samples in 1980 and 1981 were taken from this point (faucet on the pipe).
- 1.1.26 September, 1979 - The Al Lueck, Jr. Dairy moved to a new location approximately 25 miles east of PVNGS.

2.0 Description of the Monitoring Program

ANPP has contracted with CEP to determine the ambient radiation levels in the environment around PVNGS during its operation.

ANPP personnel collect the samples and ship them to CEP. The types of environmental samples collected include: vegetation (produce and citrus fruits), groundwater, drinking water, surface water, fresh milk, airborne particulates, and radioiodine.

The locations of the monitoring sites are shown in Figure I. The monitoring sites and the respective sample types collected are described in Table I. Table II describes the sample collection frequency. Information concerning new sample types, locations, and collection frequency are included in these tables where applicable.

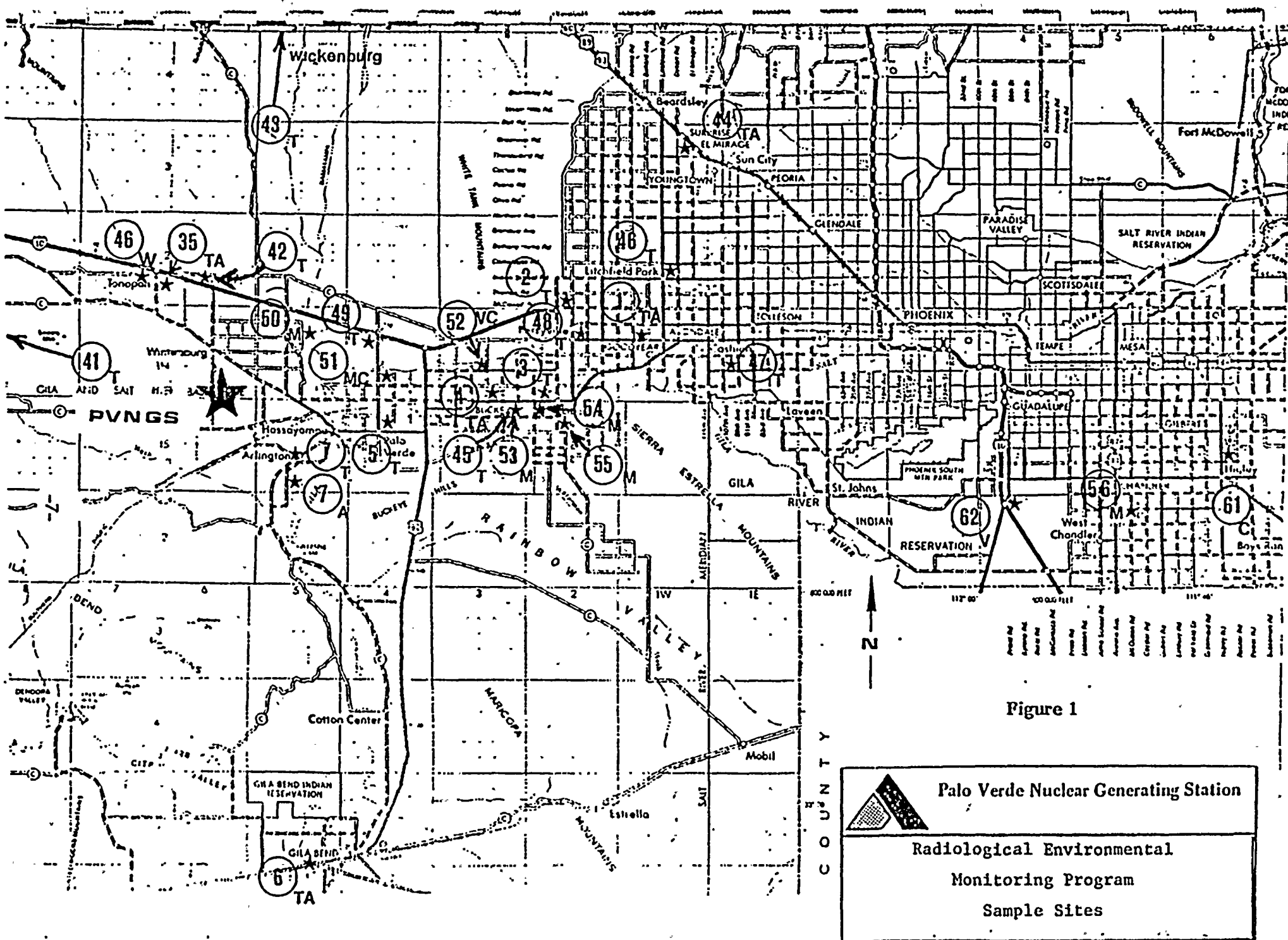



Figure 1

	Palo Verde Nuclear Generating Station
	Radiological Environmental Monitoring Program
	Sample Sites

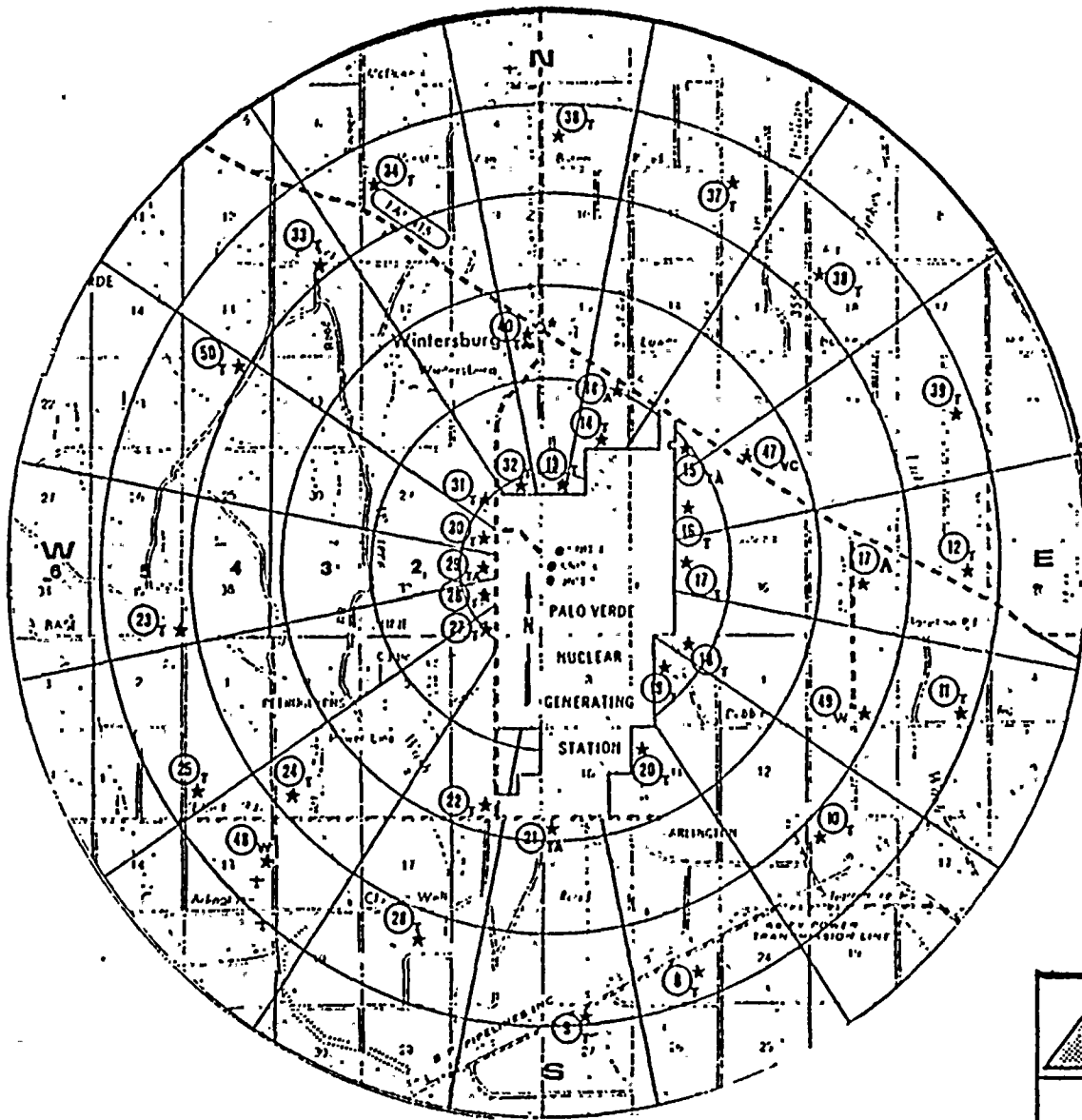


Figure 2


	Palo Verde Nuclear Generating Station
Radiological Environmental Monitoring Program Sample Sites	

TABLE I
COLLECTION LOCATIONS

<u>Sample Site #</u>	<u>Sample Type</u>	<u>Location Designation (a)</u>	<u>Location Description</u>
1	Air	E30	APS Coodyear Office
4	Air	E20	APS Buckeye Office
6	Air (Control)	SSE35	APS Gila Bend Substation
7A	Air	SE8	Arlington School
14A	Air	NNE2	Buckeye-Salome Rd. & 371st Ave.
15	Air	NE2	NE Site Boundary
17A	Air	E4	351st Ave., 1 mi. S of B-S Rd.
21	Air	S3	S Site Boundary
35	Air	NNW9	Tonopah, Palo Verde Inn Fire Station
40	Air	N3	Trailer Park at Wintersburg
44	Air	ENE35	APS El Mirage Office (Sun City)
46	Water, Veg.	NNW9	McArthur's Farm, Tonopah
47	Vegetation	ENE3	Adam's Residence, 355th Avenue & Buckeye - Salome Road
48	Water	SW5	Well 19bbb - Desert Farms
49	Water	ESE4	Wedgeworth Residence, 351st Ave. & Dobbins Rd.
50	Milk	NE7	Cordell Baisley Dairy, 331st Ave. & Van Buren
51	Milk, Veg.	E11	Butler Dairy, Palo Verde Rd. & Southern
52	Vegetation	E15	Cambron Farm, Miller Rd. & Broadway
53	Milk	E26	Kerr Dairy, Dean & Buckeye Rds.
54	Milk	E27	Skousen Dairy, Airport & Dobbins Rds.
55	Milk	E28	Al Lueck Dairy Jr., Jackrabbit & Hazen Rds.
56	Milk (Control)	E75	Hamstra Dairy #2, McQueen & Ryan Rds.
57	Water	Onsite	Well 27ddc
58	Water	Onsite	Well 34abb
59	Surface Water	Onsite	PVNGS Evaporation Pond
60	Surface Water	Onsite	PVNGS Reservoir
61	Vegetation (Control)	E30	Cooley Farm, McQueen & Cuadalupe Road
62	Vegetation (Control)	E60	AJA! Farms Inc., Chandler Industrial Park

(a) Based on Table J-1, NUREG-0654; distances are from centerline of Unit 2 containment in miles.

TABLE II
1985 COLLECTION SCHEDULE

<u>Collection Site</u>	<u>Air Particulates</u>	<u>Airborne Radioiodine</u>	<u>Domestic Meats</u>	<u>Fresh Milk</u>	<u>Vegetation</u>	<u>Groundwater</u>	<u>Drinking Water</u>	<u>Surface Water</u>
#1, APS Goodyear Office	W	W						
#4, APS Buckeye Office	W	W						
#6, APS Gila Bend Substation	W	W						
#7A, Arlington School	W	W						
#14A, Buckeye-Salome Rd. & 371st Ave.	W	W						
#15, NE Site Boundary	W	W						
#17A, 351st. Ave., 1 mi. S of B-S Rd.	W	W						
#21, S Site Boundary	W	W						
#29, W Site Boundary	W	W						
#35, Tonopah, Palo Verde Inn Fire Station	W	W						
#40, Trailer Park at Wintersburg	W	W						
#44, APS El Mirage Office	W	W						
#46, McArthur's Farm			Q		AA		M	
#47, Adam's Residence					AA			
#48, Desert Farms							M	
#49, Wedgeworth Residence							M	
#50, Cordell Baisley Dairy				M				
#51, Butler Dairy			Q	M	AA			
#52, Cambron Farm					AA			
#53, Kerr Dairy				M				
#54, Skousen Dairy				M				
#55, Al Lueck, Jr. Dairy				M				

TABLE II (Cont.)
1985 COLLECTION SCHEDULE

<u>Collection Site</u>	<u>Air Particulates</u>	<u>Airborne Radioiodine</u>	<u>Domestic Meats</u>	<u>Fresh Milk</u>	<u>Vegetation</u>	<u>Groundwater</u>	<u>Drinking Water</u>	<u>Surface Water</u>
#56, Hamstra #2 Dairy				M				
#57, Well 27ddc						Q		
#58, Well 34abb						Q		
#59, PVNGS Evaporation Pond								W
#60, PVNGS Reservoir								W
#61, Cooley Farm					AA			
#62, AJM Farms, Inc.					AA			

W = Weekly

M = Monthly

AA = As available during growing season

Q = Quarterly

3.0 Analytical Procedures

The analytical procedures discussed in this report are those routinely used by CEP to analyze samples.

3.1 Fresh Milk

3.1.1 Iodine-131

Two liters of milk containing standardized Iodine carrier are stirred with Amberlite IRA-400 anion exchange resin for one hour. The Iodine is stripped from the resin with sodium perchlorate (NaClO_4) and precipitated with silver nitrate (AgNO_3). The precipitate is filtered on a tared glass fiber filter. The dried precipitate is weighed for percent recovery and counted for Iodine-131 in a thin window, gas flow, proportional counter (Beckman Low Beta II or Berthold LB770). These instruments have a forty-one percent efficiency and a forty-five percent, respectively using Iodine-131 precipitated as silver iodide (AgI).

3.1.2 Strontium-89

The Strontium is precipitated with concentrated fuming nitric acid, redissolved in water, made basic with dilute ammonium hydroxide and precipitated as the oxalate. The dried oxalate precipitate is counted in a low background proportional counter (Beckman Low Beta II or Berthold LB770) having sixty percent and forty-five percent Strontium-Yttrium-90 efficiencies, respectively. The Strontium-89 activity is determined by subtracting the previously measured Strontium-90 activity and its corresponding Yttrium-90 ingrowth from the measured gross Strontium activity.

3.1.3 Strontium-90

An aliquot of milk containing standardized Strontium and Yttrium carriers, is stirred with Dowex 50WX8 cation exchange resin at a pH of six for thirty

minutes. All nuclides are stripped from the resin with strong acid. After the ingrowth period has been established, the Yttrium-90 is extracted with five percent di-2-ethylhexyl phosphoric acid (D₂EHPA) in toluene, back extracted into an aqueous phase, precipitated as the oxalate and counted in a low background internal gas flow proportional counter (Beckman Low Beta II or Berthold LB770) to determine the Strontium-90 content of the sample. These systems have Strontium-Yttrium-90 efficiency of sixty percent and forty-five percent, respectively.

3.1.4 Gamma Spectrometry

A suitable aliquot of sample is placed in a Marinelli beaker and counted with a multi-channel analyzer equipped with an intrinsic Germanium detector which is coupled to a 4096 channel, computer based, multi-channel analyzer (Northern Scientific TN4500). The resulting spectrum is analyzed by the computer, and specific nuclides, if present, identified and quantified.

3.2 Vegetation

3.2.1 Gamma Spectrometry

Refer to Milk Subsection 3.1.4.

3.2.2 Iodine-131

Required on leafy vegetation only. After appropriate preparation of the sample, analysis is performed as discussed in Subsection 3.1.4.

3.3 Groundwater and Drinking Water

3.3.1 Gross Alpha and Beta

A 1.0-liter aliquot of water is evaporated to dryness and transferred to a weighed planchet. The Gross Alpha and Gross Beta radioactivity is measured by counting the planchet in an internal gas flow, simultaneous proportional, low background counter (Beckman Wide Beta II or Berthold

LB770), or by counting the planchet in a low background simultaneous counter (Tennelec LB5100).

3.3.2 Gamma Spectrometry

Refer to Milk Subsection 3.1.4.

3.3.3 Strontium-90

A 1.0 liter aliquot of the sample containing standardized stable Strontium carrier is evaporated to dryness and wet ashed with concentrated nitric acid (HNO_3) and hydrogen peroxide (H_2O_2). The Yttrium-90 is extracted with five percent Di-2-ethylhexyl phosphoric acid (D2EHPA) in toluene after the ingrowth period has been established, back extracted into an aqueous phase, precipitated as the oxalate and counted with an integral gas flow proportional counter (Beckman Low Beta II or Berthold LB770) having a Strontium, Yttrium-90 efficiencies of sixty percent and forty-five percent, respectively. The counting results are back calculated to give Strontium-90 activity.

3.3.4 Tritium

Three milliliters of the water sample are mixed with NEF-934 Aquasol cocktail which is manufactured by New England Nuclear Corporation. The mixture used is nineteen percent sample in a clear gel type aquasol. This gives a Tritium counting efficiency of approximately thirty percent. The counting system used is a Beckman LS-100 Liquid Scintillation Spectrometer. Six Tritium standards, certified by NBS, are counted before each set of water samples to check the counting system's efficiency. A counting efficiency is derived from these standards which are equal in activity but vary in the amount of quenching.

3.4 Surface Water

3.4.1 Iodine-131

One liter of water containing standardized Iodine carrier is acidified with nitric acid (HNO_3), then extracted with carbon tetrachloride (CCl_4) and sodium nitrite (NaNO_2) to remove the Iodine. The Iodine is back extracted from the carbon tetrachloride (CCl_4) using a 0.2% hydrazine solution which supplies more purification and an aqueous media for precipitation. Iodine is precipitated with silver nitrate (AgNO_3) and filtered on a tared glass fiber filter as silver iodide (AgI). The dried precipitate is weighed for recovery and counted for Iodine-131 in a thin window, gas flow, proportional counter (Beckman Low Beta II or Berthold LB770) having forty-one percent and forty-five percent efficiencies, respectively for Iodine-131 precipitated as silver iodide (AgI).

3.4.2 Gross Alpha and Beta

An aliquot of the monthly composite is taken and analyzed according to Ground and Drinking Water Subsection 3.4.1.

3.4.3 Gamma Spectrometry

An aliquot of the monthly composite is taken and analyzed according to Milk Subsection 3.1.4.

3.4.4 Strontium-89

An aliquot of the monthly composite is taken and analyzed according to Milk Subsection 3.1.2.

3.4.5 Strontium-90

An aliquot of the monthly composite is taken and analyzed according to Groundwater and Drinking Water Subsection 3.4.3.

3.4.6 Tritium

An aliquot of the monthly composite is taken and analyzed according to

Ground and Drinking Water Subsection 3.4.4.

3.5 Air Particulate

3.5.1 Gross Alpha and Beta

The Sartorius filter (cellulose nitrate filter with a 3 micron pore size), is placed in a 50 mm stainless steel planchet and counted for Gross Alpha and Gross Beta radioactivity using a low background internal gas flow, simultaneous proportional counter (Beckman Wide Beta II), or by using a low background simultaneous counter (Tennelec LB5100).

3.5.2 Gamma Spectrometry

The air filters are sealed in small, plastic Marinelli beakers and counted utilizing the method described in Milk Subsection 3.1.4.

3.6 Airborne Radioiodine

Two analytical methods for airborne radioiodine are used by CEP depending upon the length of time between the sample collection date and the date of sample receipt at CEP. The sensitivity of the Gamma Spectrometry Method decreases significantly after an Iodine-131 decay of greater than one half-life (8.04 days). Therefore, if more than one week has elapsed between sample collection and analysis of the sample the Alkaline Leach Method provides a greater sensitivity and is thus the analytical method of choice.

3.6.1 Alkaline Leach Method

Radioiodine is removed from activated charcoal along with a standardized iodine carrier using concentrated ammonium hydroxide (NH_4OH) and hydrogen peroxide (H_2O_2). The charcoal is filtered and the remaining solution is acidified with nitric acid (HNO_3) and extracted with carbon tetrachloride (CCl_4). A 0.2% hydrazine solution supplies further purification and an aqueous media for precipitation. Iodine is precipitated with silver nitrate and filtered on a tared glass fiber filter as silver iodide

(AgI). The dried precipitate is weighed for recovery and counted for Iodine-131 in a thin window, gas flow, proportional counter (Beckman Low Beta II or Berthold LB770) having forty-one percent and forty-five percent efficiencies, respectively for Iodine-131 precipitated as silver iodide (AgI).

3.6.2 Gamma Spectrometry Method

The direct gamma counting method for Iodine-131 consists of placing the charcoal canister directly on an intrinsic germanium detector and analyzing the resulting spectrum for Iodine-131 using the computer, based Northern Scientific TN 4500 System. The system is calibrated using charcoal filters which have been uniformly loaded (in the first 5 mm) with standardized isotopes traceable to NBS and calibration verification is performed by analyzing a charcoal filter which has been uniformly loaded (in the first 5 mm) with standardized Iodine-131 traceable to NBS. Deposition of activity in the first 5 mm of the filters is done to simulate actual sample loading and both standards and samples are placed on the detector so that the load gradient is decreasing with distance from the detector.

4.0 Sample Preparation Methods

The following sample preparation methods are routinely used by CEP.

4.1 Vegetation Sample Preparation

1. The plastic bags are opened and the sample weighed immediately to obtain the wet weight.
3. After weighing, the sample is transferred to a drying pan and placed in an oven at 110°C.
4. The dry sample is ground to a fine powder and homogenized.
5. The sample is then dissolved or ashed, whichever is required for further isotopic analysis.

4.2 Milk

Iodine carrier (Potassium Iodide), formalin and sodium bisulfate are added when the milk is collected to stabilize the Iodine-131 during shipment of samples to CEP. The procedure for Fresh Milk is then followed as described in Section 3.1, of this report.

5.0 Nuclear Instrumentation

5.1 Tracor Northern Computer Based Gamma Spectrometer

The Gamma Spectrometer consists of a Tracor Northern TN-4500 Multichannel Analyzer equipped with: a) DEC LSI-11/23 Microprocessor; b) DEC RT-11 Version IV Operating System; c) Free Standing Console consisting of a full ASCII keyboard; d) Comprehensive MCA Control Section, and e) Two Solid State Ce(Li) Detectors and Three Intrinsic Detectors having 2.8 KeV, 3.0 KeV, 2.07 KeV, 1.35 KeV and 1.35 KeV resolutions and respective efficiencies of 16.1%, 8.9%, 22.6%, 30.6% and 25.1%.

The Computer Based Tracor Northern Gamma Spectrometry System is used for all gamma counting. The system uses the latest software to search and identify, as well as quantize the peaks of interest.

5.2 Beckman Wide Beta II Low Background Gas Proportional System

The Beckman Wide Beta II Two-inch Detector Counting System has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The system can also be set up for one-inch detector. The system capacity is one hundred samples. The detector has an efficiency of 60% for Strontium-90 and 40% for Plutonium-239.

5.3 Beckman Wide Beta II Low Background Gas Proportional System (Simultaneous)

The Beckman Wide Beta II Two-inch Planchet Counting System has an average of 2.5 cpm Beta background and 0.1 cpm Alpha background. The detector has a 60% efficiency for Strontium-90 and 40% for Plutonium-239. This system has

been designed for simultaneous Alpha and Beta counting. The system sample capacity is one hundred samples.

5.4 Beckman Low Beta II Low Background Beta System

The Beckman Low Beta II Gas Proportional One-inch Detector Counting System has an average of 1.5 cpm Beta background and 0.1 cpm Alpha background and detector efficiency of 60% for Strontium-90 and 40% for Plutonium-239. The system capacity is one hundred samples. The system can also be set up for two-inch detector having 2.5 cpm Beta background and 0.1 cpm Alpha background.

5.5 Beckman Low Beta II Low Background Beta System

The Beckman Low Beta II Gas Proportional Two-inch Detector Counting System has an average of 3.0 cpm Beta background and 0.2 cpm Alpha background and detector efficiency of 60% for Strontium-90 and 40% for Plutonium-239. The system capacity is one hundred samples. This system can also be set up for one-inch detector having 1.5 cpm Beta background and 0.1 cpm Alpha background.

5.6 Beckman Liquid Scintillation Counting Systems

Two Beckman LS-100 Liquid Scintillation Counters will be used for all Tritium determinations, as well as C-14, P-32, S-35 and other Beta emitters.

5.7 Low Background Alpha Gas Flow Systems

The Gross Alpha Counting Systems consist of two windowless gas flow detectors manufactured by Nuclear Measurements Corporation with an Alpha efficiency of 55% with a background of less than 0.1 cpm.

5.8 Low Background Scintillation Counter

The Low Background Scintillation Counter consists of a Zinc Sulfide screen. The system has an average Alpha of 0.1 cpm.

5.9 Tennelec LB5100 System

The Tennelec LB5100 System has a Two-inch Planchet Counting System and has an average of 2 cpm Beta background and 0.1 cpm Alpha background. This

system has been designed for simultaneous Alpha and Beta counting. The sample capacity is fifty samples.

5.10 Low Level Planchet Counting Systems (2)

Each Berthold 10-Channel Low Level Planchet Counting System (Model LB700) is capable of simultaneously counting 10 planchets for Gross Alpha and Gross Beta activities alternately with Proportional Gas Flow Detectors. The systems have an average background count rate of less than 1 count per minute. The instruments have an Alpha efficiency of 33% for Plutonium-239 and Beta efficiencies of 45% for Strontium, Yttrium-90 and 43% for Cesium-137.

5.11 Beckman Liquid Scintillation Counting System

A Beckman LS-5801 Liquid Scintillation System will be used for all Tritium determinations. The system has a tritium counting efficiency of sixty percent in a wide open window.

6.0 Isotopic Detection Limits and Activity Determinations

Analytical detection limits are governed by a number of factors including:

6.1 Sample Size

The sample size taken is based on the numerical data one wishes to obtain which can describe a particular situation and can be interpreted as a basis for possible action. The sample size has to be representative and provide for accurate analysis or the entire process is invalid (Table III).

6.2 Counting Efficiency

The fundamental quality in the measurement of a radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, it is seldom possible to make an absolute measurement of the disintegration rate but rather it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency which may

then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

6.3 Background Count Rate

Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surroundings; 2) cosmic radiation; and 3) the natural radioactivity in the counter material itself. The background counting rate will depend on the amount of these types of radiation and the sensitivity of the counter to the radiation.

6.4 Background and Sample Counting Time

The amount of time devoted to counting background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample (Table IV).

6.5 Time Interval Between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived isotopes. The disintegration constant, or its related quantity, the half-life, is one of the basic characteristics of a specific radionuclide and is readily determined if the half-life is sufficiently short.

6.6 Chemical Recovery of the Analytical Procedures

Most radiochemical analyses are carried out in such a way that losses occur during the separations. These losses occur due to a large number of contaminants that may be present and interfere during chemical separations. Thus it is necessary to include a technique for estimating these losses in the development of the analytical procedure.

The Lower Limits of detection are calculated using the following formula:

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

WHERE:

LLD = "A priori" lower limit of detection as defined above (as pCi per unit mass or volume).

s_b = Standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute).

E = Counting efficiency (as counts per disintegration).

V = Sample size (in units of mass or volume).

2.22 = Number of disintegrations per minute per picocurie.

Y = Fractional radiochemical yield (when applicable).

λ = Radioactive decay constant for the particular radioisotope.

Δt = Elapsed time between sample collection (or end of the sample collection period) and time of counting.

The value of s_b used in the calculation of the LLD for a particular measurement system is based on the actual observed variance of the background counting rate, or, of the counting rate of the blank sample, (as appropriate), rather than on an unverified theoretically predicated variance.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background included the typical contributions of other nuclides normally present in the samples.

The activities per unit sample mass or volume are determined using the following formula:

$$A = \frac{C-B}{(2.22)(V)(R)(E)(e^{-\lambda t})} \pm \frac{1.96 \sqrt{\frac{C+B}{T^2}}}{(2.22)(V)(R)(E)(e^{-\lambda t})}$$

WHERE:

- A = Activity as pCi per units sample mass or volume.
- C = Sample count rate in counts per minute.
- B = Background counts per minute.
- V = Sample volume or mass analyzed.
- E = Counter efficiency as cpm/dpm.
- 2.22 = Numerical constant to convert disintegrations per minute to picocuries.
- $(e^{-\lambda t})$ = Decay factor to correct the activity to time of collection.
- T = Counting time in minutes.
- 1.96 = Statistical constant for the 95% confidence level.
- R = Chemical recovery or photon yield.

7.0 Quality Control Program

CEP employs a mutli-faceted Quality Control Program designed to maintain high performance of its laboratory. The overall objectives of the program are to:

1. Verify that work procedures are adequate to meet specifications of ANPP.
2. Coordinate an in-house quality control program independent of external programs, to assure that CEP is operating at maximum efficiency.

Objectives are met by a variety of procedures that oversee areas of sample receipt and handling, analysis and data review. These procedures include standard operating procedures, known and unknown spike analysis, blank analysis, reagent, carrier and nuclide standardization as well as participation in the U.S. Environmental Protection Agency's Interlaboratory Cross-check Program. (See Appendix A for EPA Radiological Cross-check results).

TABLE III
ALIQUOT SCANNED FOR DETECTION LIMIT CALCULATION
AND ACTUAL ANALYSIS

<u>Sample Type</u>	<u>Gross Alpha</u>	<u>Gross Beta</u>	<u>Gamma Spec.</u>	<u>Iodine-131</u>	<u>Strontium-89</u>	<u>Strontium-90</u>	<u>Tritium</u>
Air Particulates	265 m ³	265 m ³	265 m ³				
Airborne Radioiodine				265 m ³			
Domestic Meats (Beef)			500 g				
Fresh Milk			1000 mls	2000 mls	2000 mls	2000 mls	
Vegetation (Citrus Fruits)			500 g				
Vegetation (Leafy)			500 g	100 g			
Groundwater	1000 mls	1000 mls	1000 mls			1000 mls	3 ml
Drinking Water	1000 mls	1000 mls	1000 mls			1000 mls	3 ml
Surface Water	1000 mls	1000 mls	1000 mls	1000 mls	1000 mls	1000 mls	3 ml

TABLE IV
SAMPLE COUNTING TIMES

<u>Sample Type</u>	<u>Gross Alpha</u>	<u>Gross Beta</u>	<u>Gamma Spec.</u>	<u>Iodine-131</u>	<u>Strontium-89</u>	<u>Strontium-90</u>	<u>Tritium</u>
Air Particulates	100 min	100 min	8 hrs				
Airborne Radioiodine				8 hrs*			
Domestic Meats (Beef)			8 hrs				
Fresh Milk			8 hrs	100 min	100 min	100 min	
Vegetation (Citrus Fruits)			8 hrs				
Vegetation (Leafy)			8 hrs	100 min			
Groundwater	100 min	100 min	8 hrs			100 min	500 min
Drinking Water	100 min	100 min	8 hrs			100 min	500 min
Surface Water	100 min	100 min	8 hrs	100 min	100 min	100 min	500 min

*Alkaline Leach Method Counted for 100 mins

TABLE V

DETECTION LIMITS BY OTHER THAN GAMMA SPECTROMETRY

<u>Sample Type</u>	<u>Gross Alpha</u>	<u>Gross Beta</u>	<u>Iodine-131</u>	<u>Strontium-89</u>	<u>Strontium-90</u>	<u>Tritium</u>
Air Particulates	0.005 pCi/m ³	0.002 pCi/m ³				
Airborne Radioiodine			0.007 pCi/m ³ **			
Fresh Milk			0.5 pCi/l	1.0 pCi/l	0.5 pCi/l	
Vegetation (Leafy)			0.02 pCi/g*			
Groundwater	1 pCi/l	2 pCi/l			0.5 pCi/l	1000 pCi/l
Drinking Water	1 pCi/l	2 pCi/l			0.5 pCi/l	1000 pCi/l
Surface Water	1 pCi/l	2 pCi/l	0.5 pCi/l	1.0 pCi/l	0.5 pCi/l	1000 pCi/l

*As Wet Weight

**Alkaline Leach Method. I-131 Detection Limit by Gamma Spectrometry 0.020 pCi/m³

TABLE VI
DETECTION LIMITS BY GAMMA SPECTROMETRY

<u>Energy MeV</u>	<u>Isotope</u>	<u>Sensitivity pCi/gm* Vegetation</u>	<u>Sensitivity pCi/l* Groundwater, Drinking Water and Surface Water</u>	<u>Sensitivity pCi/l* Fresh Milk</u>	<u>Sensitivity pCi/m³ Air Particulate</u>
0.134	Cerium-144	0.121	18	10	0.005
0.537	Barium-140	0.075	4	4	0.030
0.605	Cesium-134	0.029	10	10	0.023
0.622	Ru,Rh-106	0.143	2	2	0.001
0.662	Cesium-137	0.056	2	2	0.001
0.765	Zr,Nb-95	0.066	10	8	0.026
0.835	Manganese-54	0.021	2	2	0.001
1.095	Iron-59	0.021	3	3	0.006
1.115	Zinc-65	0.060	16	16	0.045
1.173	Cobalt-60	0.063	5	5	0.019
1.596	Lanthanum-140	0.465	15	15	0.030

*See Table III for aliquots used in the calculation of these sensitivities.

8.0 Data Interpretation and Conclusions

Interpretations and conclusions regarding all types of samples analyzed during 1985 are discussed in the following sections. Assessment of pre-operational and operational data revealed no significant changes to environmental radiation levels. There was no observed impact on the environment due to PVNGS operations. For the calculation of means, a value of one half the detection limit is used for all samples with activities below the detection limit.

8.1 Air Particulates

Air particulate samples were collected from each of the twelve monitoring sites on a weekly basis during 1985.

Air filters were analyzed for gross alpha and gross beta activities. Gamma Spectral analysis of the air filters was done on the individual filters for Stations 14A, 15, 17A, 21, 29 and 40 due to the Salt Drift Monitoring Program. Gamma Spectral analysis for the other stations was performed on quarterly composites by station.

Ten air particulate samples were marked as possibly invalid upon arrival at CEP.

The samples and the reason for the questionable statuses are listed below:

<u>Second Quarter 1985</u>		
<u>Date Collected</u>	<u>Site #</u>	<u>Reason</u>
05/29/85	17A	Malfunction of pressure relief valve
<u>Third Quarter 1985</u>		
<u>Date Collected</u>	<u>Site #</u>	<u>Reason</u>
07/31/85	6	Power interrupted during sampling period
08/07/85	4	Flow calibration failed
08/07/85	6	Flow calibration and redline criteria not available
09/18/85	29A	Numerous insects on air particulate filter
10/02/85	4A	Heavy dirt on air particulate filter

Fourth Quarter 1985

<u>Date Collected</u>	<u>Site #</u>	<u>Reason</u>
10/09/85	29A	Insects on particulate filter
10/16/85	15	Malfunctioning sampler
10/23/85	15	Malfunctioning sampler
12/11/85	4A	Wet air particulate filter

Table VII presents second quarter Gross Beta results. Station 6A showed the highest activity during the quarter (0.041 ± 0.002 pCi/m³ collected 06/19/85-06/26/85). The Station 1A sample collected 05/29/85-06/05/85 showed the lowest level at 0.015 ± 0.002 pCi/m³. Weekly mean activities ranged from a low of 0.018 ± 0.002 pCi/m³ during the period of 05/29/85-06/05/85 to a high of 0.032 ± 0.003 pCi/m³ in the week of 06/26/85-07/03/85. The range of results are comparable to previous quarterly data and do not indicate any anomalies.

Table VIII presents the Gross Beta levels during the third quarter of 1985. A maximum value of 0.036 ± 0.002 pCi/m³ was observed at Stations 35A and 44A (collected 07/03/85-07/10/85). The lowest level of activity was 0.010 ± 0.002 pCi/m³ at Station 44A during the collection period of 07/24/85-07/31/85. Weekly mean activities ranged from a minimum of 0.018 ± 0.002 pCi/m³ (07/17/85-07/24/85), to a maximum of 0.032 ± 0.003 pCi/m³ in the period of 07/03/85-07/10/85. The range of results are comparable to previous quarterly data and do not indicate any anomalies.

Table IX presents the Gross Beta activities seen in the fourth quarter. Observed levels varied from 0.008 ± 0.006 pCi/m³ at Station 14A (collected 12/26/85-01/02/86), to 0.057 ± 0.002 pCi/m³ at Station 6A (collected 12/26/85-01/02/86). Weekly mean activities ranged from 0.013 ± 0.002 pCi/m³ during the collection period of 11/27/85-12/04/85 to 0.037 ± 0.003 pCi/m³ collected 10/23/85-10/30/85

and 0.037 ± 0.005 pCi/g collected 12/18/85-12/26/85. Based on data from other nuclear reactor environmental monitoring programs, the trend for Gross Beta in air particulates for the PVNGS during the fourth quarter of 1985 is similar to those for other reactor sites located west of the Mississippi River.

Table X contains the mean Gross Beta activities by station. Mean quarterly and mean annual activities are calculated using all weekly activities except those marked invalid. Mean activities for each quarter ranged from a low of 0.023 ± 0.006 at Station 21A during the third quarter, to a high of 0.033 ± 0.010 pCi/m³ at Station 15A in the fourth quarter. Annual mean activities compare very well and fall between 0.026 ± 0.006 pCi/m³ (Stations 17A, 21A and 35A) and 0.029 ± 0.007 pCi/m³ (Station 15A). Mean activities seen during 1985 are consistent with past results.

The average gross beta activity for each quarter is as follows:

	<u>pCi/m³</u>
Second Quarter 1985	0.027 ± 0.005
Third Quarter 1985	0.024 ± 0.004
Fourth Quarter 1985	0.030 ± 0.009

Gross Beta levels determined during 1985 are slightly higher than those during 1982, 1983, and 1984.

No man-made Gamma-emitting Nuclides were detected in any of the air filter samples collected during 1985.

Tables XI thru XIII show the Gross Alpha activity for each week during 1985. No air particulate samples collected in 1985 had activity above detection limit. The data showed that fewer air filters in 1985 contained Gross Alpha activity above 0.005 pCi/m^3 than in 1984.

TABLE VII
GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)

SECOND QUARTER

1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
05/22/85 - 05/29/85	0.025 _± 0.002	0.029 _± 0.002	0.026 _± 0.002	0.031 _± 0.002	0.027 _± 0.002	0.031 _± 0.002	0.015 _± 0.002 ^a
05/29/85 - 06/05/85	0.015 _± 0.002	0.019 _± 0.002	0.021 _± 0.002	0.020 _± 0.002	0.018 _± 0.002	0.021 _± 0.002	0.018 _± 0.002
06/05/85 - 06/12/85	0.025 _± 0.002	0.029 _± 0.002	0.027 _± 0.002	0.024 _± 0.002	0.029 _± 0.002	0.029 _± 0.002	0.027 _± 0.002
06/12/85 - 06/19/85	0.023 _± 0.002	0.029 _± 0.002	0.029 _± 0.002	0.031 _± 0.002	0.029 _± 0.002	0.039 _± 0.002	0.031 _± 0.002
06/19/85 - 06/26/85	0.028 _± 0.002	0.024 _± 0.002	0.041 _± 0.002	0.027 _± 0.002	0.028 _± 0.002	0.026 _± 0.002	0.025 _± 0.002
06/26/85 - 07/03/85	0.032 _± 0.002	0.034 _± 0.002	0.038 _± 0.002	0.034 _± 0.002	0.029 _± 0.002	0.030 _± 0.002	0.031 _± 0.002

^aInvalid sample.

TABLE VII (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)

SECOND QUARTER

1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Beta Activities ± Standard Deviation of the Mean</u>
05/22/85 - 05/29/85	0.031 _± 0.002	0.029 _± 0.002	0.027 _± 0.002	0.031 _± 0.002	0.028 _± 0.002	0.029 _± 0.002
05/29/85 - 06/05/85	0.016 _± 0.002	0.020 _± 0.002	0.017 _± 0.002	0.019 _± 0.002	0.018 _± 0.002	0.018 _± 0.002
06/05/85 - 06/12/85	0.026 _± 0.002	0.025 _± 0.002	0.028 _± 0.002	0.028 _± 0.002	0.029 _± 0.002	0.027 _± 0.002
06/12/85 - 06/19/85	0.028 _± 0.002	0.032 _± 0.002	0.028 _± 0.002	0.029 _± 0.002	0.029 _± 0.002	0.030 _± 0.004
06/19/85 - 06/26/85	0.026 _± 0.002	0.027 _± 0.002	0.026 _± 0.002	0.035 _± 0.002	0.026 _± 0.002	0.028 _± 0.005
06/26/85 - 07/03/85	0.028 _± 0.002	0.032 _± 0.002	0.033 _± 0.002	0.036 _± 0.002	0.032 _± 0.002	0.032 _± 0.003

TABLE VIII
GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)

THIRD QUARTER

1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
07/03/85 - 07/10/85	0.033 _± 0.002	0.034 _± 0.002	0.034 _± 0.002	0.028 _± 0.002	0.032 _± 0.002	0.032 _± 0.002	0.035 _± 0.002
07/10/85 - 07/17/85	0.028 _± 0.002	0.030 _± 0.002	0.030 _± 0.002	0.026 _± 0.002	0.025 _± 0.002	0.028 _± 0.002	0.030 _± 0.002
07/17/85 - 07/24/85	0.019 _± 0.002	0.018 _± 0.002	0.019 _± 0.002	0.016 _± 0.002	0.018 _± 0.002	0.018 _± 0.002	0.019 _± 0.002
07/24/85 - 07/31/85	0.022 _± 0.002	0.029 _± 0.002	*	0.023 _± 0.002	0.022 _± 0.002	0.022 _± 0.002	0.024 _± 0.002
07/31/85 - 08/07/85	0.022 _± 0.002	0.024 _± 0.002*	0.020 _± 0.002*	0.021 _± 0.002	0.023 _± 0.002	0.024 _± 0.002	0.024 _± 0.002
08/07/85 - 08/14/85	0.022 _± 0.002	0.022 _± 0.002	0.022 _± 0.002	0.021 _± 0.002	0.032 _± 0.002	0.021 _± 0.002	0.023 _± 0.002
08/14/85 - 08/21/85	0.025 _± 0.002	0.026 _± 0.002	0.025 _± 0.002	0.026 _± 0.002	0.024 _± 0.002	0.025 _± 0.002	0.025 _± 0.002
08/21/85 - 08/28/85	0.025 _± 0.002	0.025 _± 0.002	0.025 _± 0.002	0.023 _± 0.002	0.022 _± 0.002	0.025 _± 0.002	0.024 _± 0.002
08/28/85 - 09/04/85	0.028 _± 0.002	0.023 _± 0.002	0.027 _± 0.002	0.027 _± 0.002	0.025 _± 0.002	0.026 _± 0.002	0.024 _± 0.002
09/04/85 - 09/11/85	0.022 _± 0.002	0.019 _± 0.002	0.018 _± 0.002	0.020 _± 0.002	0.019 _± 0.002	0.020 _± 0.002	0.018 _± 0.002
09/11/85 - 09/18/85	0.024 _± 0.002	0.021 _± 0.002	0.023 _± 0.002	0.025 _± 0.002	0.025 _± 0.002	0.023 _± 0.002	0.025 _± 0.002
09/18/85 - 09/25/85	0.022 _± 0.002	0.024 _± 0.002	0.025 _± 0.002	0.024 _± 0.002	0.025 _± 0.002	0.026 _± 0.002	0.022 _± 0.002
09/25/85 - 10/02/85	0.023 _± 0.002	0.027 _± 0.002*	0.021 _± 0.002	0.022 _± 0.002	0.022 _± 0.002	0.022 _± 0.002	0.022 _± 0.002

*Invalid sample.

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TABLE VIII (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)

THIRD QUARTER

1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Beta Activities + Standard Deviation of the Mean</u>
07/03/85 - 07/10/85	0.028 _± 0.002	0.031 _± 0.002	0.036 _± 0.002	0.029 _± 0.002	0.036 _± 0.002	0.032 _± 0.003
07/10/85 - 07/17/85	0.027 _± 0.002	0.028 _± 0.002	0.029 _± 0.002	0.026 _± 0.002	0.033 _± 0.002	0.028 _± 0.002
07/17/85 - 07/24/85	0.017 _± 0.002	0.016 _± 0.002	0.018 _± 0.002	0.018 _± 0.002	0.023 _± 0.002	0.018 _± 0.002
07/24/85 - 07/31/85	0.022 _± 0.002	0.025 _± 0.002	0.025 _± 0.002	0.023 _± 0.002	0.010 _± 0.002	0.022 _± 0.005
07/31/85 - 08/07/85	0.021 _± 0.002	0.021 _± 0.002	0.025 _± 0.002	0.023 _± 0.002	0.024 _± 0.002	0.023 _± 0.001
08/07/85 - 08/14/85	0.023 _± 0.002	0.024 _± 0.002	0.021 _± 0.002	0.023 _± 0.002	0.027 _± 0.002	0.023 _± 0.003
08/14/85 - 08/21/85	0.025 _± 0.002	0.025 _± 0.002	0.026 _± 0.002	0.027 _± 0.002	0.027 _± 0.002	0.026 _± 0.001
08/21/85 - 08/28/85	0.023 _± 0.002	0.023 _± 0.002	0.023 _± 0.002	0.024 _± 0.002	0.025 _± 0.002	0.024 _± 0.001
08/28/85 - 09/04/85	0.026 _± 0.002	0.027 _± 0.002	0.026 _± 0.002	0.025 _± 0.002	0.025 _± 0.002	0.026 _± 0.001
09/04/85 - 09/11/85	0.019 _± 0.002	0.021 _± 0.002	0.021 _± 0.002	0.024 _± 0.002	0.019 _± 0.009	0.020 _± 0.002
09/11/85 - 09/18/85	0.023 _± 0.002	0.021 _± 0.002*	0.023 _± 0.002	0.022 _± 0.002	0.028 _± 0.002	0.024 _± 0.002
09/18/85 - 09/25/85	0.025 _± 0.002	0.024 _± 0.002	0.027 _± 0.002	0.025 _± 0.002	0.023 _± 0.002	0.024 _± 0.001
09/25/85 - 10/02/85	0.020 _± 0.002	0.022 _± 0.002	0.022 _± 0.002	0.023 _± 0.002	0.022 _± 0.002	0.022 _± 0.001

*Invalid sample.

TABLE IX

GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)FOURTH QUARTER1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
10/02/85 - 10/09/85	0.034 \pm 0.002	0.034 \pm 0.002	0.030 \pm 0.002	0.031 \pm 0.002	0.032 \pm 0.002	0.034 \pm 0.002	0.032 \pm 0.002
10/09/85 - 10/16/85	0.022 \pm 0.002	0.021 \pm 0.002	0.019 \pm 0.002	0.024 \pm 0.002	0.018 \pm 0.002	*	0.018 \pm 0.002
10/16/85 - 10/23/85	0.027 \pm 0.002	0.025 \pm 0.002	0.023 \pm 0.002	0.022 \pm 0.002	0.024 \pm 0.002	*	0.022 \pm 0.002
10/23/85 - 10/30/85	0.030 \pm 0.002	0.038 \pm 0.002	0.038 \pm 0.002	0.042 \pm 0.002	0.037 \pm 0.002	0.040 \pm 0.002	0.035 \pm 0.002
10/30/85 - 11/06/85	0.036 \pm 0.002	0.036 \pm 0.002	0.034 \pm 0.002	0.036 \pm 0.002	0.034 \pm 0.002	0.038 \pm 0.002	0.033 \pm 0.002
11/06/85 - 11/13/85	0.031 \pm 0.002	0.029 \pm 0.002	0.023 \pm 0.002	0.023 \pm 0.002	0.027 \pm 0.002	0.026 \pm 0.002	0.024 \pm 0.002
11/13/85 - 11/20/85	0.030 \pm 0.002	0.030 \pm 0.002	0.027 \pm 0.002	0.028 \pm 0.002	0.031 \pm 0.002	0.032 \pm 0.002	0.027 \pm 0.002
11/20/85 - 11/27/85	0.027 \pm 0.002	0.030 \pm 0.002	0.025 \pm 0.002	0.029 \pm 0.002	0.026 \pm 0.002	0.025 \pm 0.002	0.027 \pm 0.002
11/27/85 - 12/04/85	0.014 \pm 0.002	0.014 \pm 0.002	0.014 \pm 0.002	0.015 \pm 0.002	0.011 \pm 0.002	0.013 \pm 0.002	0.014 \pm 0.003
12/04/85 - 12/11/85	0.031 \pm 0.002	0.029 \pm 0.002*	0.027 \pm 0.002	0.032 \pm 0.002	0.027 \pm 0.002	0.028 \pm 0.002	0.029 \pm 0.002
12/11/85 - 12/18/85	0.032 \pm 0.002	0.034 \pm 0.002	0.035 \pm 0.002	0.036 \pm 0.002	0.037 \pm 0.002	0.036 \pm 0.002	0.032 \pm 0.002
12/18/85 - 12/26/85	0.038 \pm 0.002	0.043 \pm 0.002	0.047 \pm 0.002	0.040 \pm 0.002	0.033 \pm 0.002	0.036 \pm 0.002	0.033 \pm 0.002
12/26/85 - 01/02/86	0.050 \pm 0.002	0.051 \pm 0.003	0.057 \pm 0.002	0.055 \pm 0.002	0.008 \pm 0.006	0.055 \pm 0.002	0.049 \pm 0.002

*Invalid sample.

TABLE IX (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (pCi/m³)

FOURTH QUARTER

1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Beta Activities ± Standard Deviation of the Mean</u>
10/02/85 - 10/09/85	0.032±0.002	0.034±0.002*	0.033±0.002	0.034±0.002	0.032±0.002	0.032±0.001
10/09/85 - 10/16/85	0.019±0.002	0.023±0.002	0.017±0.002	0.019±0.002	0.018±0.002	0.020±0.002
10/16/85 - 10/23/85	0.024±0.002	0.024±0.002	0.022±0.002	0.025±0.002	0.022±0.002	0.024±0.002
10/23/85 - 10/30/85	0.036±0.002	0.037±0.002	0.034±0.002	0.039±0.002	0.034±0.002	0.037±0.003
10/30/85 - 11/06/85	0.032±0.002	0.033±0.002	0.032±0.002	0.038±0.002	0.032±0.002	0.034±0.002
11/06/85 - 11/13/85	0.029±0.002	0.023±0.002	0.021±0.002	0.024±0.002	0.026±0.002	0.026±0.003
11/13/85 - 11/20/85	0.026±0.002	0.030±0.002	0.027±0.002	0.031±0.002	0.020±0.002	0.028±0.003
11/20/85 - 11/27/85	0.029±0.002	0.025±0.002	0.024±0.002	0.027±0.002	0.022±0.002	0.026±0.002
11/27/85 - 12/04/85	0.014±0.002	0.014±0.002	0.010±0.002	0.013±0.002	0.010±0.002	0.013±0.002
12/04/85 - 12/11/85	0.027±0.002	0.028±0.002	0.027±0.002	0.027±0.002	0.025±0.002	0.028±0.002
12/11/85 - 12/18/85	0.030±0.002	0.039±0.002	0.034±0.002	0.037±0.002	0.027±0.002	0.034±0.003
12/18/85 - 12/26/85	0.038±0.002	0.035±0.002	0.035±0.002	0.034±0.002	0.029±0.002	0.037±0.005
12/26/85 - 01/02/86	0.053±0.002	0.040±0.002	0.047±0.002	0.040±0.002	0.044±0.002	0.046±0.013

*Invalid sample.

TABLE X

GROSS BETA IN AIR PARTICULATE (pCi/m³)

STATION SUMMARY

1985

<u>Mean Gross Beta Activities ± Standard Deviation of the Mean</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>
Second Quarter	0.025±0.006	0.027±0.005	0.030±0.008	0.028±0.005	0.027±0.004	0.029±0.006
Third Quarter	0.024±0.004	0.025±0.005	0.024±0.005	0.023±0.003	0.024±0.004	0.024±0.004
Fourth Quarter	0.031±0.008	0.032±0.010	0.031±0.012	0.032±0.010	0.026±0.009	0.033±0.010
Annual	0.027±0.006	0.028±0.007	0.028±0.008	0.028±0.006	0.027±0.006	0.029±0.007

TABLE X (Cont.)

GROSS BETA IN AIR PARTICULATE (pCi/m³)

STATION SUMMARY

1985

<u>Mean Gross Beta Activities ± Standard Deviation of the Mean</u>	<u>Station 17A</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>
Second Quarter	0.026 _± 0.005	0.026 _± 0.005	0.028 _± 0.005	0.026 _± 0.005	0.030 _± 0.006	0.027 _± 0.005
Third Quarter	0.024 _± 0.004	0.023 _± 0.003	0.024 _± 0.004	0.025 _± 0.004	0.024 _± 0.003	0.025 _± 0.006
Fourth Quarter	0.029 _± 0.009	0.030 _± 0.009	0.029 _± 0.008	0.028 _± 0.009	0.030 _± 0.008	0.026 _± 0.008
Annual	0.026 _± 0.006	0.026 _± 0.006	0.027 _± 0.006	0.026 _± 0.006	0.028 _± 0.006	0.026 _± 0.006

TABLE XI
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
SECOND QUARTER
1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
05/22/85 - 05/29/85	*	*	*	*	*	*	*
05/29/85 - 06/05/85	*	*	*	*	*	*	*
06/05/85 - 06/12/85	*	*	*	*	*	*	*
06/12/85 - 06/19/85	*	*	*	*	*	*	*
06/19/85 - 06/26/85	*	*	*	*	*	*	*
06/26/85 - 07/03/85	*	*	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

TABLE XI (Cont.)
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
SECOND QUARTER
1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Alpha Activities ± Standard Deviation of the Mean</u>
05/22/85 - 05/29/85	*	*	*	*	*	*
05/29/85 - 06/05/85	*	*	*	*	*	*
06/05/85 - 06/12/85	*	*	*	*	*	*
06/12/85 - 06/19/85	*	*	*	*	*	*
06/19/85 - 06/26/85	*	*	*	*	*	*
06/26/85 - 07/03/85	*	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

TABLE XII
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
THIRD QUARTER
1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
07/03/85 - 07/10/85	*	*	*	*	*	*	*
07/10/85 - 07/17/85	*	*	*	*	*	*	*
07/17/85 - 07/24/85	*	*	*	*	*	*	*
07/24/85 - 07/31/85	*	*	**	*	*	*	*
07/31/85 - 08/07/85	*	**	**	*	*	*	*
08/07/85 - 08/14/85	*	*	*	*	*	*	*
08/14/85 - 08/21/85	*	*	*	*	*	*	*
08/21/85 - 08/28/85	*	*	*	*	*	*	*
08/28/85 - 09/04/85	*	*	*	*	*	*	*
09/04/85 - 09/11/85	*	*	*	*	*	*	*
09/11/85 - 09/18/85	*	*	*	*	*	*	*
09/18/85 - 09/25/85	*	*	*	*	*	*	*
09/25/85 - 10/02/85	*	**	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

**Invalid sample.

TABLE XII (Cont.)
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
THIRD QUARTER
1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Alpha Activities ± Standard Deviation of the Mean</u>
07/03/85 - 07/10/85	*	*	*	*	*	*
07/10/85 - 07/17/85	*	*	*	*	*	*
07/17/85 - 07/24/85	*	*	*	*	*	*
07/24/85 - 07/31/85	*	*	*	*	*	*
07/31/85 - 08/07/85	*	*	*	*	*	*
08/07/85 - 08/14/85	*	*	*	*	*	*
08/14/85 - 08/21/85	*	*	*	*	*	*
08/21/85 - 08/28/85	*	*	*	*	*	*
08/28/85 - 09/04/85	*	*	*	*	*	*
09/04/85 - 09/11/85	*	*	*	*	*	*
09/11/85 - 09/18/85	*	**	*	*	*	*
09/18/85 - 09/25/85	*	*	*	*	*	*
09/25/85 - 10/02/85	*	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

**Invalid sample.

TABLE XIII
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
FOURTH QUARTER
1985

<u>Collection Period</u>	<u>Station 1A</u>	<u>Station 4A</u>	<u>Station 6A</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15A</u>	<u>Station 17A</u>
10/02/85 - 10/09/85	*	*	*	*	*	*	*
10/09/85 - 10/16/85	*	*	*	*	*	**	*
10/16/85 - 10/23/85	*	*	*	*	*	**	*
10/23/85 - 10/30/85	*	*	*	*	*	*	*
10/30/85 - 11/06/85	*	*	*	*	*	*	*
11/06/85 - 11/13/85	*	*	*	*	*	*	*
11/13/85 - 11/20/85	*	*	*	*	*	*	*
11/20/85 - 11/27/85	*	*	*	*	*	*	*
11/27/85 - 12/04/85	*	*	*	*	*	*	*
12/04/85 - 12/11/85	*	**	*	*	*	*	*
12/11/85 - 12/18/85	*	*	*	*	*	*	*
12/18/85 - 12/26/85	*	*	*	*	*	*	*
12/26/85 - 01/02/86	*	*	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

**Invalid sample.

TABLE XIII (Cont.)
GROSS ALPHA IN AIR PARTICULATE DATA (pCi/m³)
FOURTH QUARTER
1985

<u>Collection Period</u>	<u>Station 21A</u>	<u>Station 29A</u>	<u>Station 35A</u>	<u>Station 40A</u>	<u>Station 44A</u>	<u>Weekly Mean Gross Alpha Activities + Standard Deviation of the Mean</u>
10/02/85 - 10/09/85	*	**	*	*	*	*
10/09/85 - 10/16/85	*	*	*	*	*	*
10/16/85 - 10/23/85	*	*	*	*	*	*
10/23/85 - 10/30/85	*	*	*	*	*	*
10/30/85 - 11/06/85	*	*	*	*	*	*
11/06/85 - 11/13/85	*	*	*	*	*	*
11/13/85 - 11/20/85	*	*	*	*	*	*
11/20/85 - 11/27/85	*	*	*	*	*	*
11/27/85 - 12/04/85	*	*	*	*	*	*
12/04/85 - 12/11/85	*	*	*	*	*	*
12/11/85 - 12/18/85	*	*	*	*	*	*
12/18/85 - 12/26/85	*	*	*	*	*	*
12/26/85 - 01/02/86	*	*	*	*	*	*

*Less than detection limit; 0.005 pCi/m³.

**Invalid sample.

Figure 3
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 1A

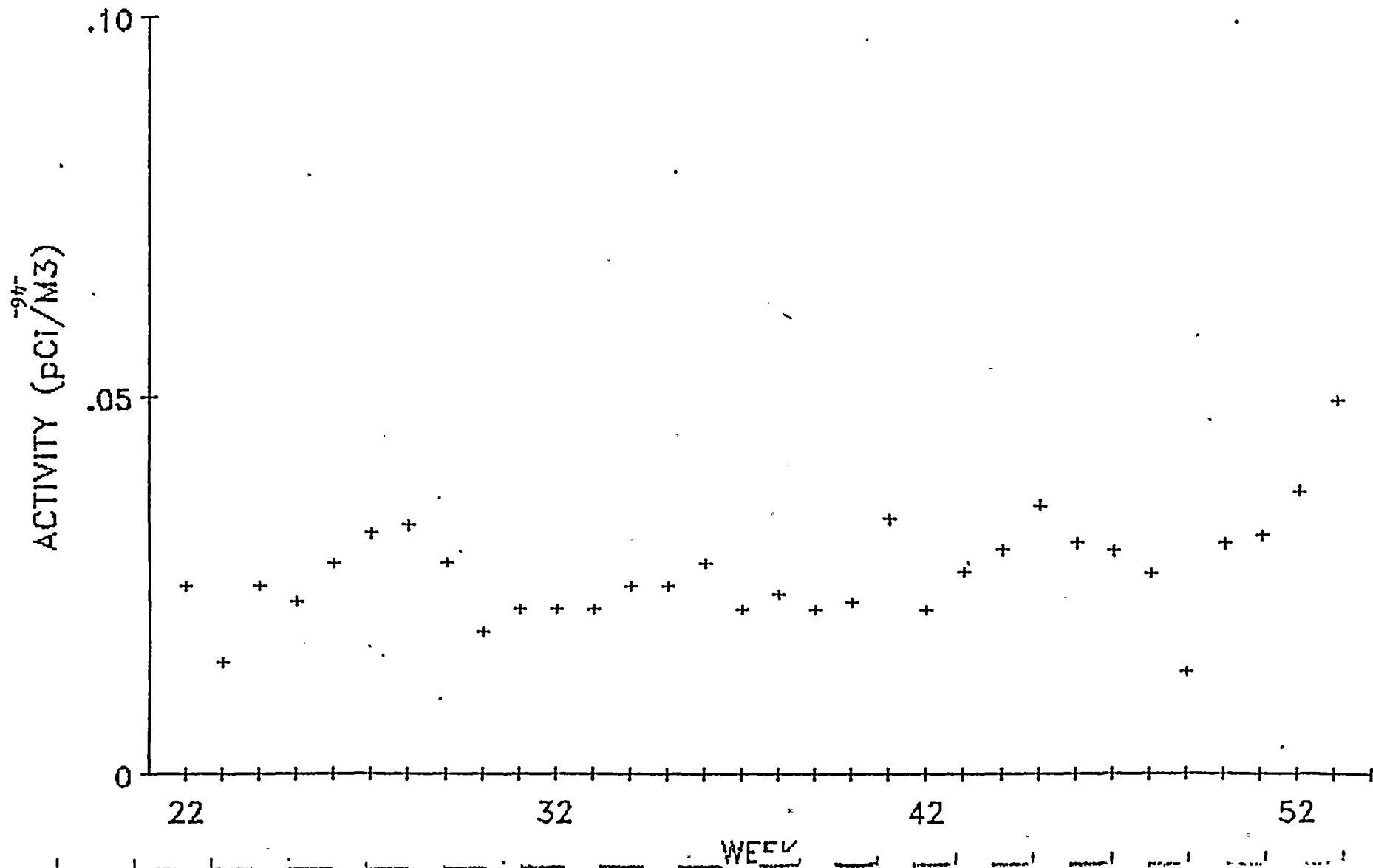


Figure 4
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 4A

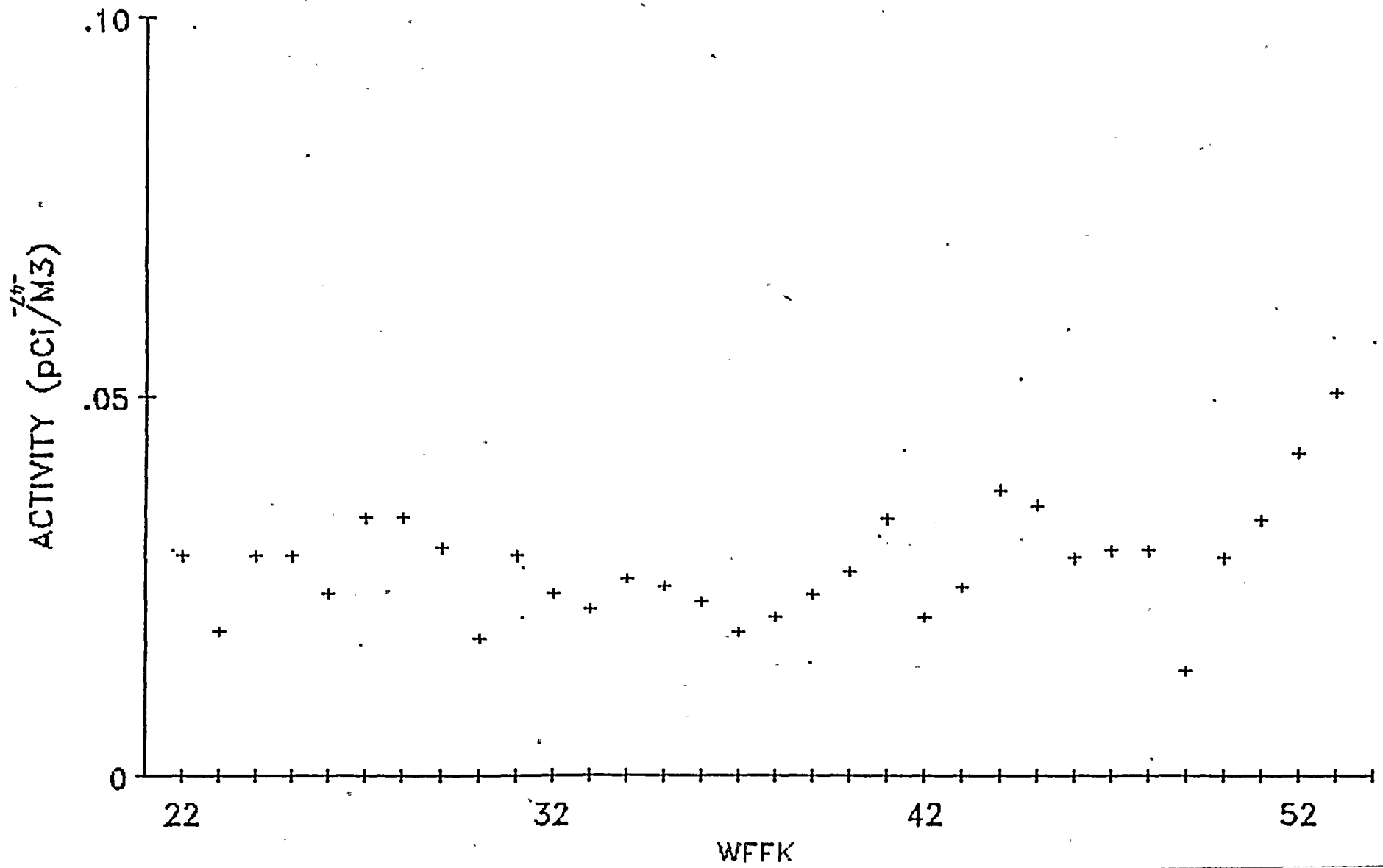


Figure 5
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 6A

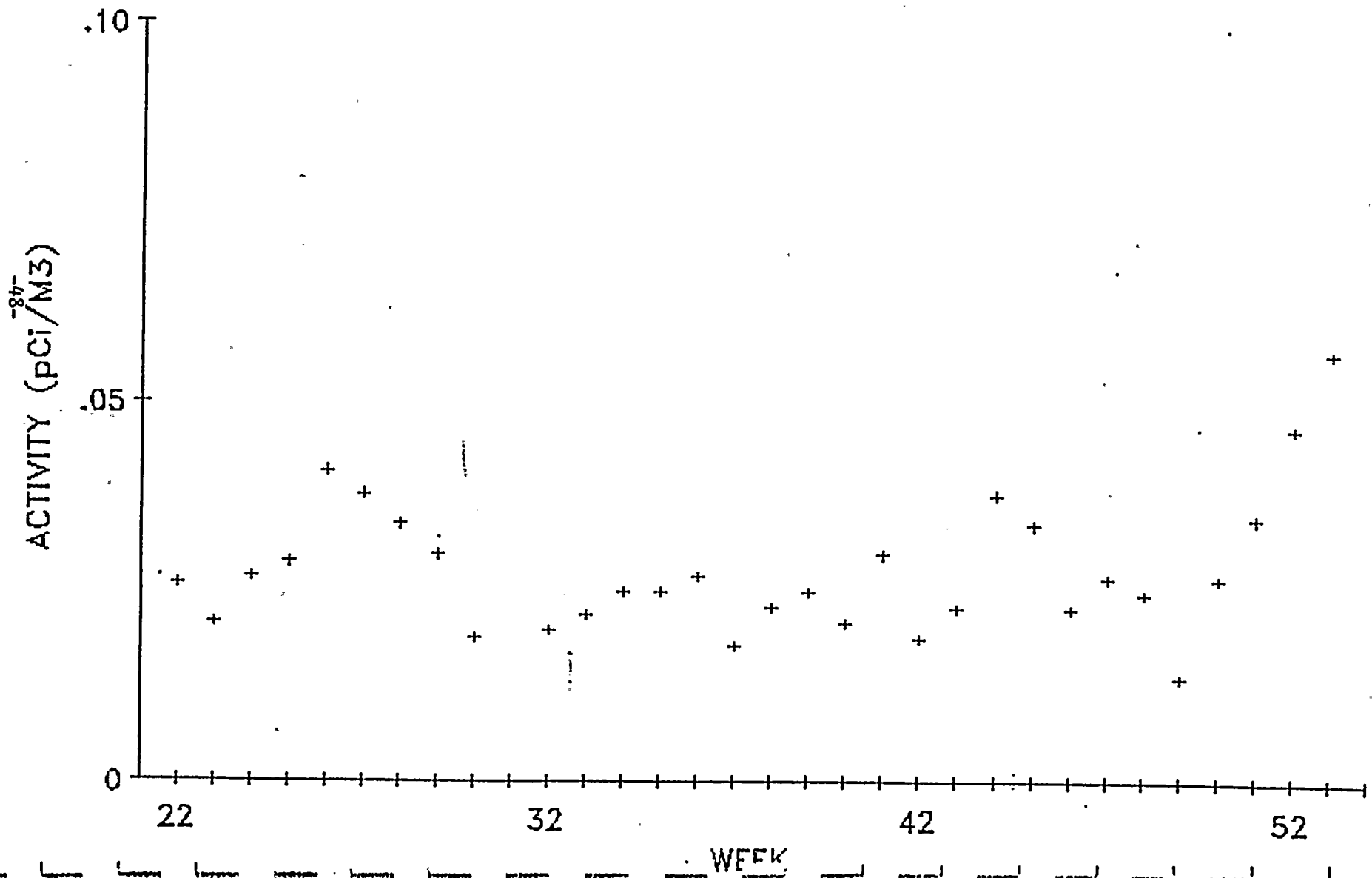


Figure 6
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 7A

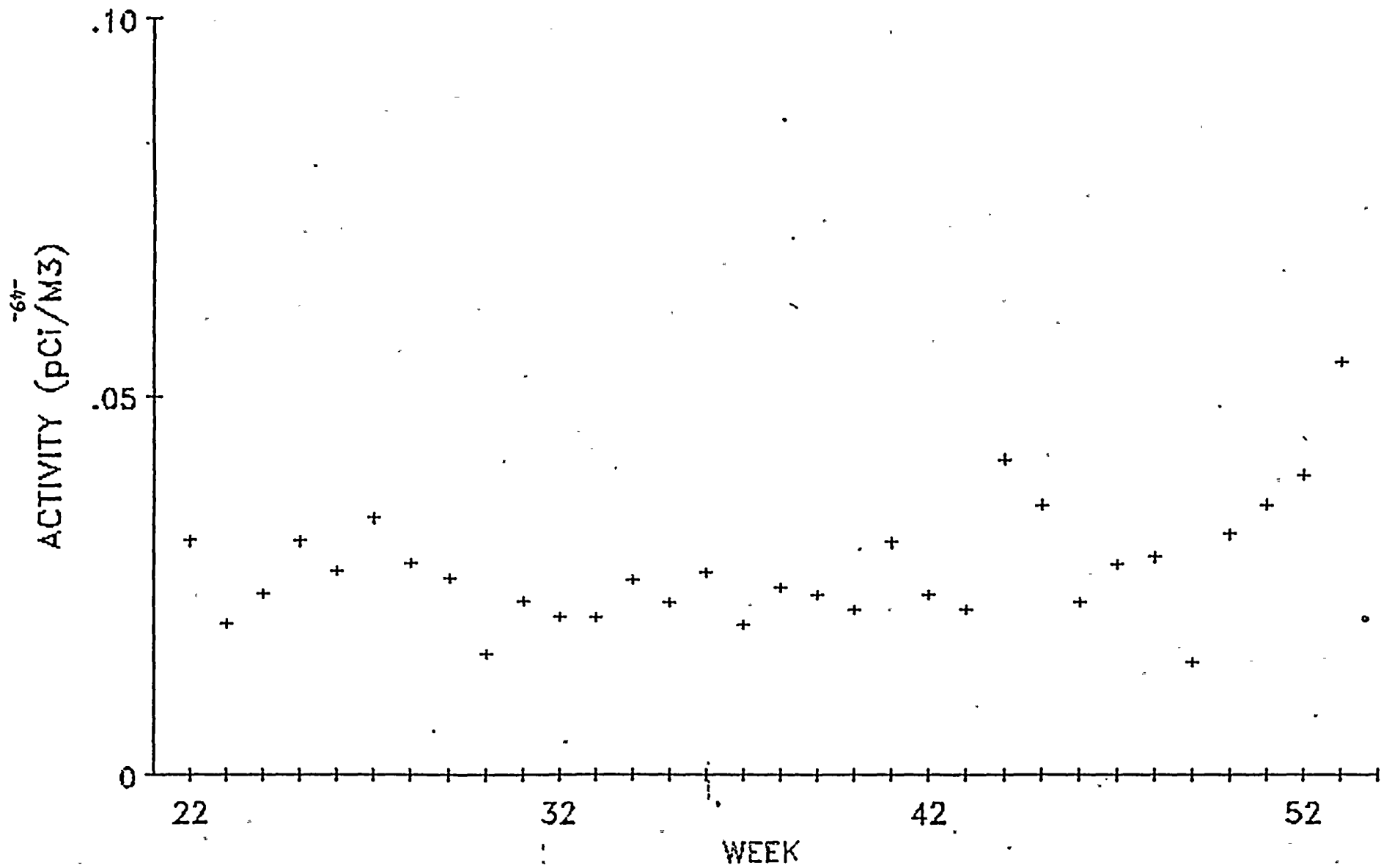


Figure 7
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 14A

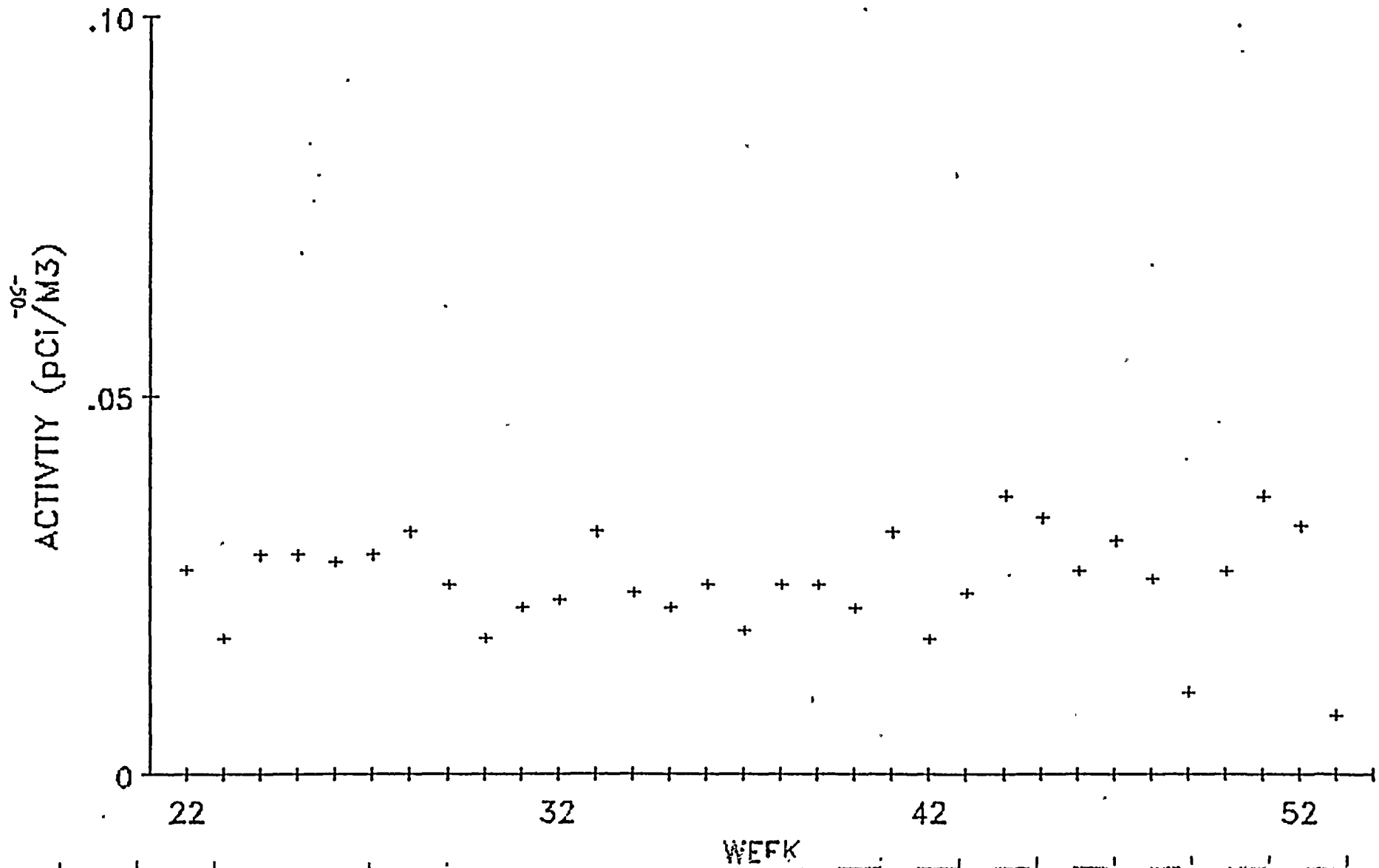


Figure 8
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 15A

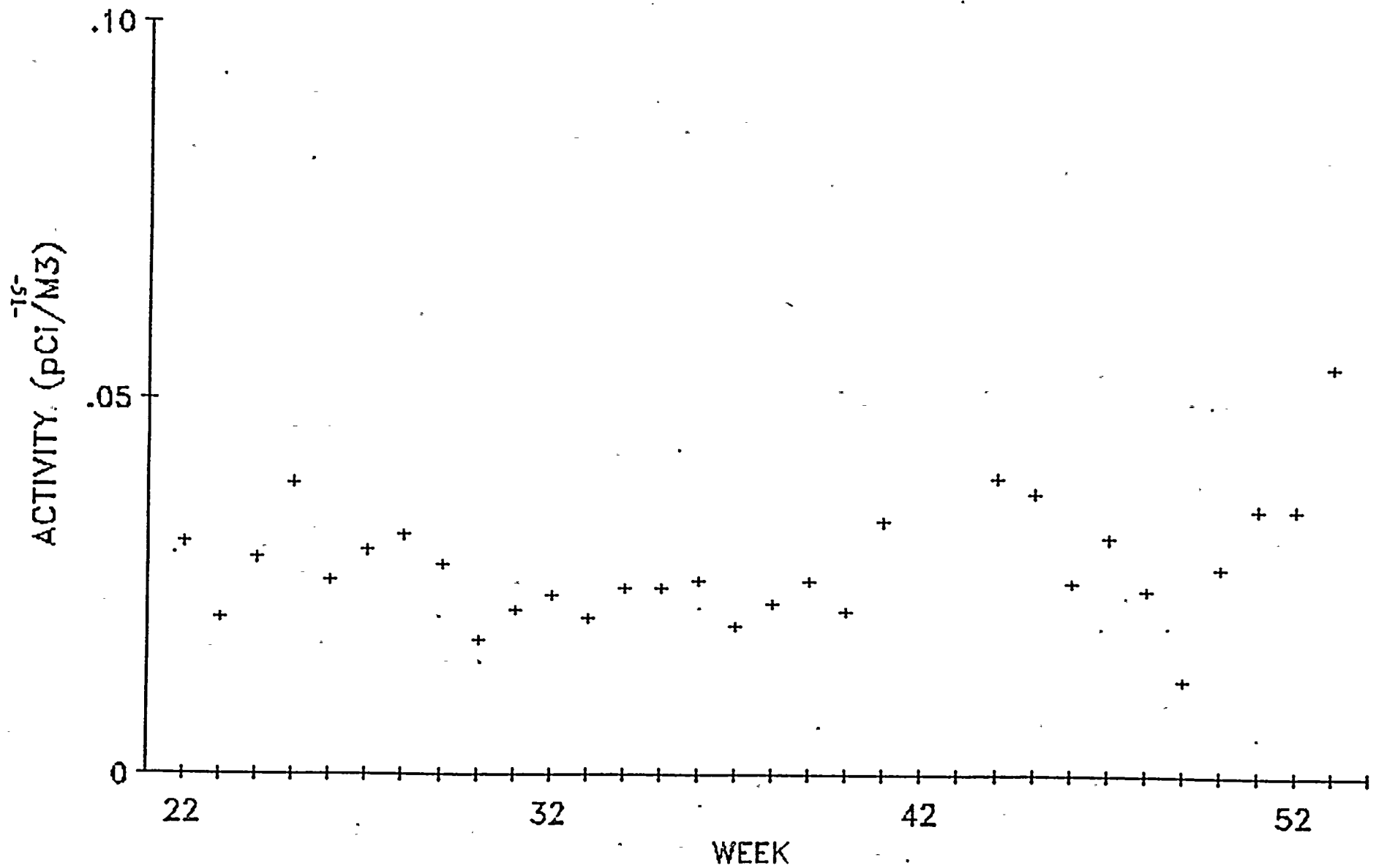


Figure 9
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 17A

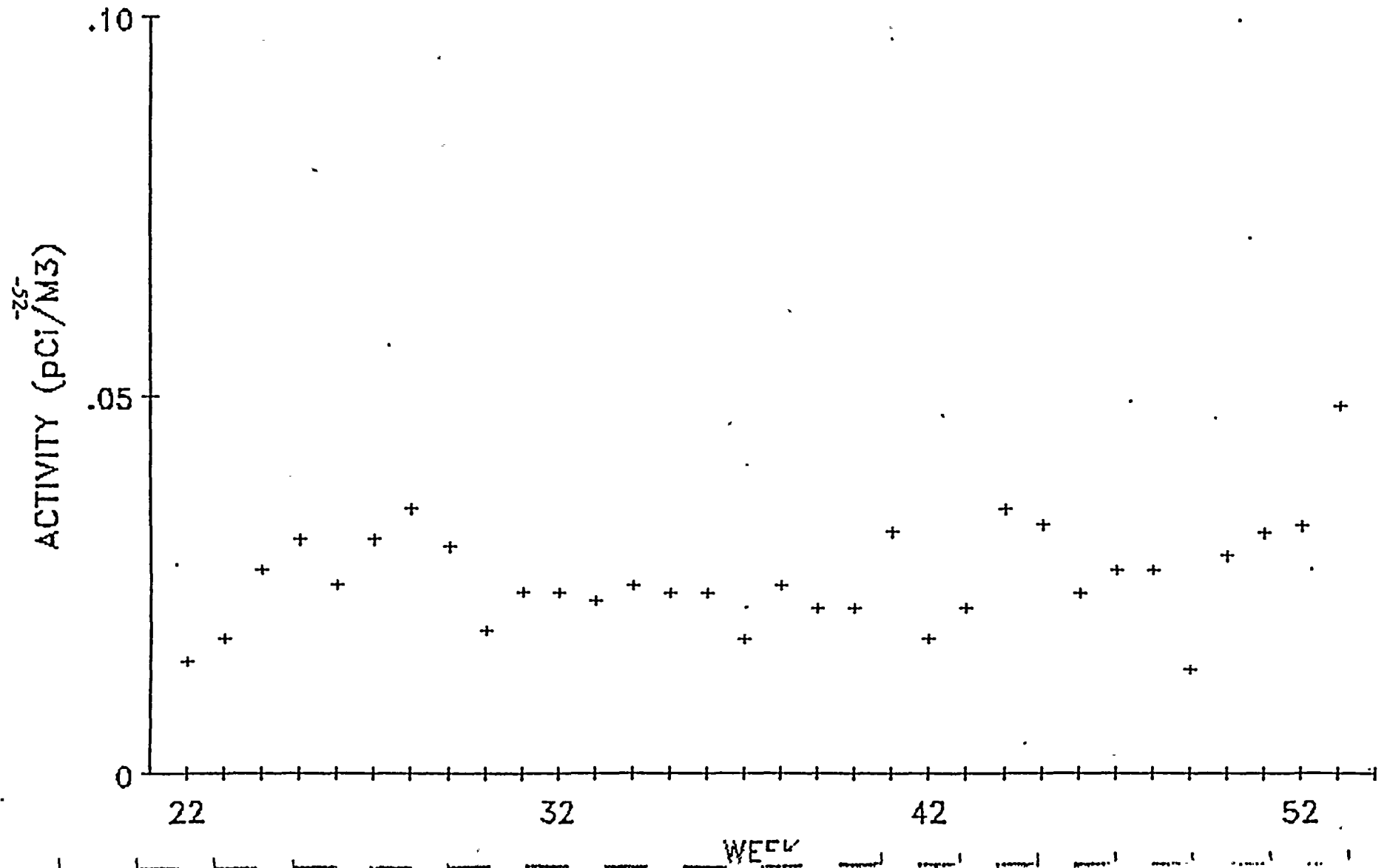


Figure 10
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 21A

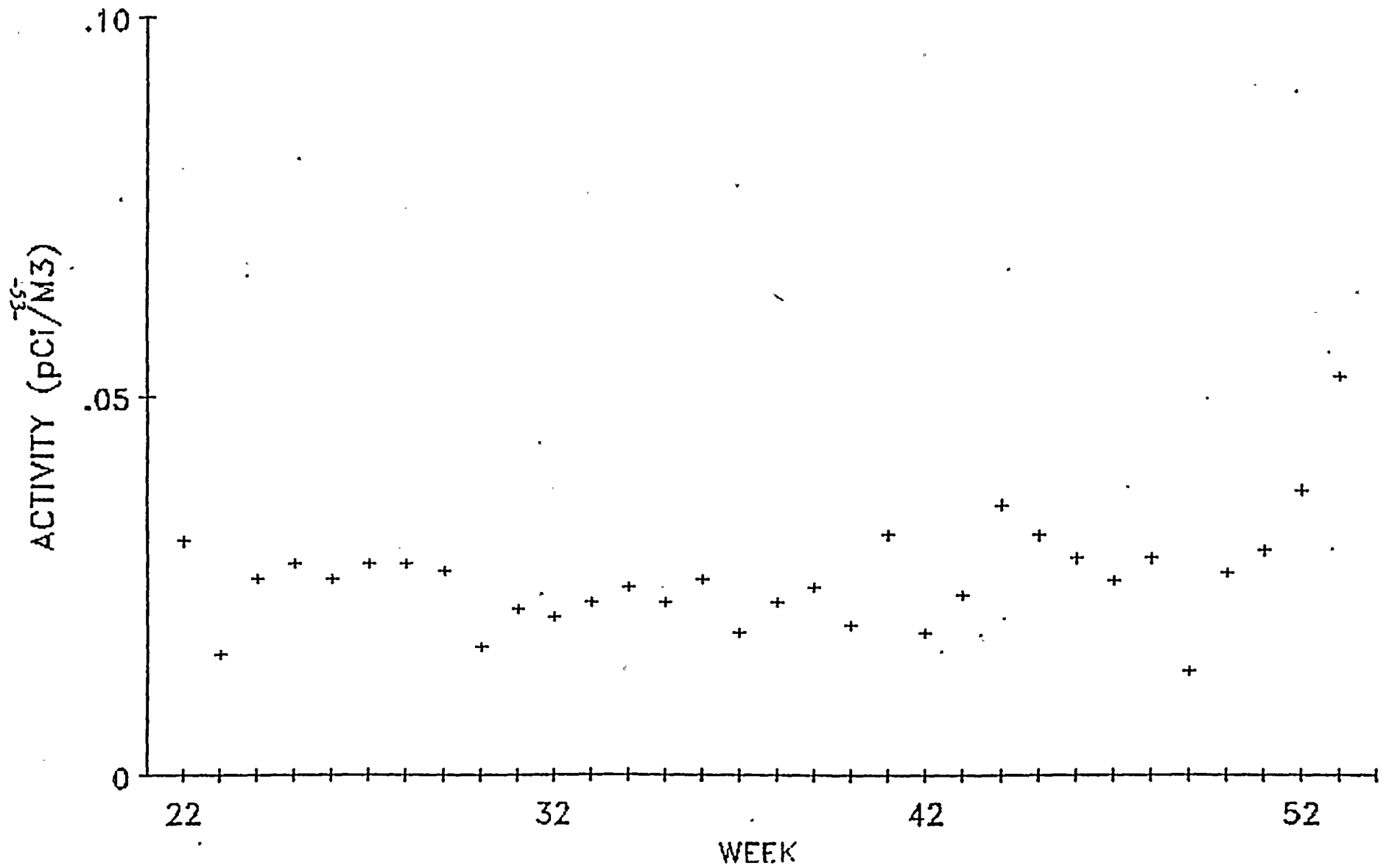


Figure 11
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 29A

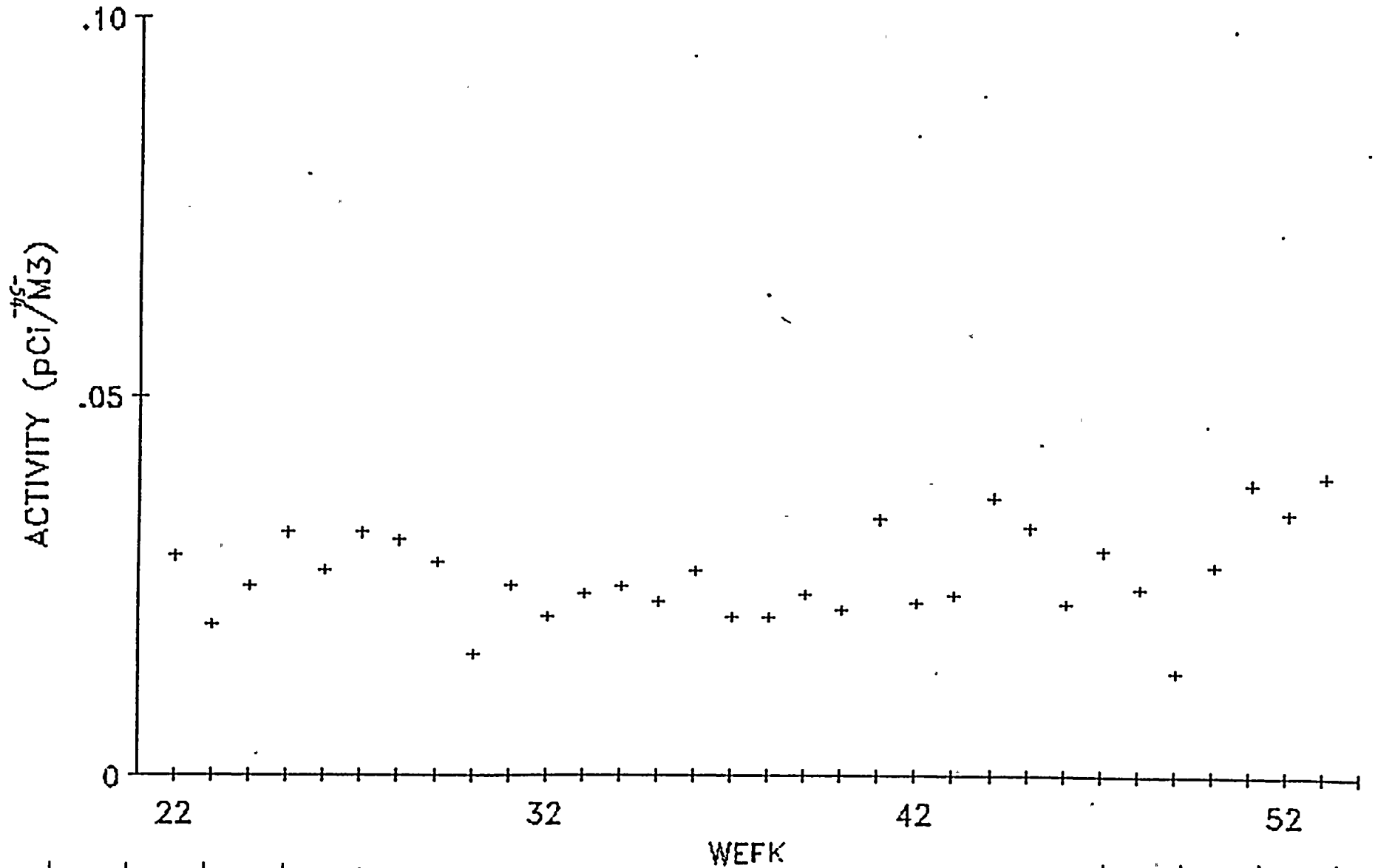


Figure 12
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 35A

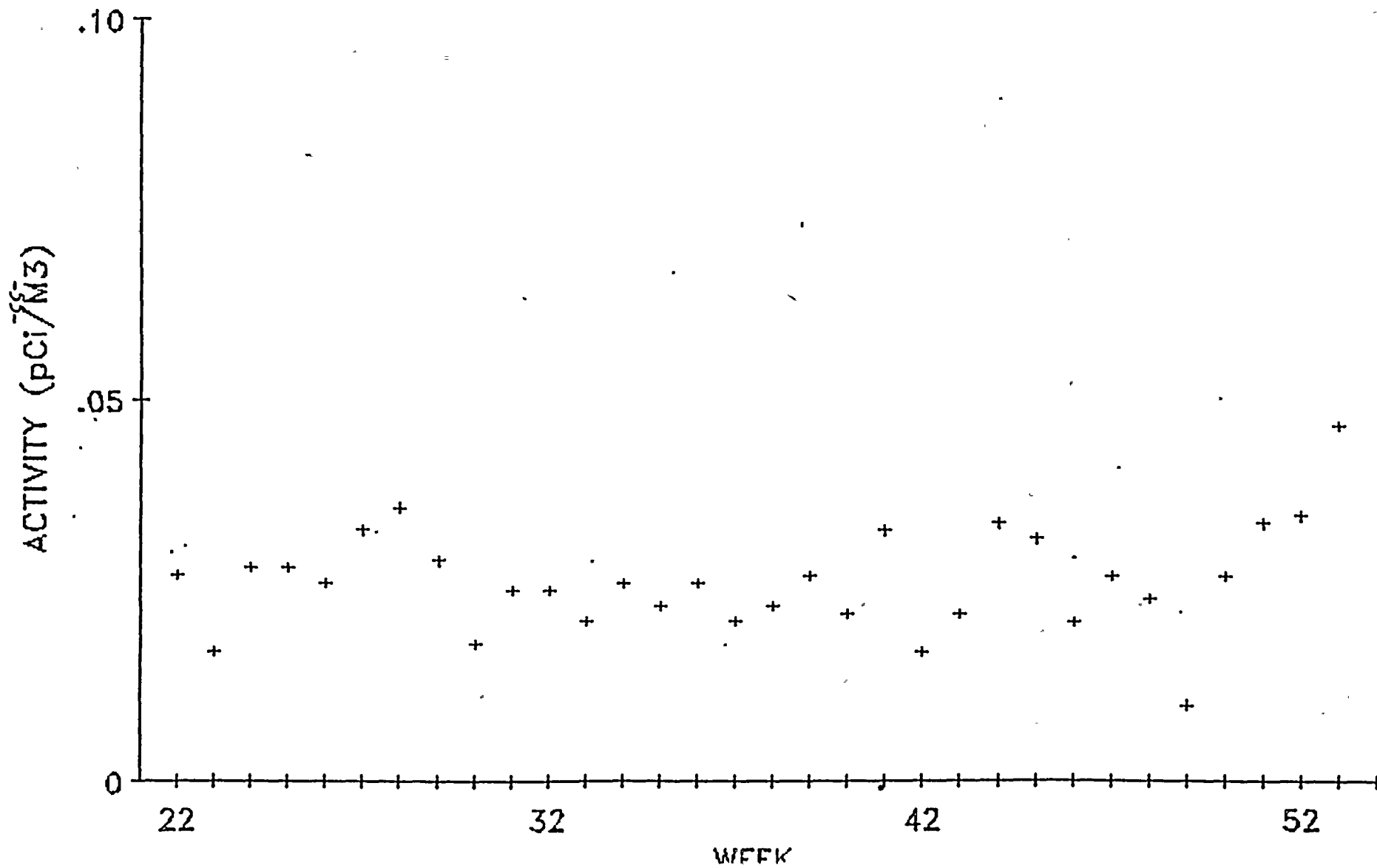


Figure 13
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 40A

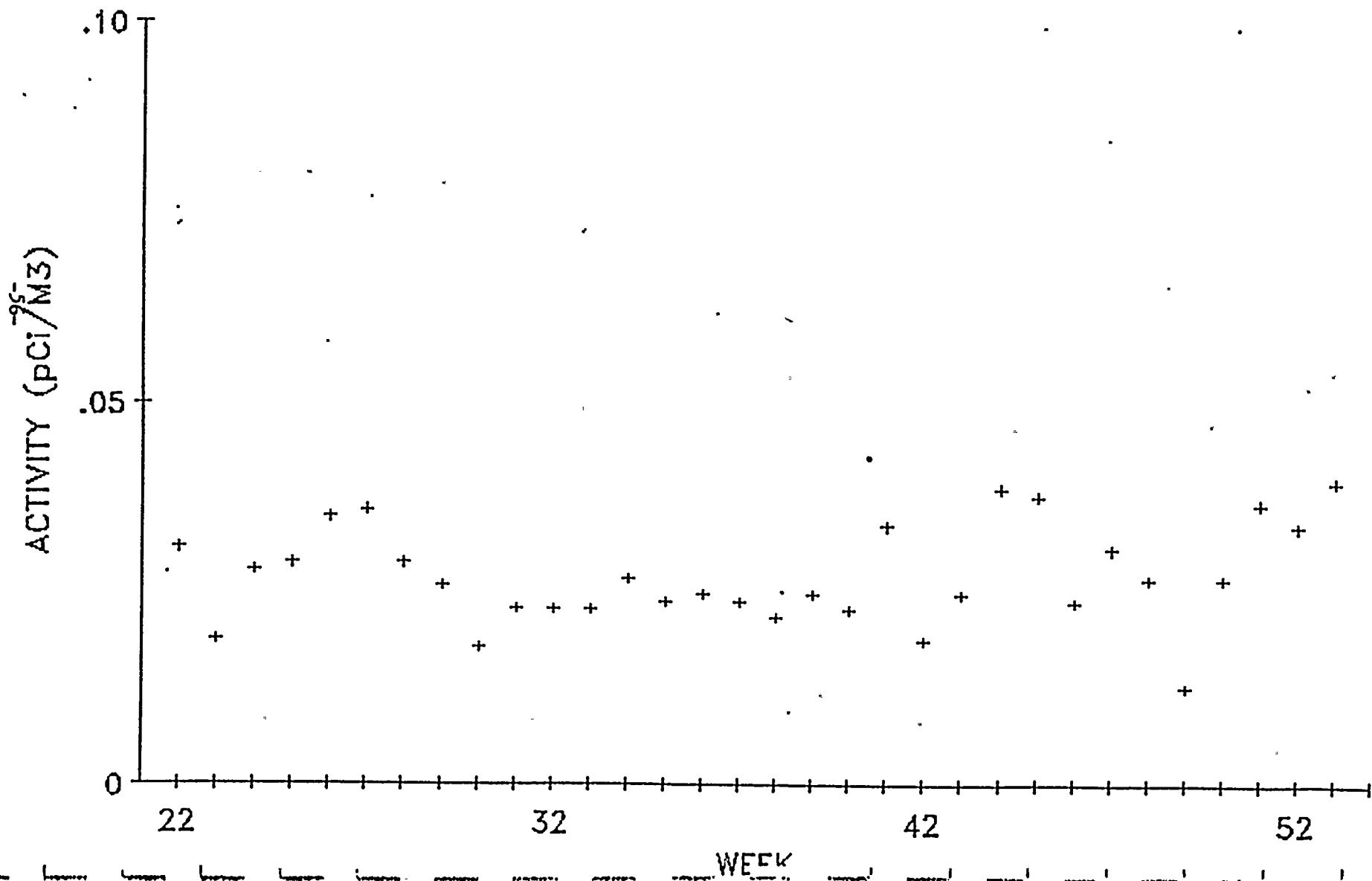


Figure 14
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1985
STATION 44A

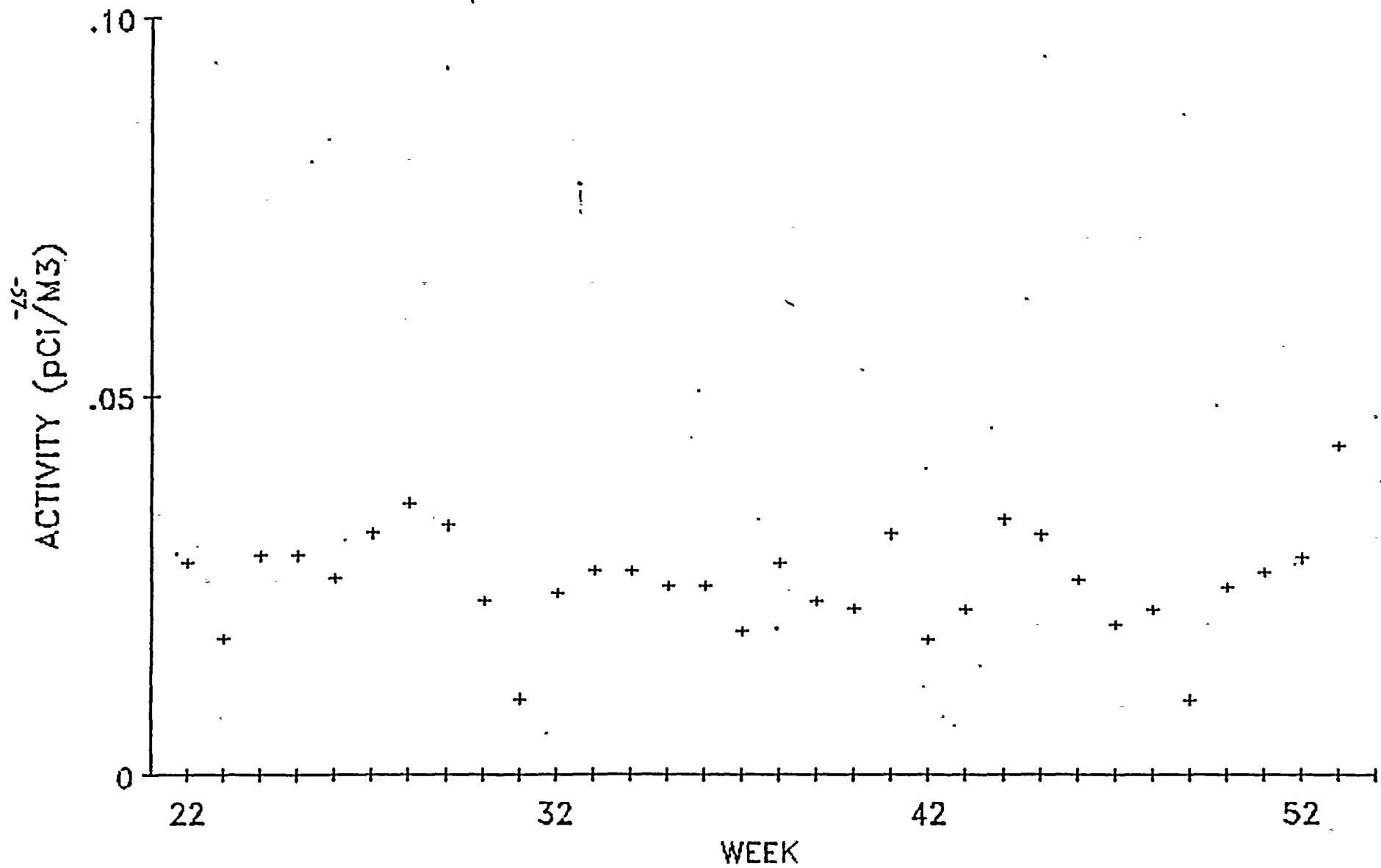
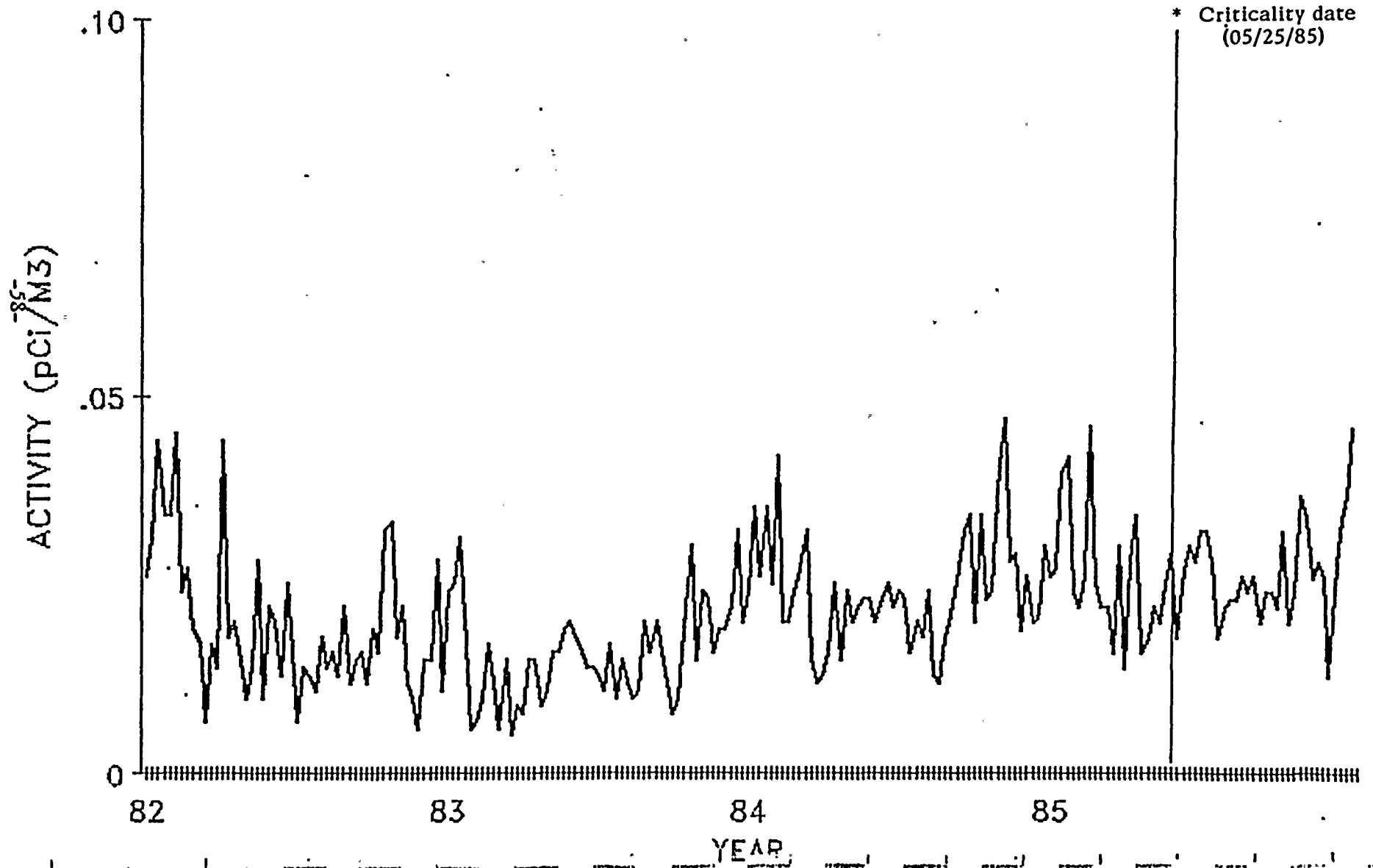


Figure 15
GROSS BETA IN AIR PARTICULATES
MEAN WEEKLY ACTIVITY
1982-1985



8.2 Airborne Radioiodine

Samples for airborne radioiodine monitoring are collected concurrently with the air particulate samples. These samples are collected in charcoal cartridges and analyzed for I-131.

As can be seen in Table XIV no radioiodine samples collected during the second quarter of 1985 showed observable I-131 activity.

Third quarter radioiodine data may be found in Table XV. No samples indicated I-131 activity above the detection limit of 0.007 pCi/m^3 .

As can be seen in Table XVI no radioiodine samples collected during the fourth quarter of 1985 showed observable I-131 activity.

TABLE XIV
AIRBORNE RADIOIODINE
SECOND QUARTER
1985

<u>Collection Period</u>	<u>Station 1</u>	<u>Station 4</u>	<u>Station 6</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15</u>	<u>Station 17A</u>
05/22/85 - 05/29/85	*	*	*	*	*	*	*
05/29/85 - 06/05/85	*	*	*	*	*	*	*
06/05/85 - 06/12/85	*	*	*	*	*	*	*
06/12/85 - 06/19/85	*	*	*	*	*	*	*
06/19/85 - 06/26/85	*	*	*	*	*	*	*
06/26/85 - 07/03/85	*	*	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

TABLE XIV (Cont.)
AIRBORNE RADIOIODINE
SECOND QUARTER
1985

<u>Collection Period</u>	<u>Station 21</u>	<u>Station 29</u>	<u>Station 35</u>	<u>Station 40</u>	<u>Station 44</u>
05/22/85 - 05/29/85	*	*	*	*	*
05/29/85 - 06/05/85	*	*	*	*	*
06/05/85 - 06/12/85	*	*	*	*	*
06/12/85 - 06/19/85	*	*	*	*	*
06/19/85 - 06/26/85	*	*	*	*	*
06/26/85 - 07/03/85	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

TABLE XV
AIRBORNE RADIOIODINE
THIRD QUARTER
1985

<u>Collection Period</u>	<u>Station 1</u>	<u>Station 4</u>	<u>Station 6</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15</u>	<u>Station 17A</u>
07/03/85 - 07/10/85	*	*	*	*	*	*	*
07/10/85 - 07/17/85	*	*	*	*	*	*	*
07/17/85 - 07/24/85	*	*	*	*	*	*	*
07/24/85 - 07/31/85	*	*	**	*	*	*	*
07/31/85 - 08/07/85	*	*	*	*	*	*	*
08/07/85 - 08/14/85	*	*	*	*	*	*	*
08/14/85 - 08/21/85	*	*	*	*	*	*	*
08/21/85 - 08/28/85	*	*	*	*	*	*	*
08/28/85 - 09/04/85	*	*	*	*	*	*	*
09/04/85 - 09/11/85	*	*	*	*	*	*	*
09/11/85 - 09/18/85	*	*	*	*	*	*	*
09/18/85 - 09/25/85	*	*	*	*	*	*	*
09/25/85 - 10/02/85	*	*	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

**Invalid sample.

TABLE XV (Cont.)
AIRBORNE RADIOIODINE
THIRD QUARTER
1985

<u>Collection Period</u>	<u>Station 21</u>	<u>Station 29</u>	<u>Station 35</u>	<u>Station 40</u>	<u>Station 44</u>
07/03/85 - 07/10/85	*	*	*	*	*
07/10/85 - 07/17/85	*	*	*	*	*
07/17/85 - 07/24/85	*	*	*	*	*
07/24/85 - 07/31/85	*	*	*	*	*
07/31/85 - 08/07/85	*	*	*	*	*
08/07/85 - 08/14/85	*	*	*	*	*
08/14/85 - 08/21/85	*	*	*	*	*
08/21/85 - 08/28/85	*	*	*	*	*
08/28/85 - 09/04/85	*	*	*	*	*
09/04/85 - 09/11/85	*	*	*	*	*
09/11/85 - 09/18/85	*	*	*	*	*
09/18/85 - 09/25/85	*	*	*	*	*
09/25/85 - 10/02/85	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

TABLE XVI
AIRBORNE RADIOIODINE
FOURTH QUARTER
1985

<u>Collection Period</u>	<u>Station 1</u>	<u>Station 4</u>	<u>Station 6</u>	<u>Station 7A</u>	<u>Station 14A</u>	<u>Station 15</u>	<u>Station 17A</u>
10/02/85 - 10/09/85	*	*	*	*	*	**	*
10/09/85 - 10/16/85	*	*	*	*	*	**	*
10/16/85 - 10/23/85	*	*	*	*	*	*	*
10/23/85 - 10/30/85	*	*	*	*	*	*	*
10/30/85 - 11/06/85	*	*	*	*	*	*	*
11/06/85 - 11/13/85	*	*	*	*	*	*	*
11/13/85 - 11/20/85	*	*	*	*	*	*	*
11/20/85 - 11/27/85	*	*	*	*	*	*	*
11/27/85 - 12/04/85	*	*	*	*	*	*	*
12/04/85 - 12/11/85	*	*	*	*	*	*	*
12/11/85 - 12/18/85	*	*	*	*	*	*	*
12/18/85 - 12/26/85	*	*	*	*	*	*	*
12/26/85 - 01/02/86	*	*	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

**Invalid sample.

TABLE XVI (Cont.)
AIRBORNE RADIOIODINE
FOURTH QUARTER
1985

<u>Collection Period</u>	<u>Station 21</u>	<u>Station 29</u>	<u>Station 35</u>	<u>Station 40</u>	<u>Station 44</u>
10/02/85 - 10/09/85	*	*	*	*	*
10/09/85 - 10/16/85	*	*	*	*	*
10/16/85 - 10/23/85	*	*	*	*	*
10/23/85 - 10/30/85	*	*	*	*	*
10/30/85 - 11/06/85	*	*	*	*	*
11/06/85 - 11/13/85	*	*	*	*	*
11/13/85 - 11/20/85	*	*	*	*	*
11/20/85 - 11/27/85	*	*	*	*	*
11/27/85 - 12/04/85	*	*	*	*	*
12/04/85 - 12/11/85	*	*	*	*	*
12/11/85 - 12/18/85	*	*	*	*	*
12/18/85 - 12/26/85	*	*	*	*	*
12/26/85 - 01/02/86	*	*	*	*	*

*Iodine-131 activity less than 0.007 pCi/m³.

8.3 Thermoluminescent Dosimetry

Thermoluminescent dosimeters were placed in fifty locations ranging from one to forty-five miles from the Palo Verde Nuclear Generating Station. Beginning in 1984 the Panasonic Model 812 Dosimeter replaced all other TLD's in use. The 812 is a multi-element dosimeter combining 2 elements of Lithium Borate and 2 Calcium Sulfate elements.

Tables XVII to XIX present the results of the Quarterly exposures for 1985. Quarterly data obtained from TLD's are graphically presented in Figures 16 to 18.

Differences in individual station mean values represent statistical variation more so than actual fluctuations in the background radiation around the Palo Verde Nuclear Generating Station and tend to vary about an approximate mean of 24 mRem/quarter. Operational data for 1985 compare very closely with pre-operational data.

Figure 19 illustrates the mean TLD activity from 1981 through 1985. These values were obtained by averaging all TLD's in the field during the quarter. (The control TLD was not included). Figure 19 illustrates the mean exposure with high and low standard deviations of the mean for each quarter.

TABLE XVII
QUARTERLY THERMOLUMINESCENT DOSIMETRY
SECOND QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
1	APS Goodyear, E 30 Office	23.0
2	ENE 24 Scott-Libby School	23.5
3	E 25, Liberty School	23.0
4	E 20, APS Buckeye School	26.0
5	ESE 15, Palo Verde	21.0
6	SSE 35, APS Gila Bend Sub-station	29.0
7	SE 8, Arlington School	29.0
8	SSE, Corner of 363rd Ave. and SPP Rd.	23.0
9	S5, Corner of 371st Ave. and SPP Rd.	30.0
10	SE 5, Corner of 355th Ave. and Ward Rd.	25.5
11	ESE 5, Corner of 339th Ave. and Dobbins Rd.	26.5
12	E5, Corner of 339th Ave., and B-S Rd.	26.0
13	N 1, N Site Boundary	25.5
14	NNE 2, NNE Site Boundary	27.0
15	NE 2, Site Boundary	25.0
16	ENE 2, ENE Site Boundary	24.0
17	E 2, E Site Boundary	27.0
18	ESE 2, ESE Site Boundary	24.5
19	SE 2, SE Site Boundary	27.0
20	SSE 2, SSE Site Boundary	26.0
21	S 3, S Site Boundary	27.0
22	SSW 3, SSW Site Boundary	28.0
23	W 5, Benchmark at Baseline	24.5
24	SW 5, Ward Rd. at Well 18bbb	24.5
25	WSW 5, Ward Rd. at DF Well 2 Rd.	*
26	SSW Well 21 Cbb2	Missing

*Missing data

TABLE XVII (Cont.)
QUARTERLY THERMOLUMINESCENT DOSIMETRY
SECOND QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
27	SW 2, SW Site Boundary	27.0
28	WSW 1, WSW Site Boundary	27.0
29	W 1, W Site Boundary	26.0
30	WNW 1, WNW Site Boundary	27.0
31	NW 2, NW Site Boundary	23.0
32	NNW 1, NNW Site Boundary	26.0
33	NW 5, Yuma Rd., ½ mile W of Belmont Rd.	29.0
34	NNW 5, Corner of Belmont Rd. and Van Buren Rd.	29.0
35	NNW 9, Tonopah, Palo Verde Inn Fire Station	30.0
36	N 5, Corner of Wintersburg Rd. and Van Buren Rd.	26.0
37	NNE 5, Corner of 363rd Ave. and Van Buren Rd.	24.0
38	Corner of 355th Ave. and Yuma Rd.	23.0
39	ENE 5, 343rd Ave., ½ mile S of L. Buckeye	24.0
40	N 3, Trailer Park at Wintersburg	25.0
41	WNW 20, Harquahala Valley School	27.0
42	N 8, Ruth Fisher School	*
43	N 45, Vulture Mine Rd. School, Wickenburg	Missing
44	ENE 35, APS El Mirage Office, Sun City	23.0
45	ENE 50, APS Deer Valley Office	7.0
46	Litchfield Park School	24.0
47	Littleton School, Cashion	29.0
48	Perryville	26.0
49	Hopeville	24.0
50	Clinski Rd., 5 mile, WNW Sector	21.0

*Missing data

TABLE XVIII
QUARTERLY THERMOLUMINESCENT DOSIMETRY
THIRD QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
1	APS Goodyear, E 30 Office	24.0
2	ENE 24 Scott-Libby School	26.0
3	E 25, Liberty School	25.0
4	E 20, APS Buckeye School	27.0
5	ESE 15, Palo Verde	21.0
6	SSE 35, APS Gila Bend Sub-station	30.0
7	SE 8, Arlington School	30.0
8	SSE, Corner of 363rd Ave. and SPP Rd.	26.0
9	S5, Corner of 371st Ave. and SPP Rd.	35.0
10	SE 5, Corner of 355th Ave. and Ward Rd.	27.0
11	ESE 5, Corner of 339th Ave. and Dobbins Rd.	29.0
12	E5, Corner of 339th Ave., and B-S Rd.	27.0
13	N 1, N Site Boundary	29.0
14	NNE 2, NNE Site Boundary	29.0
15	NE 2, Site Boundary	27.0
16	ENE 2, ENE Site Boundary	24.0
17	E 2, E Site Boundary	28.0
18	ESE 2, ESE Site Boundary	27.0
19	SE 2, SE Site Boundary	28.0
20	SSE 2, SSE Site Boundary	28.0
21	S 3, S Site Boundary	30.0
22	SSW 3, SSW Site Boundary	30.0
23	W 5, Benchmark at Baseline	28.0
24	SW 5, Ward Rd. at Well 18bbb	25.0
25	WSW 5, Ward Rd. at DF Well 2 Rd.	26.0
26	SSW Well 21 Cbb ₂	29.0

TABLE XVIII (Cont.)
QUARTERLY THERMOLUMINESCENT DOSIMETRY
THIRD QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
27	SW 2, SW Site Boundary	29.0
28	WSW 1, WSW Site Boundary	29.0
29	W 1, W Site Boundary	29.0
30	WNW 1, WNW Site Boundary	29.0
31	NW 2, NW Site Boundary	28.0
32	NNW 1, NNW Site Boundary	28.0
33	NW 5, Yuma Rd., ½ mile W of Belmont Rd.	32.0
34	NNW 5, Corner of Belmont Rd. and Van Buren Rd.	31.0
35	NNW 9, Tonopah, Palo Verde Inn Fire Station	34.0
36	N 5, Corner of Wintersburg Rd. and Van Buren Rd.	28.0
37	NNE 5, Corner of 363rd Ave. and Van Buren Rd.	30.0
38	Corner of 355th Ave. and Yuma Rd.	31.0
39	ENE 5, 343rd Ave., ½ mile S of L. Buckeye	27.0
40	N 3, Trailer Park at Wintersburg	27.0
41	WNW 20, Harquahala Valley School	31.0
42	N 8, Ruth Fisher School	29.0
43	N 45, Vulture Mine Rd. School, Wickenburg	31.0
44	ENE 35, APS El Mirage Office, Sun City	25.0
45	ENE 50, APS Deer Valley Office	8.5
46	Litchfield Park School	25.0
47	Littleton School, Cashion	30.0
48	Perryville	26.0
49	Hopeville	25.0
50	Olinski Rd., 5 mile, WNW Sector	22.0

TABLE XIX
QUARTERLY THERMOLUMINESCENT DOSIMETRY
FOURTH QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
1	APS Goodyear, E 30 Office	23.0
2	ENE 24 Scott-Libby School	24.2
3	E 25, Liberty School	21.3
4	E 20, APS Buckeye School	25.2
5	ESE 15, Palo Verde	20.6
6	SSE 35, APS Gila Bend Sub-station	29.1
7	SE 8, Arlington School	28.3
8	SSE, Corner of 363rd Ave. and SPP Rd.	24.4
9	S5, Corner of 371st Ave. and SPP Rd.	32.5
10	SE 5, Corner of 355th Ave. and Ward Rd.	25.3
11	ESE 5, Corner of 339th Ave. and Dobbins Rd.	26.0
12	E5, Corner of 339th Ave., and B-S Rd.	25.4
13	N 1, N Site Boundary	26.2
14	NNE 2, NNE Site Boundary	26.9
15	NE 2, Site Boundary	25.8
16	ENE 2, ENE Site Boundary	24.0
17	E 2, E Site Boundary	26.2
18	ESE 2, ESE Site Boundary	25.0
19	SE 2, SE Site Boundary	27.2
20	SSE 2, SSE Site Boundary	26.3
21	S 3, S Site Boundary	27.2
22	SSW 3, SSW Site Boundary	28.2
23	W 5, Benchmark at Baseline	24.8
24	SW 5, Ward Rd. at Well 18bbb	23.8
25	WSW 5, Ward Rd. at DF Well 2 Rd.	24.8
26	SSW Well 21 Cbb ₂	29.2

TABLE XIX (Cont.)

QUARTERLY THERMOLUMINESCENT DOSIMETRY

FOURTH QUARTER 1985

<u>Map Location</u>	<u>Collection Location</u>	<u>Total Exposure (mrem)</u>
27	SW 2, SW Site Boundary	29.6
28	WSW 1, WSW Site Boundary	27.6
29	W 1, W Site Boundary	27.1
30	WNW 1, WNW Site Boundary	28.7
31	NW 2, NW Site Boundary	25.0
32	NNW 1, NNW Site Boundary	27.2
33	NW 5, Yuma Rd., ½ mile W of Belmont Rd.	30.3
34	NNW 5, Corner of Belmont Rd. and Van Buren Rd.	29.9
35	NNW 9, Tonopah, Palo Verde Inn Fire Station	33.7
36	N 5, Corner of Wintersburg Rd. and Van Buren Rd.	26.7
37	NNE 5, Corner of 363rd Ave. and Van Buren Rd.	25.3
38	Corner of 355th Ave. and Yuma Rd.	29.4
39	ENE 5, 343rd Ave., ½ mile S of L. Buckeye	25.7
40	N 3, Trailer Park at Wintersburg	26.4
41	WNW 20, Harquahala Valley School	27.9
42	N 8, Ruth Fisher School	26.5
43	N 45, Vulture Mine Rd. School, Wickenburg	29.4
44	ENE 35, APS El Mirage Office, Sun City	23.0
45	ENE 50, APS Deer Valley Office	7.5
46	Litchfield School	24.9
47	Littleton School, Cashion	30.1
48	Perryville	24.1
49	Hopeville	24.3
50	Olinski Rd., 5 mile, WNW Sector	21.2

Figure 16
QUARTERLY THERMOLUMINESCENT DOSIMETRY
SECOND QUARTER
1985

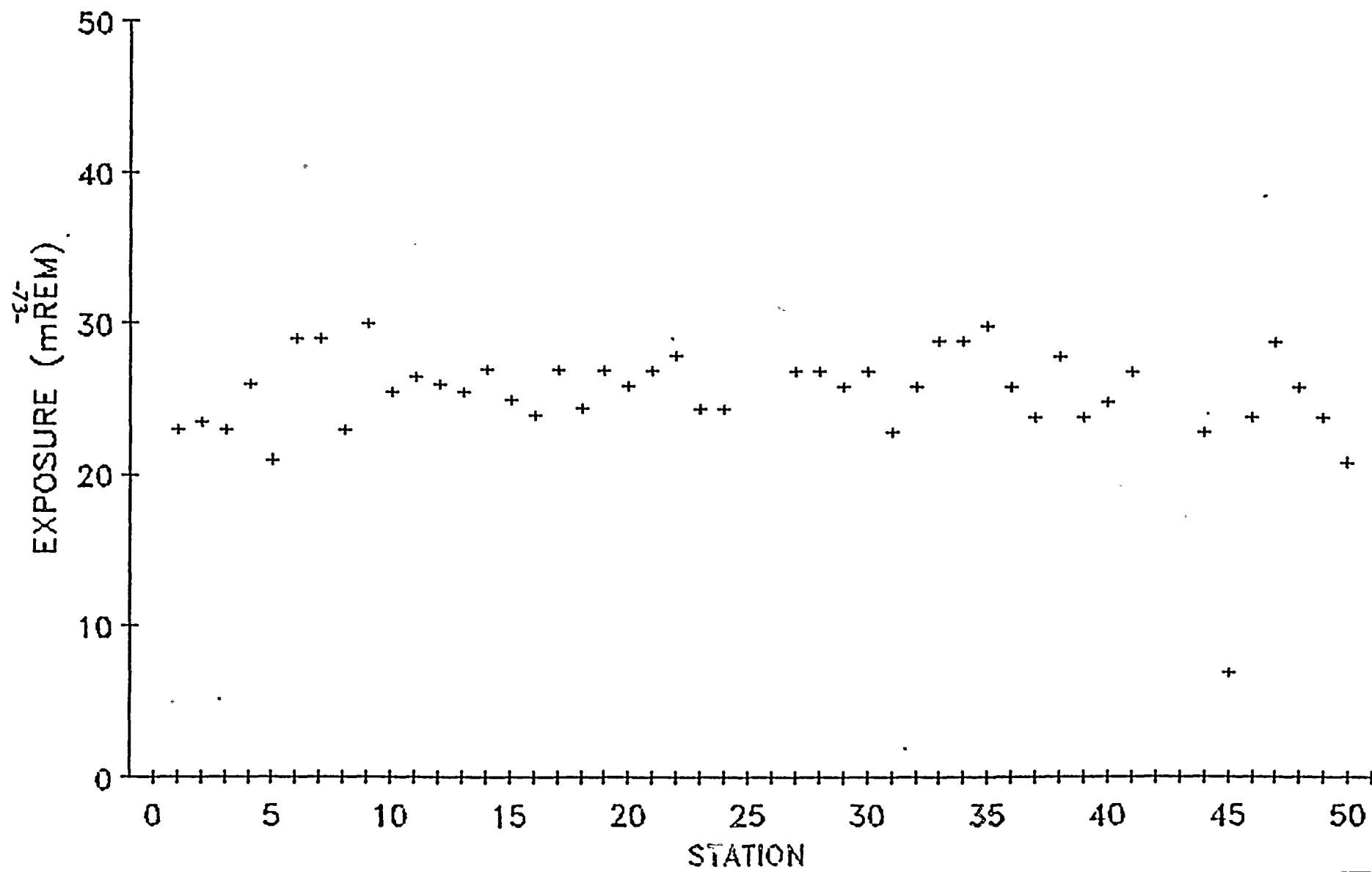


Figure 17
QUARTERLY THERMOLUMINESCENT DOSIMETRY
THIRD QUARTER
1985

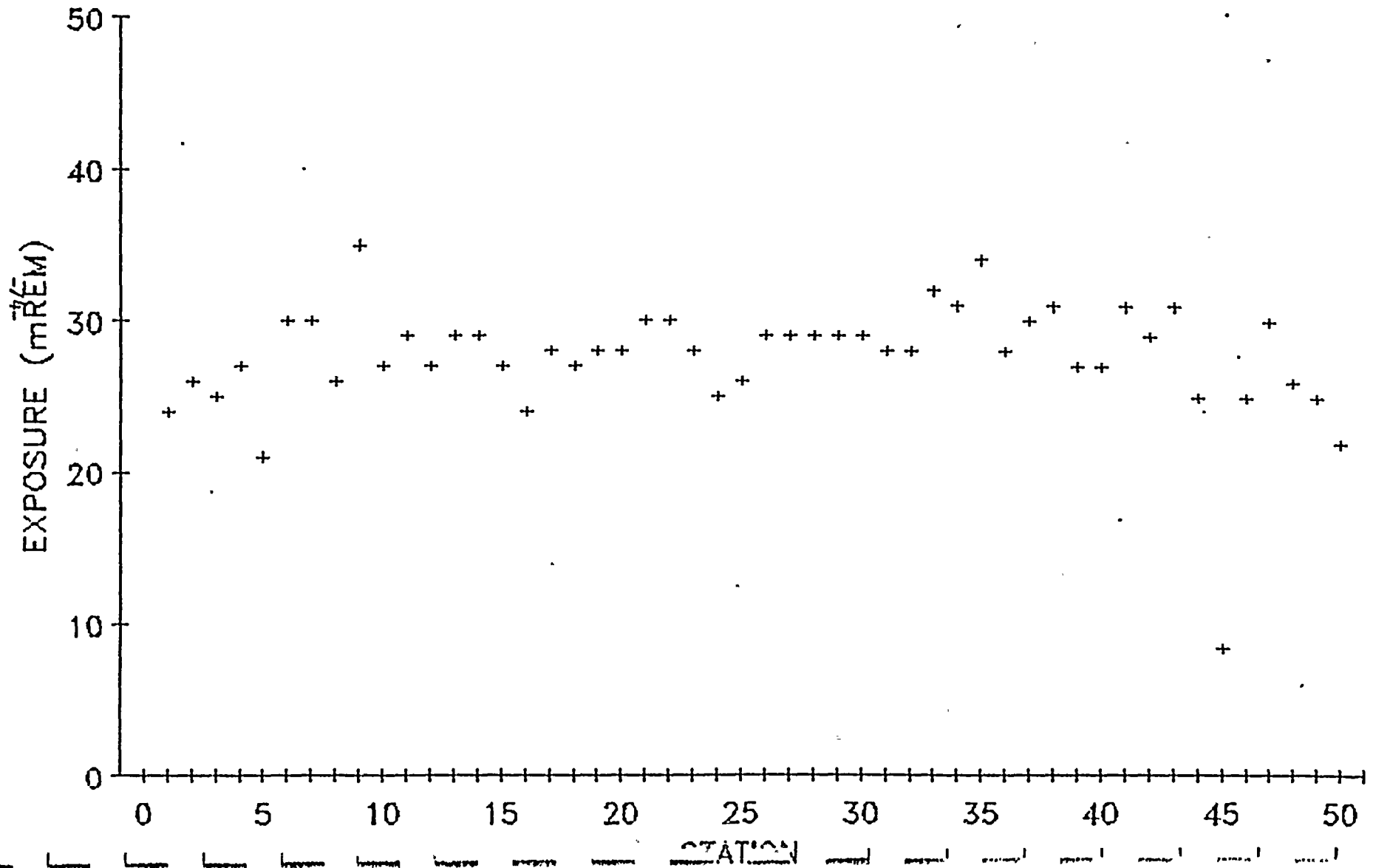


Figure 18
QUARTERLY THERMOLUMINESCENT DOSIMETRY
FOURTH QUARTER
1985

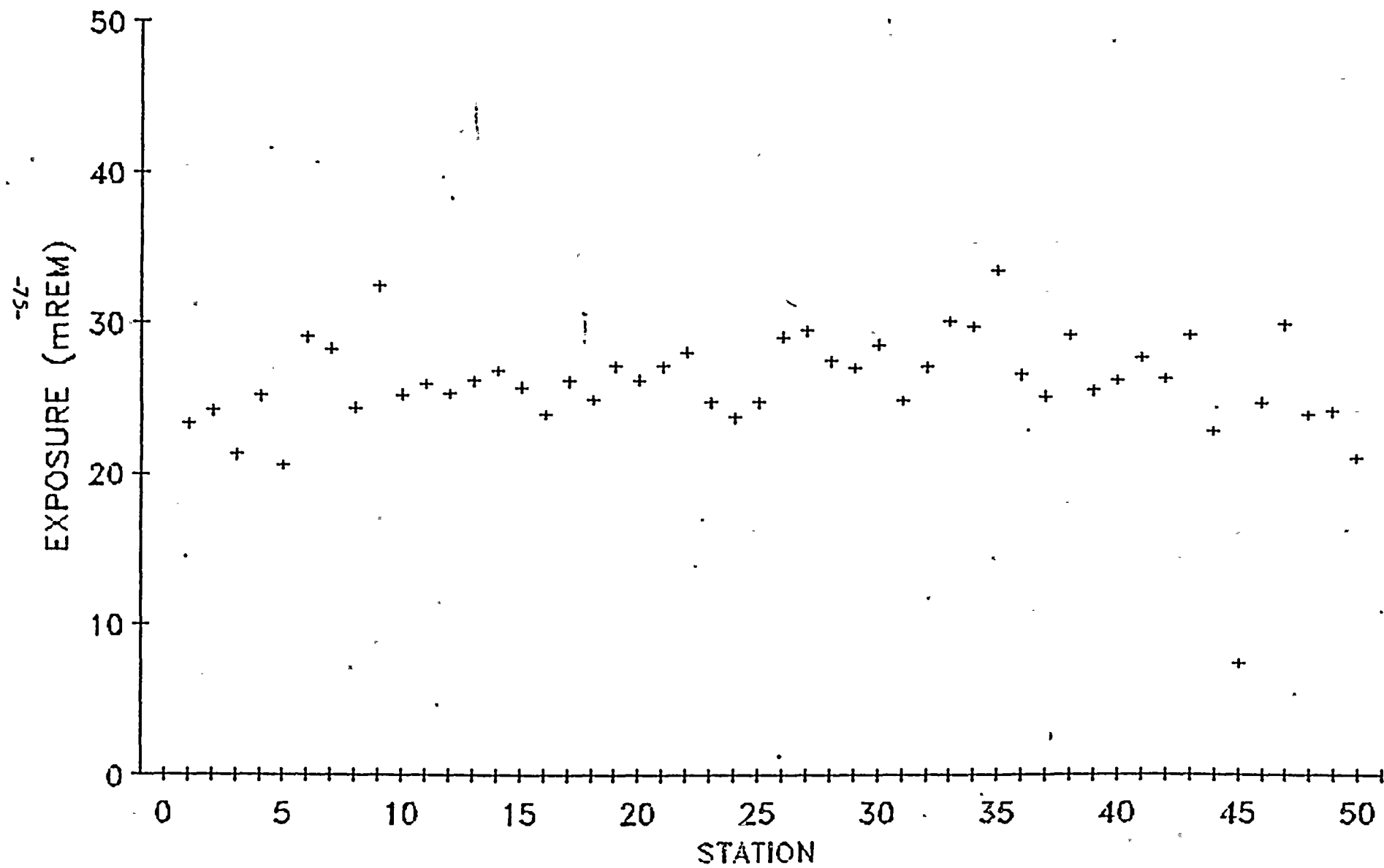
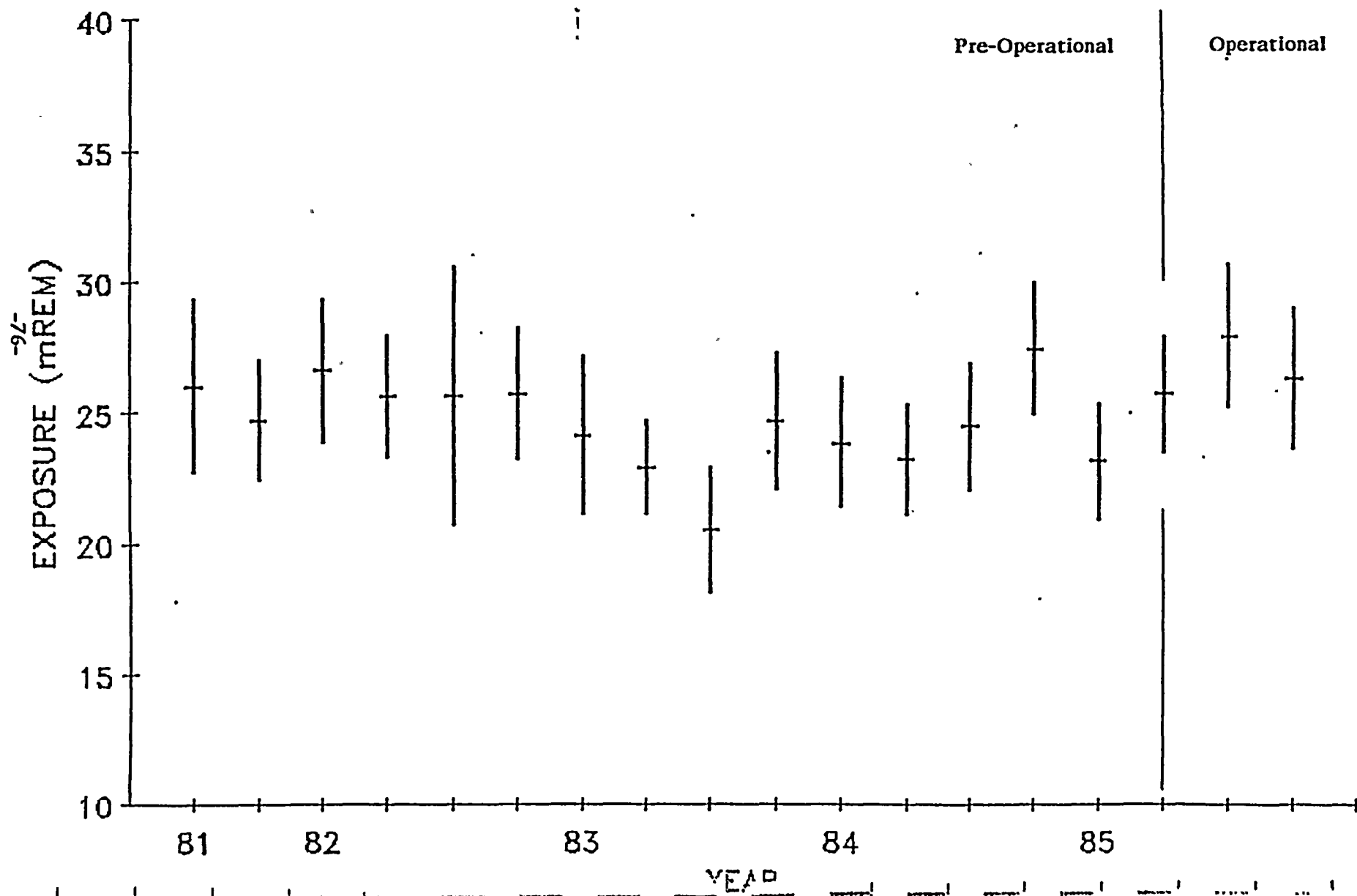


Figure 19
MEAN QUARTERLY THERMOLUMINESCENT DOSIMETRY
1981-1985



8.4 Vegetation

Vegetation samples were collected from five local farms since no commercial companies are located in the area. The leafy vegetation samples collected during 1985 included: mustard greens, cabbage, swiss chard, turnip greens, and lettuce. The citrus samples included grapefruits, and oranges.

Table XX presents Iodine-131 data for the vegetation samples collected during 1985. No observable activity was detected in any of the samples. The results of the gamma spectral analyses for all vegetation samples is presented in Tables XXI and XXII. No man-made Gamma emitting nuclides were detected in any of the samples.

TABLE XX
VEGETATION
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>Iodine-131 pCi/gm (Wet)</u>
<u>Leafy:</u>		
<u>Cambron Garden</u>		
Lettuce	11/14/85	< 0.02
Cabbage	11/14/85	< 0.02
<u>AJM Farms, Inc.</u>		
Leafy	11/15/85	< 0.02
<u>De Shazo</u>		
Leafy	12/14/85	< 0.02
<u>Thomas</u>		
Leafy	12/17/85	< 0.02
<u>Adams</u>		
Swiss Chard	06/14/85	< 0.02
<u>Citrus:</u>		
<u>Butler Dairy</u>		
Grapefruits	11/14/85	< 0.02
<u>Adams</u>		
Grapefruits	11/14/85	< 0.02
Lemons	11/14/85	< 0.02
Oranges	11/14/85	< 0.02

TABLE XXI
VEGETATION (Leafy)
GAMMA SPECTROMETRY
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/gm (wet)</u>									
		<u>Ba-140</u>	<u>Co-60</u>	<u>Mn-54</u>	<u>Ru,Rh-106</u>	<u>Zn-65</u>	<u>Zr,Nb-95</u>	<u>Cs-137</u>	<u>Cs-134</u>	<u>Ce-144</u>	<u>Fe-59</u>
		<u>0.075*</u>	<u>0.063*</u>	<u>0.021*</u>	<u>0.143*</u>	<u>0.060*</u>	<u>0.066*</u>	<u>0.056*</u>	<u>0.029*</u>	<u>0.121*</u>	<u>0.021*</u>
<u>Cambron Garden</u>											
Lettuce	11/14/85										
Cabbage	11/14/85										
<u>AJM Farms, Inc</u>											
Leafy	11/15/85										
<u>De Shazo</u>											
Leafy	12/14/85										
NONE DETECTED											
<u>Thomas</u>											
Leafy	12/17/85										
<u>Adams</u>											
Swiss Chard	06/14/85										

*Detection Limit

TABLE XXII
VEGETATION (Citrus Fruits)
GAMMA SPECTROMETRY
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/gm(wet)</u>									
		<u>Ba-140</u>	<u>Co-60</u>	<u>Mn-54</u>	<u>Ru,Rh-106</u>	<u>Zn-65</u>	<u>Zr,Nb-95</u>	<u>Cs-137</u>	<u>Cs-134</u>	<u>Ce-144</u>	<u>Fe-59</u>
		<u>0.075*</u>	<u>0.063*</u>	<u>0.021*</u>	<u>0.143*</u>	<u>0.060*</u>	<u>0.066*</u>	<u>0.056*</u>	<u>0.029*</u>	<u>0.121*</u>	<u>0.021*</u>
<u>Butler Dairy</u>											
Grapefruits	11/14/85										
<u>Adams</u>											
Grapefruits	11/14/85	NONE DETECTED									
Lemons	11/14/85	NONE DETECTED									
Oranges	11/14/85	NONE DETECTED									

*Detection Limit

8.5 Drinking Water

Drinking water samples were taken monthly from Desert Farms, McArthur Farm, and beginning in April, the Wedgeworth Farm. All of the samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Tritium and for Gamma-emitting nuclides. Results of these analyses are summarized in Tables XXIII and XXIV.

Nine of the samples showed Gross Alpha activity above the detection limit of 1.0 pCi/l. The range of gross alpha activity in Drinking water samples collected during 1985 was from less than 1.0 pCi/l to 3.8 ± 1.6 pCi/l (Desert Farms collected 08/15/85).

Gross Beta activity ranged from less than 2.0 pCi/l to a high of 6.1 ± 1.5 pCi/l (Desert Farms collected 09/19/85). Results do not appear to be anomalous and may be attributed to naturally occurring nuclides present in water (i.e. Potassium-40, etc.).

Strontium-90 was detected in none of the drinking water samples collected during 1985.

Tritium results, for all drinking water samples collected during 1985, were less than 1000 pCi/l. In addition, no Gamma-emitting nuclides of man-made origin were detected in any of the samples.

TABLE XXIII
DRINKING WATER
1985

Collection Location	Date Collected	pCi/l			
		Gross Alpha 1.0*	Gross Beta 2.0*	Strontium-90 0.5*	Tritium 1000*
Desert Farms	06/13/85 ^a	1.1 ± 0.6	4.2 ± 0.6	<0.5	< 1000
	06/13/85 ^b	2.0 ± 1.2	3.4 ± 0.5	<0.5	< 1000
	07/18/85	1.4 ± 1.3**	< 2.0	<0.5	< 1000
	08/15/85	3.8 ± 1.6**	4.5 ± 0.6**	<0.5	< 1000
	09/19/85	<1.0	6.1 ± 1.5**	<0.5	< 1000
	10/17/85	3.6 ± 1.9	5.4 ± 0.6	<0.5	< 1000
	11/14/85	<1.0	< 2.0	<0.5	< 1000
	12/19/85	2.2 ± 1.3	4.7 ± 0.6	<0.5	< 1000
McArthur Farm	06/13/85 ^a	<1.0	4.4 ± 0.6	<0.5	< 1000
	06/13/85 ^b	<1.0	< 2.0	<0.5	< 1000
	07/18/85	<1.0	< 2.0	<0.5	< 1000
	08/15/85	<1.0	2.6 ± 0.5	<0.5	< 1000
	09/19/85	<1.0	< 2.0	<0.5	< 1000
	10/17/85	<1.0	2.5 ± 0.5	<0.5	< 1000
	11/14/85	<1.0	< 2.0	<0.5	< 1000
	12/19/85	1.3 ± 1.1	2.3 ± 0.5	<0.5	< 1000
Wedgeworth	06/14/85 ^a	<1.0	< 2.0	<0.5	< 1000
	06/13/85 ^b	1.5 ± 1.2	2.4 ± 0.9	<0.5	< 1000
	07/18/85	<1.0	2.1 ± 0.5	<0.5	< 1000
	08/15/85	<1.0	2.3 ± 0.5	<0.5	< 1000
	09/19/85	<1.0	2.0 ± 0.7	<0.5	< 1000
	10/17/85	2.1 ± 1.8	3.2 ± 1.8	<0.5	< 1000
	11/14/85	<1.0	< 2.0	<0.5	< 1000
	12/19/85	<1.0	< 2.0	<0.5	< 1000

*Detection Limit

**Verified by reanalysis

^aComposite Sample

^bGrab Sample

TABLE XXIV
DRINKING WATER
GAMMA SPECTROMETRY
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/l</u>									
		<u>Ba-140</u> 4*	<u>Co-60</u> 5*	<u>Mn-54</u> 2*	<u>Ru,Rh-106</u> 10*	<u>Zn-65</u> 16*	<u>Zr,Nb-95</u> 10*	<u>Cs-137</u> 2*	<u>Cs-134</u> 10*	<u>Ce-144</u> 18*	<u>Fe-59</u> 3*
Desert Farms	06/13/85 ^a										
	06/13/85 ^b										
	07/18/85										
	08/15/85										
	09/19/85										
	10/17/85										
	11/14/85										
	12/19/85										
McArthur Farm	06/13/85 ^a	NONE DETECTED									
	06/13/85 ^b										
	07/18/85										
	08/15/85										
	09/19/85										
	10/17/85										
	11/14/85										
	12/19/85										
Wedgeworth	06/13/85 ^b										
	06/14/85 ^a										
	07/18/85										
	08/15/85										
	09/19/85										
	10/17/85										
	11/14/85										
	12/19/85										

*Detection Limit
^aComposite Sample
^bGrab Sample

8.6 Groundwater

Quarterly groundwater samples were collected from the on-site wells (Well 27ddc and Well 34abb). All groundwater samples were analyzed for Gross Alpha, Gross Beta, Strontium-90, Tritium and for Gamma-emitting nuclides. Results obtained from the analysis of the samples is presented in Tables XXV and XXVI.

Two groundwater samples collected during 1985 exhibited Gross Alpha activity. Gross Alpha activity ranged from less than 1.0 pCi/l to 2.2 ± 1.4 pCi/l.

Gross Beta activity of 2.1 ± 0.5 was detected in one of the groundwater samples collected during 1985 (Well 27ddc - 08/15/85).

No groundwater sample collected during 1985 had detectable levels of Tritium or Strontium-90. In addition, no isotopes of interest were detected by gamma spectral analysis of the groundwater samples.

TABLE XXV
GROUNDWATER
1985

Collection Location	Date Collected	pCi/l			
		Gross Alpha 1.0*	Gross beta 2.0*	Strontium-90 0.5*	Tritium 1000*
Well 27ddc	08/15/85	2.2 ± 1.4**	2.1 ± 0.5**	< 0.5	< 1000
	11/14/85	< 1.0	< 2.0	< 0.5	< 1000
Well 34abb	08/15/85	1.9 ± 1.3**	< 2.0	< 0.5	< 1000
	11/14/85	< 1.0	< 2.0	< 0.5	< 1000

*Detection limit

**Verified by reanalysis

TABLE XXVI
GROUNDWATER
GAMMA SPECTROMETRY
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/l</u>									
		<u>Ba-140</u> <u>4*</u>	<u>Co-60</u> <u>5*</u>	<u>Mn-54</u> <u>2*</u>	<u>Ru,Rh-106</u> <u>10*</u>	<u>Zn-65</u> <u>16*</u>	<u>Zr,Nb-95</u> <u>10*</u>	<u>Cs-137</u> <u>2*</u>	<u>Cs-134</u> <u>10*</u>	<u>Ce-144</u> <u>18*</u>	<u>Fe-59</u> <u>3*</u>
Well 27ddc	08/15/85 11/14/85										
Well 34abb	08/15/85 11/14/85	NONE DETECTED									

*Detection Limit

8.7 Surface Water

Surface water samples were introduced into the monitoring program during the third quarter of 1982. Samples from PVNGS Reservoir and PVNGS Evaporation Pond were collected weekly throughout 1985.

These samples were analyzed for Iodine-131 activity, then composited at the end of each month and analyzed for Gross Alpha, Gross Beta, Strontium-89, Strontium-90, Tritium and Gamma-emitting nuclides. Results of these analyses are presented in Tables XXVII, XXVIII, XXIX, and XXX.

Iodine-131 was detected in none of the 1985 surface water samples collected.

Table XXIX presents data obtained for analyses of Gross Alpha, Gross Beta, Strontium-89, Strontium-90 and Tritium on the monthly composite samples. Gross Alpha activity was detected in two of the monthly composite's one (November) from the PVNGS Evaporation Pond (3.2 ± 1.6 pCi/l) and one (November) from the PVNGS Reservoir (1.9 ± 1.4 pCi/l).

PVNGS Reservoir composites demonstrated Gross Beta activities ranging from less than 2.0 pCi/l to 12.9 ± 0.7 pCi/l (November composite). The composite samples from the PVNGS Evaporation Pond showed Gross Beta activities ranging from less than 2.0 pCi/l to 12.9 ± 2.0 pCi/l (June composite).

As can be seen from Table XXIX, none of the monthly composite samples exhibited any observable activity for Strontium-89, Strontium-90, or Tritium above the detection limits of 1.0 pCi/l, and 1000 pCi/l respectively.

Gamma Spectral analysis of the monthly composites (PVNCS Reservoir and Evaporation Pond) showed no detectable activity for any of the nuclides of interest. (See Table XXX).

TABLE XXVII
SURFACE WATER
1985

<u>Collection Location</u>	<u>Collection Date</u>	<u>I-131 (pCi/l) 0.5*</u>
PVNGS Reservoir	05/30/85	< 0.5
	06/06/85	< 0.5
	06/13/85	< 0.5
	06/20/85	< 0.5
	06/27/85	< 0.5
	07/04/85	< 0.5
	07/11/85	< 0.5
	07/18/85	< 0.5
	07/25/85	< 0.5
	08/01/85	< 0.5
	08/08/85	< 0.5
	08/15/85	< 0.5
	08/22/85	< 0.5
	08/29/85	< 0.5
	09/05/85	< 0.5
	09/12/85	< 0.5
	09/19/85	< 0.5
	09/26/85	< 0.5
	10/03/85	< 0.5
	10/10/85	< 0.5
	10/17/85	< 0.5
	10/24/85	< 0.5
	10/31/85	< 0.5
	11/07/85	< 0.5
	11/14/85	< 0.5
	11/21/85	< 0.5
11/27/85	< 0.5	
12/05/85	< 0.5	
12/12/85	< 0.5	
12/19/85	< 0.5	
12/26/85	< 0.5	

*Detection Limit

TABLE XXVIII
SURFACE WATER
1985

<u>Collection Location</u>	<u>Collection Date</u>	<u>I-131 (pCi/l) 0.5*</u>
PVNGS Evaporation Pond	05/30/85	< 0.5
	06/06/85	< 0.5
	06/13/85	< 0.5
	06/20/85	< 0.5
	06/27/85	< 0.5
	07/04/85	< 0.5
	07/11/85	< 0.5
	07/18/85	< 0.5
	07/25/85	< 0.5
	08/01/85	< 0.5
	08/08/85	< 0.5
	08/15/85	< 0.5
	08/22/85	< 0.5
	08/29/85	< 0.5
	09/05/85	< 0.5
	09/12/85	< 0.5
	09/19/85	< 0.5
	09/26/85	< 0.5
	10/03/85	< 0.5
	10/10/85	< 0.5
	10/17/85	< 0.5
	10/24/85	< 0.5
	10/31/85	< 0.5
	11/07/85	< 0.5
	11/14/85	< 0.5
	11/21/85	< 0.5
11/27/85	< 0.5	
12/05/85	< 0.5	
12/12/85	< 0.5	
12/19/85	< 0.5	
12/26/85	< 0.5	

*Detection Limit

TABLE XXIX
SURFACE WATER (Composite)

1985

<u>Collection Location</u>	<u>Composite Period</u>	<u>pCi/l</u>				
		<u>Gross Alpha 1.0*</u>	<u>Gross Beta 2.0*</u>	<u>Strontium-89 1.0*</u>	<u>Strontium-90 0.5*</u>	<u>Tritium 1000*</u>
PVNGS Reservoir	May	< 1.0	5.9 ± 0.6	< 1.0	< 0.5	< 1000
	June	< 1.0	6.6 ± 0.6	< 1.0	< 0.5	< 1000
	July	< 1.0	7.0 ± 1.0	< 1.0	< 0.5	< 1000
	August	< 1.0	8.3 ± 0.7	< 1.0	< 0.5	< 1000
	September	< 1.0	5.4 ± 0.6	< 1.0	< 0.5	< 1000
	October	< 1.0	3.0 ± 0.5	< 1.0	< 0.5	< 1000
	November	1.9 ± 1.4	10.9 ± 0.7	< 1.0	< 0.5	< 1000
	December	< 1.0	5.3 ± 0.6	< 1.0	< 0.5	< 1000
PVNGS Pond	May	< 1.0	9.1 ± 0.7	< 1.0	< 0.5	< 1000
	June	< 1.0	12.9 ± 2.0**	< 1.0	< 0.5	< 1000
	July	< 1.0	12.0 ± 1.0	< 1.0	< 0.5	< 1000
	August	< 1.0	10.5 ± 0.7	< 1.0	< 0.5	< 1000
	September	< 1.0	6.8 ± 0.6	< 1.0	< 0.5	< 1000
	October	< 1.0	8.3 ± 0.7	< 1.0	< 0.5	< 1000
	November	3.2 ± 1.6	6.7 ± 0.6	< 1.0	< 0.5	< 1000
	December	< 1.0	7.9 ± 0.6	< 1.0	< 0.5	< 1000

*Detection Limit

**Verified by reanalysis

TABLE XXX
SURFACE WATER (Composite)
GAMMA SPECTROMETRY
1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/l</u>									
		<u>Ba-140</u> 4*	<u>Co-60</u> 5*	<u>Mn-54</u> 2*	<u>Ru,Rh-106</u> 10*	<u>Zn-65</u> 16*	<u>Zr,Nb-95</u> 10*	<u>Cs-137</u> 2*	<u>Cs-134</u> 10*	<u>Ce-144</u> 18*	<u>Fe-59</u> 3*
PVNGS Reservoir	May	NONE DETECTED									
	June										
	July										
	August										
	September										
	October										
	November										
	December										
PVNGS Pond	May	NONE DETECTED									
	June										
	July										
	August										
	September										
	October										
	November										
	December										

*Detection Limit

8.8 Milk (Fresh)

Fresh milk samples were collected on a monthly basis during 1985 from the following locations:

1. Al Lueck, Jr. Dairy
2. Cordell Baisley Dairy
3. Butler Dairy
4. John Kerr Dairy
5. Hamstra #2 (designated operational control location)
6. Paul Skousen Dairy

All milk samples were analyzed for Iodine-131, Strontium-89, Strontium-90 and Gamma-emitting nuclides. Results of these analyses are presented in Tables XXXI and XXXII.

Iodine-131 analyses of the milk samples showed no results above the detection limit of 0.5 pCi/l.

Strontium-90 analyses of the milk samples revealed no positive results above the detection limit of 0.5 pCi/l. Results for all milk samples for Strontium-89 analyses were less than the detection limit of 1.0 pCi/l.

Gamma-emitting nuclides of interest remain below the level of detection for all milk samples analyzed in 1985.

TABLE XXXI

MILK (Fresh)

1985

Collection Location	Date Collected	pCi/l		
		Iodine-131 0.5*	Strontium-89 1.0*	Strontium-90 0.5*
John Kerr Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5
Al Lueck, Jr. Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5
Paul Skousen Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5
Hamstra #2 Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5
Cordell Baisley Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5

*Detection Limit

TABLE XXXI (Continued)

MILK (Fresh)

1985

<u>Collection Location</u>	<u>Date Collected</u>	<u>pCi/l</u>		
		<u>Iodine-131 0.5*</u>	<u>Strontium-89 1.0*</u>	<u>Strontium-90 0.5*</u>
Butler Dairy	06/14/85	< 0.5	< 1.0	< 0.5
	07/19/85	< 0.5	< 1.0	< 0.5
	08/16/85	< 0.5	< 1.0	< 0.5
	09/20/85	< 0.5	< 1.0	< 0.5
	10/18/85	< 0.5	< 1.0	< 0.5
	11/15/85	< 0.5	< 1.0	< 0.5
	12/20/85	< 0.5	< 1.0	< 0.5

*Detection Limit

TABLE XXXII
MILK (FRESH)
GAMMA SPECTROMETRY

1985

Collection Location	Collection Period	pCi/l									
		Ba-140 4*	Co-60 5*	Mn-54 2*	Ru,Rh-106 10*	Zn-65 16*	Zr,Nb-95 10*	Cs-137 2*	Cs-134 10*	Ce-144 18*	Fe-59 3*
Cordell Baisley Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										
Butler Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										
NONE DETECTED											
John Kerr Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										
Al Lueck, Jr. Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										

TABLE XXXII (Cont.)
MILK (FRESH)
GAMMA SPECTROMETRY
1985

Collection Location	Collection Period	pCi/l									
		Ba-140 4*	Co-60 5*	Mn-54 2*	Ru,Rh-106 10*	Zn-65 16*	Zr,Nb-95 10*	Cs-137 2*	Cs-134 10*	Ce-144 18*	Fe-59 3*
Paul Skousen Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										
		NONE DETECTED									
Hamstra #2 Dairy	06/14/85										
	07/19/85										
	08/16/85										
	09/20/85										
	10/18/85										
	11/15/85										
	12/20/85										

*Detection Limit

TABLE XXXIII
ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY
NAME OF FACILITY: PALO VERDE NUCLEAR GENERATING STATION
LOCATION OF FACILITY: MARICOPA COUNTY, ARIZONA
REPORTING PERIOD: 1985 (OPERATIONAL)

Medium or Pathway sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean		Control Location Mean (f) Range	No. of nonroutine Reported Measurements
				Name	Mean (f) Range		
Air Particulates (pCi/m ³)	Gross β (384)	0.002	0.027 (384/384) (0.008-0.037)	15A 2 miles 45 ^o	0.029 (32/32) (0.013-0.055)	0.028 (32/32) (0.014-0.057)	0
	Gross α (384)	0.005	"	"	"	"	0
	Y-spec (36)	a	"	"	"	"	0
	I-131 (384)	0.007	"	"	"	"	0
TLD (mRem)	Quarterly (50)	N/A	25.8 (150/150)	371st Ave. & SPP Rd. 5 miles 180 ^o	32.5 (3/3) (30.0-35.0)	7.7 (3/3) (7.0-8.5)	0
Vegetation (pCi/g-wet)	I-131 (10)	0.02	"	"	"	"	0
	Y-spec (10)	a	"	"	"	"	0

*All samples less than LLD

^aSee Table VI for LLD

TABLE XXXIII (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

NAME OF FACILITY: PALO VERDE NUCLEAR GENERATING STATION

LOCATION OF FACILITY: MARICOPA COUNTY, ARIZONA

REPORTING PERIOD: 1985 (OPERATIONAL)

Medium or Pathway sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean		Control Location Mean (f) Range	No. of nonroutine Reported Measurements
				Name Distance & Direction	Mean (f) Range		
Drinking Water (pCi/l)	Gross α (24)	1.0	2.1 (9/24) (1.1-3.8)	Desert Farms 5 miles 229 ^o	2.4 (6/8) (1.1-3.8)	--	0
	Gross β (24)	2.0	3.5 (15/24) (2.0-6.1)	Desert Farms 5 miles 229 ^o	4.7 (6/8) (3.4-6.1)	--	0
	Sr-90 (24)	0.5	*	*	*	*	0
Ground Water (pCi/l)	113 (24)	1,000	*	*	*	--	0
	Y-spec (24)	a	*	*	*	--	0
	Gross α (4)	1.0	2.0 (2/4) (1.9-2.2)	Well 27ddc Onsite	2.2 (1/2) (2.2)	--	0
	Gross β (4)	2.0	2.1 (1/4) (2.1)	Well 27ddc Onsite	2.1 (1/2) (2.1)	--	0
	Sr-90 (4)	0.5	*	*	*	--	0
	113 (4)	1,000	*	*	*	--	0
Surface Water (pCi/l)	Y-spec (4)	a	*	*	*	--	0
	I-131 (62)	0.5	*	*	*	--	0

* All samples less than LLD

^a See Table VI for LLD

TABLE XXXIII (Cont.)

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

NAME OF FACILITY: PALO VERDE NUCLEAR GENERATING STATION

LOCATION OF FACILITY: MARICOPA COUNTY, ARIZONA

REPORTING PERIOD: 1985 (OPERATIONAL)

Medium or Pathway sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)	All Indicator Locations Mean (f) Range	Location with Highest Annual Mean		Control Location Mean (f) Range	No. of nonroutine Reported Measurements
				Name	Mean (f) Range		
Surface Water Composites (pCi/l)	Gross α (16)	1.0	2.6 (2/16) (1.9-3.2)	PVNGS Pond Onsite	3.2 (1/8) (3.2)	--	0
	Gross β (16)	2.0	7.9 (16/16) (3.0-12.9)	PVNGS Pond Onsite	9.3 (8/8) (6.7-12.9)	--	0
	Sr-89 (16)	1.0	*	*	*	--	0
	Sr-90 (16)	0.5	*	*	*	--	0
	I13 (16)	1,000	*	*	*	--	0
	γ-spec (16)	a	*	*	*	--	0
Milk (pCi/l)	I-131 (42)	0.5	*	*	*	*	0
	Sr-89 (42)	1.0	*	*	*	*	0
	Sr-90 (42)	0.5	*	*	*	*	0
	γ-spec (42)	a	*	*	*	*	0

* All samples less than LLD

^a See Table VI for LLD

9.0 Miscellaneous Information

No miscellaneous information was obtained for the 1985 Annual Report.

10.0 References

- 1.) 1981 Annual Report, Palo Verde Nuclear Generating Station's Pre-Operational Radiological Monitoring Program.
- 2.) 1982 Annual Report, Palo Verde Nuclear Generating Station's Pre-Operational Radiological Monitoring Program.
- 3.) 1983 Annual Report, Palo Verde Nuclear Generating Station's Pre-Operational Monitoring Program.
- 4.) 1984 Annual Report, Palo Verde Nuclear Generating Station's Pre-Operational Monitoring Program.
- 5.) Palo Verde Nuclear Generating Station's Pre-Operational Radiological Monitoring Program, Summary Report 1979-1985.
- 6.) Nuclear Regulatory Commission, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plant", 10 CFR 50, Appendix B (1975).
- 7.) Environmental Radiation Data, Quarterly Reports, U.S. Environmental Protection Agency, Office of Radiation Programs.
- 8.) Nuclear Regulatory Commission, Branch Technical Position, Revision 1, 1979.

APPENDIX A
EPA CROSS CHECK RESULTS

EPA CROSS-CHECK PROGRAM

1985

Water

<u>Date</u>	<u>Parameter</u>	<u>EPA Known Value pCi/l $\pm 3 \sigma$</u>	<u>CEP Reported Value pCi/filter</u>
2/85	Chromium-51	48 ± 8.7	38 ± 7
			46 ± 7
			32 ± 7
	Cobalt-60	20 ± 8.7	20 ± 3
			25 ± 3
			20 ± 3
	Zinc-65	55 ± 8.7	51 ± 3
			50 ± 3
			55 ± 3
	Cesium-134	35 ± 8.7	33 ± 2
			29 ± 2
			32 ± 2
	Cesium-137	25 ± 8.7	23 ± 3
			25 ± 3
			28 ± 3
7/85	Cobalt-60	14.0 ± 5.0	19 ± 2
			15 ± 2
			16 ± 2
	Zinc-65	47.0 ± 5.0	52 ± 5
			49 ± 5
			44 ± 4
	Ruthenium-106	62.0 ± 5.0	73 ± 7
			74 ± 7
			69 ± 7
	Cesium-134	35.0 ± 5.0	28 ± 3
			29 ± 3
			26 ± 3
	Cesium-137	20.0 ± 5.0	19 ± 2
			16 ± 2
			14 ± 2

EPA CROSS-CHECK PROGRAM

1985

Radionuclides in Air Filters

<u>Date</u>	<u>Parameter</u>	<u>EPA Known Value pCi/l $\pm 3 \sigma$</u>	<u>CEP Reported Value pCi/filter</u>
3/85	Gross Alpha	10.0 \pm 8.7	9 \pm 1 10 \pm 1 12 \pm 1
	Gross Beta	36.0 \pm 8.7	40 \pm 4 41 \pm 4 39 \pm 4
	Strontium-90	15.0 \pm 2.6	19 \pm 2 18 \pm 2 17 \pm 2
	Cesium-137	6.0 \pm 8.7	7 \pm 2 6 \pm 2 5 \pm 2

EPA CROSS-CHECK PROGRAM

1985

Water

<u>Date</u>	<u>Parameter</u>	<u>EPA Known Value pCi/l $\pm 3 \sigma$</u>	<u>CEP Reported Value pCi/filter</u>
4/85	Iodine-131	7.5 \pm 1.3	6 \pm 2 6 \pm 2 5 \pm 2

EPA CROSS-CHECK PROGRAM

1985

Water

<u>Date</u>	<u>Parameter</u>	<u>EPA Known Value pCi/l $\pm 3 \sigma$</u>	<u>CEP Reported Value pCi/filter</u>
1/85	Gross Alpha	5.0 \pm 5.0	6 \pm 2
			7 \pm 2
	Gross Beta	15.0 \pm 5.0	7 \pm 2
			13 \pm 2
5/85	Gross Alpha	12.0 \pm 5.0	14 \pm 2
			15 \pm 2
	Gross Beta	11.0 \pm 5.0	14 \pm 2
			12 \pm 2
7/85	Gross Alpha	11 \pm 5	13 \pm 2
			8 \pm 2
	Gross Beta	8 \pm 5	11 \pm 2
			9 \pm 2
9/85	Gross Alpha	8 \pm 5	13 \pm 2
			12 \pm 2
	Gross Beta	8 \pm 5	10 \pm 3
			9 \pm 3
11/85	Gross Alpha	10 \pm 5	11 \pm 3
			6 \pm 3
	Gross Beta	13 \pm 5	5 \pm 3
			8 \pm 3
	Gross Alpha	10 \pm 5	9 \pm 3
			8 \pm 3
	Gross Beta	13 \pm 5	10 \pm 3
			14 \pm 3
			13 \pm 3
			15 \pm 3

EPA CROSS-CHECK PROGRAM

1985

Water

<u>Date</u>	<u>Parameter</u>	<u>EPA Known Value pCi/l \pm 3 σ</u>	<u>CEP Reported Value pCi/filter</u>
2/85	Tritium	3796 \pm 634	3750 \pm 600 3610 \pm 600 3540 \pm 600
4/85		3559 \pm 630	3437 \pm 500 3265 \pm 500 3301 \pm 500
6/85		2416 \pm 351	3260 \pm 571 3191 \pm 576 2906 \pm 405
8/85		4480 \pm 448	3893 \pm 485 3944 \pm 476 3847 \pm 477

APPENDIX B
PALO VERDE NUCLEAR GENERATING STATION
LAND USE CENSUS
1985

ANPP
PVNGS
1985 LAND USE CENSUS
DECEMBER, 1985

7146C/dg

1.0 INTRODUCTION

In accordance with PVNGS Technical Specification 12.2, the annual Land Use Census within a five mile radius of mid line PVNGS Unit 2 containment was performed during December, 1985 by Ralph B. Ochoa and Tim Hodges.

Observations were made in each of the 16 meteorological sectors of the nearest milking animals (cows and goats), nearest residence, and the nearest garden of greater than 500 ft² producing broad leaf vegetation. This census was completed by driving the roads within a five mile radius of PVNGS noting the location of the above-mentioned items.

The results of the Land Use Census are presented in Table 1 and discussed below. In the table, the radial direction and mileage from Unit 2 containment are presented for each location. The radial direction is one of the 16 different compass points. The mileage was estimated from map position from each location.

2.0 CENSUS RESULTS

2.1 Nearest Resident

Table 1 presents the location of the nearest resident to the PVNGS in each of the 16 meteorological sectors. There were two changes in the nearest resident noted in the 1985 census. These changes were in the NNW and WSW sectors.

2.2 Milking Animals

There were no milking animals observed during the 1985 census. No changes to the REMP milk sampling locations were made as a result of this census.

2.3 Vegetable Gardens

No gardens greater than 500 square feet producing broad leaf vegetation were found during the 1985 Land Use Census.

2.4 No changes were made to the REMP as a result of the 1985 Land Use Census.

Table 1

NEAREST RESIDENCE WITHIN FIVE MILES OF PVNGS
December, 1985

<u>Meteorological Sector</u>	<u>Radial Mileage</u>
N	1.50
NNE	1.50
NE	2.00
ENE	1.75
E	3.00
ESE	3.75
SE	4.00
SSE	4.50
S	4.50
SSW	No Residents
SW	2.75
WSW	1.75 (new)
W	No Residents
WNW	No Residents
NW	4.00
NNW	2.50 (new)

