ARIZONA NUCLEAR POWER PROJECT

PALO VERDE NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 1987

(Rev. 1)

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Abstract

This Annual Radiological Environmental Operating Report reports on the Radiological Environmental Program, comprised of (a) the Radiological Environmental Monitoring Program (REMP), (b) the Annual Land Use Census, and (c) the Interlaboratory Comparison Program. Activities in all 3 program elements are reported.

The REMP is an ongoing study conducted by Controls for Environmental Pollution, Inc. (CEP) and Arizona State University (ASU) 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 and ASU personnel and analyzed by CEP and ASU during 1987.

In order to determine radiation levels in the environment around the PVNGS, the following types of samples were collected: animal vegetation, human vegetation (including fruits and vegetables), fresh milk, groundwater, drinking water, surface water, airborne particulate and radioiodine. TLD's are utilized for determining environmental direct radiation levels.

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

On July 1, 1987, Arizona State University assumed responsibility for environmental analyses with the exception of vegetation, TLD, airborne particulate and airborne radioiodine samples. Results presented are a compilation of CEP and ASU data for the year. CEP data will be indicated by the letter (a) and ASU data will be indicated by the letter (b) throughout the Tables in this report. TLD data are PVNGS'.

ARIZONA NUCLEAR POWER PROJECT

PALO VERDE NUCLEAR GENERATING STATION

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1.0 Introduction (CEP)

This report first presents results of the operational radiological environmental monitoring program conducted during 1987 by Controls for Environmental Pollution, Inc. (CEP) and Arizona State University (ASU) for Arizona Nuclear Power Project (ANPP), Palo Verde Nuclear Generating Station (PVNGS), followed by Interlaboratory Comparison Program results and Land Use Census results.

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 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 Operational Radiological Monitoring Program Changes (1987)

1.1.1 July 1, 1987 - ASU assumes responsibility for analysis of REMP samples with the exception that CEP continues analysis of vegetation and airborne particulate and radioiodine, and ANPP continues TLD analysis.

1.1.2 August 30, 1987 - Baisley Dairy closed down. Samples from four other existing sample locations and one control location assure that Technical Specifications for milk sampling are met.

1.2 Operational Radiological Monitoring Program Changes 1986

1.2.1 April 24, 1986 - Weekly samplings of PVNGS Reservoir (Sample Site #60) and Pond (Sample Site #59) now include collection of a sample in a glass container for Tritium analysis.

1.2.2 July 17, 1986 - Wedgeworth house (Sample Site #49) drinking water sample site changed name to Glover.

1.2.3 October 16, 1986 - Gavette Drinking Water sample (Sample Site #48) added to REMP, replacing Desert Farms.

1.3 Introduction (ASU)

In the spring of 1983, the Arizona State University (ASU) Radiation Measurements Facility (RMF) implemented a long-term independent radiological environmental assessment program for the Palo Verde Nuclear Generating Station (PVNGS).

In July, 1987 the RMF was certified as a vendor by the PVNGS Quality Assurance Department and assumed responsibility for many of the environmental assessments performed in support of PVNGS. The data presented in this report were obtained from samples collected by PVNGS or RMF personnel during the calendar year 1987 and analyzed by RMF personnel in the RMF complex.

The assessment program consists of routine measurements of background gamma radiation and of radionuclide concentrations in media such as air, ground water, drinking water, surface water, fresh milk and vegetation.

Monthly milk samples were collected from six sites until September 198 when one dairy ceased operation. Five samples were collected thereafter. All samples are assayed for iodine and gamma isotopic.

Weekly water samples are collected routinely from three sites. Monthly samples are collected from three residence wells and quarterly samples are obtained from two on-site wells. Samples are assayed for iodine-131, strontium-89, strontium-90, gross alpha, gross beta, tritium and/or gamma isotopic.

Four RMF staff members are trained and certified by PVNGS to perform routine sampling of air, surface and ground water, and milk. Three staff members are certified by PVNGS for collection of thermoluminescent dosimeters.

2.0 Description of the Monitoring Program

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

The types of environmental samples collected include: animal vegetation, human vegetation (produce and citrus fruits), groundwater, drinking water, surface water, fresh milk, airborne particulates, and radioiodine. The TLD network is managed by ANPP personnel. TLD evaluations are conducted by the PVNGS Dosimetry Group.

The locations of the monitoring sites are shown in Figure 1 and Figure 2. 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 is included in these tables where applicable.

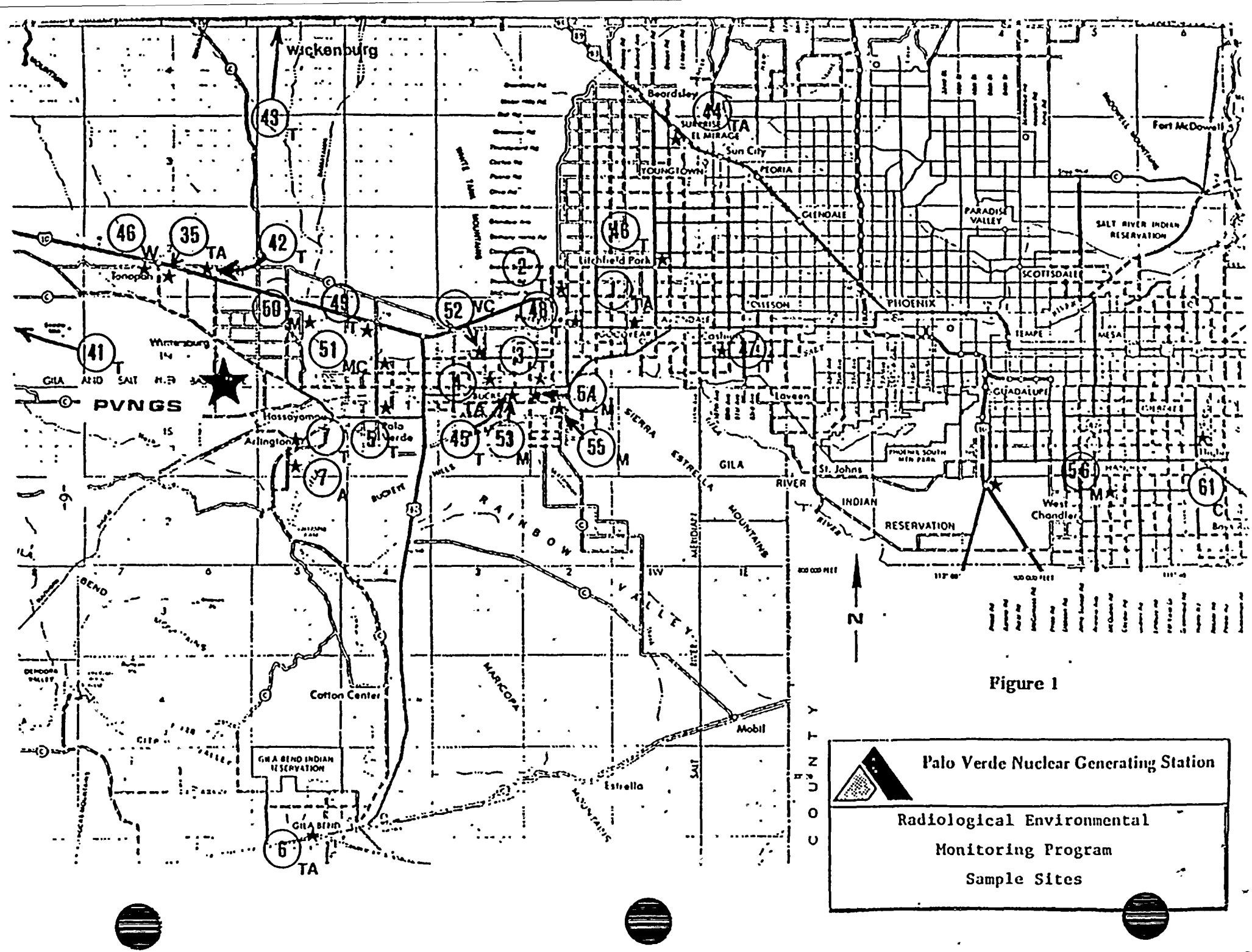

Figure 1

Palo Verde Nuclear Generating Station

Radiological Environmental Monitoring Program Sample Sites

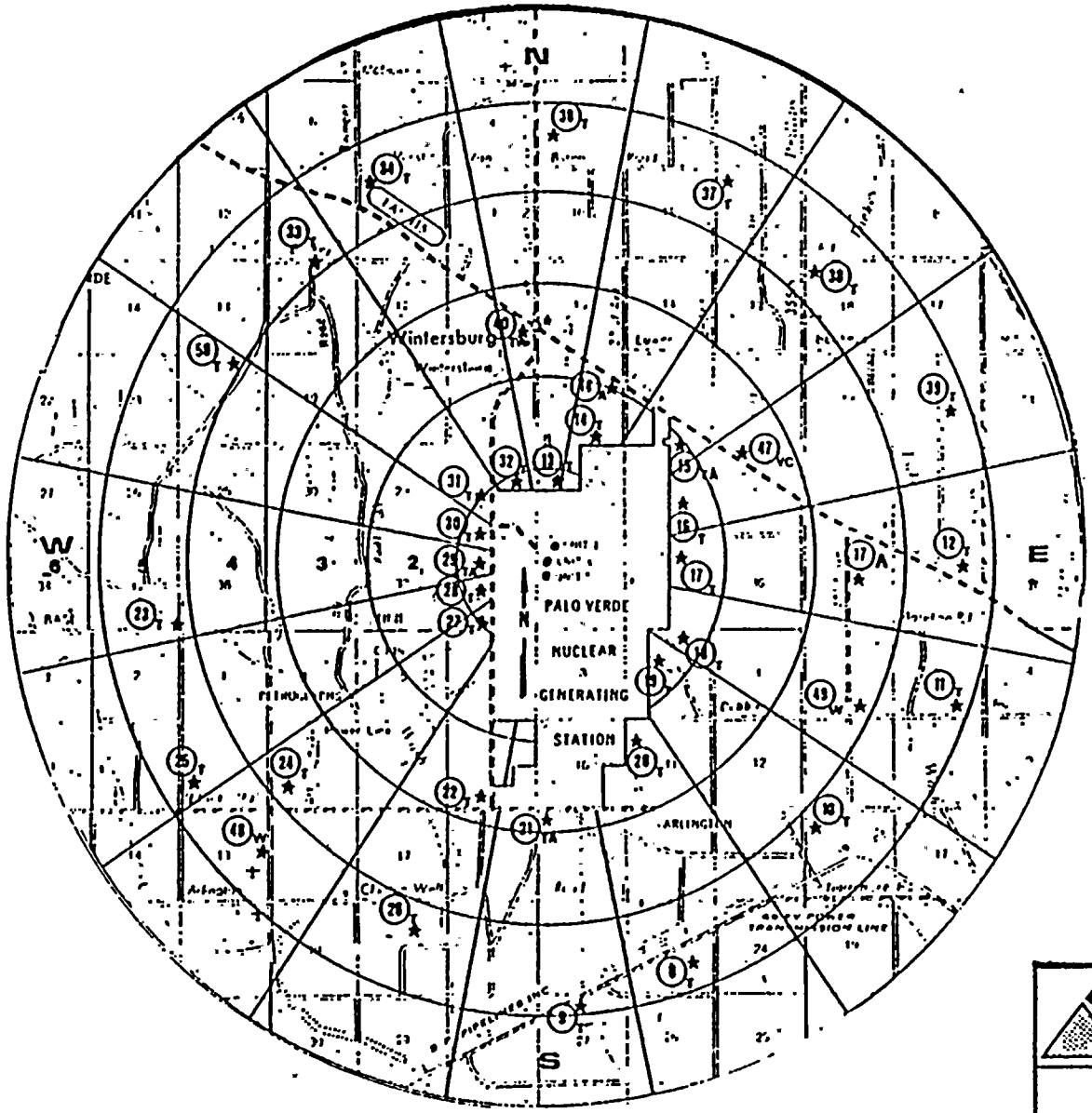

Figure 2

Palo Verde Nuclear Generating Station

Radiological Environmental
Monitoring Program
Sample Sites

TABLE I

COLLECTION LOCATIONS

Sample Site #	Sample Type	Location(a)	Location Description
1A	Air	E30	APS Goodyear Office
4A	Air	E20	APS Buckeye Office
6A	Air (Control)	SSE35	APS Gila Bend Substation
7A	Air	SE8	Arlington School
14A	Air	NNE2	Buckeye-Salome Rd. & 371st Ave.
15A	Air	NE2	NE Site Boundary
17A	Air	E4	351st Ave., 1 mi. S of B-S Rd.
21A	Air	S3	S Site Boundary
29A	Air	W1	W Site Boundary
35A	Air	NNW9	Tonopah, Palo Verde Inn Fire Station
40A	Air	N3	Wintersburg, AZ
44A	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	Gavette residence, 39326 W. Elliot Rd.
49	Water	ESE4	Glover 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)	E80	Ray Rd. and Higley Rd., Higley, Arizona

(a) Directions are based on 16 compass points; distances are from centerline of Unit 2 containment, in miles.

TABLE II

1987 COLLECTION SCHEDULE

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

TABLE II (Cont.)

1987 COLLECTION SCHEDULE

Collection Site	Air Particulates	Airborne Radioiodine	Domestic Meats	Fresh Milk	Vegetation	Groundwater	Drinking Water	Surface Water
#56, Hamstra #2 Dairy (Control)				M				
#57, Well 27ddc						Q		
#58, Well 34abb						Q		
#59, PVNGS Evaporation Pond								W
#60, PVNGS Reservoir								W
#61, Cooley Farm (Control)					AA			

W = Weekly M = Monthly AA = As available monthly during growing season Q = Quarterly

3.0 Analytical Procedures

3.1 Analytical Procedures (CEP)

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

3.1.1 Fresh Milk

3.1.1.1 Iodine-131

Two liters of milk containing standardized Iodine carrier is 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 efficiency, respectively, using Iodine-131 precipitated as silver iodide (AgI).

3.1.1.2 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.

3.1.1.3 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 resi with strong acid. After the ingrowth period has been established, the Yttrium-90 is extracted with five percent di-2-ethylhexyl phosphoric acid (D_2EHPA) 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.

3.1.1.4 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.

3.1.2 Vegetation

3.1.2.1 Gamma Spectrometry

Refer to Milk Subsection 3.1.1.4.

3.1.2.2 Iodine-131

Required on leafy vegetation only. After appropriate preparation of the sample, analysis is performed as discussed in Subsection 3.1.1.4.

3.1.3 Groundwater and Drinking Water

3.1.3.1 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).

3.1.3.2 Gamma Spectrometry

Refer to Milk Subsection 3.1.1.4.

3.1.3.3 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 (D_2EHPA) 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.

3.1.3.4 Tritium

Three milliliters of the water sample is mixed with Packard Opti-fluor cocktail. The mixture used is nineteen percent sample in a non-organic cocktail. This gives a Tritium counting efficiency of approximately thirty percent. The counting system used is a Beckman LS-5801 Liquid Scintillation Counter.

3.1.4 Surface Water

3.1.4.1 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).

3.1.4.2 Gross Alpha and Beta

An aliquot of the monthly composite is taken and analyzed according to Ground and Drinking Water Subsection 3.1.3.1.

3.1.4.3 Gamma Spectrometry

An aliquot of the monthly composite is taken and analyzed according to Milk Subsection 3.1.1.4.

3.1.4.4 Strontium-89

An aliquot of the monthly composite is taken and analyzed according to Milk Subsection 3.1.1.2.

3.1.4.5 Strontium-90

An aliquot of the monthly composite is taken and analyzed according to Groundwater and Drinking Water Subsection 3.1.3.3.

3.1.4.6 Tritium

An aliquot is taken and analyzed according to Ground and Drinking Water Subsection 3.1.3.4.

3.1.5 Air Particulate

3.1.5.1 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).

3.1.5.2 Gamma Spectrometry

The air filters are sealed in small, plastic Marinelli beakers and counted utilizing the method described in Milk Subsection 3.1.1.4.

3.1.6 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.

3.1.6.1 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).

3.1.6.2 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 Nuclear Data Model ND9900 System. The system is calibrated using charcoal filters which have been uniformly loaded (in the first 5 mm) with standardized isotopes traceable to NBS. 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 loading. Both standards and samples are placed on the detector so that the load gradient is decreasing with distance from the detector.

3.2 Analytical Procedures (ASU)

3.2.1 Gamma Spectroscopy

All gamma detectors are energy calibrated weekly. Efficiency calibrations are done annually using triplicate aliquots of mixed gamma emitting solution whose activity is explicitly traceable to the National Bureau of Standards (NBS).

Water

Two liters of sample is evaporated to 500 ml and counted in a Marinelli beaker.

Milk

Milk cannot be concentrated conveniently and is counted, as received, in a Marinelli beaker.

Soil, Animal Feeds

500 ml of these types of samples is counted in a Marinelli beaker. The Marinelli beaker geometry is volume, but the sample size is grams or kilograms. Therefore sufficient material is uniformly packed into a volume of 500 ml to give an apparent density of 1.0 to 1.1.

3.2.2 Iodine-131

Milk and Water

Iodine is sorbed onto Dowex 1-X8 resin, stripped with hypochlorite, extracted into chloroform, stripped, precipitated as PdI_2, and counted in a low background gas-flow proportional counter.

Charcoal

Charcoal cartridges are counted using a Ge(Li) detector whose efficiency is determined by a standard cartridge spiked with NBS traceable mixed gamma emitter. The activity is loaded onto the first 10% of the charcoal, and the cartridge is turned over halfway through the count.

3.2.3 Strontium-89 and 90

Milk

Radiostrontium and added carrier are sorbed onto Dowex 50W-X8 and stripped with nitric acid. Calcium is separated by repeated extractions with fuming nitric acid. The Yttrium-90 daughter is separated and counted to determine Strontium-90. Strontium-89 is determined by counting Strontium-89 and Strontium-90 before Yttrium-90 ingrowth and subtracting Strontium-90.

Water

Radiostrontium and added carrier are precipitated from the sample as the carbonate. The remainder of the procedure follows that for milk, beginning with nitric acid separations.

3.2.4 Tritium

Water

Water samples are distilled from alkaline permanganate and counted in a liquid scintillation counter.

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.
2. After weighing, the sample is transferred to a drying pan and placed in an oven at 110°C.
3. The dry sample is ground to a fine powder and homogenized.
4. 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 3.1.1 of this report.

.0 Nuclear Instrumentation

5.1 Nuclear Instrumentation (CEP)

5.1.1 Nuclear Data Genie Model ND9900 Gamma Spectrometer

The Nuclear Data Gamma Spectrometer Model ND9900 is a fully integrated multiple user, data acquisition, display and processing system equipped with a DEC Micro VAX II computer, along with an auxiliary power battery pack to ensure no loss of data. This system has complete spectral display manipulation, including ROI selection and applications interface. Other features include linear and logarithmic spectral data display, display of two spectra for comparison, intensified regions of interest and display of experiment status parameters. This system is expandable to 32 ADC's with a live time resolution of 0.01 sec.

5.1.2 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.

5.1.3 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.

5.1.4 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.

5.1.5 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.

5.1.6 Beckman Liquid Scintillation Counting Systems

Beckman LS-5801 Liquid Scintillation Counter will be used for all Tritium determinations, as well as C-14, P-32, S-35 and other Beta emitters. The system has a tritium counting efficiency of sixty percent on an unquenched sample.

5.1.7 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.

5.1.8 Low Background Scintillation Counter

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

5.1.9 Tennelec LB5100 System

The Tennelec LB 5100 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.

5.1.10 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.

5.2 Detectors and Equipment (ASU)

Gamma spectra are analyzed by a Canberra Series 95 Multichannel Analyzer (MCA) using a microVax computer. Four detectors are available:

1. PGT Ge(Li), 26% efficiency, 1.90 keV FWHM @ 1332.5 keV
2. Canberra Ge(Li), 14% efficiency, 2.08 keV FWHM
3. ORTEC HPGe, 13% efficiency, 1.98 keV FWHM
4. Canberra HPGe, 28% efficiency, 3.96 keV FWHM

Two Tennelec LB-5100 low background proportional counters are used for alpha and beta counting. One of the systems has been interfaced to a personal computer and is completely automatic. Sample results and background counts are stored on disk. In addition, the computer is able to automatically produce control charts for background or check source counts and averages background data. Plateaus are automatically determined also. The second Tennelec system will be interfaced to a personal computer as soon as the computer and RMF designed electronics are available.

Alpha spectroscopy is available from either of two solid state silicon surface barrier detectors which are interfaced to the Series 95 MCA.

Liquid scintillation counting is done on one of two Beckman LS-1801 Liquid scintillation spectrometers. The RMF has improved the automatic quench compensation feature through a modification which adds a quench correction for background.

6.0 Isotopic Detection Limits and Activity Determinations

6.1 Isotopic Detection Limits and Activity Determinations (CEP)

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

6.1.1 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 to provide for accurate analysis or the entire process is invalid (Table III).

6.1.2 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 sampl counts per minute (cpm) to disintegrations per minute (dpm).

6.1.3 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.

6.1.4 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).

6.1.5 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.

6.1.6 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:

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

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 predicted 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:

$$A = \frac{C-B}{(2.22)(V)(R)(E)(e^{-\lambda t})} \pm \frac{1.96 \left[\frac{C+B}{T^2}\right]^{\frac{1}{2}}}{(2.22)(V)(R)(E)(e^{-\lambda t})}$$

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.

6.2 Isotopic Detection Limits and Activity Determinations (ASU)

6.2.1 Lower Levels of Detection

The Lower Limits of Detection (LLD) and the methods for calculation are specified in Table 4.12-1 of the PVNGS Technical Specifications.

6.2.2 Sample Errors

Errors are reported as ± 1 sigma (plus or minus one sigma). Gamma isotopic errors are reported as % ± 1 sigma (plus or minus one sigma expressed as a percentage) and are counting errors only. For all other data uncertainties expressed are the result of the propagation of all known sources of error.

7.0 Quality Control Programs

7.1 Quality Control Program (CEP)

CEP employs a multi-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 Appendices A and B for EPA Radiological Cross-check results.)

7.2 Quality Assurance Intercomparison Results (ASU)

7.2.1 Intercomparisons

The Radiation Measurements Facility (RMF) routinely participates in intercomparisons sponsored by U.S. Environmental Protection Agency (EPA), U.S. Department of Energy Environmental Measurements Laboratory (DOE EML) and Canada's Department of National Health and Welfare. In 1987, an additional intercomparison was provided by the U.S. Nuclear Regulatory Commission (USNRC).

EPA intercomparison results are listed in Appendix C. Gamma spectrometry results on samples with low levels of activity were improved, over the 1986 intercomparisons, by concentrating the sample prior to counting. Milk samples cannot be concentrated by evaporation, at least not in a practical way. Therefore, MDA's for milk are generally a factor of four higher.

The DOE EML Quality Assurance Program restarted in 1987. Results can be found in Appendix C.

In addition the RMF analyzed one USNRC sample which was supplied by PVNGS. Results are in Appendix C.

A charcoal canister was spiked with iodine (I-131) by Analytics, Inc., Atlanta, Georgia and sent to the RMF for assay. Results are in Appendix C.

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TABLE III

ALIQUOT SCANNED FOR DETECTION LIMIT CALCULATION

AND ACTUAL ANALYSIS

Sample Type	Gross Alpha	Gross Beta	Gamma Spec.	Iodine-131	Strontium-89	Strontium-90	Tritium
Air Particulates	265 m^3(a)	265 m^3(a)	265 m^3(a)				
Airborne Radioiodine				265 m^3(a)			
Domestic Meats (Beef)			500 g(a)				
Fresh Milk			1000 mls(a) 500 mls(b)	2000 mls(a) 2000 mls(b)	2000 mls(a)	2000 mls(a)	
Vegetation (Citrus Fruits)			500 g(a)				
Vegetation (Leafy)			500 g(a)	100 g(a)			
Groundwater	1000 mls(a) 250 mls(b)	1000 mls(a) 250 mls(b)	1000 mls(a) 500 mls(b)			1000 mls(a) 2000 mls(b)	3 ml(a) 10 ml(b)
Drinking Water	1000 mls(a) 250 mls(b)	1000 mls(a) 250 mls(b)	1000 mls(a) 500 mls(b)			1000 mls(a) 2000 mls(b)	3 ml(a) 10 ml(b)
Surface Water	1000 mls(a) 250 mls(b)	1000 mls(a) 250 mls(b)	1000 mls(a) 500 mls(b)	1000 mls(a) 2000 mls(b)	1000 mls(a) 2000 mls(b)	1000 mls(a) 2000 mls(b)	3 ml(a) 10 ml(b)

(a) CEP data
(b) ASU data. Typical times between collection and counting are 2-4 days (milk) and 1-3 days (water).

TABLE IV

SAMPLE COUNTING TIMES

Sample Type	Gross Alpha	Gross Beta	Gamma Spec.	Iodine-131	Strontium-89	Strontium-90	Tritium
Air Particulates	100 min(a)	100 min(a)	8 hrs(a)				
Airborne Radioiodine				8 hrs*(a)			
Domestic Meats (Beef)			8 hrs(a)				
Fresh Milk			8 hrs(a) 8 hrs(b)	100 min(a) 300 min(b)	100 min(a)	100 min(a)	
Vegetation (Citrus Fruits)			8 hrs(a)				
Vegetation (Leafy)			8 hrs(a)	100 min(a)			
Groundwater	100 min(a)	100 min(a) 200 min(b)	8 hrs(a) 8 hrs(b)			100 min(a) 300 min(b)	50 min(a) 100 min(b)
Drinking Water	100 min(a)	100 min(a) 200 min(b)	8 hrs(a) 8 hrs(b)			100 min(a) 300 min(b)	50 min(a) 100 min(b)
Surface Water	100 min(a)	100 min(a) 200 min(b)	8 hrs(a) 8 hrs(b)	100 min(a) 300 min(b)	100 min(a) 100 min(b)	100 min(a) 300 min(b)	50 min(a) 100 min(b)

*Alkaline Leach Method Counted for 100 mins

(a) CEP data
(b) ASU data

TABLE V

DETECTION LIMITS BY OTHER THAN GAMMA SPECTROMETRY

Sample Type	Gross Alpha	Gross Beta	Iodine-131	Strontium-89	Strontium-90	Tritium
Air Particulates	0.005 pCi/m^3(a)	0.002 pCi/m^3(a)				
Airborne Radioiodine			0.007 pCi/m^3**(a)			
Fresh Milk			0.5 pCi/L(a) 0.5 pCi/L(b)	1.0 pCi/L(a)	0.5 pCi/L(a)	
Vegetation (Leafy)			20 pCi/kg*(a)			
Vegetation (Animal feed)				100 pCi/kg(a)	50 pCi/kg(a)	
Groundwater	1.0 pCi/L(a)	2.0 pCi/L(a) 4.0 pCi/L(b)			0.5 pCi/L(a) 0.5 pCi/L(b)	1000 pCi/L(a) 1000 pCi/L(b)
Drinking Water	1.0 pCi/L(a)	2.0 pCi/L(a) 4.0 pCi/L(b)			0.5 pCi/L(a) 0.5 pCi/L(b)	1000 pCi/L(a) 1000 pCi/L(b)
Surface Water	1.0 pCi/L(a)	2.0 pCi/L(a) 4.0 pCi/L(b)	0.5 pCi/L(a) 0.5 pCi/L(b)	1.0 pCi/L(a) 1.0 pCi/L(b)	0.5 pCi/L(a) 0.5 pCi/L(b)	1000 pCi/L(a) 1000 pCi/L(b)

*As Wet Weight

**Alkaline Leach Method. I-131 Detection Limit by Gamma Spectrometry 0.020 pCi/m^3

(a) CEP data

(b) ASU data. Typical times between collection and counting are 2-4 days (milk) and 1-3 days (water).

TABLE VI

DETECTION LIMITS BY GAMMA SPECTROMETRY

Energy MeV	Isotope	(a) Sensitivity pCi/kg* Vegetation	Sensitivity pCi/l* Groundwater, Drinking Water and Surface Water	Sensitivity pCi/l* Fresh Milk	(a) Sensitivity pCi/m^3* Air Particulate	(b) Detector Efficiency
.364	Iodine-131	-	1(a) 8(b)	-(a) 8(b)	0.020	0.015
.537	Barium-140	75	4(a) 30(b)	4(a) 34(b)	0.030	0.010
.605	Cesium-134	29	10(a) 8(b)	10(a) 9(b)	0.001	0.0091
.662	Cesium-137	56	2(a) 10(b)	2(a) 10(b)	0.001	0.0083
.765	Zr, Nb-95	66	8(a) 17,11(b)	8(a) 17,11(b)	0.026	0.0072
.81	Cobalt-58	20	5(a) 8(b)	3(a) 9(b)	0.001	0.0068
.835	Manganese-54	21	2(a) 8(b)	2(a) 9(b)	0.001	0.0066
.095	Iron-59	21	3(a) 17(b)	3(a) 22(b)	0.006	0.0051
.115	Zinc-65	60	16(a) 19(b)	16(a) 24(b)	0.045	0.0050
.173	Cobalt-60	63	5(a) 9(b)	5(a) 10(b)	0.019	0.0047
.596	Lanthanum-140	465	4(a) 10(b)	4(a) 12(b)	0.030	0.0036

See Table III for aliquots used in the calibration of these sensitivities.
a) CEP data.
b) ASU data.

8.0 Data Interpretation and Conclusions

Interpretations and conclusions regarding all types of samples analyzed during 1987 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.

8.1 Air Particulates

Air particulate samples were collected from each of the twelve monitoring sites on a weekly basis during 1987. The twelve sites are 1A, 4A, 6A, 7A, 14A, 15A, 17A, 21A, 29A, 35A, 40A and 44A. 6A is the control site. 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, 15A, 17A, 21A, 29A and 40A due to the Salt Drift Monitoring Program. Gamma Spectral analysis for the other stations was performed on quarterly composites by station.

Thirty-four air particulate samples were invalid. The samples and the reason for the statuses are listed below:

First Quarter 1987

Date Collected	Site #	Reason
01/07/87	7A	Redline exceeded
02/04/87	15A	Low total flow
03/18/87	4A	Excessive flow rate
03/25/87	6A(Control)	Excessive flow rate

Second Quarter 1987

Date Collected	Site #	Reason
04/15/87	6A(Control)	Excessive flow rate
06/10/87	6A(Control)	Excessive flow rate
06/17/87	1A,44A	Redline exceeded

Third Quarter 1987

Date Collected	Site #	Reason
07/21/87	35A	Sampler malfunction
07/28/87	14A,17A	Loss of power
07/28/87	35A	ETM malfunction
08/04/87	7A,17A	Pump malfunction
09/01/87	1A,17A,44A	Redline exceeded
09/08/87	40A	Redline exceeded
09/15/87	1A,4A,17A,44A	Redline exceeded
09/22/87	1A,17A,44A	Redline exceeded

Fourth Quarter 1987

Date Collected	Site #	Reason
10/06/87	1A,4A,17A,44A	Redline exceeded
10/27/87	1A	Redline exceeded
10/27/87	21A	ETM malfunction
11/24/87	35A	Redline exceeded
12/15/87	40A	ETM malfunction
12/29/87	1A	Redline exceeded

Table VII presents first quarter Gross Beta results. Station 6A showed the highest activity during the quarter (0.047 ±0.002 pCi/m^3) collected 01/07/87. Station 6A showed the lowest activity (0.012 ±0.002 pCi/m^3) collected on 02/18/87. Weekly mean activities ranged from a low of 0.014 ±0.002 pCi/m^3 during the week of 02/11/87-02/18/87 to a high of 0.043 ±0.002 pCi/m^3 in the week of 12/30/86-01/07/87. The range of results is comparable to previous quarterly data and does not indicate any anomalies.

Table VIII presents second quarter Gross Beta results. Several stations showed the highest activity during the quarter of 0.031 ±0.002 pCi/m^3. The Station 6A sample collected 06/10/87-06/17/87 showed the lowest level at 0.017 ±0.002 pCi/m^3. Weekly mean activities ranged from a low of 0.020 pCi/m^3 during the periods of 04/01/87-04/08/87 and 06/10/87-06/17/87 to a high of 0.029 ±0.001 pCi/m^3 in the weeks of 05/13/87-

05/20/87 and 05/27/87-06/03/87. The range of results is comparable to previous quarterly data and does not indicate any anomalies.

Table IX presents the Gross Beta levels during the third quarter of 1987. The lowest value of 0.015 ±0.002 pCi/m^3 was observed at station 44A collected during the week of 08/11/87-08/18/87. The highest level of activity was 0.040 ±0.002 pCi/m^3 at Station 29A during the collection period of 09/15/87-09/22/87. Weekly mean activities ranged from a minimum of 0.018 ±0.002 pCi/m^3 (08/11/87-08/18/87), to a maximum of 0.037 ±0.002 pCi/m^3 in the period of 09/15/87-09/22/87. The range of results is comparable to pervious quarterly data and does not indicate any anomalies.

Table X presents the Gross Beta activities seen in the fourth quarter. Observed levels varied from 0.016 ±0.002 pCi/m^3 at Station 40A (collected 11/03/87-11/10/87), to 0.055 ±0.003 pCi/m^3 at several stations collected on 11/24/87-12/01/87. Weekly mean activities ranged from 0.019 ±0.002 pCi/m^3 during the collection period of 11/03/87-11/10/87 to 0.050 ±0.005 collected 11/24/87-12/01/87. 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 1987 is similar to those for other reactor sites located west of the Mississippi River.

Table XI contains the mean Gross Beta activities by station. Mean quarterly activities are calculated using all weekly activities except those marked invalid. Mean activities for each quarter ranged from a low of 0.024 ±0.006 at several stations during the year, to a high of 0.038 ±0.009 pCi/m^3 at Station 21A in the fourth quarter.

The average Gross Beta activity for each quarter is as follows:

	pCi/m^3
First Quarter 1987	0.028 ±0.001
Second Quarter 1987	0.025 ±0.001
Third Quarter 1987	0.026 ±0.001
Fourth Quarter 1987	0.034 ±0.003

No man-made Gamma-emitting nuclides were detected in any of the air filter samples collected during 1987.

Tables XII thru XV show the Gross Alpha activity for each week during 1987. Gross Alpha activity was detected in five samples collected in 1987. These data are consistent with the activity seen during preoperational monitoring.

TABLE VII

GROSS BETA IN AIR PARTICULATE DATA (a)

FIRST QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
12/30/86 - 01/07/87	0.044±0.002	0.044±0.002	0.047±0.002	**	0.039±0.002	0.041±0.002	0.043±0.002
01/07/87 - 01/14/87	0.029±0.002	0.030±0.002	0.032±0.002	0.037±0.002	0.034±0.002	0.032±0.002	0.034±0.002
01/14/87 - 01/21/87	0.039±0.002	0.042±0.002	0.043±0.002	0.041±0.002	0.039±0.002	0.044±0.002	0.041±0.002
01/21/87 - 01/28/87	0.038±0.002	0.037±0.002	0.039±0.002	0.041±0.002	0.035±0.002	0.035±0.002	0.033±0.002
01/28/87 - 02/04/87	0.033±0.002	0.032±0.002	0.035±0.002	0.036±0.002	0.036±0.002	**	0.034±0.002
02/04/87 - 02/11/87	0.024±0.002	0.026±0.002	0.023±0.002	0.025±0.002	0.024±0.002	0.027±0.002	0.024±0.002
02/11/87 - 02/18/87	0.013±0.002	0.014±0.002	0.012±0.002	0.015±0.002	0.014±0.002	0.013±0.002	0.013±0.002
02/18/87 - 02/25/87	0.018±0.002	0.019±0.002	0.018±0.002	0.018±0.002	0.019±0.002	0.018±0.002	0.018±0.002
02/25/87 - 03/04/87	0.022±0.002	0.027±0.002	0.025±0.002	0.037±0.002	0.026±0.002	0.025±0.002	0.028±0.002
03/04/87 - 03/11/87	0.032±0.002	0.031±0.002	0.029±0.002	0.032±0.002	0.020±0.002	0.024±0.002	0.024±0.002
03/11/87 - 03/18/87	0.021±0.002	**	0.021±0.002	0.021±0.002	0.020±0.002	0.018±0.002	0.016±0.002
03/18/87 - 03/25/87	0.017±0.002	0.018±0.002	**	0.015±0.002	0.015±0.002	0.015±0.002	0.015±0.002
03/25/87 - 04/01/87	0.022±0.002	0.025±0.002	0.024±0.002	0.023±0.002	0.024±0.002	0.024±0.002	0.021±0.002

(a)CEP data
**Invalid Sample

TABLE (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (a)

FIRST QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A	Weekly Mean Gross Beta Activities ±Standard Deviation of the Mean
12/30/86 - 01/07/87	0.044±0.002	0.044±0.002	0.039±0.002	0.042±0.002	0.041±0.002	0.043±0.002
01/07/87 - 01/14/87	0.034±0.002	0.033±0.002	0.032±0.002	0.033±0.002	0.026±0.002	0.032±0.003
01/14/87 - 01/21/87	0.042±0.002	0.042±0.002	0.040±0.002	0.044±0.002	0.043±0.002	0.042±0.002
01/21/87 - 01/28/87	0.040±0.002	0.039±0.002	0.035±0.002	0.037±0.002	0.032±0.002	0.037±0.003
01/28/87 - 02/04/87	0.036±0.002	0.037±0.002	0.036±0.002	0.035±0.002	0.027±0.002	0.034±0.003
02/04/87 - 02/11/87	0.027±0.002	0.028±0.002	0.023±0.002	0.025±0.002	0.026±0.002	0.025±0.002
02/11/87 - 02/18/87	0.014±0.002	0.014±0.002	0.014±0.002	0.017±0.002	0.018±0.002	0.014±0.002
02/18/87 - 02/25/87	0.019±0.002	0.019±0.002	0.016±0.002	0.021±0.002	0.018±0.002	0.018±0.001
02/25/87 - 03/04/87	0.025±0.002	0.025±0.002	0.026±0.002	0.023±0.002	0.027±0.002	0.026±0.004
03/04/87 - 03/11/87	0.037±0.002	0.036±0.002	0.031±0.002	0.036±0.002	0.025±0.002	0.030±0.005
03/11/87 - 03/18/87	0.020±0.002	0.019±0.002	0.016±0.002	0.019±0.002	0.019±0.002	0.019±0.002
03/18/87 - 03/25/87	0.015±0.002	0.015±0.002	0.016±0.002	0.013±0.002	0.015±0.002	0.015±0.001
03/25/87 - 04/01/87	0.022±0.002	0.022±0.002	0.022±0.002	0.021±0.002	0.019±0.002	0.022±0.002

(a)CEP data

TABLE VIII

GROSS BETA IN AIR PARTICULATE DATA (a)

SECOND QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
04/01/87 - 04/08/87	0.020±0.002	0.020±0.002	0.018±0.002	0.019±0.002	0.020±0.002	0.019±0.002	0.018±0.002
04/08/87 - 04/15/87	0.025±0.002	0.030±0.002	**	0.026±0.002	0.028±0.002	0.028±0.002	0.025±0.002
04/15/87 - 04/22/87	0.024±0.002	0.026±0.002	0.023±0.002	0.026±0.002	0.026±0.002	0.027±0.002	0.021±0.002
04/22/87 - 04/29/87	0.026±0.002	0.024±0.002	0.023±0.002	0.024±0.002	0.024±0.002	0.027±0.002	0.025±0.002
04/29/87 - 05/06/87	0.023±0.002	0.026±0.002	0.024±0.002	0.026±0.002	0.023±0.002	0.025±0.002	0.023±0.002
05/06/87 - 05/13/87	0.024±0.002	0.026±0.002	0.024±0.002	0.025±0.002	0.026±0.002	0.023±0.002	0.024±0.002
05/13/87 - 05/20/87	0.029±0.002	0.031±0.002	0.031±0.002	0.030±0.002	0.028±0.002	0.028±0.002	0.029±0.002
05/20/87 - 05/27/87	0.027±0.002	0.028±0.002	0.030±0.002	0.025±0.002	0.025±0.002	0.024±0.002	0.026±0.002
05/27/87 - 06/03/87	0.026±0.002	0.029±0.002	0.029±0.002	0.029±0.002	0.030±0.002	0.031±0.002	0.030±0.002
06/03/87 - 06/10/87	0.024±0.002	0.022±0.002	**	0.028±0.002	0.024±0.002	0.023±0.002	0.023±0.002
06/10/87 - 06/17/87	**	0.019±0.002	0.017±0.002	0.020±0.002	0.019±0.002	0.020±0.002	0.020±0.002
06/17/87 - 06/24/87	0.026±0.002	0.023±0.002	0.023±0.002	0.027±0.002	0.021±0.002	0.024±0.002	0.026±0.002
06/24/87 - 07/01/87	0.022±0.002	0.022±0.002	0.022±0.002	0.026±0.002	0.026±0.002	0.021±0.002	0.023±0.002

**Invalid Sample
(a)CEP data

TABLE II (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (a)

SECOND QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A	Weekly Mean Gross Beta Activities ±Standard Deviation of the Mean
04/01/87 - 04/08/87	0.023±0.002	0.019±0.002	0.021±0.002	0.019±0.002	0.018±0.002	0.020±0.001
04/08/87 - 04/15/87	0.026±0.002	0.027±0.002	0.023±0.002	0.027±0.002	0.025±0.002	0.026±0.002
04/15/87 - 04/22/87	0.025±0.002	0.025±0.002	0.025±0.002	0.026±0.002	0.025±0.002	0.025±0.002
04/22/87 - 04/29/87	0.024±0.002	0.024±0.002	0.026±0.002	0.024±0.002	0.024±0.002	0.025±0.001
04/29/87 - 05/06/87	0.025±0.002	0.026±0.002	0.025±0.002	0.025±0.002	0.024±0.002	0.025±0.001
05/06/87 - 05/13/87	0.024±0.002	0.024±0.002	0.025±0.002	0.027±0.002	0.022±0.002	0.025±0.001
05/13/87 - 05/20/87	0.031±0.002	0.030±0.002	0.027±0.002	0.029±0.002	0.029±0.002	0.029±0.001
05/20/87 - 05/27/87	0.025±0.002	0.028±0.002	0.023±0.002	0.025±0.002	0.030±0.002	0.026±0.002
05/27/87 - 06/03/87	0.028±0.002	0.030±0.002	0.031±0.002	0.028±0.002	0.028±0.002	0.029±0.001
06/03/87 - 06/10/87	0.023±0.002	0.023±0.002	0.027±0.002	0.024±0.002	0.025±0.002	0.024±0.002
06/10/87 - 06/17/87	0.020±0.002	0.023±0.002	0.018±0.002	0.019±0.002	**	0.020±0.002
06/17/87 - 06/24/87	0.024±0.002	0.024±0.002	0.023±0.002	0.024±0.002	0.024±0.002	0.024±0.002
06/24/87 - 07/01/87	0.023±0.002	0.021±0.002	0.024±0.002	0.024±0.002	0.022±0.002	0.023±0.002

(a)CEP data
**Invalid Sample

TABLE IX

GROSS BETA IN AIR PARTICULATE DATA (a)

THIRD QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	Station 6A (Control)	Station 7A	Station 14A	Station 15A	Station 17A
07/01/87 - 07/07/87	0.027±0.002	0.028±0.002	0.028±0.002	0.028±0.002	0.028±0.002	0.031±0.002	0.033±0.002
07/07/87 - 07/14/87	0.023±0.002	0.021±0.002	0.021±0.002	0.022±0.002	0.022±0.002	0.023±0.002	0.025±0.002
07/14/87 - 07/21/87	0.021±0.002	0.020±0.002	0.019±0.002	0.020±0.002	0.020±0.002	0.024±0.002	0.020±0.002
07/21/87 - 07/28/87	0.019±0.002	0.020±0.002	0.017±0.002	0.022±0.002	**	0.023±0.002	**
07/28/87 - 08/04/87	0.020±0.002	0.018±0.002	0.021±0.002	**	0.020±0.002	0.025±0.002	**
08/04/87 - 08/11/87	0.026±0.002	0.025±0.002	0.026±0.002	0.024±0.002	0.025±0.002	0.026±0.002	0.026±0.002
08/11/87 - 08/18/87	0.018±0.002	0.018±0.002	0.024±0.002	0.016±0.002	0.019±0.002	0.017±0.002	0.021±0.002
08/18/87 - 08/25/87	0.026±0.002	0.025±0.002	0.028±0.002	0.026±0.002	0.029±0.002	0.024±0.002	0.027±0.002
08/25/87 - 09/01/87	**	0.032±0.002	0.032±0.002	0.033±0.002	0.031±0.002	0.032±0.002	**
09/01/87 - 09/08/87	0.034±0.002	0.035±0.002	0.033±0.002	0.029±0.002	0.033±0.002	0.036±0.002	0.035±0.002
09/08/87 - 09/15/87	**	**	0.026±0.002	0.027±0.002	0.024±0.002	0.027±0.002	**
09/15/87 - 09/22/87	**	0.037±0.002	0.038±0.002	0.037±0.002	0.037±0.002	0.035±0.002	**
09/22/87 - 09/29/87	0.026±0.002	0.025±0.002	0.033±0.002	0.027±0.002	0.028±0.002	0.031±0.002	0.030±0.002

**Invalid Sample
(a)CEP data

TABLE X (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (a)

THIRD QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A	Weekly Mean Gross Beta Activities ±Standard Deviation of the Mean
07/01/87 - 07/07/87	0.027±0.002	0.029±0.002	0.031±0.002	0.030±0.002	0.031±0.002	0.029±0.002
07/07/87 - 07/14/87	0.023±0.002	0.021±0.002	0.029±0.002	0.022±0.002	0.022±0.002	0.023±0.002
07/14/87 - 07/21/87	0.022±0.002	0.024±0.002	**	0.016±0.002	0.019±0.002	0.020±0.002
07/21/87 - 07/28/87	0.020±0.002	0.020±0.002	**	0.017±0.002	0.025±0.002	0.020±0.003
07/28/87 - 08/04/87	0.020±0.002	0.023±0.002	0.020±0.002	0.019±0.002	0.018±0.002	0.020±0.002
08/04/87 - 08/11/87	0.023±0.002	0.024±0.002	0.026±0.002	0.025±0.002	0.028±0.002	0.025±0.001
08/11/87 - 08/18/87	0.018±0.002	0.016±0.002	0.018±0.002	0.018±0.002	0.015±0.002	0.018±0.002
08/18/87 - 08/25/87	0.032±0.002	0.027±0.002	0.028±0.002	0.026±0.002	0.026±0.002	0.027±0.002
08/25/87 - 09/01/87	0.031±0.002	0.034±0.002	0.030±0.002	0.027±0.002	**	0.031±0.002
09/01/87 - 09/08/87	0.035±0.002	0.034±0.002	0.038±0.002	**	0.032±0.002	0.034±0.002
09/08/87 - 09/15/87	0.025±0.002	0.029±0.002	0.026±0.002	0.026±0.002	**	0.026±0.001
09/15/87 - 09/22/87	0.035±0.002	0.040±0.002	0.033±0.002	0.037±0.002	**	0.037±0.002
09/22/87 - 09/29/87	0.031±0.002	0.031±0.002	0.027±0.002	0.024±0.002	0.022±0.002	0.028±0.003

**Invalid Sample
(a)CEP data

TABLE X

GROSS BETA IN AIR PARTICULATE DATA (a)

FOURTH QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
09/29/87 - 10/06/87	**	**	0.041±0.002	0.040±0.002	0.042±0.002	0.041±0.002	**
10/06/87 - 10/13/87	0.038±0.002	0.034±0.002	0.038±0.002	0.037±0.002	0.038±0.002	0.040±0.002	0.039±0.002
10/13/87 - 10/20/87	0.035±0.002	0.038±0.002	0.036±0.002	0.042±0.002	0.046±0.002	0.039±0.002	0.043±0.002
10/20/87 - 10/27/87	**	0.024±0.002	0.025±0.002	0.024±0.002	0.026±0.002	0.029±0.002	0.026±0.002
10/27/87 - 11/03/87	0.021±0.002	0.024±0.002	0.020±0.002	0.021±0.002	0.020±0.002	0.034±0.002	0.025±0.002
11/03/87 - 11/10/87	0.021±0.002	0.018±0.002	0.018±0.002	0.019±0.002	0.019±0.002	0.018±0.002	0.018±0.002
11/10/87 - 11/17/87	(d)	0.033±0.002	0.034±0.002	0.037±0.002	0.038±0.002	0.036±0.002	0.042±0.002
11/17/87 - 11/24/87	(d)	0.026±0.002	0.032±0.002	0.031±0.002	0.029±0.002	0.025±0.002	0.027±0.002
11/24/87 - 12/01/87	(d)	0.041±0.002	0.050±0.002	0.055±0.003	0.052±0.003	0.042±0.002	0.052±0.002
12/01/87 - 12/08/87	(d)	0.042±0.002	0.047±0.002	0.047±0.003	0.043±0.002	0.044±0.002	0.042±0.002
12/08/87 - 12/15/87	(d)	0.031±0.002	0.039±0.002	0.035±0.002	0.028±0.002	0.029±0.002	0.032±0.002
12/15/87 - 12/22/87	(d)	0.033±0.002	0.030±0.002	0.037±0.002	0.035±0.002	0.030±0.002	0.032±0.002
12/22/87 - 12/29/87	**	0.028±0.002	0.035±0.002	0.036±0.002	0.034±0.002	0.038±0.002	0.032±0.002

(a)CEP data
**Invalid Sample
(d)Sample not collected

TABLE X (Cont.)

GROSS BETA IN AIR PARTICULATE DATA (a)

FOURTH QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A	Weekly Mean Gross Beta Activities ±Standard Deviation of the Mean
09/29/87 - 10/06/87	0.041±0.002	0.041±0.002	0.041±0.002	0.039±0.002	**	0.041±0.001
10/06/87 - 10/13/87	0.045±0.002	0.041±0.002	0.041±0.002	0.053±0.002	0.036±0.002	0.040±0.005
10/13/87 - 10/20/87	0.042±0.002	0.044±0.002	0.038±0.002	0.042±0.002	0.036±0.002	0.040±0.004
10/20/87 - 10/27/87	**	0.029±0.002	0.029±0.002	0.026±0.002	0.031±0.002	0.027±0.002
10/27/87 - 11/03/87	0.022±0.002	0.021±0.002	0.021±0.002	0.018±0.002	0.018±0.002	0.022±0.004
11/03/87 - 11/10/87	0.021±0.002	0.017±0.002	(d)	0.016±0.002	(d)	0.019±0.002
11/10/87 - 11/17/87	0.042±0.002	0.039±0.002	0.033±0.002	0.038±0.002	(d)	0.037±0.003
11/17/87 - 11/24/87	0.034±0.002	0.032±0.002	**	0.031±0.002	(d)	0.030±0.003
11/24/87 - 12/01/87	0.055±0.003	0.055±0.003	0.048±0.003	0.051±0.003	(d)	0.050±0.005
12/01/87 - 12/08/87	0.043±0.002	0.052±0.002	0.041±0.002	0.052±0.003	(d)	0.045±0.004
12/08/87 - 12/15/87	0.041±0.003	0.032±0.002	0.028±0.002	**	(d)	0.033±0.005
12/15/87 - 12/22/87	0.036±0.002	0.038±0.002	0.035±0.002	0.037±0.002	(d)	0.034±0.003
12/22/87 - 12/29/87	0.036±0.002	0.032±0.002	0.031±0.002	0.034±0.002	(d)	0.034±0.003

(a)CEP data
**Invalid Sample
(d)Sample not collected

TABLE XI

GROSS BETA IN AIR PARTICULATE DATA(a)

STATION SUMMARY

1987

(pCi/m^3)

Station	Mean Activity			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
1A	0.027 ±0.010	0.025 ±0.002	0.024 ±0.005	0.029 ±0.009
4A	0.029 ±0.009	0.025 ±0.004	0.025 ±0.006	0.031 ±0.007
6A(Control)	0.029 ±0.011	0.024 ±0.004	0.027 ±0.006	0.034 ±0.009
7A	0.028 ±0.010	0.025 ±0.003	0.026 ±0.006	0.035 ±0.011
14A	0.027 ±0.009	0.025 ±0.003	0.026 ±0.006	0.035 ±0.010
15A	0.026 ±0.010	0.025 ±0.004	0.027 ±0.005	0.034 ±0.008
17A	0.026 ±0.010	0.024 ±0.003	0.027 ±0.005	0.034 ±0.010
21A	0.029 ±0.011	0.025 ±0.003	0.026 ±0.006	0.038 ±0.009
29A	0.029 ±0.010	0.025 ±0.003	0.027 ±0.007	0.036 ±0.011
35A	0.027 ±0.009	0.024 ±0.003	0.028 ±0.006	0.035 ±0.008
40A	0.028 ±0.010	0.025 ±0.003	0.024 ±0.006	0.036 ±0.012
44A	0.026 ±0.009	0.025 ±0.003	0.024 ±0.006	0.030 ±0.009

(a) CEP data

TABLE XII

GROSS ALPHA IN AIR PARTICULATE DATA (a)

FIRST QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
12/30/86 - 01/07/87	<LLD	<LLD	<LLD	**	<LLD	<LLD	<LLD
01/07/87 - 01/14/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/14/87 - 01/21/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/21/87 - 01/28/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/28/87 - 02/04/87	<LLD	<LLD	<LLD	<LLD	<LLD	**	<LLD
02/04/87 - 02/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/11/87 - 02/18/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/18/87 - 02/25/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/25/87 - 03/04/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
03/04/87 - 03/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
03/11/87 - 03/18/87	<LLD	**	<LLD	<LLD	<LLD	<LLD	<LLD
03/18/87 - 03/25/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
03/25/87 - 04/01/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XII (Cont.)

GROSS ALPHA IN AIR PARTICULATE DATA (a)

FIRST QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
12/30/86 - 01/07/87	<LLD	<LLD	<LLD	<LLD	0.005±0.001
01/07/87 - 01/14/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/14/87 - 01/21/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/21/87 - 01/28/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/28/87 - 02/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/04/87 - 02/11/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/11/87 - 02/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/18/87 - 02/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/25/87 - 03/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/04/87 - 03/11/87	0.005±0.001	<LLD	<LLD	0.006±0.001	<LLD
03/11/87 - 03/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/18/87 - 03/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/25/87 - 04/01/87	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XIII

GROSS ALPHA IN AIR PARTICULATE DATA (a)

SECOND QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
04/01/87 - 04/08/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/08/87 - 04/15/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
04/15/87 - 04/22/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/22/87 - 04/29/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/29/87 - 05/06/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/06/87 - 05/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/13/87 - 05/20/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/20/87 - 05/27/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/27/87 - 06/03/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/03/87 - 06/10/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
06/10/87 - 06/17/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/17/87 - 06/24/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/24/87 - 07/01/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XIII (Cont.)

GROSS ALPHA IN AIR PARTICULATE DATA (a)

SECOND QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
04/01/87 - 04/08/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/08/87 - 04/15/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/15/87 - 04/22/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/22/87 - 04/29/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/29/87 - 05/06/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/06/87 - 05/13/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/13/87 - 05/20/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/20/87 - 05/27/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/27/87 - 06/03/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/03/87 - 06/10/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/10/87 - 06/17/87	<LLD	<LLD	<LLD	<LLD	**
06/17/87 - 06/24/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/24/87 - 07/01/87	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

T XIV

GROSS ALPHA IN AIR PARTICULATE DATA (a)

THIRD QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
07/01/87 - 07/07/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
07/07/87 - 07/14/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
07/14/87 - 07/21/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
07/21/87 - 07/28/87	<LLD	<LLD	<LLD	<LLD	**	<LLD	**
07/28/87 - 08/04/87	<LLD	<LLD	<LLD	**	<LLD	<LLD	**
08/04/87 - 08/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/87 - 08/18/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/18/87 - 08/25/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/25/87 - 09/01/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	**
09/01/87 - 09/08/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
09/08/87 - 09/15/87	**	**	<LLD	<LLD	<LLD	<LLD	**
09/15/87 - 09/22/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	**
09/22/87 - 09/29/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XIV (Cont.)

GROSS ALPHA IN AIR PARTICULATE DATA (a)

THIRD QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
07/01/87 - 07/07/87	<LLD	<LLD	<LLD	<LLD	<LLD
07/07/87 - 07/14/87	<LLD	<LLD	<LLD	<LLD	<LLD
07/14/87 - 07/21/87	<LLD	<LLD	**	<LLD	<LLD
07/21/87 - 07/28/87	<LLD	<LLD	**	<LLD	<LLD
07/28/87 - 08/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/04/87 - 08/11/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/87 - 08/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/18/87 - 08/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/25/87 - 09/01/87	<LLD	<LLD	<LLD	<LLD	**
09/01/87 - 09/08/87	<LLD	<LLD	<LLD	**	<LLD
09/08/87 - 09/15/87	<LLD	<LLD	<LLD	<LLD	**
09/15/87 - 09/22/87	<LLD	<LLD	<LLD	<LLD	**
09/22/87 - 09/29/87	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

XV

GROSS ALPHA IN AIR PARTICULATE DATA (a)

FOURTH QUARTER

1987

(pCi/m^3)

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
09/29/87 - 10/06/87	**	**	<LLD	<LLD	<LLD	<LLD	**
10/06/87 - 10/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/13/87 - 10/20/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/20/87 - 10/27/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/27/87 - 11/03/87	<LLD	<LLD	<LLD	<LLD	<LLD	0.008±0.002	0.007±0.001
11/03/87 - 11/10/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/10/87 - 11/17/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/17/87 - 11/24/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/24/87 - 12/01/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/01/87 - 12/08/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/08/87 - 12/15/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/15/87 - 12/22/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/22/87 - 12/29/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data
(d)Sample not collected

TABLE XV (Cont.)

GROSS ALPHA IN AIR PARTICULATE DATA (a)

FOURTH QUARTER

1987

(pCi/m^3)

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
09/29/87 - 10/06/87	<LLD	<LLD	<LLD	<LLD	**
10/06/87 - 10/13/87	<LLD	<LLD	<LLD	<LLD	<LLD
10/13/87 - 10/20/87	<LLD	<LLD	<LLD	<LLD	<LLD
10/20/87 - 10/27/87	**	<LLD	<LLD	<LLD	<LLD
10/27/87 - 11/03/87	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/87 - 11/10/87	<LLD	<LLD	(d)	<LLD	(d)
11/10/87 - 11/17/87	<LLD	<LLD	<LLD	<LLD	(d)
11/17/87 - 11/24/87	<LLD	<LLD	**	<LLD	(d)
11/24/87 - 12/01/87	<LLD	<LLD	<LLD	<LLD	(d)
12/01/87 - 12/08/87	<LLD	<LLD	<LLD	<LLD	(d)
12/08/87 - 12/15/87	<LLD	<LLD	<LLD	<LLD	(d)
12/15/87 - 12/22/87	<LLD	<LLD	<LLD	<LLD	(d)
12/22/87 - 12/29/87	<LLD	<LLD	<LLD	<LLD	(d)

**Invalid Sample
(a)CEP data
(d)Sample not collected

Figure 3
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 1A

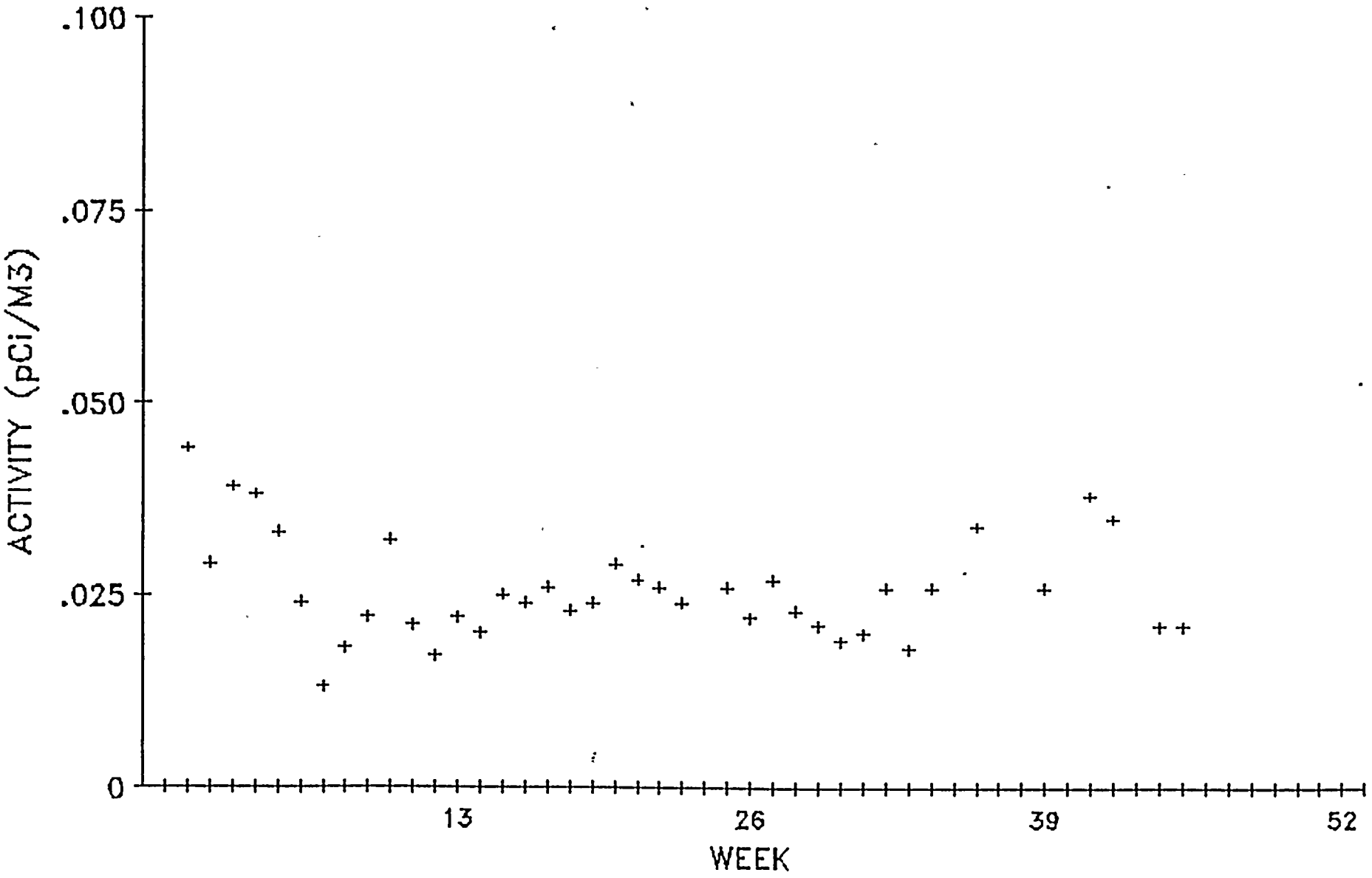


Figure 4
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 4A

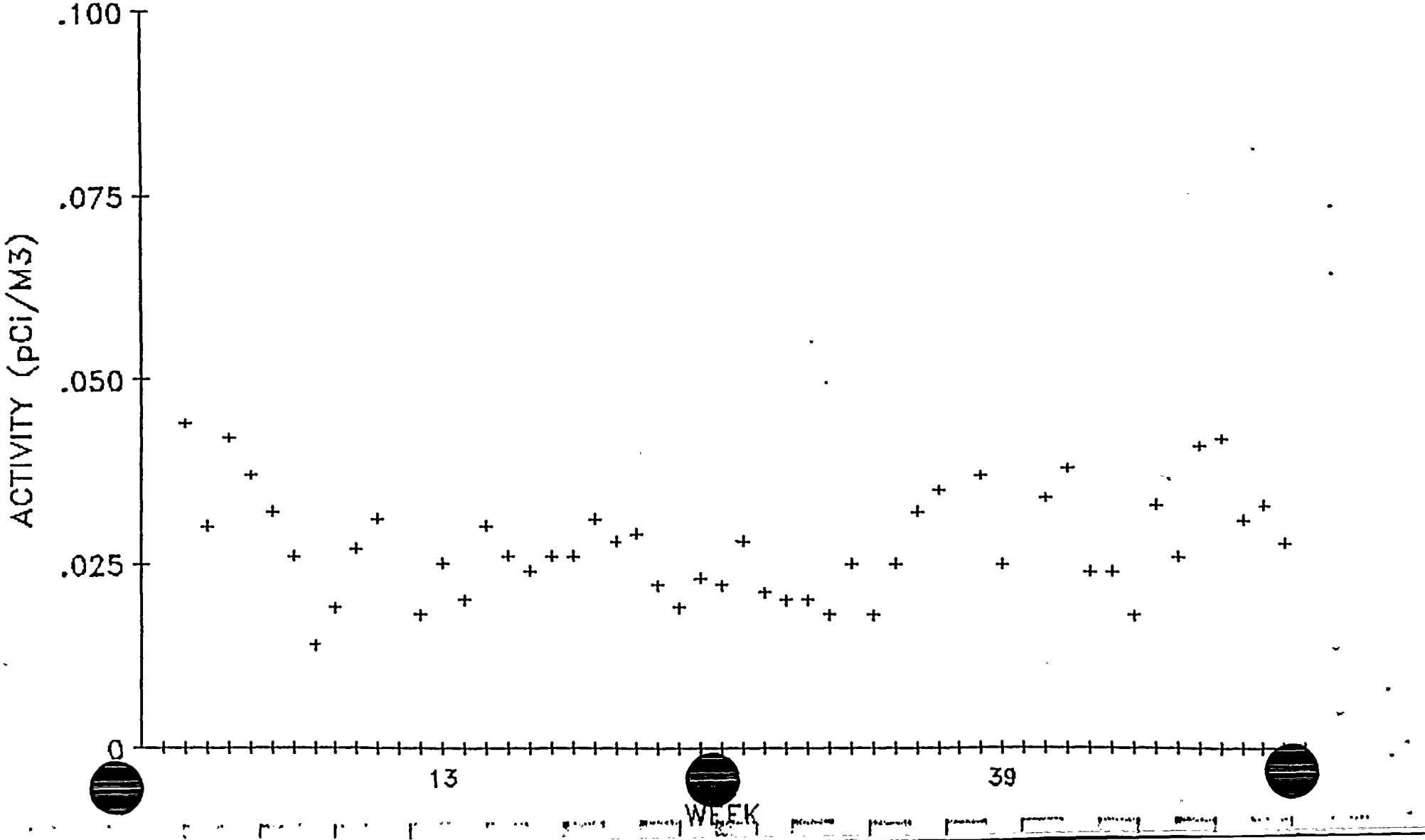


Figure 5
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 6A

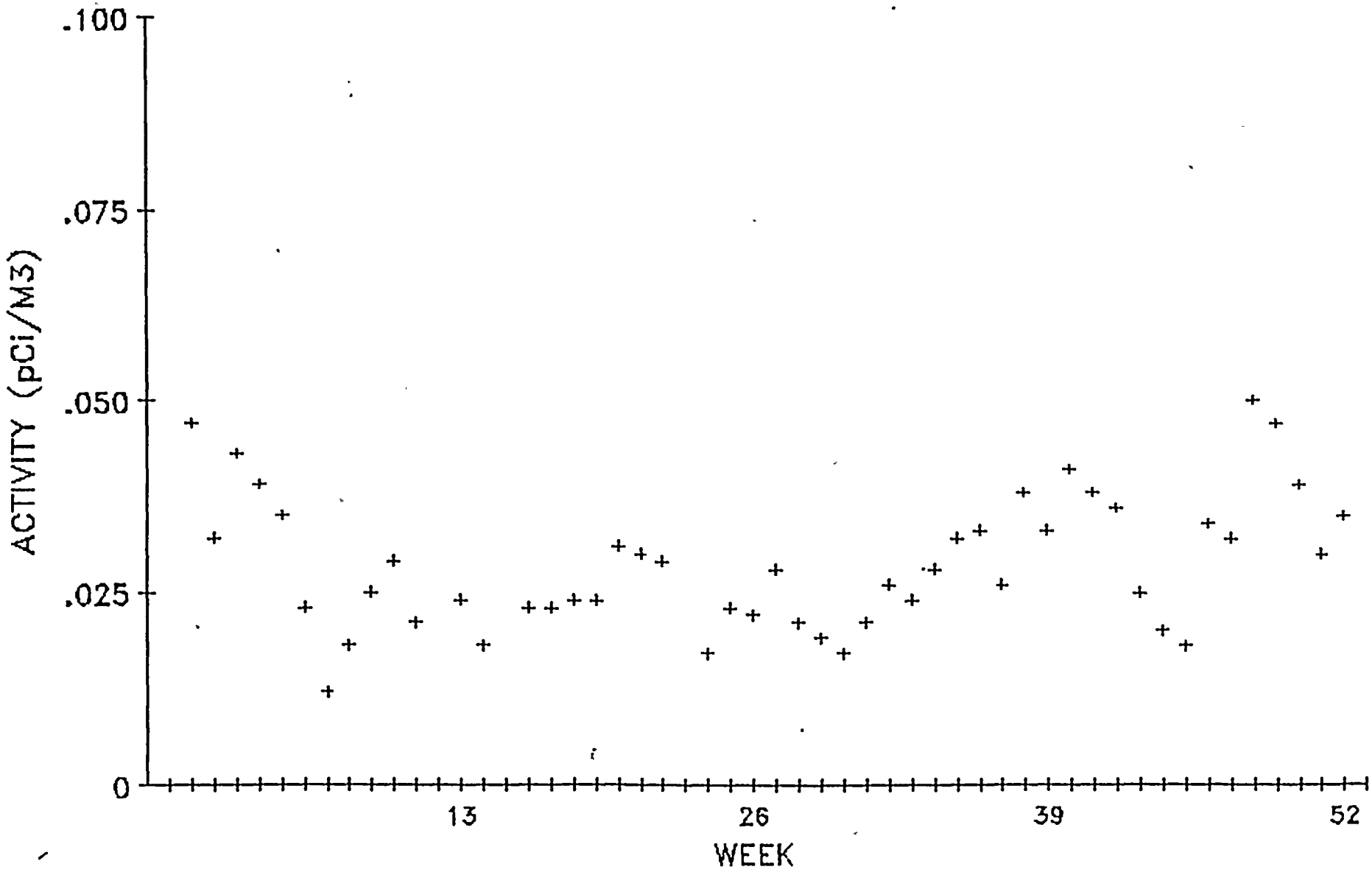


Figure 6
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 7A

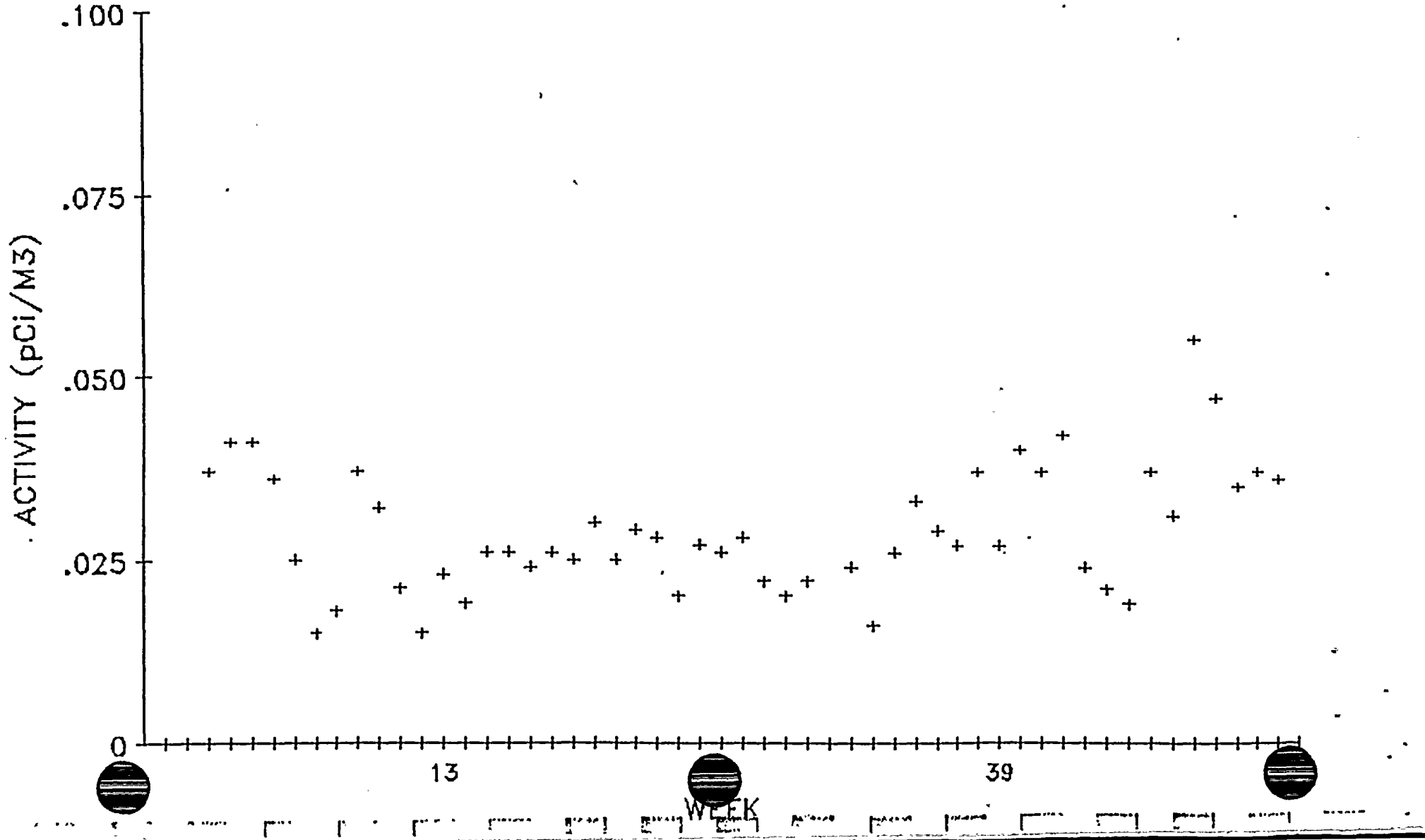


Figure 7
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 14A

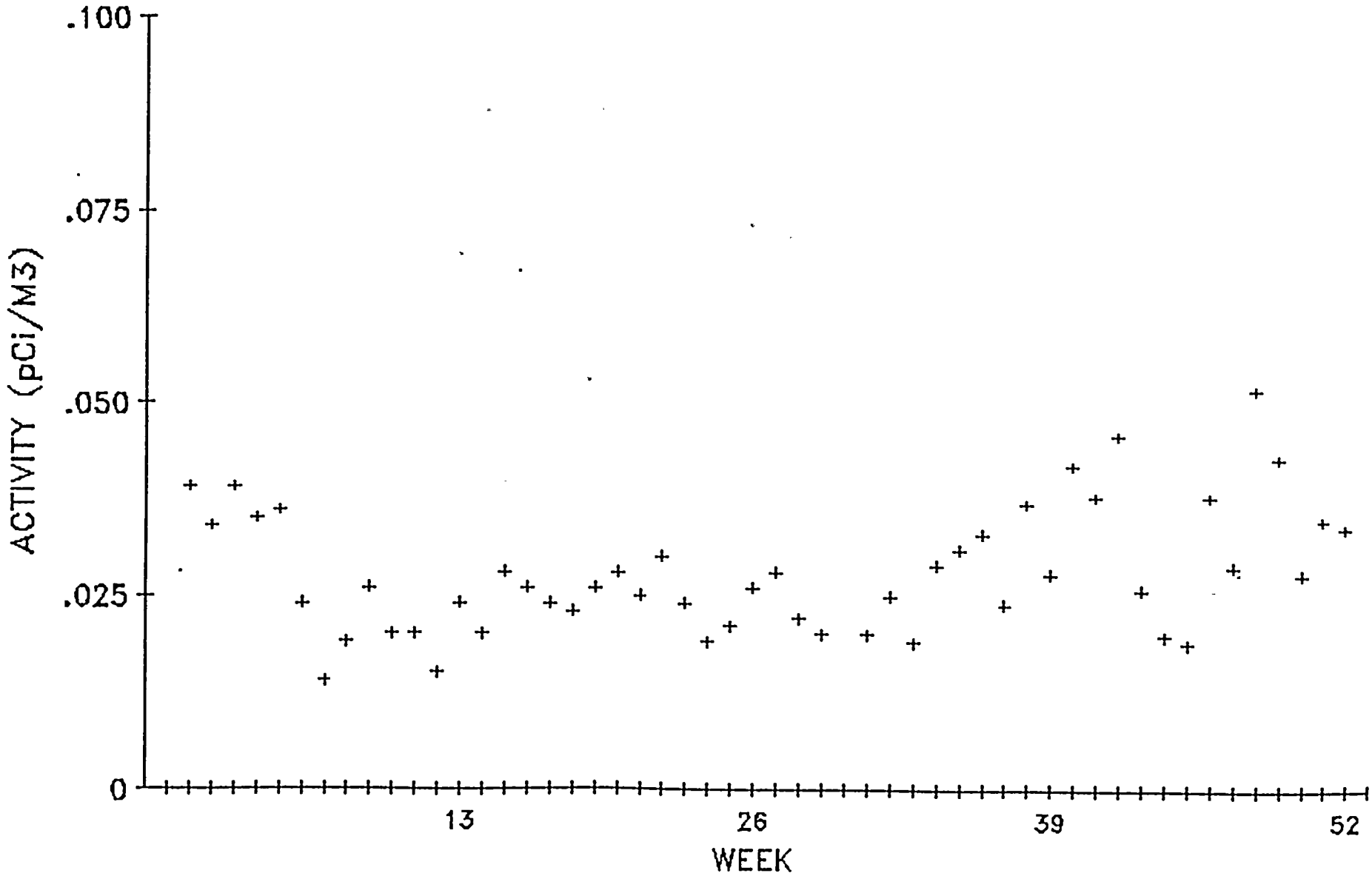


Figure 8
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 15A

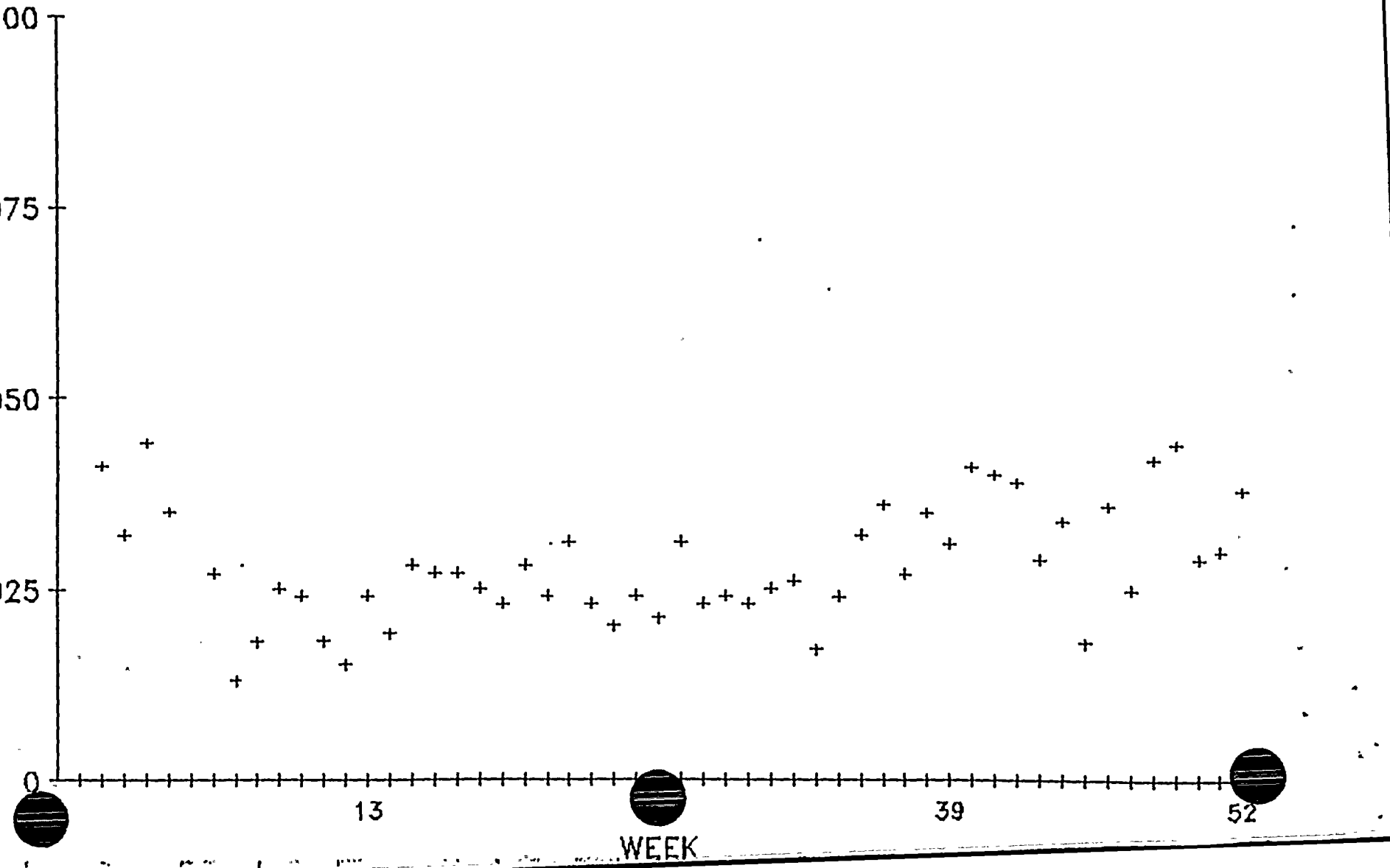


Figure 9
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 17A

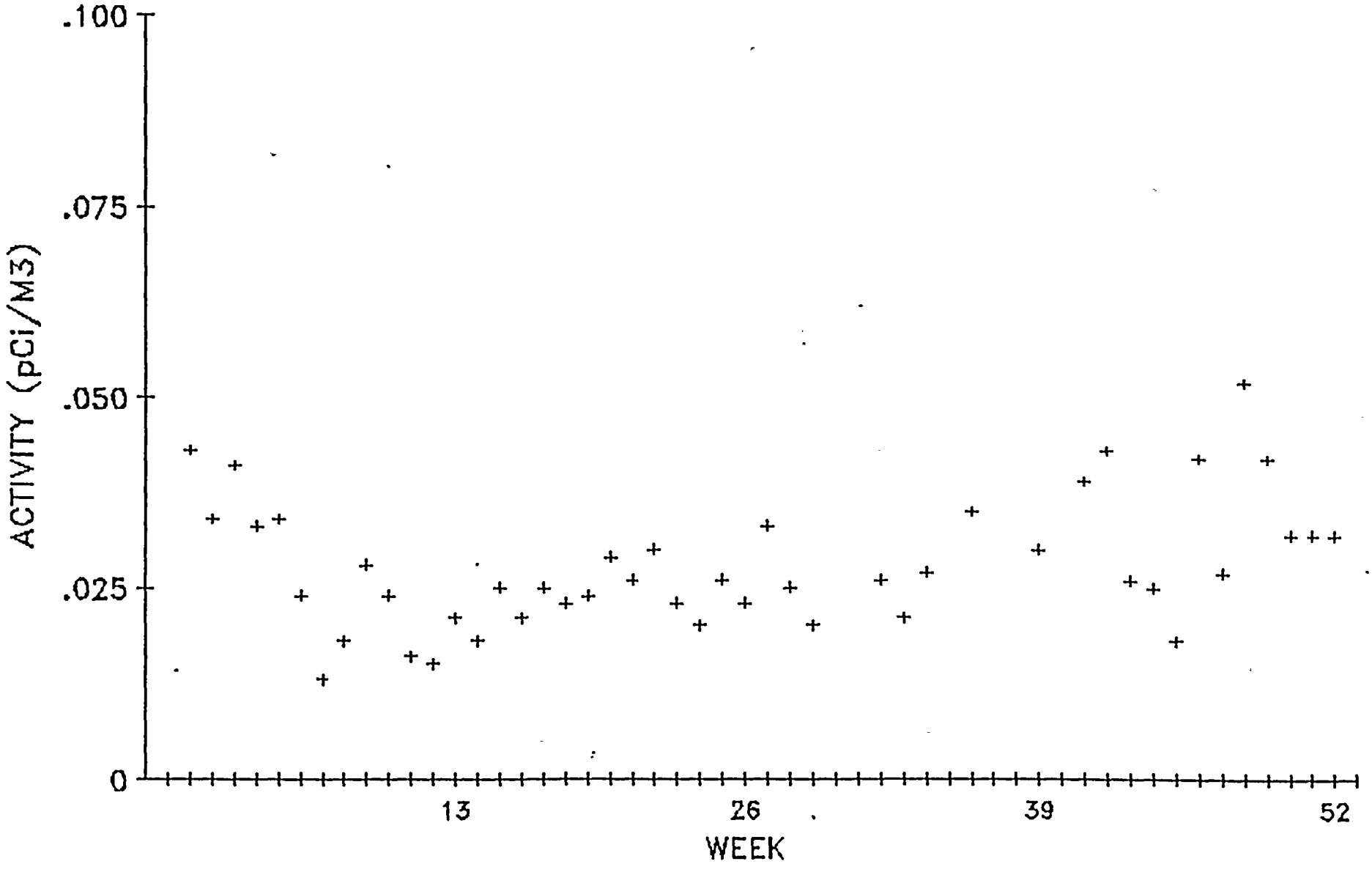


Figure 10
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 21A

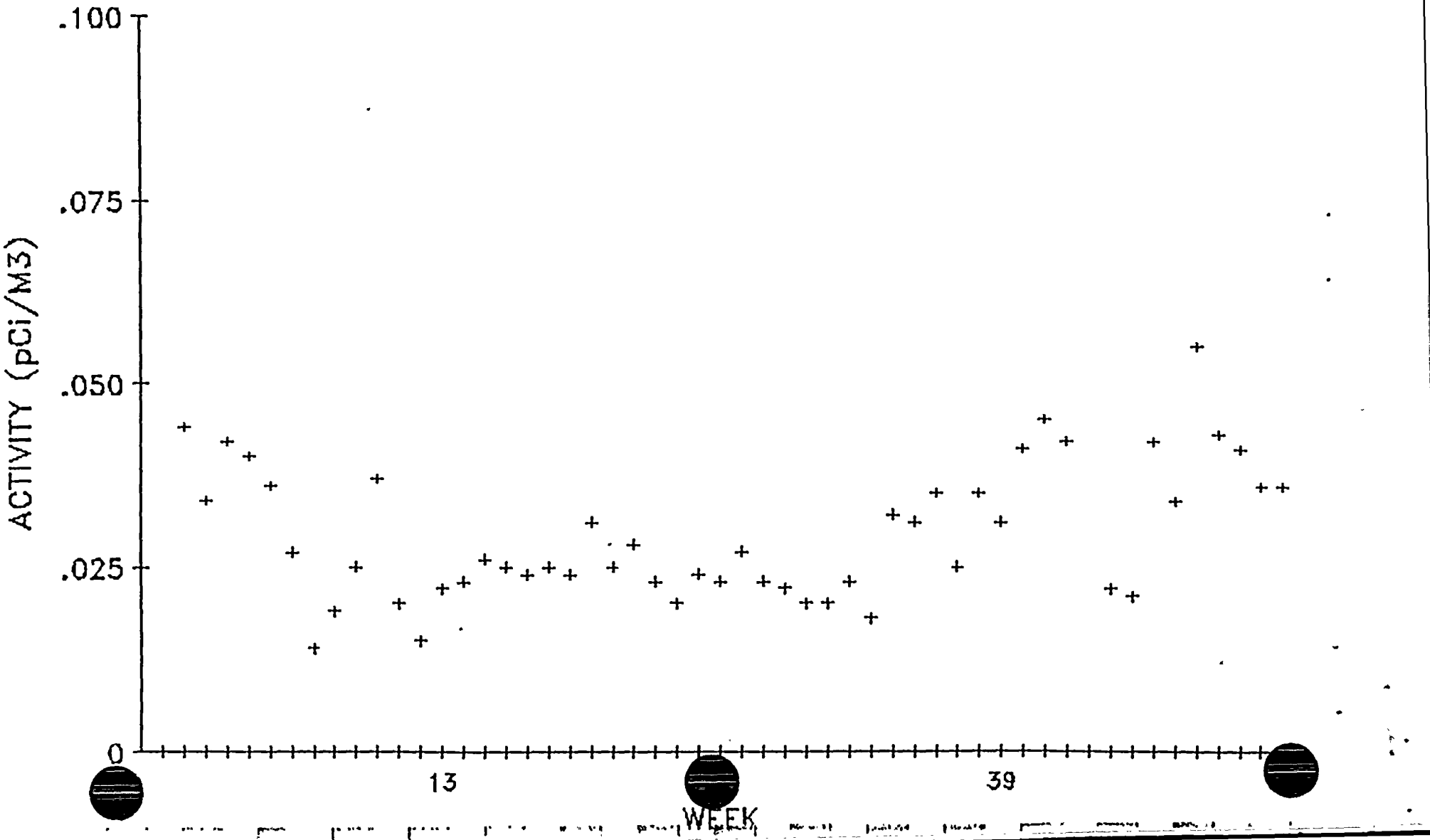


Figure 11
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 29A

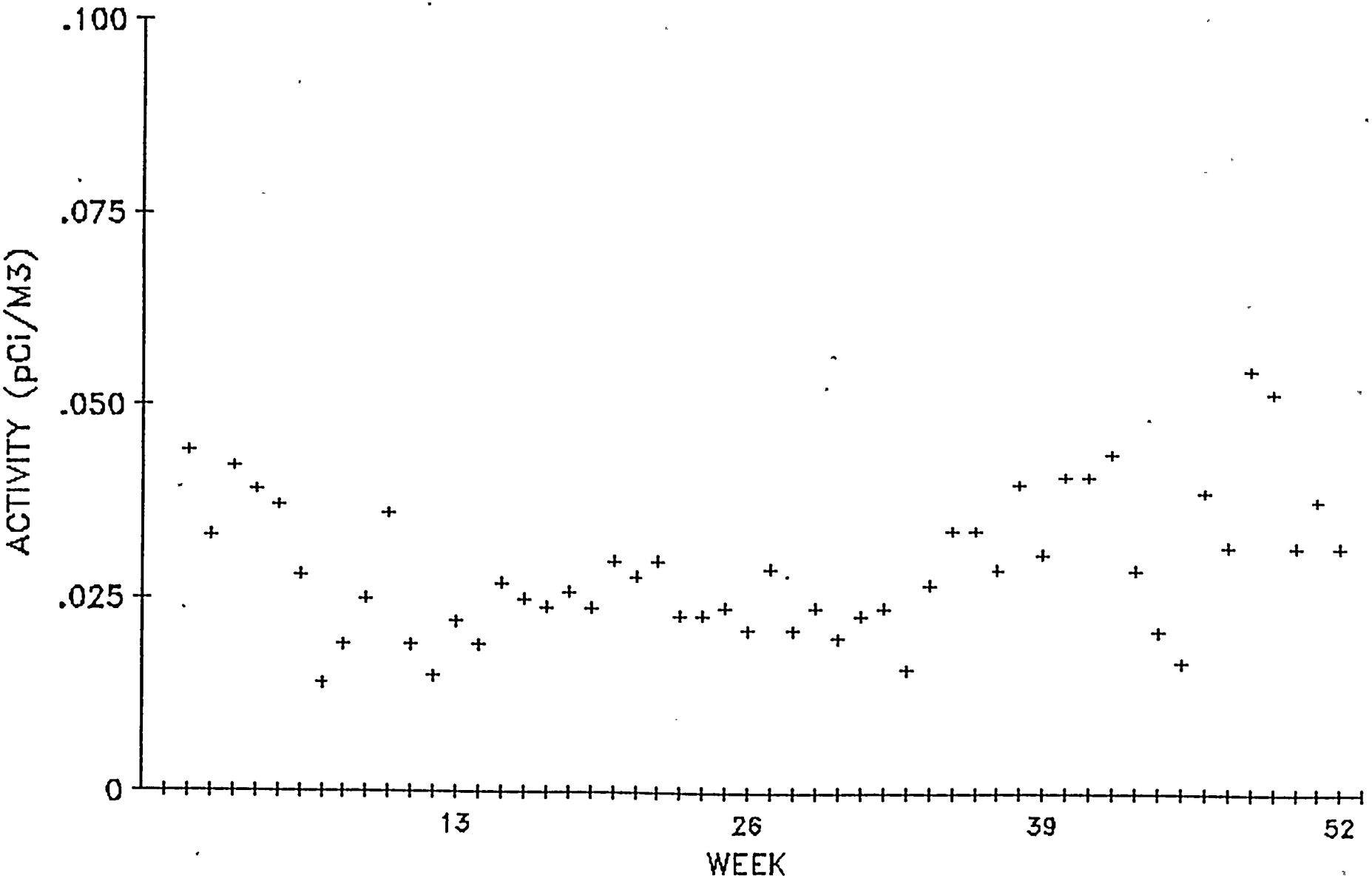


Figure 12
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 35A

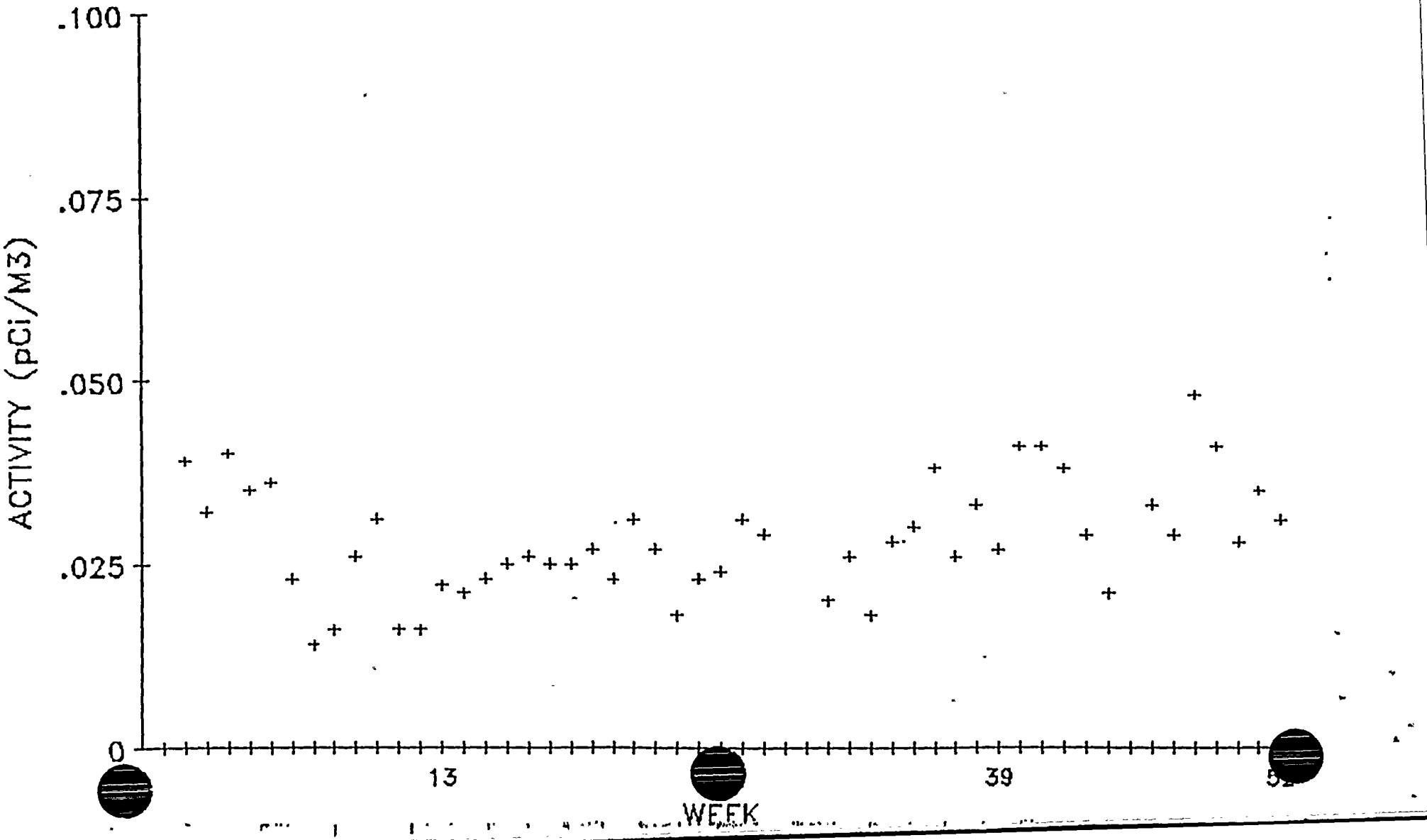


Figure 13
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 40A

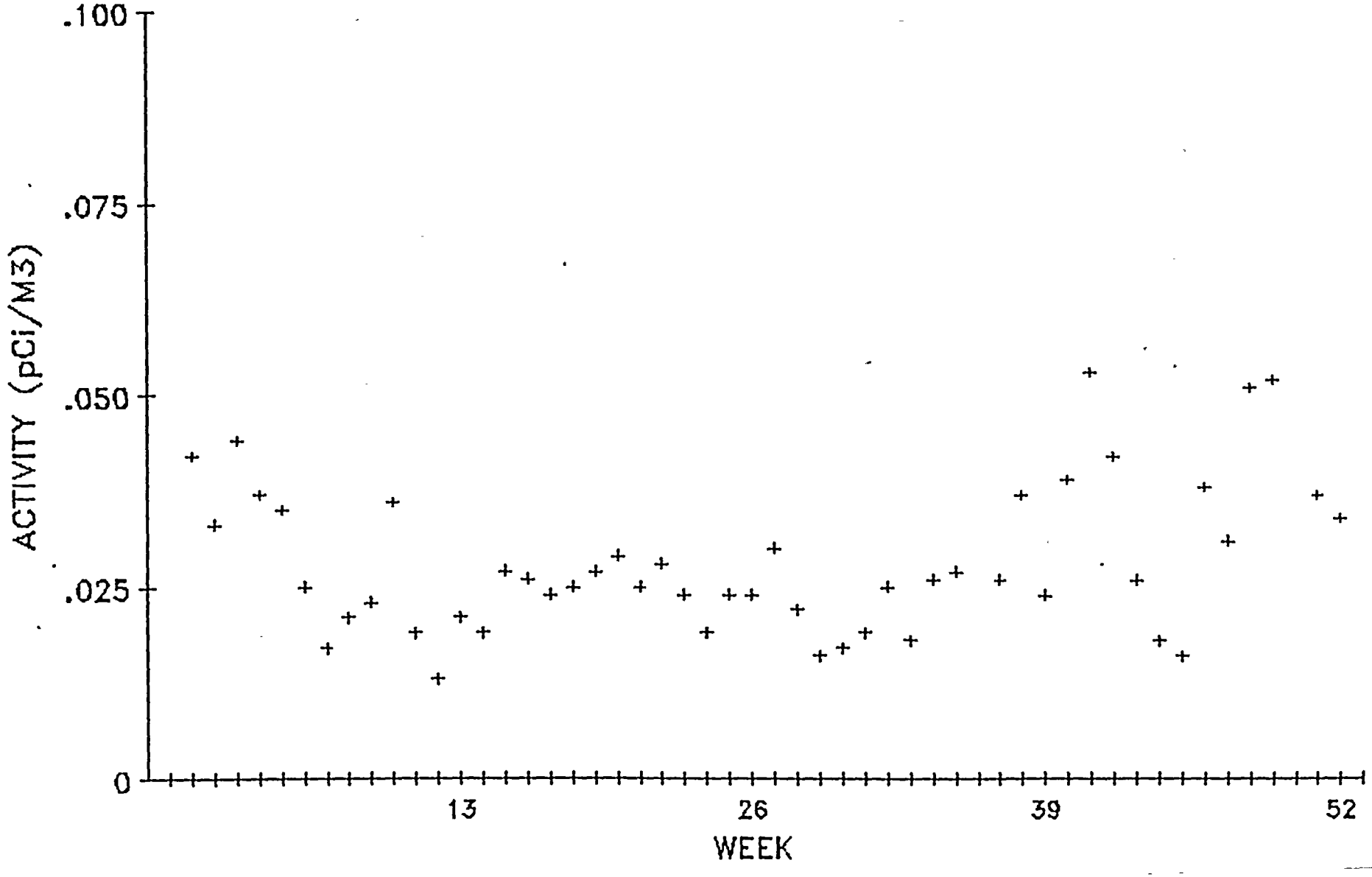


Figure 14
GROSS BETA IN AIR PARTICULATES
WEEKLY ACTIVITY-1987
STATION 44A

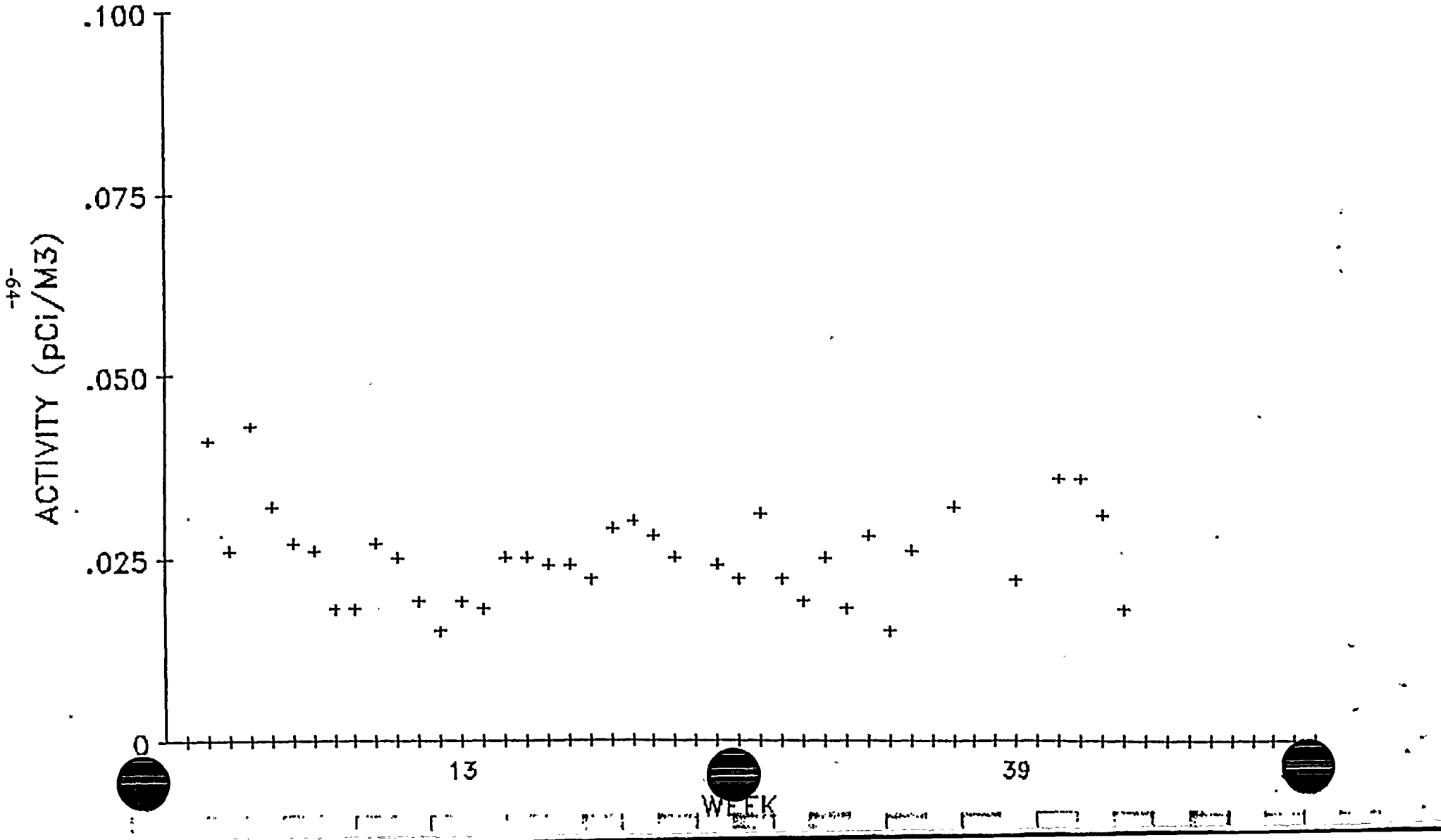
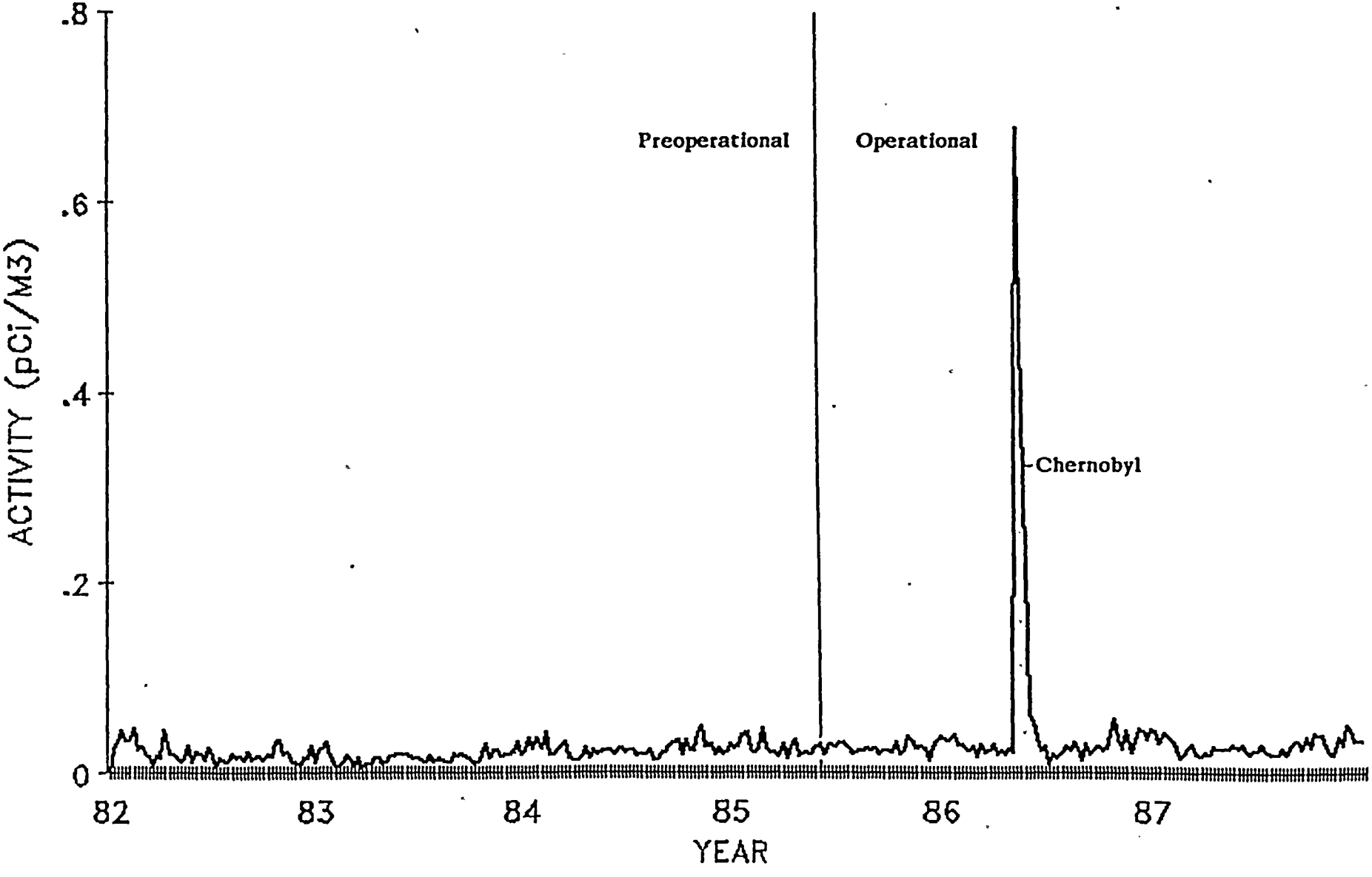


Figure 15
GROSS BETA IN AIR PARTICULATES
MEAN WEEKLY ACTIVITY
1982-1987



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 Iodine-131. Station 6A is the control site.

As can be seen in Table XVI one radioiodine sample collected during the first quarter of 1987 indicated detectable Iodine-131 activity (at Sample Station 40A).

The second quarter of 1987 (Table XVII) two samples indicated detectable Iodine-131 activity (Stations 6A and 35A).

Third quarter radioiodine data may be found in Table XVIII. One sample at Station 4A indicated Iodine-131 activity above the detection limit of 0.007 pCi/m^3.

As can be seen in Table XIX six samples collected during the fourth quarter of 1987 indicated detectable Iodine-131 activity.

These samples were analyzed by chemical separation of iodine, followed by gross beta counting. Verification of the indicated iodine-131 activity was subsequently performed by additional gross beta counting for half-life analysis, rather than by gamma spectrometry.

INTENTIONALLY LEFT BLANK

STATION #	LOCATION
43	N45, Vulture Mine Rd. School, Wickenburg
44	ENE 35, APS El Mirage Office, Sun City
45	ENE 20, REMP Lab, Buckeye, Arizona
46	Litchfield Park School
47	Littleton School, Cashion
48	Perryville
49	Hopeville
50	Olinski Rd., 5 mile, WNW Sector

STATION #	LOCATION
18	ESE 2, ESE Site Boundary
19	SE 2, SE Site Boundary
20	SSE 2, SSE Site Boundary
21	S 3, S Site Boundary
22	SSW 3, SSW Site Boundary
23	W 5, J.M.M. Parkway & Ward
24	SW 5, Ward Rd. near Desert Farms
25	WSW 5, Ward Rd. at Cattleguard
26	SSW 4.5, Shephard Farm
27	SW 2, SW Site Boundary
28	WSW 1, WSW Site Boundary
29	W 1, W Site Boundary
30	WNW 1, WNW Site Boundary
31	NW 2, NW Site Boundary
32	NNW 1, NNW Site Boundary
33	NW 5, Yuma Rd., 1/2 mile W of Belmont Rd.
34	NNW 5, Corner of Belmont Rd. and Van Buren Rd.
35	NNW 9, Tonopah, Palo Verde Inn Fire Station
36	N 5, Corner of Wintersburg Rd. and Van Buren Rd.
37	NNE 5, Corner of 363rd Ave. and Van Buren Rd.
38	NE 5, Corner of 355th Ave. and Yuma Rd.
39	ENE 5, 343rd Ave., 1/2 mile S of L. Buckeye
40	N 3, Trailer Park at Wintersburg
41	WNW 20, Harquahala Valley School
42	N 8, Ruth Fisher School

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.

The results of the quarterly TLD exposures for 1987 were corrected for transit exposure and republished in the 1988 Annual Report. Accordingly, Tables XX through XXIII and Figures 16 through 20 are deleted. TLD's were placed at the following locations:

STATION #	LOCATION
1	E 30, APS Western Division Offices
2	ENE 24 Scott-Libby School
3	E 25, Liberty School
4	E20, APS Buckeye Offices
5	ESE 15, Palo Verde
6	SSE 35, APS Gila Bend Sub-station
7	SE 8, Arlington School
8	SSE 5, Gladden Residence
9	S5, SPRR (West of Gladden)
10	SE 5, Corner of 355th Ave. and Elliot Rd.
11	ESE 5, Corner of 339th Ave. and Dobbins Rd.
12	E5, Corner of 339th Ave., and Buckeye-Salome Rd.
13	N 1, N Site Boundary
14	NNE 2, NNE Site Boundary
15	NE 2, NE Site Boundary
16	ENE 2, ENE Site Boundary
17	E 2, E Site Boundary

TABLE XIX (Cont.)

AIRBORNE RADIOIODINE DATA (a)

FOURTH QUARTER

1987

pCi/m^3

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
09/29/87 - 10/06/87	<LLD	<LLD	<LLD	<LLD	**
10/06/87 - 10/13/87	<LLD	<LLD	<LLD	<LLD	<LLD
10/13/87 - 10/20/87	<LLD	<LLD	<LLD	<LLD	<LLD
10/20/87 - 10/27/87	**	<LLD	<LLD	<LLD	<LLD
10/27/87 - 11/03/87	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/87 - 11/10/87	<LLD	<LLD	(d)	<LLD	(d)
11/10/87 - 11/17/87	<LLD	<LLD	<LLD	<LLD	(d)
11/17/87 - 11/24/87	<LLD	0.009±0.004(t)	**	0.013±0.004(t)	(d)
11/24/87 - 12/01/87	<LLD	<LLD	<LLD	<LLD	(d)
12/01/87 - 12/08/87	<LLD	<LLD	<LLD	<LLD	(d)
12/08/87 - 12/15/87	<LLD	<LLD	<LLD	<LLD	(d)
12/15/87 - 12/22/87	<LLD	<LLD	<LLD	<LLD	(d)
12/22/87 - 12/29/87	<LLD	<LLD	<LLD	<LLD	(d)

**Invalid Sample
(a)CEP data
(d)Sample not collected
(t)Verified by $t_{½}$ analysis

TABLE XIX

AIRBORNE RADIOIODINE DATA (a)

FOURTH QUARTER

1987

pCi/m^3

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
09/29/87 - 10/06/87	**	**	<LLD	<LLD	<LLD	<LLD	**
10/06/87 - 10/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/13/87 - 10/20/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/20/87 - 10/27/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
10/27/87 - 11/03/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/03/87 - 11/10/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/10/87 - 11/17/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
11/17/87 - 11/24/87	(d)	<LLD	<LLD	<LLD	0.024±0.006(t)	<LLD	0.014±0.004(t)
11/24/87 - 12/01/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/01/87 - 12/08/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/08/87 - 12/15/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/15/87 - 12/22/87	(d)	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
12/22/87 - 12/29/87	**	<LLD	<LLD	0.008±0.005(t)	<LLD	0.024±0.006(t)	<LLD

**Invalid Sample
(a)CEP data
(d)Sample not collected
(t)Verified by $t_{½}$ analysis

TABLE XVIII (Cont.)

AIRBORNE RADIOIODINE DATA (a)

THIRD QUARTER

1987

pCi/m^3

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
07/01/87 - 07/07/87	<LLD	<LLD	<LLD	<LLD	<LLD
07/07/87 - 07/14/87	<LLD	<LLD	<LLD	<LLD	<LLD
07/14/87 - 07/21/87	<LLD	<LLD	**	<LLD	<LLD
07/21/87 - 07/28/87	<LLD	<LLD	**	<LLD	<LLD
07/28/87 - 08/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/04/87 - 08/11/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/87 - 08/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/18/87 - 08/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
08/25/87 - 09/01/87	<LLD	<LLD	<LLD	<LLD	**
09/01/87 - 09/08/87	<LLD	<LLD	<LLD	**	<LLD
09/08/87 - 09/15/87	<LLD	<LLD	<LLD	<LLD	**
09/15/87 - 09/22/87	<LLD	<LLD	<LLD	<LLD	**
09/22/87 - 09/29/87	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE VIII

AIRBORNE RADIOIODINE DATA (a)

THIRD QUARTER

1987

pCi/m^3

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
07/01/87 - 07/07/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
07/07/87 - 07/14/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
07/14/87 - 07/21/87	<LLD	0.013±0.003	<LLD	<LLD	<LLD	<LLD	<LLD
07/21/87 - 07/28/87	<LLD	<LLD	<LLD	<LLD	**	<LLD	**
07/28/87 - 08/04/87	<LLD	<LLD	<LLD	**	<LLD	<LLD	**
08/04/87 - 08/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/11/87 - 08/18/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/18/87 - 08/25/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
08/25/87 - 09/01/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	**
09/01/87 - 09/08/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
09/08/87 - 09/15/87	**	**	<LLD	<LLD	<LLD	<LLD	**
09/15/87 - 09/22/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	**
09/22/87 - 09/29/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XVII (Cont.)

AIRBORNE RADIOIODINE DATA (a)

SECOND QUARTER

1987

pCi/m^3

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
04/01/87 - 04/08/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/08/87 - 04/15/87	<LLD	<LLD	0.012±0.005	<LLD	<LLD
04/15/87 - 04/22/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/22/87 - 04/29/87	<LLD	<LLD	<LLD	<LLD	<LLD
04/29/87 - 05/06/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/06/87 - 05/13/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/13/87 - 05/20/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/20/87 - 05/27/87	<LLD	<LLD	<LLD	<LLD	<LLD
05/27/87 - 06/03/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/03/87 - 06/10/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/10/87 - 06/17/87	<LLD	<LLD	<LLD	<LLD	**
06/17/87 - 06/24/87	<LLD	<LLD	<LLD	<LLD	<LLD
06/24/87 - 07/01/87	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XVII

AIRBORNE RADIOIODINE DATA (a)

SECOND QUARTER

1987

pCi/m^3

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
04/01/87 - 04/08/87	<LLD	<LLD	0.008±0.005	<LLD	<LLD	<LLD	<LLD
04/08/87 - 04/15/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
04/15/87 - 04/22/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/22/87 - 04/29/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
04/29/87 - 05/06/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/06/87 - 05/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/13/87 - 05/20/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/20/87 - 05/27/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
05/27/87 - 06/03/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/03/87 - 06/10/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
06/10/87 - 06/17/87	**	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/17/87 - 06/24/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
06/24/87 - 07/01/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

TABLE XVI (Cont.)

AIRBORNE RADIOIODINE DATA (a)

FIRST QUARTER

1987

pCi/m^3

Collection Period	Station 21A	Station 29A	Station 35A	Station 40A	Station 44A
12/30/86 - 01/07/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/07/87 - 01/14/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/14/87 - 01/21/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/21/87 - 01/28/87	<LLD	<LLD	<LLD	<LLD	<LLD
01/28/87 - 02/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/04/87 - 02/11/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/11/87 - 02/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/18/87 - 02/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
02/25/87 - 03/04/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/04/87 - 03/11/87	<LLD	<LLD	<LLD	0.016±0.004	<LLD
03/11/87 - 03/18/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/18/87 - 03/25/87	<LLD	<LLD	<LLD	<LLD	<LLD
03/25/87 - 04/01/87	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XVI

AIRBORNE RADIOIODINE DATA (a)

FIRST QUARTER

1987

pCi/m^3

Collection Period	Station 1A	Station 4A	(Control) Station 6A	Station 7A	Station 14A	Station 15A	Station 17A
12/30/86 - 01/07/87	<LLD	<LLD	<LLD	**	<LLD	<LLD	<LLD
01/07/87 - 01/14/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/14/87 - 01/21/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/21/87 - 01/28/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
01/28/87 - 02/04/87	<LLD	<LLD	<LLD	<LLD	<LLD	**	<LLD
02/04/87 - 02/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/11/87 - 02/18/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/18/87 - 02/25/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
02/25/87 - 03/04/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
03/04/87 - 03/11/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
03/11/87 - 03/18/87	<LLD	**	<LLD	<LLD	<LLD	<LLD	<LLD
03/18/87 - 03/25/87	<LLD	<LLD	**	<LLD	<LLD	<LLD	<LLD
03/25/87 - 04/01/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

**Invalid Sample
(a)CEP data

8.4 Vegetation

Human vegetation samples were collected from four local farms since no commercial companies were located in the area. The leafy vegetation samples collected during 1987 included: mustard greens and lettuce. The citrus samples included grapefruits, oranges, tangerines and lemons. The four sample locations were #47, 51, 52 and 61. Location 61 is the control. Samples were collected monthly during the growing season, as available.

Table XXIV presents Iodine-131 data for the human vegetation samples collected during 1987. No observable activity was detected in any of the samples. The results of the Gamma Spectral analyses for all human vegetation samples is presented in Tables XXV and XXVI. No man-made Gamma emitting nuclides were detected in any of the samples.

Animal vegetation samples were collected from six local farms participating in the milk survey. Types of vegetation collected included: grain, hay, haylage and silage. These samples were analyzed for Strontium-89, Strontium-90 and Gamma emitting nuclides. The six sample locations were #50, 51, 53, 54, 55 and 56.

Table XXVII indicates no Strontium-89/90 was detected in 1987. One hay sample collected on 02/13/87 from the Skousen Dairy (sample location #54) indicated Cesium-137 activity of 199 ±38 pCi/kg. No other Gamma emitting nuclides were detected (Table XXVIII).

TABLE XXIV

HUMAN VEGETATION(a)

1987

Collection Location	Date Collected	Iodine-131 pCi/kg (Wet)
Leafy:		
Cambron Garden (Site #52)		
Lettuce	01/15/87	<LLD
Mustard Greens	01/15/87	<LLD
Citrus:		
Adams (Site #47)		
Grapefruit	01/15/87	<LLD
Lemons	01/15/87	<LLD
Oranges	01/15/87	<LLD
Lemons	02/12/87	<LLD
Oranges	02/12/87	<LLD
Grapefruit	02/12/87	<LLD
Grapefruit	03/12/87	<LLD
Lemons	03/12/87	<LLD
Tangerines	03/12/87	<LLD
Grapefruit	04/16/87	<LLD
Oranges	04/16/87	<LLD
Cooley Farms (Site #61) (Control)		
Oranges	01/15/87	<LLD
Tangerines	01/15/87	<LLD
Grapefruit	01/15/87	<LLD
Grapefruit	02/12/87	<LLD
Grapefruit	03/12/87	<LLD
Oranges	03/12/87	<LLD
Grapefruit	04/16/87	<LLD

(a) CEP data

TABLE XXIV (Cont.)

HUMAN VEGETATION(a)

1987

Collection Location	Date Collected	Iodine-131 pCi/kg (Wet)
Citrus (Cont.):		
Butler (Site #51)		
Grapefruit	01/15/87	<LLD
Grapefruit	02/13/87	<LLD
Grapefruit	03/12/87	<LLD
Grapefruit	04/16/87	<LLD
Cambron Garden (Site #52)		
Grapefruit	01/15/87	<LLD
Tangerines	01/15/87	<LLD
Oranges	01/15/87	<LLD
Grapefruit	02/12/87	<LLD
Tangerines	02/12/87	<LLD
Oranges	02/12/87	<LLD
Grapefruit	03/12/87	<LLD
Tangerines	03/12/87	<LLD
Oranges	03/12/87	<LLD
Grapefruit	04/16/87	<LLD
Tangerines	04/16/87	<LLD
Oranges	04/16/87	<LLD

(a) CEP data

TABLE XXV

VEGETATION (Leafy) (a)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Cambron Garden (Site #52)										
Lettuce	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Mustard Greens	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XXVI

HUMAN VEGETATION (Citrus) (a)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Adams (Site #47)										
Grapefruit	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Lemons	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Lemons	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Lemons	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cooley (Site #61) (Control)										
Oranges	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XXVI (Cont.)

HUMAN VEGETATION (Citrus) (a)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Butler (Site #51)										
Grapefruit	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Cambron Garden (Site #52)										
Oranges	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	01/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	02/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	03/12/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Grapefruit	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Tangerines	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Oranges	04/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XXVII
ANIMAL VEGETATION (a)
1987

Collection Location	Type	Date Collected	Strontium-89	Strontium-90
Kerr (Site #53)	Grain	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD
Butler (Site #51)	Grain	01/16/87	<LLD	<LLD
	Haylage	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Haylage	02/13/87	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Haylage	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Haylage	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Haylage	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD

(a) CEP data

TABLE XXVII (Cont.)

ANIMAL VEGETATION (a)

1987

Collection Location	Type	Date Collected	Strontium-89	Strontium-90
Lueck (Site #55)	Grain	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Haylage	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Haylage	02/13/87	<LLD	<LLD
	Beet Pulp	02/13/87	<LLD	<LLD
	Hominy Corn	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Haylage	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Haylage	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD
	Haylage	05/15/87	<LLD	<LLD
Hamstra #2 (Site #56)	Grain	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD

(a) CEP data

TABLE XXVII (Cont.)

ANIMAL VEGETATION (a)

1987

Collection Location	Type	Date Collected	Strontium-89	Strontium-90
Baisley (Site #50)	Grain	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD
kousen ite #54)	Grain	01/16/87	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD
	Silage	01/16/87	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD
	Silage	02/13/87	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD
	Silage	03/13/87	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD
	Silage	04/17/87	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD
	Silage	05/15/87	<LLD	<LLD

(a) CEP data

TABLE XXVIII

ANIMAL VEGETATION (a)

GAMMA SPECTROMETRY

1987

Collection Location	Type	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Kerr (Site #53)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Butler (Site #51)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XXVIII (Cont.)

ANIMAL VEGETATION (a)

GAMMA SPECTROMETRY

1987

Collection Location	Type	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Lueck (Site #55)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Beet Pulp	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hominy Corn	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Haylage	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Hamstra #2 (Site #56)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data

TABLE XXVIII (Cont.)

ANIMAL VEGETATION (a)

GAMMA SPECTROMETRY

1987

Collection Location	Type	Date Collected	pCi/kg (wet) Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59
Baisley (Site #50)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
Skousen (Site #54)	Grain	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Silage	01/16/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Silage	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	02/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	199±38(t)	<LLD	<LLD
	Grain	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Silage	03/13/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Silage	04/17/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Grain	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Hay	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	Silage	05/15/87	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

(a)CEP data
(t)Verified by reanalysis

8.5 Drinking Water

Drinking water samples were taken monthly. 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 XXIX and XXX. The sample locations were #46, 48 and 49.

Twenty-one (21) 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 1987 was from less than 1.0 pCi/l to 7.6 pCi/l (Glover Residence, Site #49, collected 07/14/87).

Gross Beta activity ranged from less than 2.0 pCi/l to a high of 10.0 ±0.8 pCi/l (McArthur Residence, Site #46, collected 03/12/87).

Strontium-90 was not detected above 0.8 pCi/l in any of the drinking water samples collected during 1987.

Tritium results, for all drinking water samples collected during 1987, were less than 1340 pCi/l. In addition, no Gamma-emitting nuclides of man-made origin were detected in any of the samples.

TABLE XXIX

DRINKING WATER

1987

Collection Location	Date Collected	pCi/l Gross Alpha	Gross Beta	Strontium-90	Tritium
McArthur Residence (Site #46)	01/15/87[a]	<LLD	<LLD	<LLD	<LLD
	02/12/87[a]	<LLD	<LLD	<LLD	<LLD
	03/12/87[a]	<LLD	10.0 ±0.8	<LLD	<LLD
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD
	06/18/87[a]	<LLD	2.8 ±0.4	<LLD	<LLD
	07/14/87[b]	<6.9	6.6 ±1.3	<0.68	<1040
	08/11/87[b]	3.7 ±5.0	<4.9[e]	<LLD	<LLD
	09/15/87[b]	5.7 ±4.8	7.7 ±1.3	<0.73	<LLD
	10/13/87[b]	<5.2	5.6 ±1.4	<LLD	<LLD
	11/10/87[b]	6.6 ±3.1	<5.2[e]	<LLD	<1320
	12/15/87[b]	<2.4	8.7 ±1.1	<0.75	[d]

[a]CEP data

[b]ASU data

[d]Not sampled

[e]High TDS (Self-Absorption)

TABLE XXIX (Cont.)

DRINKING WATER

1987

Collection Location	Date Collected	pCi/l Gross Alpha	Gross Beta	Strontium-90	Tritium
Glover Residence (Site #49)	01/15/87[a]	1.4 ±1.0	<LLD	<LLD	<LLD
	02/12/87[a]	<LLD	<LLD	<LLD	<LLD
	03/12/87[a]	<LLD	2.0 ±0.5	<LLD	<LLD
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD
	05/14/87[a]	1.5 ±1.1	<LLD	<LLD	<LLD
	06/18/87[a]	1.1 ±1.0	2.0 ±0.4	<LLD	<LLD
	07/14/87[b]	7.6 ±4.6	2.7 ±0.9	<0.81	<1030
	08/11/87[b]	3.3 ±4.4	<4.7[e]	<LLD	<LLD
	09/15/87[b]	4.4 ±3.7	6.2 ±1.3	<0.75	<LLD
	10/13/87[b]	<1.8	5.8 ±1.6	<LLD	<LLD
	11/10/87[b]	1.7 ±2.6	<4.6[e]	<LLD	<1340
	12/15/87[b]	<1.4	5.3 ±1.0	<0.67	[d]

[a]CEP data

[b]ASU data

[d]Not sampled

[e]High TDS (Self-Absorption)

TABLE XXIX (Cont.)

DRINKING WATER

1987

Collection Location	Date Collected	pCi/l Gross Alpha	Gross Beta	Strontium-90	Tritium
Gavette Residence (Site #48)	01/15/87[a]	<LLD	<LLD	<LLD	<LLD
	02/12/87[a]	<LLD	2.4 ±0.5	<LLD	<LLD
	03/12/87[a]	<LLD	3.0 ±0.5	<LLD	<LLD
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD
	06/18/87[a]	<LLD	2.4 ±0.5	<LLD	<LLD
	07/14/87[b]	<4.4	4.0 ±1.3	<0.81	<1030
	08/11/87[b]	<1.3	<4.8[e]	<LLD	<LLD
	09/15/87[b]	4.0 ±5.2	4.8 ±1.4	<0.75	<LLD
	10/13/87[b]	<5.5	6.8 ±1.5	<LLD	<LLD
	11/10/87[b]	<2.3	<5.0[e]	<LLD	<1310
	12/15/87[b]	<2.5	7.3 ±1.3	<0.80	[d]

[a]CEP data

[b]ASU data

[d]Not sampled

[e]High TDS (Self-Absorption)

TABLE XXX

DRINKING WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
McArthur Residence (Site #46)	01/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	02/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	03/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	06/18/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	07/14/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<9.1[e]	<LLD
	08/11/87[b]	c	c	c	c	c	c	c	c	c	d	c
	09/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/13/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

[d]No Sample Collected

[e]Gamma spec decay corrected

TABLE XXX (Cont.)

DRINKING WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
Glover Residence (Site #49)	01/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/18/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/14/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/13/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data
[b]ASU data
[c]Not Determined

TABLE XXX (Cont.)

DRINKING WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
Gavette Residence (Site #48)	01/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/18/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/14/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<9.1[e]	<LLD
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/13/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

[e]Gamma spec decay corrected

8.6 Groundwater

Quarterly groundwater samples were collected from the on-site wells (Well 27ddc and Well 34abb, Sample Sites #57 and 58, respectively). 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 are presented in Tables XXXI and XXXII.

Both groundwater samples collected on 11/10/87 analyzed positive for Gross Alpha activity.

Gross Beta activity was detected in two of the groundwater samples collected during 1987: Well 27ddc, 4.6 ±5.7 pCi/l (08/11/87) and Well 34abb, 3.0 ±7.7 pCi/l (08/11/87); these are sample sites #57 and 58, respectively.

No groundwater sample collected during 1987 had detectable levels of Strontium-90. In addition, no isotopes of interest were detected by Gamma Spectral analysis of the groundwater samples.

TABLE XXXI

GROUNDWATER

1987

Collection Location	Date Collected	pCi/l Gross Alpha	Gross Beta	Strontium-90	Tritium
27ddc (Site #57)	02/12/87[a]	<LLD	<LLD	<LLD	<LLD
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD
	08/11/87[b]	[c]	4.6 ±5.7	<LLD	<LLD
	11/10/87[b]	4.2 ±3.1	<5.3[e]	<LLD	<1320
34abb (Site #58)	02/12/87[a]	<LLD	<LLD	<LLD	<LLD
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD
	08/11/87[b]	[c]	3.0 ±7.7	<LLD	<LLD
	11/10/87[b]	4.1 ±4.5	<5.5[e]	<LLD	<1320

[a]CEP data

[b]ASU data

[c]Not determined

[e]High TDS (Self-Absorption)

TABLE XXXII

GROUNDWATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
27ddc (Site #57)	02/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
34abb (Site #58)	02/12/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/14/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

8.7 Surface Water

Surface water samples were introduced into the monitoring program during the third quarter of 1982. Samples from PVNGS Reservoir (Sample Site #60) and PVNGS Evaporation Pond (Sample Site #59) were collected weekly throughout 1987.

These samples were analyzed for Iodine-131, Gross Alpha, Gross Beta, Strontium-89, Strontium-90, Tritium and Gamma-emitting nuclides. Results of these analyses are presented in Tables XXXIII through XXXVI.

Iodine-131 was detected in forty-eight of the 1987 surface water samples collected. Activity ranged from less than 0.5 pCi/l to a high of 25.0 ±3.0 pCi/l on 08/25/87 at the PVNGS Reservoir (Sample Site #60).

PVNGS Reservoir samples demonstrated Gross Beta activities ranging from 3.4 ±0.5 pCi/l (a monthly composite sample) to 21 ±2 pCi/l (12/29/87). The samples from the PVNGS Evaporation Pond (Sample Site #59) showed Gross Beta activities ranging from 8.0 ±0.6 pCi/l (a monthly composite sample) to 270 ±10 pCi/l (09/22/87).

PVNGS Reservoir and PVNGS Evaporation Pond samples demonstrated strontium -90 activity ranging from less than 0.5 pCi/l to 1.4 pCi/l. Strontium-89 results ranged from less than 1 pCi/l to 3.1 pCi/l.

Gamma Spectral analysis of the samples showed no detectable activity for Gamma emitting nuclides of interest except Iodine-131 (Table XXXVI).

The surface water samples were analyzed for Tritium activity. The PVNGS Reservoir (Sample Site #60) sample results were all less than LLD. The PVNGS Evaporation Pond (Sample Site #59) sample results demonstrated Tritium activity throughout most of 1987.

TABLE XXXIII

SURFACE WATER

PVNGS RESERVOIR
(Sample Site #60)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
01/08/87[a]	c	c	<LLD	<LLD	c	c
01/15/87[a]	c	c	<LLD	<LLD	c	c
01/22/87[a]	c	c	<LLD	<LLD	c	c
01/29/87[a]	c	c	<LLD	<LLD	c	c
02/05/87[a]	c	c	<LLD	<LLD	c	c
02/12/87[a]	c	c	<LLD	c	c	c
02/19/87[a]	c	c	<LLD	c	c	c
02/26/87[a]	c	c	<LLD	c	c	c
03/05/87[a]	c	c	<LLD	c	c	c
03/12/87[a]	c	c	<LLD	c	c	c
03/19/87[a]	c	c	<LLD	c	c	c
03/26/87[a]	c	c	<LLD	c	c	c
04/02/87[a]	c	c	<LLD	c	c	c
04/09/87[a]	c	c	<LLD	c	c	c
04/16/87[a]	c	c	<LLD	c	c	c
04/23/87[a]	c	c	<LLD	c	c	c
04/30/87[a]	c	c	<LLD	c	c	c
05/07/87[a]	c	c	6.1±1.4	c	c	c
05/14/87[a]	c	c	<LLD	c	c	c

[a]CEP data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE XXXIII (Cont.)

SURFACE WATER

PVNGS RESERVOIR
(Sample Site #60)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
05/21/87[a]	c	c	<LLD	c	c	c
05/28/87[a]	c	c	<LLD	c	c	c
06/04/87[a]	c	c	1.8±1.1	c	c	c
06/11/87[a]	c	c	2.3±1.7	c	c	c
06/18/87[a]	c	c	<LLD	c	c	c
06/25/87[a]	c	c	3.0±1.6	c	c	c
07/01/87[b]	<4.8	16±3	5.9±0.5	<LLD	<LLD	<LLD
07/07/87[b]	<3.8	17±3	4.5±0.4	<1020	<LLD	<LLD
07/14/87[b]	<3.4	18±3	10.6±0.5	<LLD	<1.5	<0.58
07/21/87[b]	<14	18±2	6.6±0.3	<1010	<3.1	<1.4
07/28/87[b]	<10	20±3	6.0±0.3	<1050	<1.3	<0.71
08/04/87[b]	<7.8	19±2	5.4±0.3	<LLD	<1.2	<0.77
08/11/87[b]	4.2±10	12±2	2.5±0.1	<LLD	<LLD	<0.65
08/18/87[b]	3.3±1.3	15±2	11.0±1.0	<LLD	<LLD	<0.71
08/25/87[b]	<8.8	18±2	25.0±3.0	<LLD	<LLD	<LLD
09/01/87[b]	<9.2	18±2	9.5±1.4	<LLD	<LLD	<0.63
09/08/87[b]	<8.6	14±2	4.4±1.3	<LLD	<LLD	<0.66
09/15/87[b]	<9.2	19±2	6.0±0.6	<LLD	<LLD	<0.79
09/22/87[b]	<4.2	16±2	5.0±0.4	<LLD	<LLD	<LLD
09/29/87[b]	<4.2	18±2	5.2±0.4	<LLD	<LLD	<LLD
10/06/87[b]	<7.2	17±2	3.8±0.5	<LLD	<LLD	<LLD
10/13/87[b]	<8.5	16±2	3.0±0.2	<LLD	<LLD	<LLD
10/20/87[b]	<8.1	19±2	3.5±0.3	<LLD	<LLD	<LLD
10/27/87[b]	<8.8	18±2	1.9±0.2	<LLD	<LLD	<LLD

[a]CEP data
[b]ASU data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE III (Cont.)

SURFACE WATER

PVNGS RESERVOIR
(Sample Site #60)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
11/03/87[b]	<7.5	19±2	<LLD	<LLD	<LLD	<LLD
11/10/87[b]	<8.1	18±2	8.7±0.6	<LLD	<LLD	<LLD
11/17/87[b]	<11	20±2	5.0±0.3	<LLD	<LLD	<LLD
11/24/87[b]	<10	20±2	2.5±0.2	<LLD	0.52±0.05	<LLD
12/01/87[b]	<5.8	20±2	1.8±0.1	<LLD	<LLD	<LLD
12/08/87[b]	<5.6	19±2	4.7±0.4	<LLD	<LLD	<LLD
12/15/87[b]	<2.9	18±2	4.8±0.3	[c]	<LLD	<LLD
12/22/87[b]	<2.9	15±2	12.5±0.7	<LLD	<LLD	<0.83
12/29/87[b]	<3.8	21±2	7.5±0.6	<LLD	<LLD	<0.83

[b]ASU data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE XXXIV

SURFACE WATER

PVNGS EVAPORATION POND
(Sample Site #59)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
01/08/87[a]	c	c	<LLD	3349±924	c	c
01/15/87[a]	c	c	<LLD	2459±1217	c	c
01/22/87[a]	c	c	<LLD	3791±1297	c	c
01/29/87[a]	c	c	<LLD	3091±1270	c	c
02/05/87[a]	c	c	<LLD	3333±1313	c	c
02/12/87[a]	c	c	<LLD	c	c	c
02/19/87[a]	c	c	<LLD	c	c	c
02/26/87[a]	c	c	<LLD	c	c	c
03/05/87[a]	c	c	<LLD	c	c	c
03/12/87[a]	c	c	<LLD	c	c	c
03/19/87[a]	c	c	<LLD	c	c	c
03/26/87[a]	c	c	<LLD	c	c	c
04/02/87[a]	c	c	<LLD	c	c	c
04/09/87[a]	c	c	<LLD	c	c	c
04/16/87[a]	c	c	2.8±1.7	c	c	c
04/23/87[a]	c	c	<LLD	c	c	c
04/30/87[a]	c	c	<LLD	c	c	c
05/07/87[a]	c	c	<LLD	c	c	c
05/14/87[a]	c	c	<LLD	c	c	c

*Not Determined
[a]CEP data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE XIV (Cont.)

SURFACE WATER

PVNGS EVAPORATION POND
(Sample Site #59)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
05/21/87[a]	c	c	<LLD	c	c	c
05/28/87[a]	c	c	<LLD	c	c	c
06/04/87[a]	c	c	<LLD	c	c	c
06/11/87[a]	c	c	<LLD	c	c	c
06/18/87[a]	c	c	1.6±1.4	c	c	c
06/25/87[a]	c	c	<LLD	c	c	c
07/01/87[b]	< 46	220±20	<1.4	1590±60	<LLD	0.59±0.04
07/07/87[b]	< 47	210±20	1.1±0.1	<LLD	<LLD	0.33±0.02
07/14/87[b]	<130	190±10	0.73±0.04	1450±50	<1.3	<0.56
07/21/87[b]	<140	210±9	7.7±0.4	<1030	<1.4	<0.72
07/28/87[b]	<130	190±7	1.2±0.1	1620±60	<1.4	<0.85
08/04/87[b]	< 55	190±12	4.3±0.2	<LLD	<1.2	<0.83
08/11/87[b]	< 34	210±8	1.08±0.06	1020±30	<LLD	<0.58
08/18/87[b]	< 33	220±9	3.8±0.4	1420±50	<LLD	<0.65
08/25/87[b]	< 88	210±9	<1.4	1150±40	<LLD	<0.55
09/01/87[b]	< 91	230±9	1.8±0.3	<LLD	<1.1	<0.65
09/08/87[b]	< 95	220±9	2.1±0.4	1020±40	<LLD	<0.69
09/15/87[b]	<220	230±8	1.3±0.1	1000±40	<LLD	<0.70
09/22/87[b]	<110	270±10	1.2±0.1	<LLD	<LLD	0.59±0.05
09/29/87[b]	< 77	220±10	<1.0	1190±40	<LLD	0.66±0.05
10/06/87[b]	<130	230±10	<1.1	1290±40	<LLD	0.67±0.05
10/13/87[b]	<140	220±10	<0.61	850±30	<LLD	0.67±0.05
10/20/87[b]	<220	230±10	2.6±0.2	780±30	<LLD	0.71±0.05
10/27/87[b]	<250	220±10	<0.6	<LLD	<LLD	0.74±0.06

[a]CEP data
[b]ASU data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE XXXIV (Cont.)

SURFACE WATER

PVNGS EVAPORATION POND
(Sample Site #59)

1987

Radiochemical Analysis (pCi/l)

Collection Date	Gross Alpha	Gross Beta	Iodine-131	Tritium	Strontium-89	Strontium-90
11/03/87[b]	<170	250±10	1.0±0.08	660±20	<LLD	<LLD
11/10/87[b]	<260	240±10	<0.52	980±40	<LLD	0.97±0.06
11/17/87[b]	<270	230±9	0.70±0.05	890±30	<LLD	0.76±0.05
11/24/87[b]	<230	220±8	<0.68	890±30	<LLD	0.50±0.03
12/01/87[b]	< 74	260±10	<0.54	1090±40	<LLD	0.58±0.04
12/08/87[b]	< 95	250±10	<0.96	820±30	<LLD	0.59±0.04
12/15/87[b]	< 27	220±10	<0.68	[c]	<LLD	0.97±0.06
12/22/87[b]	< 26	210±10	0.99±0.6	820±30	<LLD	<0.81
12/29/87[b]	< 17	230±10	1.2±0.1	1140±40	<LLD	<0.81

[b]ASU data
[c]Not determined on individual samples. See Table XXXV for results on composite samples.

TABLE XXXV

SURFACE WATER (COMPOSITE)[a]

1987

Collection Location	Composite Period	pCi/l Gross Alpha	Gross Beta	Strontium-89	Strontium-90	Tritium
PVNGS Reservoir (Site #60)	January	<LLD	6.4±0.6	<LLD	<LLD	<LLD
	February	<LLD	6.7±0.6	<LLD	<LLD	<LLD
	March	2.0±1.0	6.6±0.7	<LLD	<LLD	<LLD
	April	<LLD	3.4±0.5	<LLD	<LLD	<LLD
	May	<LLD	6.6±0.6	<LLD	<LLD	<LLD
	June	<LLD	3.9±0.5	<LLD	<LLD	<LLD
PVNGS Evaporation Pond (Site #59)	January	<LLD	14.9±0.8	<LLD	<LLD	2421±1282
	February	<LLD	14.0±0.8	<LLD	<LLD	1482±899
	March	1.7±1.0	10.7±0.8	<LLD	<LLD	3071±1194
	April	<LLD	8.1±0.7	<LLD	<LLD	2739±908
	May	<LLD	8.0±0.6	<LLD	<LLD	<LLD
	June	1.5±0.9	16.7±0.7	<LLD	<LLD	<LLD

[a]CEP DATA

TABLE XXXVI

SURFACE WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
PVNGS Reservoir (Site #60)	January[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	February[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	March[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	April[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	May[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	June[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	7.5	<LLD
	07/07/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	3.7	<LLD
	07/14/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	8.9	<LLD
	07/21/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	5.4	<LLD
	07/28/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	5.0	<LLD
	08/04/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.4	<LLD
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.6	<LLD

[a]CEP data (monthly composite)

[b]ASU data

[c]Not Determined

TABLE XXVI (Cont.)

SURFACE WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
PVNGS Reservoir (Cont.) (Site #60)	08/18/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	11	<LLD
	08/25/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	13	<LLD
	09/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	7.1	<LLD
	09/08/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	5.4	<LLD
	09/22/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.9	<LLD
	09/29/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	7.0	<LLD
	10/06/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	5.8	<LLD
	10/13/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	3.7	<LLD
	10/20/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/27/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/03/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	8.3	<LLD
	11/17/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.2	<LLD
	11/24/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/08/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.3	<LLD
	12/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.8	<LLD
	12/22/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	13	<LLD
	12/29/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	7.6	<LLD

[b]ASU data

TABLE XXXVI (Cont.)

SURFACE WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
PVNGS Evaporation Pond (Site #59)	January[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	February[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	March[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	April[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	May[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	June[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	07/07/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	07/14/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	07/21/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	8.5	<LLD
	07/28/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	08/04/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	5.3	<LLD
	08/11/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data (monthly composite)

[b]ASU data

[c]Not Determined

TABLE XXXVI (Cont.)

SURFACE WATER

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l										
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	I-131	La-140
PVNGS Evaporation Pond (Cont.) (Site #59)	08/18/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	4.0	<LLD
	08/25/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/08/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/22/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	09/29/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/06/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/13/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/20/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	10/27/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/03/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/10/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/17/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/24/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/01/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/08/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/15/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/22/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/29/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	7.3	<LLD

[b]ASU data

8.8 Milk (Fresh)

Fresh milk samples were collected on a monthly basis during 1987 from the following locations:

1. Al Lueck, Jr. Dairy (Sample Site #55)
2. Cordell Baisley Dairy (closed 08/30/87) (Sample Site #50)
3. Butler Dairy (Sample Site #51)
4. John Kerr Dairy (Sample Site #53)
5. Hamstra #2 (designated operational control location) (Sample Site #56)
6. Paul Skousen Dairy (Sample Site #54)

Milk samples were analyzed for Iodine-131, Strontium-89, Strontium-90 and Gamma-emitting nuclides. Results of these analyses are presented in Tables XXXVII and XXXVIII. Site #56 is the control. Analytic method involved radiochemical separation, followed by gas flow beta proportional counting.

Iodine-131 analyses of the milk samples showed positive results in two of the samples. Activity was detected on 05/15/87 samples from the Al Lueck, Jr. Dairy (2.6 ±0.7 pCi/l) and the Cordell Baisley Dairy (2.4 ±0.7 pCi/l) (Sample Sites #55 and 50, respectively). Sample Site #55 again yielded activity on 07/20/87, but below 1 pCi/liter.

None of the milk samples were positive for Strontium-89 or -90.

Milk samples gave no positive results for gamma-emitting nuclides, except that Iodine-131 was detected in a 09/21/87 sample from Hamstra #2 Dairy (Sample Site #56) via gamma spectral analysis. Radiochemical analysis of the same sample determined Iodine-131 to be <0.96 pCi/l, via gas flow beta proportional counting--the analytical method used to generate the data in Table XXXVII.

TABLE XXXVII

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l Iodine-131	Strontium-89	Strontium-90
Al Lueck, Jr. Dairy (Site #55)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	2.6 ±0.7	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	0.69 ±0.04	[c]	[c]
	08/17/87[b]	<0.59	[c]	[c]
	09/21/87[b]	<0.97	[c]	[c]
	10/19/87[b]	<0.65	[c]	[c]
	11/16/87[b]	<0.57	[c]	[c]
	12/21/87[b]	<LLD	[c]	[c]

[a]CEP data

[b]ASU data

[c]Not determined

TABLE XXXVII (Cont.)

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l		
		Iodine-131	Strontium-89	Strontium-90
Paul Skousen Dairy (Site #54)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	<LLD	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	<0.57	[c]	[c]
	08/17/87[b]	<0.58	[c]	[c]
	09/21/87[b]	<0.97	[c]	[c]
	10/19/87[b]	<0.65	[c]	[c]
	11/16/87[b]	<0.56	[c]	[c]
	12/21/87[b]	<0.51	[c]	[c]

[a]CEP data

[b]ASU data

[c]Not determined

TABLE XXXVII (Cont.)

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l Iodine-131	Strontium-89	Strontium-90
John Kerr Dairy (Site #53)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	<LLD	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	<LLD	[c]	[c]
	08/17/87[b]	<0.57	[c]	[c]
	09/21/87[b]	<0.96	[c]	[c]
	10/19/87[b]	<0.66	[c]	[c]
	11/16/87[b]	<0.55	[c]	[c]
	12/21/87[b]	<LLD	[c]	[c]

[a]CEP data

[b]ASU data

[c]Not determined

TABLE XXXVII (Cont.)

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l Iodine-131	Strontium-89	Strontium-90
Butler Dairy (Site #51)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	<LLD	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	<0.57	[c]	[c]
	08/17/87[b]	<0.59	[c]	[c]
	09/21/87[b]	<1.0	[c]	[c]
	10/19/87[b]	<0.64	[c]	[c]
	11/16/87[b]	<0.55	[c]	[c]
	12/21/87[b]	<LLD	[c]	[c]

[a]CEP data

[b]ASU data

[c]Not determined

TABLE XXXVII (Cont.)

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l Iodine-131	Strontium-89	Strontium-90
Cordell Baisley Dairy (Site #50)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	2.4 ±0.7	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	<0.52	[c]	[c]
	08/17/87[b]	<0.59	[c]	[c]
	09/21/87[b]	[d]	[d]	[d]
	10/19/87[b]	[d]	[d]	[d]
	11/16/87[b]	[d]	[d]	[d]
	12/21/87[b]	[d]	[d]	[d]

[a]CEP data

[b]ASU data

[c]Not determined

[d]Not sampled (Dairy closed)

TABLE XXXVII (Cont.)

MILK (Fresh)

1987

Collection Location	Date Collected	pCi/l Iodine-131	Strontium-89	Strontium-90
Hamstra #2 Dairy (Site #56) (Control)	01/16/87[a]	<LLD	<LLD	<LLD
	02/13/87[a]	<LLD	<LLD	<LLD
	03/13/87[a]	<LLD	<LLD	<LLD
	04/17/87[a]	<LLD	<LLD	<LLD
	05/15/87[a]	<LLD	<LLD	<LLD
	06/19/87[a]	<LLD	<LLD	<LLD
	07/20/87[b]	<0.55	[c]	[c]
	08/17/87[b]	<2.1[e]	[c]	[c]
	09/21/87[b]	<0.96	[c]	[c]
	10/19/87[b]	<0.68	[c]	[c]
	11/16/87[b]	<0.59	[c]	[c]
	12/21/87[b]	<LLD	[c]	[c]

[a]CEP data

[b]ASU data

[c]Not determined

[e]Due to background fluctuation

TABLE XXXVIII

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
Al Lueck, Jr. Dairy (Site #55)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/20/87[b]	<LLD	<11	<10	<11	<LLD	<LLD	<11	<9.5	<LLD	<LLD
	08/17/87[b]	<36	<11	<9.8	<11	<LLD	<LLD	<11	<9.9	<LLD	<13
	09/21/87[b]	<40	<11	<10	<9.4	<LLD	<18/LLD	<LLD	<LLD	<LLD	<14
	10/19/87[b]	<38	<11	<11	<11	<LLD	<18/LLD	<LLD	<LLD	<LLD	<13
	11/16/87[b]	<39	<11	<10	<10	<LLD	<LLD	<11	<LLD	<LLD	<16
	12/21/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

TABLE XXXVIII (Cont.)

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
Paul Skousen Dairy (Site #54)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/20/87[b]	<40	<11	<10	<9.7	<26	<18/LLD	<11	<9.6	<24	<16
	08/17/87[b]	<LLD	<12	<9.7	<9.8	<LLD	<LLD	<11	<LLD	<24	<14
	09/21/87[b]	<38	<11	<9.2	<9.1	<26	<19/LLD	<11	<9.5	<LLD	<17
	10/19/87[b]	<40	<11	<12	<10	<LLD	<19/LLD	<12	<10	<25	<17
	11/16/87[b]	<45	<12	<11	<11	<LLD	<18/<12	<12	<11	<23	<17
	12/21/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

TABLE XXXVIII (Cont.)

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
John Kerr Dairy (Site #53)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/20/87[b]	<42	<12	<10	<9.7	<LLD	<18/LLD	<LLD	<9.1	<LLD	<13
	08/17/87[b]	<LLD	<11	<9.6	<9.5	<LLD	<18/LLD	<LLD	<LLD	<LLD	<LLD
	09/21/87[b]	<36	<12	<9.8	<9.8	<LLD	<LLD	<LLD	<LLD	<LLD	<13
	10/19/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/16/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/21/87[b]	<35	<11	<10	<10	<LLD	<LLD	<14	<9.5	<LLD	<14

[a]CEP data

[b]ASU data

[c]Not Determined

TABLE XXXVIII (Cont.)

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
Butler Dairy (Site #51)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/20/87[b]	<LLD	<12	<11	<9.9	<LLD	<18/LLD	<LLD	<9.1	<LLD	<LLD
	08/17/87[b]	<35	<12	<LLD	<9.5	<LLD	<LLD	<11	<LLD	<LLD	<13
	09/21/87[b]	<41	<LLD	<11	<10	<LLD	<18/LLD	<11	<LLD	<24	<16
	10/19/87[b]	<37	<12	<9.1	<10	<LLD	<LLD	<11	<10	<24	<13
	11/16/87[b]	<40	<12	<11	<11	<LLD	<18/LLD	<12	<10	<26	<16
	12/21/87[b]	<35	<11	<9.2	<10	<LLD	<LLD	<18	<11	<LLD	<LLD

[a]CEP data

[b]ASU data

[c]Not Determined

TABLE XXXVIII (Cont.)

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
Cordell Baisley Dairy (Site #50)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	c
	07/20/87[b]	<41	<11	<11	<10	<LLD	<19/LLD	<11	<LLD	<LLD	<14
	08/17/87[b]	<39	<11	<10	<9.3	<LLD	<LLD	<11	<9.3	<LLD	<15
	09/21/87[b]	d	d	d	d	d	d	d	d	d	d
	10/19/87[b]	d	d	d	d	d	d	d	d	d	d
	11/16/87[b]	d	d	d	d	d	d	d	d	d	d
	12/21/87[b]	d	d	d	d	d	d	d	d	d	d

[a]CEP data

[b]ASU data

[c]Not Determined

[d]No sample taken (dairy closed)

TABLE XXXVIII (Cont.)

MILK (FRESH)

GAMMA SPECTROMETRY

1987

Collection Location	Date Collected	pCi/l									
		Ba-140	Co-60	Co-58	Mn-54	Zn-65	Zr,Nb-95	Cs-137	Cs-134	Fe-59	La-140
Hamstra #2 Dairy (Site #56) (Control)	01/16/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	02/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	03/13/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	04/17/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	05/15/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	06/19/87[a]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	[c]
	07/20/87[b]	<LLD	<13	<10	<9.6	<26	<LLD	<11	<9.2	<LLD	<14
	08/17/87[b]	<36	<12	<11	<9.3	<LLD	<18/LLD	<11	<9.5	<LLD	<17
	09/21/87[b]	<38	<11	<10	<10	<LLD	<LLD	<11	<9.2	<24	<14
	10/19/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	11/16/87[b]	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD	<LLD
	12/21/87[b]	<39	<11	<10	<10	<LLD	<18/LLD	<13	<10	<LLD	<13

[a]CEP data

[b]ASU data

[c]Not Determined

8.9 Further Observations

Gamma isotopic assays of 68 milk samples yielded only one, Hamstra #2 Dairy (Sample Site #56) (September 21), in which any gamma isotope exceeded the lower limit of detection. In this instance, the iodine-131 concentration (11.4 pCi/l) was extremely close to the lower limit of detection. Radiochemical analysis of the same sample determined iodine-131 to be <0.96 pCi/l.

Three of the 68 milk samples analyzed radiochemically contained iodine-131 above the lower limit of detection.

Mean values of Iodine-131 in the evaporation pond and the reservoir were 2.1 pCi/l and 6.0 pCi/l, respectively.

Gross alpha and beta analyses were performed on 110 surface water, ground water and drinking water samples. All ground water and drinking water samples were within the natural backgrounds found in the area. The gross beta activity in the evaporation pond (Sample Site #59) was approximately ten times greater than that measured in the reservoir (Sample Site #60).

Strontium-90 analyses were performed on 110 surface water, ground water and drinking water samples. Except for certain indications of strontium-90 in drinking water and surface water, all results were less than the lower limits of detection for the specific measurements. The indications of strontium-90 were <1.4 pCi/l in all instances.

Strontium-89 analyses were performed on 66 surface water samples. Except for one result of 0.52 pCi/liter, all results were less than the lower limits of detection for the specific measurements. The indications of strontium-89 were typically less than 1 pCi/liter; the maximum indication was <3.1 pCi/liter.

All of the 36 milk samples assayed for strontium-89 and strontium-90 were below the lower limits of detection.

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

ANNUAL SUMMARY

1987

T[illegible] XXXIX

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Palo Verde Nuclear Generating Station Reporting Period: 1987

Location of Facility: Maricopa County, Arizona

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)(a)	All Indicator Locations Mean(f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean(f) Range	Control Locations Mean(f) Range	Number of Nonroutine Reported Measurements
Air Particulates (pCi/m^3)	Gross Beta(576)	0.002	0.028(527/527) 0.013-0.055	21A+ 3 miles S	0.029(51/51) 0.014-0.055	0.028(49/49) 0.012-0.050	0
	Gross Alpha(576)	0.005	0.006(5/527) 0.005-0.008	15A 2 miles NE	0.008(1/51) 0.008	<LLD	0
	Gamma Spec(48)	(b)					
	Iodine-131(576)	0.007	0.015(9/527) 0.008-0.024	14A 2 miles NNE	0.024(1/51) 0.024	0.008(1/49) 0.008	0
Human Vegetation (pCi/kg - wet)	Iodine-131(36)	20	<LLD	<LLD	<LLD	<LLD	0
	Gamma Spec(36)	(b)	<LLD	<LLD	<LLD	<LLD	0
Animal Vegetation (pCi/kg)	Strontium-89(76)	100	<LLD	<LLD	<LLD	N/A	0
	Strontium-90(76)	50	<LLD	<LLD	<LLD	N/A	0
	Gamma Spec(76)	(b)					
	Cs-137	56	199(1/76) 199	Skousen Dairy 27 Miles E (Site #54)	199(1/15) 199	N/A	0
Drinking Water (pCi/l)	Gross Alpha(36)	1.0	4.3(21/36) 1.1-18.0	McArthur Residence 9 miles NNW (Site #46)	5.1(6/12) 2.4-6.9	N/A	0

TABLE XXXIX (Cont.)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Palo Verde Nuclear Generating Station Reporting Period: 1987

Location of Facility: Maricopa County, Arizona

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)(a)	All Indicator Locations Mean(f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean(f) Range	Control Locations Mean(f) Range	Number of Nonroutine Reported Measurements
Drinking Water (pCi/l) Cont.	Gross Beta(36)	2.0	5.0(25/36) 2.0-10.0	McArthur Residence 9 miles NNW (Site #46)	6.4(8/12) 2.8-10.0	N/A	0
	Strontium-90(36)	0.5	0.7(9/36) 0.7-0.8	N/A	0.7(3/12) 0.7-0.8	N/A	0
	Tritium(54)	1000	1180(6/33) 1030-1340	N/A	1180(2/11) 1030-1340	N/A	0
	Gamma Spec(54)	(b)	<LLD	<LLD	<LLD	N/A	0
Groundwater (pCi/l)	Gross Alpha(6)	1.0	4.2(2/6) 4.1-4.2	Well 27ddc Onsite (Site #57)	4.2(1/3) 4.2	N/A	0
	Gross Beta(8)	2.0	4.6(4/8) 3.0-5.5	Well 27ddc Onsite (Site #57)	5.0(2/4) 4.6-5.3	N/A	0
	Strontium-90(8)	0.5	<LLD	<LLD	<LLD	N/A	0
	Tritium(8)	1000	1320(2/8) 1320-1320	N/A	1320(1/4) 1320-1320	N/A	0
	Gamma Spec	(b)	<LLD	<LLD	<LLD	N/A	0

TABLE XIX (Cont.)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Palo Verde Nuclear Generating Station Reporting Period: 1987

Location of Facility: Maricopa County, Arizona

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)(a)	All Indicator Locations Mean(f) Range	Location with Highest Annual Mean Name Distance Direction	Location with Highest Annual Mean Mean(f) Range	Control Locations Mean(f) Range	Number of Nonroutine Reported Measurements
Surface Water (pCi/l)	Gross Alpha(66)	1.0	2.5(5/66) 1.5-4.2	Reservoir Onsite (Site #60)	3.2(3/33) 2.0-4.2	N/A	0
	Gross Beta(66)	2.0	100.2(66/66) 3.4-270	Evap Pond Onsite (Site #59)	184.9(33/33) 8.0-270	N/A	0
	Iodine-131(104)	0.5	4.5(48/104) 0.7-25.0	Reservoir Onsite (Site #60)	6.0(30/52) 1.8-25.0	N/A	0
	Tritium(74)	1000	1561(33/74) 660-3791	Evap Pond Onsite (Site #59)	1615(30/37) 660-3791	N/A	0
	Strontium-89(66)	1.0	<LLD	<LLD	<LLD	N/A	0
	Strontium-90(66)	0.5	0.69(13/66) 0.50-0.97	Evap Pond Onsite (Site #59)	0.69(13/33) 0.50-0.97	N/A	0
	Gamma Spec Iodine-131(66)	1.0	6.6(25/66) 3.7-13.0	Reservoir Onsite (Site #60)	6.6(21/33) 3.7-13.0	N/A	0

TABLE XXXIX (Cont.)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Name of Facility: Palo Verde Nuclear Generating Station Reporting Period: 1987

Location of Facility: Maricopa County, Arizona

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD)(a)	All Indicator Locations Mean(f) Range	Location with Highest Annual Mean Name Distance Direction	Mean(f) Range	Control Locations Mean(f) Range	Number of Nonroutine Reported Measurements
Milk (pCi/l)	Iodine-131(68)	0.5	0.8(24/56) 0.5-2.6	Cordell Baisley 7 miles NE (Site #50)	1.2(3/8) 0.5-2.4	1.0(5/12) 0.6-2.1	0
	Strontium-89(36)	1.0	<LLD	<LLD	<LLD	<LLD	0
	Strontium-90(36)	0.5	<LLD	<LLD	<LLD	<LLD	0
	Gamma Spec(68)	(b)	<LLD	<LLD	<LLD	<LLD	0

(a)CEP data

(b) See Table VI

+Location 29A (1 mile west) has the same mean and range, with an (f) value of (52/52).

N/A Not Applicable

Mean and Range are based on detectable measurements only. The fraction of detectable measurements at specified locations is indicated in parentheses (f). "<" data points are set equal to the value that the measurement is less than (except gamma spec and surface water).

9.0 Miscellaneous Information

No miscellaneous information was obtained for the 1987 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) 1985 Annual Report, Arizona Nuclear Power Project, Operational Radiological Environmental Monitoring Program.

7) 1986 Annual Report, Arizona Nuclear Power Project, Operational Radiological Environmental Monitoring Program.

8) Operational Radiological Environmental Monitoring Program Report for 1987; Arizona State University, Radiation Measurements Facility.

9) Nuclear Regulatory Commission, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plant," 10 CFR 50, Appendix B (1985).

10) Environmental Radiation Data, Quarterly Reports, U.S. Environmental Protection Agency, Office of Radiation Programs.

11) Nuclear Regulatory Commission, Branch Technical Position, Revision 1, 1979.

APPENDIX A

1986 EPA CROSS CHECK RESULTS (CEP)

EPA CROSS-CHECK PROGRAM

1986

Gross Alpha/Beta In Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
1/86	Gross Alpha	3 ± 5	5 ± 1 6 ± 1 7 ± 1
	Gross Beta	7 ± 5	7 ± 1 9 ± 1 10 ± 1
3/86	Gross Alpha	15 ± 5	13 ± 3 15 ± 3 16 ± 3
	Gross Beta*	8 ± 5	15 ± 3** 16 ± 3** 17 ± 3**
/86	Gross Alpha	8 ± 5	No Data Reported
	Gross Beta	15 ± 5	No Data Reported
7/86	Gross Alpha	6 ± 5	5 ± 1 6 ± 1 6 ± 1
	Gross Beta	18 ± 5	15 ± 3 16 ± 3 18 ± 3
9/86	Gross Alpha	15 ± 5	12 ± 2 12 ± 2 14 ± 2
	Gross Beta***	8 ± 5	17 ± 4 18 ± 3 20 ± 3
11/86	Gross Alpha	20 ± 5	No Data Reported
	Gross Beta	20 ± 5	No Data Reported

*Spike sample was reanalyzed and a value of 6 ± 2 pCi/l was obtained.

**Based on EPA Criteria CEP hit this spike Cross-Check.

***Spike sample was reanalyzed and a value of 7 ± 2 pCi/l was obtained.

EPA CROSS-CHECK PROGRAM

1986

Gamma In Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/86	Cesium-134	30 ± 5	29 ± 4
			24 ± 4
			33 ± 5
	Cesium-137	22 ± 5	18 ± 4
			16 ± 4
			21 ± 4
	Chromium-51	38 ± 5	55 ± 10
			53 ± 10
			52 ± 10
	Cobalt-60	18 ± 5	25 ± 2
			29 ± 4
			21 ± 3
	Zinc-65*	40 ± 5	57 ± 15
			56 ± 12
			56 ± 12
6/86	Cesium-137	10 ± 5	9 ± 2
			12 ± 2
			10 ± 2
	Chromium-51	0 ± 5	No Data Reported
	Zinc-65	86 ± 5	87 ± 8
			84 ± 8
			90 ± 8
	Cobalt-60	66 ± 5	51 ± 5
			53 ± 5
			58 ± 5

*Spike sample was reanalyzed and a value of 41 ±14 pCi/l was obtained.

EPA CROSS-CHECK PROGRAM

1986

Gamma In Water (Continued)

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
	Cesium-134	49 ± 5	37 ± 5 38 ± 5 39 ± 5
10/86	Cesium-134	28 ± 5	22 ± 2 26 ± 2 28 ± 2
	Cesium-137	44 ± 5	42 ± 4 43 ± 1 48 ± 3
	Cobalt-60	31 ± 5	28 ± 4 29 ± 4 29 ± 4
	Zinc-65	85 ± 5	77 ± 7 78 ± 7 79 ± 7
	Chromium-51	59 ± 5	32 ± 10 42 ± 10 45 ± 10

EPA CROSS-CHECK PROGRAM

1986

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/86	Tritium*	5227 ± 523	4100 ± 410
			4590 ± 459
			4190 ± 419
6/86	Tritium**	3125 ± 360	2290 ± 230
			2170 ± 220
			2050 ± 210
10/86	Tritium	5973 ± 597	5462 ± 600
			5257 ± 600
			5880 ± 600

*Spike sample was reanalyzed and a value of 5028 ± 400 pCi/l was obtained.

**Spike sample was reanalyzed with the LS-5801 and a value of 3533 ± 565 pCi/l was obtained.

EPA CROSS-CHECK PROGRAM

1986

Strontium in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
1/86	Strontium-89	31 ± 5	35 ± 1 37 ± 1 40 ± 1
	Strontium-90*	15 ± 1.5	19 ± 3.1 18 ± 3.4 22 ± 2.6
5/86	Strontium-89	5 ± 5	4 ± 1 5 ± 1 6 ± 1
	Strontium-90	5 ± 1.5	2 ± 1 3 ± 1 4 ± 1

*Spike sample was reanalyzed and a mean value of 15 ± 3 pCi/l was obtained.

EPA CROSS-CHECK PROGRAM

1986

Iodine-131 in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
4/86	Low Level	9 ± 6	9 ± 4
			7 ± 4
			7 ± 4
8/86	High Level*	45 ± 6	30 ± 4
			33 ± 4
			39 ± 4

*Spike sample was reanalyzed and a value of 40 ± 4 pCi/l was obtained.

EPA CROSS-CHECK PROGRAM

1986

Radionuclides in Milk

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
6/86	Iodine-131	41 ± 6	36 ± 6 32 ± 4 40 ± 7
	Cesium-137	31 ± 5	34 ± 5 26 ± 4 28 ± 4
	Strontium-89[a]	0 ± 5	13 ± 4 15 ± 4 16 ± 4
	Strontium-90[a]	16 ± 1.5	0 0 0
	Potassium	1600 ± 80 mg/l	1568 mg/l 1577 mg/l 1633 mg/l
10/86	Iodine-131	49 ± 6	43 ± 3 33 ± 9 37 ± 4
	Cesium-137*	39 ± 5	53 ± 25 58 ± 22 48 ± 20
	Strontium-90	0 ± 1.5	No Data Submitted
	Strontium-89	9 ± 5	No Data Submitted
	Potassium	1565 ± 78 mg/l	1470 mg/l 1490 mg/l 1505 mg/l

*Spike sample was reanalyzed and a value of 34 ± 5 pCi/l was obtained.

[a]Reported values were switched when reported. CEP reported values for Sr-89 should have been 0, 0 and 0; values for Sr-90 should have been 13, 15 and 16.

EPA CROSS-CHECK PROGRAM

1986

Iodine-131 in Milk

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/86	Low Level	9 ± 6	9 ± 1
			9 ± 1
			10 ± 1

EPA CROSS-CHECK PROGRAM

1986

Radionuclides in Air Filters

Date	Parameter	EPA Known Value pCi/filter ±1 σ	CEP Reported Value pCi/filter ±2 σ
4/86	Gross Alpha	15 ± 5	15 ± 3
			15 ± 3
			16 ± 3
	Gross Beta	47 ± 5	56 ± 6
			57 ± 6
			58 ± 6
	Strontium-90*	18 ± 1.5	26 ± 4
			27 ± 4
			28 ± 4
	Cesium-137	10 ± 5	8 ± 3
			9 ± 3
			9 ± 3
/86	Gross Alpha	22 ± 5	23 ± 2
			22 ± 2
			26 ± 2
	Gross Beta	66 ± 5	64 ± 2
			63 ± 2
			66 ± 2
	Strontium-90**	22 ± 1.5	17 ± 3
			21 ± 3
			18 ± 3
	Cesium-137	22 ± 5	23 ± 3
			25 ± 3
			22 ± 3

*Spike sample data was reviewed and indicated that a value of 17 ± 2 pCi/filter was obtained.

**Spike sample data was reviewed and indicated that a value of 22 ± 3 pCi/filter was obtained.

EPA CROSS-CHECK PROGRAM

1986

Radionuclides in Food

Date	Parameter	EPA Known Value pCi/kg ±1 σ	CEP Reported Value pCi/kg ±2 σ
1/86	Iodine-131	20 ± 6	20 ± 5 21 ± 7 22 ± 7
	Cesium-137	15 ± 5	15 ± 5 16 ± 5 17 ± 5
	Potassium	950 ± 143 mg/kg	910 mg/kg 950 mg/kg 940 mg/kg
	Strontium-89	25 ± 5	No Data Reported
	Strontium-90	10 ± 1.5	No Data Reported
7/86	Strontium-89	30 ± 5	23 ± 5 25 ± 5 27 ± 5
	Strontium-90	19 ± 1.5	22 ± 4 23 ± 4 26 ± 4
	Iodine-131*	30 ± 6	18 ± 5 18 ± 5 19 ± 5
	Cesium-137	20 ± 5	15 ± 6 16 ± 6 16 ± 6
	Potassium	1150 ± 58 mg/kg	1210 mg/kg 1235 mg/kg 1245 mg/kg

*No reason can be found for the discrepancy. Unable to reanalyze due to short half life.

APPENDIX B

1987 EPA CROSS CHECK RESULTS (CEP)

EPA CROSS-CHECK PROGRAM

1987

Radionuclides in Air Filters

Date	Parameter	EPA Known Value pCi/filter ±1 σ	CEP Reported Value pCi/filter ±2 σ
4/87	Gross Alpha	14 ± 5	20 ± 1
			18 ± 1
			17 ± 1
	Gross Beta*	43 ± 5	63 ± 2
			64 ± 2
			66 ± 2
	Strontium-90	17 ± 1.5	19 ± 10
			23 ± 10
			24 ± 10
	Cesium-137	8 ± 5	17 ± 5
			19 ± 5
			20 ± 5

*Calculation error. Reported values should have been 50 ± 5, 51 ± 5 and 53 ± 5 pCi/filter ($\bar{x}$ = 51).

EPA CROSS-CHECK PROGRAM

1987

Gross Alpha and Gross Beta in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
1/87	Gross Alpha	11 ± 5	12 ± 2
			12 ± 2
			12 ± 2
	Gross Beta*	10 ± 5	22 ± 6
			25 ± 6
			27 ± 7
3/87	Gross Alpha	3 ± 5	4 ± 2
			4 ± 2
			4 ± 2
	Gross Beta	13 ± 5	12 ± 4
			9 ± 4
			8 ± 4
5/87	Gross Alpha	11 ± 5	11 ± 2
			11 ± 2
			12 ± 2
	Gross Beta**	7 ± 5	17 ± 6
			18 ± 6
			19 ± 6

*QA glassware contamination resulted in a high beta value. Sample was reanalyzed and results were within EPA range.

**Elevated activity due to beta contamination of QA reagents. Same reagents not used in the lab and therefore client samples were not affected.

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EPA CROSS-CHECK PROGRAM

1987

Gamma in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/87	Cobalt-60	50 ± 5	55 ± 5 55 ± 5 56 ± 5
	Zinc-65	91 ± 5	102 ± 7 114 ± 6 108 ± 6
	Cesium-134	59 ± 5	61 ± 3 57 ± 2 60 ± 3
	Cesium-137	87 ± 5	109 ± 6 98 ± 6 102 ± 5
/87	Cobalt-60	64 ± 5	69 ± 5 69 ± 5 71 ± 5
	Zinc-65	10 ± 5	12 ± 3 14 ± 3 16 ± 3
	Cesium-134	40 ± 5	40 ± 3 39 ± 3 38 ± 3
	Cesium-137	80 ± 5	82 ± 5 84 ± 5 85 ± 5
	Chromium-51	41 ± 5	46 ± 3 44 ± 3 40 ± 3

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EPA CROSS-CHECK PROGRAM

1987

Tritium in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/87	Tritium	4209 ± 421	4600 ± 500
			4510 ± 500
			4330 ± 500
6/87	Tritium	2895 ± 357	2866 ± 285
			2831 ± 288
			2792 ± 288

EPA CROSS-CHECK PROGRAM

1987

Strontium in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
1/87	Strontium-89	25 ± 5	15 ± 5
			17 ± 6
			20 ± 5
	Strontium-90	25 ± 1.5	22 ± 5
			24 ± 6
			24 ± 5
5/87	Strontium-89	41 ± 5	26 ± 5
			34 ± 5
			34 ± 5
	Strontium-90	20 ± 1.5	14 ± 3
			15 ± 3
			17 ± 3

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 in Water

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
3/87	Low Level*	7.0 ± 0.7	2 ± 4
			2 ± 4
			2 ± 4

*Unable to reanalyze due to half-life decay.

EPA CROSS-CHECK PROGRAM

1987

Radionuclides in Milk

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
6/87	Strontium-90	35 ± 1.5	29 ± 3
			28 ± 3
			32 ± 3
	Cesium-137	74 ± 5	75 ± 2
			77 ± 2
			70 ± 2
	Strontium-89*	69 ± 5	5 ± 2
			5 ± 2
			4 ± 2
	Iodine-131	59 ± 6	63 ± 2
			64 ± 2
			64 ± 2
	Potassium	1525 ± 76 mg/l	1617 ± 150 mg/l
			1648 ± 150 mg/l
			1648 ± 150 mg/l

*Unable to reanalyze due to limited sample.

EPA CROSS-CHECK PROGRAM

1987

Iodine-131 in Milk

Date	Parameter	EPA Known Value pCi/l ±1 σ	CEP Reported Value pCi/l ±2 σ
2/87	Low Level	9.0 ± 0.9	9.0 ± 1.0
			8.0 ± 0.5
			8.0 ± 0.5

APPENDIX C

1987 CROSS CHECK RESULTS (ASU)

EPA INTERCOMPARISON RESULTS

JANUARY 1987 THROUGH APRIL 1987

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EPA INTERCOMPARISON RESULTS
APRIL 1987 THROUGH SEPTEMBER 1987

All values in pCi/liter

Date	Sample	Nuclide	EPA Value	RMF Value	Ave. all labs Participating
7-24-87	Water	Gross Alpha	5 ± 5	5.2 ± 0.4	4.7 ± 1.4
		Gross Beta	5 ± 5	7.8 ± 1.6	6.1 ± 1.8
8-7-87	Water	Iodine-131	48 ± 6	45.3 ± 3.1	47.2 ± 4.9
8-28-87	Air filter*	Gross Alpha	10 ± 5	11.4 ± 0.7	10.5 ± 2.2
		Gross Beta	30 ± 5	31.0 ± 2.0	30.3 ± 4.3
		Cesium-137	10 ± 5	8.7 ± 1.7	10.7 ± 1.9
		Strontium-90	10 ± 5	10.2 ± 0.2	9.6 ± 2.0

*Results are pCi/filter

EPA INTERCOMPARISON RESULTS

OCTOBER 1987 THROUGH DECEMBER 1987

All values in pCi/liter

Date	Sample	Nuclide	EPA Value	RMF Value	Ave. all labs Participating
10-9-87	Water	Chromium-51	70 ± 5	66.4 ± 3.5	68.8 ± 8.9
		Cobalt-60	15 ± 5	16.8 ± 1.8	16.4 ± 2.0
		Zinc-65	46 ± 5	45.6 ± 3.6	47.2 ± 4.7
		Cesium-134	25 ± 5	23.0 ± 0.4	24.4 ± 2.5
		Cesium-137	51 ± 5	51.3 ± 0.7	51.8 ± 3.0
11-21-87	Blind	Gross Alpha	28 ± 7	25.0 ± 2.5	28.0 ± 7.5
		Gross Beta	72 ± 5	68.8 ± 1.6	75.2 ± 9.3
		Cobalt-60	16 ± 5	16.1 ± 1.1	16.6 ± 2.2
		Cesium-134	16 ± 5	15.7 ± 0.5	15.7 ± 2.6
		Strontium-89	16 ± 5	19.2 ± 1.0	15.2 ± 3.6
		Strontium-90	10.0 ± 1.5	11.0 ± 0.2	9.9 ± 1.3
		Radium-226	4.8 ± 0.7	4.54 ± 0.23	4.7 ± 0.7
12-4-87	Water	Iodine-131	26 ± 6	27.1 ± 1.1	26.6 ± 3.1

EML QUALITY ASSURANCE PROGRAM

INTERCOMPARISON RESULTS

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EML QUALITY ASSURANCE PROGRAM

INTERCOMPARISON RESULTS

DECEMBER 1987

Sample Type	Units	Nuclide	Reported Value	EML Value
Air Filter	pCi/filter	Beryllium-7	920 ± 60	896.
Air Filter	pCi/filter	Strontium-89	45 ± 3	38.3
Air Filter	pCi/filter	Strontium-90	47 ± 3	36.9
Air Filter	pCi/filter	Zirconium-95	180 ± 10	188
Air Filter	pCi/filter	Antimony-125	820 ± 10	963
Air Filter	pCi/filter	Cesium-137	304 ± 6	290
Soil	pCi/kg	Strontium-90	12300 ± 600	12.7
Soil	pCi/kg	Strontium-90	11800 ± 600	12.7
Soil	pCi/kg	Cesium-137	190 ± 40	0.211
Soil	pCi/kg	Cesium-137	200 ± 50	0.211
Soil	pCi/kg	Radium-226	720 ± 10	0.636
Soil	pCi/kg	Radium-226	780 ± 20	0.636
Tissue	pCi/kg	Strontium-90	11400 ± 700	12.9
Tissue	pCi/kg	Cesium-137	190 ± 40	0.190
Tissue	pCi/kg	Cesium-137	190 ± 40	0.190
Vegetation	pCi/kg	Cesium-137	1900 ± 100	1.82
Vegetation	pCi/kg	Cesium-137	2100 ± 100	1.82
Water	pCi/ml	Tritium	17.1 ± 0.5	19.1
Water	pCi/ml	Manganese-54	2.26 ± 0.02	2.28
Water	pCi/ml	Cobalt-57	0.14 ± 0.01	0.142
Water	pCi/ml	Cobalt-60	2.27 ± 0.02	2.27
Water	pCi/ml	Strontium-90	0.246 ± 0.016	0.252
Water	pCi/ml	Strontium-90	0.236 ± 0.014	0.252
Water	pCi/ml	Cesium-137	2.28 ± 0.02	2.28

USNRC TEST SAMPLE RESULTS

All Values in uCi/ml

Nuclide	RMF	Certificate Value	Ratio	Agreement Range
Tritium	1.16 E-4	1.27 E-4	0.91	0.75 - 1.33
Strontium-89	1.50 E-4	1.74 E-4	0.86	0.75 - 1.33
Strontium-90	2.15 E-5	1.57 E-5	1.37	0.75 - 1.33

The USNRC sample was supplied in a plastic bottle. Tritium will undergo isotope exchange in plastics, resulting in low results. The sample was over five months old when received by the RMF.

The strontium calculations were repeated and no computational errors were found. The samples results which were originally reported by the RMF were averages of duplicate measurements. Therefore, precision is not a factor. The RMF has reviewed the sample procedures and analysis and can find no explanation for the discrepancy.

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IODINE-131 CHARCOAL CANISTER INTERCOMPARISON RESULTS

All Values in Uci

Ge(Li) Detector #	Known Value	RMF Value	RMF/Known
2	0.0720	0.0771	1.071
3	0.0720	0.0783	1.088
4	0.0720	0.0773	1.074

The vendor supplied one face-loaded charcoal canister for analysis. The results are consistent and in excellent agreement with spiked canister.

The RMF calibrates the Ge(Li) detectors by averaging three spiked canisters. The canisters are spiked with Iodine-131 standards, traceable to the National Bureau of Standards, over the first 10% of the charcoal.

1.0 INTRODUCTION

In accordance with PVNGS Technical Specification 3/4.12.2, the annual Land Use Census within a five mile radius of mid line PVNGS Unit 2 containment was performed during December 1987 by Ralph B. Ochoa and Carolyn Persson.

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 ft^2 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 the map position of 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 status noted in the 1987 census. These changes were in the east northeast and the south sectors.

2.2 Milking Animals

Milk goats were located within the five mile radius of Unit 2 during the 1986 Land Use Census. During the 1987 Land Use Census, three milk goats were located in the East Northeast Sector 4.75 miles from PVNGS Unit 2 Containment.

Milk was obtained for radiological analysis in February, 1987. Since the dose commitment was LLD, it was not 20% greater than at a location from which samples are currently being obtained in accordance with Specification 3.12.1. Therefore, the new location identified in the 1986 Land Use Census was not added to the radiological environmental monitoring program for 1987.

2.3 Vegetable Gardens

No gardens greater than 500 square feet producing broad leaf vegetation were found during the 1987 Land Use Census.

2.4 Conclusion

No changes were made to the REMP as a result of the 1987 Land Use Census.

TABLE 1

LAND USE CENSUS

December 1987

Meteorological Sector	Miles to Nearest Resident	Miles to Nearest Milk Animal	
		Cow	Goat
N	1.50	*	*
NNE	1.50	*	*
NE	2.00	*	*
ENE	2.70 (NEW)	*	4.75
E	2.25	*	*
ESE	3.75	*	*
SE	4.00	*	*
SSE	4.50	*	*
S	2.80 (NEW)	*	*
SSW	*	*	*
SW	2.90	*	*
WSW	1.75	*	*
W	*	*	*
WNW	*	*	*
NW	4.00	*	*
NNW	2.50	*	*

*None within a five mile radius of the midline of PVNGS' Unit 2 containment (reactor) building.