Palo Verde Nuclear
Generating Station

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Station P1-37
Washington, DC 20555-0001

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, & 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report 2001

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2001.

No commitments are being made to the NRC in this letter. If you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

Scott Bauer

SAB/TNW/CJJ/kg

Enclosure

cc: E. W. Merschoff
J. N. Donohew
J. M. Moorman
A. V. Godwin

IE25

ENCLOSURE

Annual Radiological Environmental Operating Report for 2001

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2001

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ABSTRACT

The Radiological Environmental Monitoring Program (REMP) is an ongoing program conducted by Arizona Public Service Company (APS) for the Palo Verde Nuclear Generating Station (PVNGS). Various types of environmental samples are collected near PVNGS and analyzed for radionuclide concentrations.

During 2001, the following categories of samples were collected by APS:

- Broad leaf vegetation
- Groundwater
- Drinking water
- Surface water
- Airborne particulate and radioiodine
- Sludge and sediment

Thermoluminescent dosimeters (TLDs) were used to measure environmental gamma radiation. The Environmental TLD program is also conducted by APS.

APS reviews analysis results for trends and anomalies for inclusion in this report.

The Arizona Radiation Regulatory Agency (ARRA) performs radiochemistry analyses on various duplicate samples provided to them by APS. Samples analyzed by ARRA include onsite samples from the Reservoir, two (2) Evaporation Ponds , and two (2) deep wells. Offsite samples analyzed by ARRA includes two (2) local resident wells. ARRA also performs air sampling at seven (7) offsite locations identical to APS and maintains fifty (50) environmental TLD monitoring locations, eighteen (18) of which are duplicates of APS locations.

Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. There were no radiological impacts on the environment due to PVNGS operations in 2001.

(NOTE: Reference to APS throughout this report refers to PVNGS personnel)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1. Introduction

This report presents the results of the operational radiological environmental monitoring program conducted by Arizona Public Service Company (APS). The Radiological Environmental Monitoring Program (REMP) was established for the Palo Verde Nuclear Generating Station (PVNGS) by APS in 1979. The REMP is performed in accordance with the federal requirements to provide a complete environmental monitoring program for nuclear reactors, and with concern for maintaining the quality of the local environment. The program complies with the requirements of 10 CFR50, Appendix I, PVNGS Technical Specifications, and with the guidance provided by the US Nuclear Regulatory Commission (USNRC) in their Radiological Assessment Branch Technical Position, Revision 1, November 1979.

This report contains the measurements and findings for 2001. All references are specifically identified in Section 12.

The objectives of the REMP are as follows: 1) to determine baseline radiation levels in the environs prior to plant operation and to compare the findings with measurements obtained during reactor operations; 2) to monitor potential critical pathways of radio-effluent to man; and 3) to determine radiological impacts on the environment caused by the operation of PVNGS.

Results from the REMP help to evaluate sources of elevated levels of radioactivity in the environment, (e.g., atmospheric nuclear detonations or abnormal plant releases).

Results of the PVNGS pre-operational environmental monitoring program are presented in Reference 1.

The initial criticality of Unit 1 occurred May 25, 1985. Initial criticality for Units 2 and 3 were April 18, 1986, and October 25, 1987, respectively. PVNGS operational findings (historical) are presented in Reference 2.

2. Description of the Monitoring Program

The pre-operational radiological environmental monitoring program, which began in 1979, was performed by APS and vendor organizations. APS and vendors continued the program into the operational phase.

2.1. 2001 PVNGS Radiological Environmental Monitoring Program

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

Samples were collected by APS at the monitoring sites shown in Figures 2.1 and 2.2. The specific sample types, sampling locations, and sampling frequencies, as set forth in the PVNGS Offsite Dose Calculation Manual (ODCM), Reference 4, are presented in Tables 2.1, 2.2 and 9.1. Additional onsite sampling (outside the scope of the ODCM) is performed to supplement the REMP. All results are included in this report. Sample analyses were performed by APS at the PVNGS Central Chemistry Laboratory.

Background gamma radiation measurements were performed by APS using TLDs at forty-eight (48) locations near PVNGS.

In addition to the monitoring of environmental media, a land use census is performed annually to identify the nearest milk animals, residents, gardens, and/or changes thereto, near PVNGS. This information is used to evaluate the potential dose to members of the public for those exposure pathways that are indicated.

2.2. Radiological Environmental Monitoring Program Changes for 2001

Two (2) vegetation sample locations were changed in 2001. Refer to Table 2.1 for a description of all current sample locations, including changes in vegetation sample locations.

2.3. REMP Deviations/Abnormal Events Summary

During calendar year 2001, there were eleven (11) deviations/abnormal events with regard to ODCM and/or implementing procedure requirements. Refer to Table 2.3 for more detail and any corrective actions taken.

- Air sample (gross beta and radioiodine) from Site #6A, Jan. 2-8, was invalid.
- Air sample (gross beta and radioiodine) from Site #35, March 12-19, was invalid.
- Air sample (gross beta and radioiodine) from Site #6A, Sept. 4-10, was invalid.
- Air sample (gross beta and radioiodine) from Site #21, Oct. 8-15, was invalid
- Air sample (gross beta and radioiodine) from Site #17A, Nov. 19-26, was invalid.
- Sedimentation Basin #2 samples indicated abnormally high levels of tritium on 1-16-01.
- Sedimentation Basin #2 samples indicated abnormally high levels of I-131 on 4-2-01.
- Due to a circulating water blowdown line leak at Unit 1, circulating water was pumped to the Reservoir to facilitate line repair. This created the potential to exceed Reservoir action levels for I-131.
- Mass flowmeter #EG-4219, used to verify flow rates for REMP air samples, was out of tolerance for the period 7-9-01 through 1-2-02.
- Supplemental well water sample from Site #55 was unavailable during the week of April 30.
- TLD #3 was missing in the 2nd Quarter.

Table 2.1 SAMPLE COLLECTION LOCATIONS

SAMPLE SITE #	*SAMPLE TYPE*	*LOCATION (a)*	*LOCATION DESCRIPTION*
4	air	E16	APS Office
6A*	air	SSE13	Old US 80
7A	air	SE8	Arlington School
14A	air	NNE2	371st Ave. and Buckeye-Salome Rd.
15	air	NE2	NE Site Boundary
17A	air	E3	351st Ave.
21	air	S3	S Site Boundary
29	air	W1	W Site Boundary
35	air	NNW8	Tonopah
40	air	N2	Transmission Rd
46	drinking water	NW9	McArthur Residence
47	vegetation (b)	NNE2	Steagall Residence (changed to Branch Residence, same distance and sector, as of August, 2001)
48	drinking water	SW1	Berryman residence
49	drinking water	N2	Chowanec Residence
52	vegetation	ESE4	Hallman Residence
55	drinking water (supplemental)	SW3	Gavette Residence
57	groundwater	ONSITE	Well 27ddc
58	groundwater	ONSITE	Well 34abb
59	surface water	ONSITE	Evaporation Pond #1
60	surface water	ONSITE	Reservoir
62*	vegetation (b)	E35	Rousseau Farming Co. (changed to Duncan Family Farms, ENE26, as of August, 2001)
63	surface water	ONSITE	Evaporation Pond #2
64	vegetation (b), supplemental	NNE2	This location was changed to a 'required' sample as of August, 2001 (see site #47).

NOTES:

* Designates a control site

(a) Distances and direction are from the center-line of Unit 2 containment and rounded to the nearest mile
(b) Denotes a change in location

Air sample sites designated with the letter 'A' are sites that have the same site number as a TLD location, but are not in the same location (e.g. site #**6** TLD location is different from site #**6A** air sample location; site #**4** TLD location is the same as site #**4** air sample location)

Table 2.2 SAMPLE COLLECTION SCHEDULE

SAMPLE SITE #	*AIR PARTICULATE*	*AIRBORNE RADIOIODINE*	*VEGETATION*	*GROUND WATER*	*DRINKING WATER*	*SURFACE WATER*
4	W	W				
6A	W	W				
7A	W	W				
14A	W	W				
15	W	W				
17A	W	W				
21	W	W				
29	W	W				
35	W	W				
40	W	W				
46					W	
47			M/AA			
48					W	
49					W	
52			M/AA			
55					W	
57				Q		
58				Q		
59						W
60						W
62			M/AA			
63						W
64			M/AA (DELETED AS OF 8/2001)			

W = WEEKLY M/AA = MONTHLY AS AVAILABLE Q = QUARTERLY

TABLE 2.3 SUMMARY OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. Air sample (gross beta and radioiodine) from Site #6A, Jan 2-8, was invalid due to sample pump seizing.	1. The pump was replaced and samples were valid the following week. No further actions necessary.
2. Air sample (gross beta and radioiodine) from Site #35, March 12-19, was invalid due to sample pump seizing.	2. The pump was replaced and samples were valid the following week. No further actions necessary.
3. Air sample (gross beta and radioiodine) Site #6A, Sept 4-10, was invalid due to malfunction of the elapsed time meter (ETM).	3. The ETM was replaced and samples were valid the following week. No further actions necessary.
4. Air sample (gross beta and radioiodine) Site #21, Oct 8-15, was invalid due to loss of power sometime during the sample period.	4. There was no power to the sample station upon arrival. This outage was attributed to construction in the area. Power was restored and the samples were valid the following week. No further action necessary.
5. Air sample (gross beta and radioiodine) Site #17A, November 19-26, was invalid due to the sample head breaking off.	5. The tubing connecting the sample head to the pump was replaced and samples were valid the following week. No further actions necessary.
6. Sedimentation Basin#2 samples indicated abnormally high levels of tritium on 1-16-01.	6. The elevated tritium concentration (7064 pCi/liter) was the result of Boric Acid Concentrator operation during periods of rainfall (see CRDR # 2355136).
7. Sedimentation Basin#2 samples indicated abnormally high levels of I-131 on 4-2-01.	7. The elevated I-131 concentration (104 pCi/liter) was the result of spillover of the Unit 1 cooling towers. The water entered the site drainage ditches and was transported to Sedimentation Basin #2. I-131 concentrations were consistent with circulating water I-131 concentrations. This event was determined to be reportable to the State of Arizona as a violation of Palo Verde's Groundwater Quality Protection Permit. The Corrective Action Program (CRDR # 2375410) addressed corrective actions to prevent recurrence.

(continued on next page)

TABLE 2.3 SUMMARY OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event (continued)	Actions taken (continued)
8. Due to a circulating water blowdown line leak at Unit 1, circulating water was pumped to the Reservoir to facilitate line repair. This created the potential to exceed Reservoir action levels for I-131.	8. Procedure action levels were not exceeded. No further actions were necessary.
9. Mass flowmeter #EG-4219, used to verify flow rates for REMP air samples, was out of tolerance for the period 7-9-01 through 1-2-02.	9. An evaluation was performed to determine the impact on REMP air sample data for this period. All data reported were in the conservative direction as evaluated by CRDR # 2453917. One additional corrective action is to replace the mass flowmeter.
10. Supplemental well water sample from Site #55 (resident well) was unavailable the week of April 30.	10. The well was returned to service the following week. No further actions are required.
11. TLD #3 was missing in the 2nd Quarter and the field holder had been vandalized. This TLD site is near an elementary school.	11. The TLDs were replaced and the holders were not vandalized in the subsequent two quarters. TLD results for the three quarters monitored were in the range of historical data. No further actions are required.

FIGURE 2.1
REMP SAMPLE SITES
(0-10 MILES)

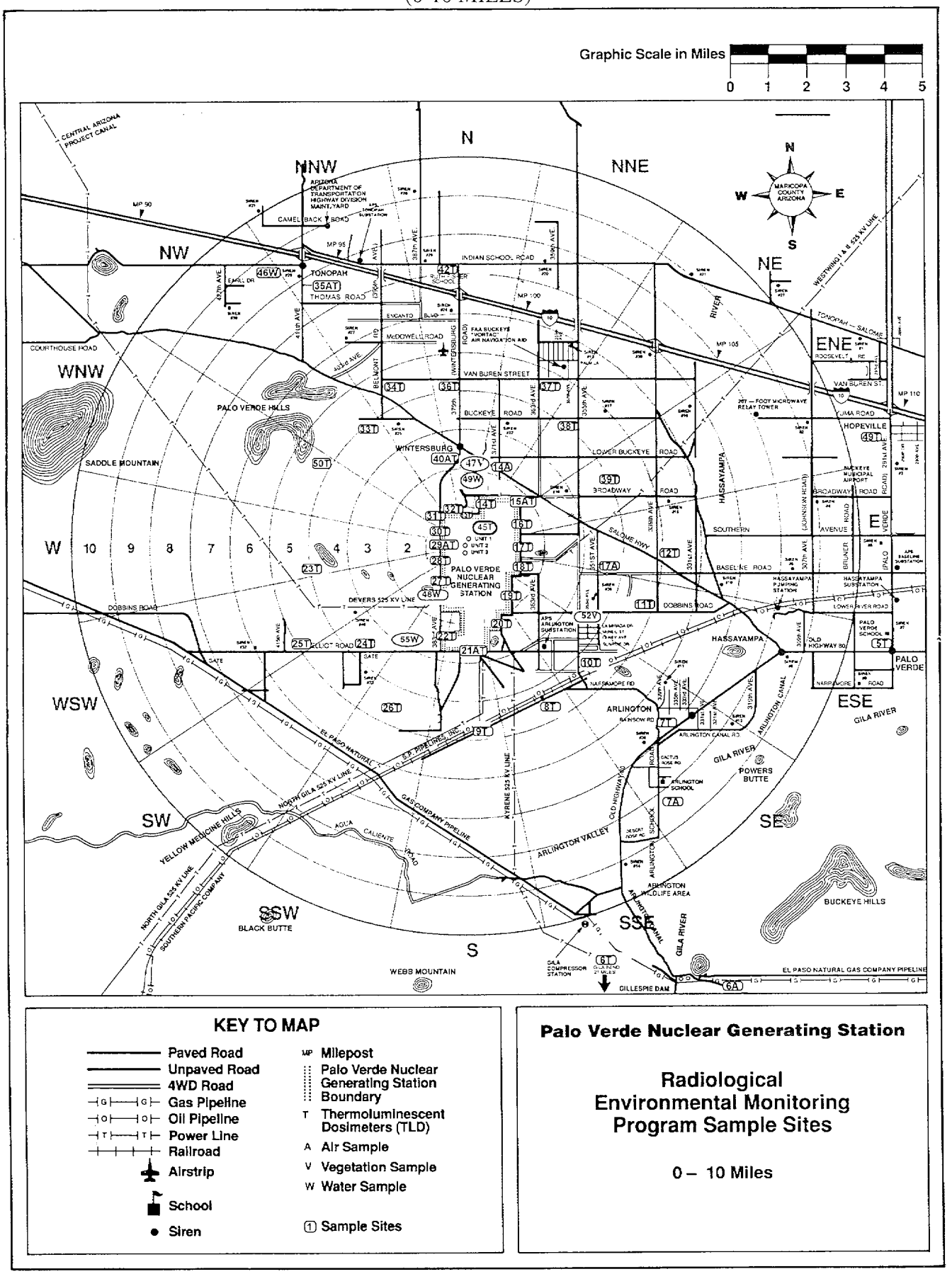
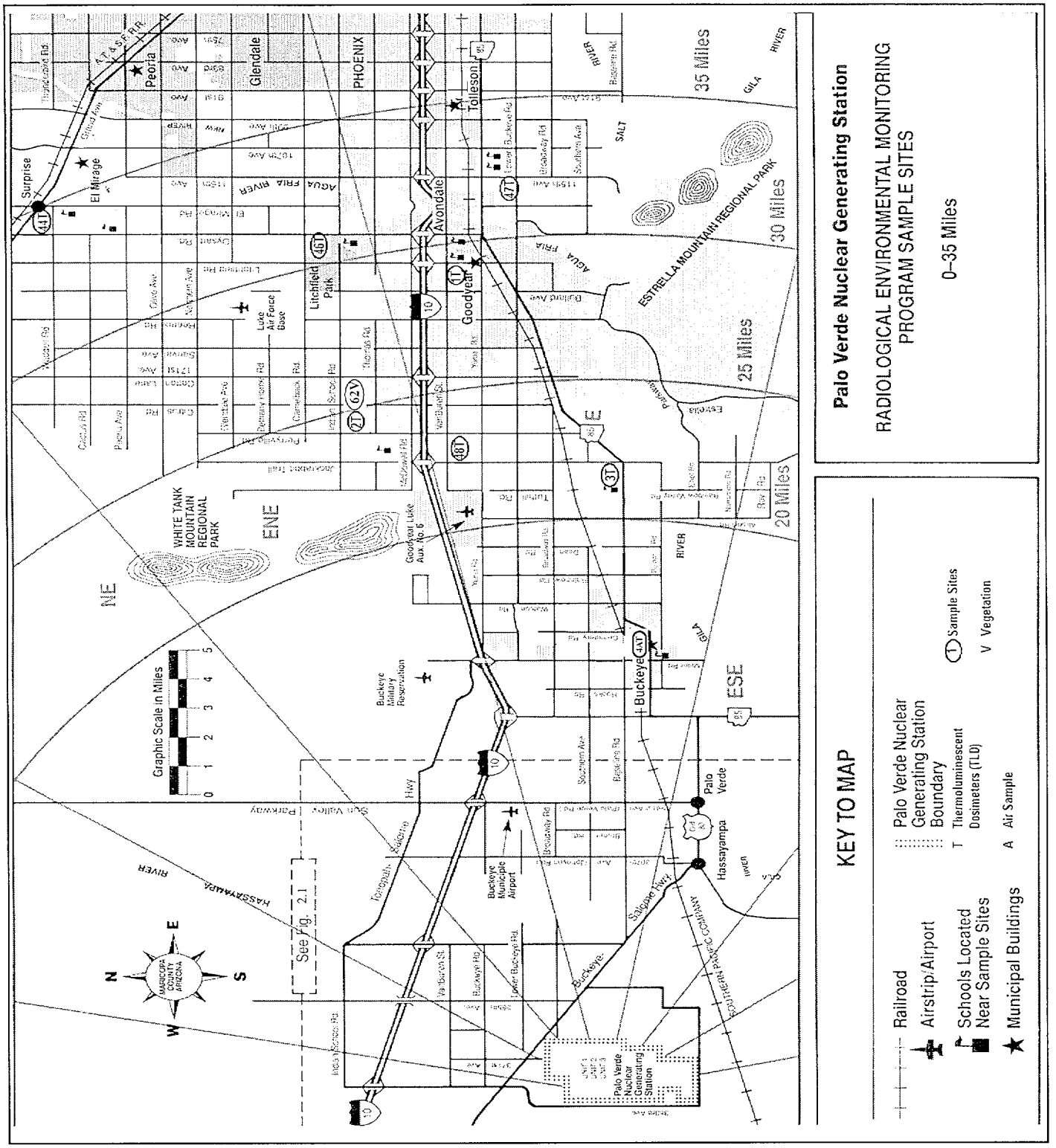


FIGURE 2.2
REMP SAMPLE SITES
(0-35 MILES)



3. Sample Collection Program

All samples were collected by APS personnel using PVNGS procedures.

3.1. Water

Weekly samples were collected from the Reservoir, Evaporation Pond #1, Evaporation Pond #2, and four (4) residence wells. Samples were collected in one-gallon cubitainers and 500 ml glass bottles. One liter of each weekly one-gallon sample was added to a monthly composite, which is preserved with nitric acid (HNO_3). The composite samples were then analyzed for gamma-emitters. Residence wells were also analyzed for gross beta activity. Weekly grab samples in glass bottles were composited quarterly and analyzed for tritium.

Quarterly grab samples were collected from onsite wells 34abb and 27ddc. Samples were collected in one-gallon cubitainers and 500 ml glass bottles. Samples were analyzed for gamma-emitters and tritium.

Treated sewage effluent from the City of Phoenix was sampled as a weekly composite at the onsite Water Reclamation Facility (WRF), and analyzed for gamma-emitters. A monthly composite was analyzed for tritium.

3.2. Vegetation

Vegetation samples were collected by APS using PVNGS procedures.

Vegetation samples were scheduled to be collected monthly, as available, and were analyzed for gamma-emitters.

3.3. Milk

Milk sampling was performed from 1979-1995 and discontinued in 1995. This was justified since there were no sample locations identified within 5 miles of PVNGS. The control location sample is also not taken since there would be no valid 'indicator' locations with which to compare results. If milk animals are located within 5 miles during the annual land use census, an evaluation is initiated to consider re-establishing a milk sample program. Refer to Section 10 for specific information regarding milk animals located during the performance of the 2001 Land Use Census.

3.4. Air

Air samples were collected by APS using PVNGS procedures.

Air particulate filters and charcoal cartridges were collected at ten (10) sites on a weekly basis. Particulate filters were analyzed for gross beta. Charcoal cartridges were analyzed for I-131. Particulate filters were composited quarterly, by location, and analyzed for gamma-emitters.

3.5. Sludge and Sediment

Sludge and sediment samples were collected by APS using PVNGS procedures.

Sludge samples were obtained weekly from the WRF waste centrifuge (whenever the plant was operational) and analyzed for gamma-emitters. Samples were collected using 1000 ml plastic bottles.

Cooling tower sludge from Unit 3 was disposed of in the WRF Landfill in 2001. Samples were analyzed for gamma-emitters.

Bottom sediment/sludge samples were obtained from Evaporation Pond #1 and #2 and analyzed for gamma-emitters. Samples were collected from a boat at various locations using a bucket to preserve the integrity of the pond liners.

4. Analytical Procedures

The procedures described in this report are those used by APS to routinely analyze samples.

4.1. Air Particulate

4.1.1. Gross Beta

A glass fiber filter sample is placed in a stainless steel planchet and counted for gross beta activity utilizing a low-background gas flow, proportional counter.

4.1.2. Gamma Spectroscopy

The glass fiber filters are placed in a standard geometry container and counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by computer and specific radionuclides, if present, are identified and quantified.

4.2. Airborne Radioiodine

The charcoal cartridge is counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by computer and I-131, if present, is identified and quantified.

4.3. Vegetation

4.3.1. Gamma Spectroscopy

The sample is pureed in a food processor, placed in a one liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by computer and specific radionuclides, if present, are identified and quantified.

4.4. Sludge/Sediment

4.4.1. Gamma Spectroscopy

The wet/dry sample is placed in a one-liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by computer and specific radionuclides, if present, are identified and quantified.

4.5. Water

4.5.1. Gamma Spectroscopy

The sample is placed in a one-liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by computer and specific radionuclides if present, are identified and quantified.

4.5.2. Tritium

The sample is evaluated to determine the appropriate method of preparation prior to counting. If the sample contains suspended solids or is turbid, it may be filtered, distilled, and/or de-ionized, as appropriate. Eight (8) milliliters of sample are mixed with fifteen (15) milliliters of liquid scintillation cocktail. The mixture is dark adapted and counted for tritium activity using a liquid scintillation counting system.

4.5.3. Gross Beta

A 200-250 milliliter sample is placed in a beaker. Five (5) milliliters of concentrated nitric (HNO_3) acid is added and the sample is evaporated down to about twenty (20) milliliters. The remaining sample is quantitatively transferred to a stainless steel planchet. The sample is heated to dryness and counted for gross beta in a gas flow, proportional counter.

4.6. Soil

4.6.1. Gamma Spectroscopy

The samples are sieved, placed in a one-liter plastic marinelli beaker, and weighed. The samples are then counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by computer and specific radionuclides if present, are identified and quantified.

5. Nuclear Instrumentation

5.1. Canberra Gamma Spectrometer

The Gamma Spectrometer consists of a Canberra System equipped with two intrinsic detectors having resolutions of 1.73 keV and 1.88 keV (as determined by full width half max with an energy of 0.5 keV per channel) and respective efficiencies of 21.5% and 38.4% (as determined by the manufacturer with Co-60). The Canberra System is used for all gamma counting. The system uses Canberra developed software (automatic radionuclide analysis) to search and identify, as well as quantify, the peaks of interest.

5.2. Beckman Liquid Scintillation Spectrometer

A Beckman LS-6500 Liquid Scintillation Counter is used for tritium determinations. The system background averages approximately 15-17 cpm with a counting efficiency of about 40% using a quenched standard.

5.3. Tennelec LB5100 Low Background Counting System

The LB5100 is a low background, gas flow proportional counter. The system contains an automatic sample changer capable of counting 50 samples in succession. Average beta background count rate is about 1-2 cpm with a beta efficiency of about 30% (Cs-137).

6. Isotopic Detection Limits and Reporting Criteria

6.1. Lower Limits of Detection

The lower limits of detection (LLD) and the method for calculation are specified in the PVNGS ODCM, Reference 4. The ODCM required *a priori* LLDs are presented in Table 6.1. For reference, *a priori* LLDs are indicated at the top of data tables for samples having required LLD values.

6.2. Data Reporting Criteria

All results that are greater than the Minimum Detectable Activity (MDA) (a posteriori LLD) are reported as positive activity with its associated 2σ counting error. All results that are less than the MDA are reported as less than values at the associated MDA. For example, if the MDA is 12 pCi/liter, the value is reported as <12.

Typical MDA values are presented in Table 6.3.

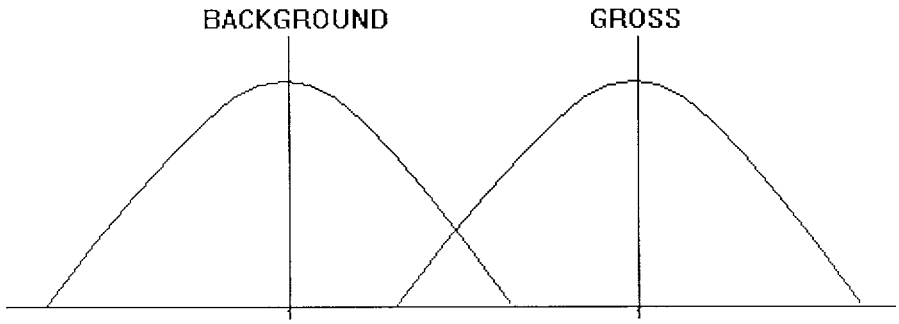
Occasionally the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- Background fluctuations
- Unavoidably small sample sizes
- The presence of interfering radionuclides
- Self absorption corrections
- Decay corrections for short half-life radionuclides
- Other uncontrollable circumstances

In these instances, the contributing factors will be noted in the table where the data are presented. A summary of discrepancies/events is presented in Table 2.3 and includes a description of any sample results that did not meet *a priori* LLD requirements.

6.3. LLD and Reporting Criteria Overview

Making a reasonable estimate of the limits of detection for a counting procedure or a radiochemical method is usually complicated by the presence of significant background. It must be considered that the background or blank is not a fixed value but that a series of replicates would be normally distributed. The desired net activity is thus the difference between the gross and background activity distributions. The interpretation of this difference becomes a problem if the two distributions intersect as indicated in the diagram.



If a sufficient number of replicate analyses are run, it is to be expected that the results would fall in a normal Gaussian Distribution. Standard statistics allow an estimate of the probability of any particular deviation from the mean value. It is common practice to report the mean ± one or two standard deviations as the result. In routine analysis, such replication is not carried out, and it is not possible to report a Gaussian standard deviation. With counting procedures, however, it is possible to estimate a Poisson standard deviation directly from the count. Data is commonly reported as the measured value ± one or two Poisson standard deviations. The reported values are then considered to give some indication of the range in which the true value might be expected to occur.

The simplest possible case to consider would be one where the background is negligible and the sample activity is zero. It is sometimes not realized that if a series of counts is taken on such a system, half of the net values should be less than zero. Negative counts are not possible, of course. However, when there is an appreciable background, the entire scale is raised. The resulting situation: half of the sample counts on a zero activity sample would be less than background. The negative net counts occur frequently in low-level measurements, causing considerable concern. Actually, such results are to be expected.

A LLD is the smallest amount of sample activity that will yield a net count for which there is confidence at a predetermined level that activity is present. LLDs are calculated values for individual radionuclides based on a number of different factors including sample size, counting efficiency and background count rate of the instrument, the background and sample counting time, the decay time, and the chemical recovery of the analytical procedures. A minimum detectable activity value (MDA) is the smallest amount of activity that can be detected in an actual sample and uses the values obtained from the instrument and outcome of the analytical process. Therefore, the MDA values may differ from the calculated LLD values if the sample size and chemical recovery, decay values, or the instrument efficiency, background, or count time differed from those used in the LLD calculation.

The factors governing the calculation of the LLD and MDA values are discussed below:

1. Sample Size

2. Counting Efficiency

The fundamental quantity 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 that may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

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 amounts of these types of radiation and the sensitivity of the counter to the radiation.

4. Background and Sample Counting Time

The amount of time devoted to the counting of the 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.

5. Time Interval between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived isotopes. The disintegration constant is one of the basic characteristics of a specific radionuclide and is readily determined, if the half-life is sufficiently short. In order to ensure the required LLDs are achieved, appropriate values are used in decay correction to allow for transit time and sample processing.

Table 6.1 ODCM REQUIRED LOWER LIMITS OF DETECTION (*a priori*)

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	MILK (pCi/liter)	VEGETATION (pCi/kg, wet)
gross beta	4	0.01		
tritium	2000*			
Mn-54	15			
Fe-59	30			
Co-58, 60	15			
Zn-65	30			
Zr-95	30			
Nb-95	15			
I-131	1**	0.07	1	60
Cs-134	15	0.05	15	60
Cs-137	18	0.06	18	80
Ba-140	60		60	
La-140	15		15	

NOTES:

* If no drinking water pathway exists, a value of 3000 pCi/liter may be used.
** If no drinking water pathway exists, a value of 15 pCi/liter may be used.

This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

Milk sampling was not required as noted in the land use census (see section 10).

Table 6.2 ODCM REQUIRED REPORTING LEVELS

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	MILK (pCi/liter)	VEGETATION (pCi/kg, wet)
tritium	20,000*			
Mn-54	1,000			
Fe-59	400			
Co-58	1,000			
Co-60	300			
Zn-65	300			
Zr/Nb-95	400			
I-131	2**	0.9	3	100
Cs-134	30	10	60	1,000
Cs-137	50	20	70	2,000
Ba/La-140	200		300	

NOTES:

* For drinking water samples. This is a 40CFR141 value. If no drinking water pathway exists, a value of 30,000 pCi/liter may be used.

** If no drinking water pathway exists, a reporting level of 20 pCi/liter may be used.

Milk sampling was not required as noted in the land use census (see section 10).

The values in this table are (calendar) quarterly average values, as stated in the ODCM.

Table 6.3 TYPICAL MDA VALUES

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	VEGETATION (pCi/kg, wet)
gross beta	3	0.007	
tritium	300		
Mn-54	9		
Fe-59	20		
Co-58	9		
Co-60	11		
Zn-65	22		
Zr-95	17		
Nb-95	10		
I-131	10 [a]	0.028 [b]	20
Cs-134	11	0.02 [b]	30
Cs-137	10	0.02 [b]	22
Ba-140	30		
La-140	10		

NOTES:

a - low level I-131 is not required since there is no drinking water pathway
b - based on 433 m^3 volume

Milk sampling was not required as noted in the land use census (see section 10).

7. Interlaboratory Comparison Program

7.1. Quality Control Program

APS maintains an extensive QA/QC Program that provides certainty that samples are collected, handled, tracked, and analyzed to specified requirements. This program includes appropriate elements of USNRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Rev. 1. Included in the program are procedures for sample collection, preparation and tracking, sample analysis, equipment calibration and checks, and ongoing participation in an interlaboratory comparison program. Duplicate/replicate samples are analyzed routinely to verify analytical precision and sample methodology. Comprehensive data reviews are performed including trending of data where appropriate.

During 2001, APS analyzed the following sample types under the interlaboratory comparison program;

- Beta/Gamma/ in Air Filter
- I-131 in Air
- Beta in Water
- Gamma in Water
- Tritium in Water

7.2. Intercomparison Results

APS participates in a crosscheck program using vendor supplied blind radionuclide samples. Results for the interlaboratory comparison program are presented in Table 7.1.

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

2nd Quarter

Sample Type	Analysis Type	Units	Nuclide	Known Value	PVNGS Value	1 sigma Error	Resolution *	Ratio	ACCEPT/REJECT
Water	Mixed Gamma	pCi/liter	Ce-141	234	229	14.0	16	0.98	ACCEPT
			Cr-51	322	352	45.5	8	1.09	ACCEPT
			Cs-134	193	166	11.0	15	0.86	ACCEPT
			Cs-137	174	181	11.5	16	1.04	ACCEPT
			Co-58	139	141	9.5	15	1.01	ACCEPT
			Mn-54	216	228	13.5	17	1.05	ACCEPT
			Fe-59	126	130	16.5	8	1.03	ACCEPT
			Zn-65	261	278	21.5	13	1.07	ACCEPT
			Co-60	194	217	13.0	17	1.12	ACCEPT
			I-131	74	83	14.0	6	1.12	ACCEPT
	Tritium	pCi/liter	H-3	7494	6085	121.5	50	0.81	ACCEPT
	Gross Beta	pCi/liter		123	151	3.5	43	1.23	ACCEPT
Air	Iodine	pCi/cartridge	I-131	81	84	14.5	6	1.04	ACCEPT
	Gross Beta	pCi/filter		85	102	1.5	68	1.20	ACCEPT
	Mixed Gamma	pCi/filter	Cr-51	176	204	43.5	5	1.16	ACCEPT
			Mn-54	118	137	7.0	20	1.16	ACCEPT
			Fe-59	69	110	11.5	10	1.59	ACCEPT
			Co-58	76	81	5.5	15	1.07	ACCEPT
			Co-60	106	116	7.0	17	1.09	ACCEPT
			Zn-65	142	173	11.0	16	1.22	ACCEPT
			Cs-134	105	96	6.0	16	0.91	ACCEPT
			Cs-137	95	109	6.5	17	1.15	ACCEPT
			Ce-141	128	143	9.5	15	1.12	ACCEPT

* calculated from PVNGS value/1 sigma error value

NRC Acceptance Criteria (a)

Resolution	Ratio
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

(a) From NRC Inspection Manual, procedure #84750, "Radioactive Waste Systems; Water Chemistry; Confirmatory Measurements

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

3rd Quarter

Sample Type	Analysis Type	Units	Nuclide	Known Value	PVNGS Value	1 sigma Error	Resolution *	Ratio	ACCEPT/REJECT
Water	Mixed Gamma	pCi/liter	Ce-141	88	99	6	17	1.13	ACCEPT
			Cr-51	265	262	26	10	0.99	ACCEPT
			Cs-134	116	107	6	18	0.92	ACCEPT
			Cs-137	232	234	12	20	1.01	ACCEPT
			Co-58	128	133	7	19	1.04	ACCEPT
			Mn-54	149	157	8	20	1.05	ACCEPT
			Fe-59	62	81	8	10	1.31	ACCEPT
			Zn-65	184	210	12	18	1.14	ACCEPT
			Co-60	193	201	10	20	1.04	ACCEPT
			I-131	60	69	9	8	1.15	ACCEPT
	Tritium	pCi/liter	H-3	4582	3961	220	18	0.86	ACCEPT
	Gross Beta	pCi/liter		232	275	6	46	1.19	ACCEPT
Air	Iodine	pCi/cartridge	I-131	66	83	5	17	1.26	ACCEPT
	Gross Beta	PCi/filter		89	102	1	102	1.15	ACCEPT
	Mixed Gamma	pCi/filter	Cr-51	174	167	21	8	0.96	ACCEPT
			Mn-54	97	109	5	22	1.12	ACCEPT
			Fe-59	41	53	6	9	1.29	ACCEPT
			Co-58	84	88	5	18	1.05	ACCEPT
			Co-60	126	129	7	18	1.02	ACCEPT
			Zn-65	121	134	9	15	1.11	ACCEPT
			Cs-134	76	69	4	17	0.91	ACCEPT
			Cs-137	152	155	8	19	1.02	ACCEPT
			Ce-141	57	62	4	16	1.09	ACCEPT

* calculated from PVNGS value/1 sigma error value

NRC Acceptance Criteria (a)

Resolution	Ratio
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

(a) From NRC Inspection Manual, procedure #84750, "Radioactive Waste Systems; Water Chemistry; Confirmatory Measurements

8. Data Interpretations and Conclusions

Associated with the analytical process are potential random and systematic errors. Systematic errors can be caused by instrument malfunctions, incomplete precipitation, and back scattering and self-absorption. Random errors are beyond the control of the analyst and are caused by the random nature of radioactive decay.

Efforts are made to eliminate both systematic and random errors in the data reported. Systematic errors are eliminated by performing reviews throughout the analysis. For example, instruments are checked routinely with radioactive sources and recovery and self-absorption factors based on individual sample analyses are incorporated into the calculation equations where necessary. Random errors are reduced by comparing all data to historical data for the same site and performing cross comparisons between analytical results when available. In addition, when data do not appear to match historical results, analyses may be rerun on a separate aliquot of the sample to verify the presence of the activity. The acceptance of data is dependent upon the results of quality control samples and is part of the data review process for all analytical results.

The "plus or minus value" reported with each analytical result represents the counting error associated with the result and gives the 95% confidence (2σ) interval around the data.

Most samples contain radioactivity associated with natural background/cosmic radioactivity (e.g. K-40, Th-234, and Be-7). Gross beta results for drinking water and air are due to natural background. **Gamma-emitting nuclides, which can be attributed to natural background sources, are not indicated in this report**.

Results and interpretation of the data for all of the samples analyzed during 2001 are presented in the following sections. Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. There were no radiological impacts on the environment due to PVNGS operations in 2001.

8.1. Air Particulates

Weekly gross beta results, in quarterly format, are presented in Tables 8.1 and 8.2. Historical trend graphs are depicted in Figures 8.1 and 8.2. Gross beta activity ranged from 0.014 to 0.084 pCi/m^3. The associated counting error ranged from 0.001 to 0.003 pCi/m^3. Mean quarterly activity is calculated using weekly activity over a thirteen (13) week period, except for those samples marked invalid. Also presented in the tables are the weekly mean values of all the sites as well as the percent relative standard deviation (RSD %) of the data. The findings are consistent with pre-operational baseline and previous operational results. Figure 8.2 shows the results of the gross beta in air from the pre-operational phase compared to the 1991-2001 gross beta in air results. As can be seen, the indicator sites trend consistently with the control site. The results are summarized in Table 11.1.

Table 8.3 displays the results of gamma spectroscopy on the quarterly composites. No Cs-134 or Cs-137 was observed.

8.2. Airborne Radioiodine

Tables 8.4 and 8.5 present the quarterly radioiodine results. No airborne radioiodine was observed in any of the samples.

8.3. Vegetation

Table 8.6 presents gamma isotopic data for the vegetation samples. No gamma-emitting nuclides were observed in any of the samples.

8.4. Drinking Water

Samples were analyzed for gross beta, tritium, and gamma-emitting nuclides. Results of these analyses are presented in Table 8.7. No tritium or gamma-emitting nuclides were detected in any samples. Gross beta activity ranged from less than detectable, to a high of 11.3 pCi/liter (Chowanec residence, February composite).

8.5. Groundwater

Groundwater samples were analyzed for tritium and gamma-emitting nuclides. Results obtained from the analysis of the samples are presented in Table 8.8.

No tritium or gamma-emitting nuclides were observed in any of the samples.

8.6. Surface Water

Surface water samples from the Reservoir and Evaporation Ponds were analyzed for tritium and gamma-emitting nuclides. The Reservoir contains processed sewage water from the City of Phoenix and is approximately 80 acres in size. The two Evaporation Ponds receive mostly circulating water from main turbine condenser cooling and are about 250 acres each. Results are presented in Table 8.9. I-131 was observed in Evaporation Pond # 1 in three (3) of the monthly composite samples (8-17 pCi/liter) and four (4) of the Reservoir monthly composite samples (10-20 pCi/liter). The I-131 is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent. Low levels of Cs-137 (11-19 pCi/liter) were observed in Evaporation Pond #2 in four (4) of the monthly composite samples. These concentrations were consistent with previous results.

Tritium was routinely observed in Evaporation Ponds 1 and 2. The highest concentration in Evaporation Pond #1 was 1563 pCi/liter and the highest concentration in Evaporation Pond #2 was 2414 pCi/liter. Tritium was not identified in the Reservoir. The tritium identified in the Evaporation Ponds has been attributed to plant gaseous effluent releases.

WRF influent (Phoenix sewage effluent) samples collected by the WRF were analyzed for gamma-emitting nuclides and tritium. The results, presented in Table 8.9, demonstrate that I-131 was observed routinely. The highest I-131 concentration was 87 pCi/liter (week of December 24th). The results are consistent with assays from the previous years. None of the samples analyzed indicated the presence of tritium.

Table 8.9 also presents gamma spectroscopy and tritium measurements of samples collected from Sedimentation Basin #2. This basin collects rain waters from site runoff and was dry for most of the year. I-131 was detected at a concentration of 104 pCi/liter in one sample and was due to Cooling Tower overflow. Tritium was detected in five (5) samples ranging from 378 to 7064 pCi/liter. The tritium in this basin has been attributed to plant gaseous effluent releases. Refer to Table 2.3 for additional information.

8.7. Sludge and Sediment

8.7.1. WRF Centrifuge waste sludge

Sludge samples were obtained from the WRF centrifuge and analyzed by gamma spectroscopy. The I-131 in the WRF waste centrifuge sludge is consistent with historical values and, as previously discussed, is due to radiopharmaceuticals in the WRF influent. I-131 was present in all fifty-two samples ranging from 319 to 3154 pCi/kg.

In-111 was also identified in the sludge in twenty-six (26) samples. The highest concentration was 75 pCi/kg. It was previously established that In-111 is in use in the Phoenix area as a radiopharmaceutical. Results for WRF centrifuge waste sludge can be found in Table 8.10.

8.7.2. Evaporation Ponds #1 and #2 sediment

A set of ten (10) Evaporation Pond samples, five (5) from each pond, indicated no gamma-emitters. Sample results can be found in Table 8.10.

8.7.3. Cooling Tower sludge

Sludge originating from Unit 3 was disposed of in the WRF landfill during 2001. The following table presents a summary of the gamma spectroscopy results from the sludge samples.

DATE	UNIT	APPROXIMATE VOLUME (yd^3)	ISOTOPE	ACTIVITY RANGE (pCi/kg) and fraction of samples above the MDA	
9-18-01	3	247	Mn-54	<MDA-27	(1 of 30 samples)
			Co-60	<MDA-357	(25 of 30 samples)
			Cs-134	<MDA-63	(2 of 30 samples)
			Cs-137	<MDA-206	(19 of 30 samples)

8.8. Data Trends

Figures 8.1-8.5 present data in graphical format. Where practical, historical data are displayed for comparison.

TABLE 8.1 PARTICULATE GROSS BETA IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
1	26-Dec-00	2-Jan-01	0.070	0.069	0.073	0.060	0.062	0.061	0.054	0.062	0.060	0.061	0.063	9.0
2	2-Jan-01	8-Jan-01	0.080	invalid (a)	0.074	0.074	0.084	0.071	0.065	0.068	0.075	0.072	0.074	7.8
3	8-Jan-01	16-Jan-01	0.025	0.021	0.029	0.026	0.026	0.025	0.025	0.029	0.030	0.029	0.027	10.4
4	16-Jan-01	22-Jan-01	0.052	0.052	0.054	0.042	0.056	0.048	0.051	0.054	0.050	0.045	0.050	8.6
5	22-Jan-01	29-Jan-01	0.035	0.036	0.039	0.031	0.039	0.034	0.034	0.039	0.037	0.032	0.036	8.2
6	29-Jan-01	5-Feb-01	0.027	0.029	0.030	0.025	0.030	0.031	0.029	0.026	0.029	0.023	0.028	9.2
7	5-Feb-01	12-Feb-01	0.037	0.033	0.034	0.034	0.033	0.032	0.032	0.031	0.031	0.032	0.033	5.4
8	12-Feb-01	19-Feb-01	0.023	0.023	0.021	0.020	0.028	0.023	0.025	0.019	0.027	0.021	0.023	12.8
9	19-Feb-01	26-Feb-01	0.024	0.018	0.023	0.019	0.019	0.022	0.021	0.021	0.018	0.020	0.021	10.1
10	26-Feb-01	5-Mar-01	0.027	0.023	0.025	0.018	0.025	0.027	0.024	0.023	0.023	0.022	0.024	11.1
11	5-Mar-01	12-Mar-01	0.014	0.018	0.020	0.020	0.022	0.018	0.018	0.019	0.019	0.018	0.019	11.1
12	12-Mar-01	19-Mar-01	0.029	0.030	0.029	0.030	0.031	0.024	0.029	0.029	invalid (a)	0.027	0.029	7.2
13	19-Mar-01	26-Mar-01	0.029	0.029	0.031	0.032	0.031	0.029	0.029	0.031	0.030	0.030	0.030	3.7
	Mean		0.036	0.032	0.037	0.033	0.037	0.034	0.034	0.035	0.036	0.033	0.035	5.4

2nd Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
14	26-Mar-01	2-Apr-01	0.027	0.030	0.028	0.027	0.027	0.030	0.028	0.025	0.028	0.029	0.028	5.5
15	2-Apr-01	9-Apr-01	0.020	0.021	0.020	0.021	0.024	0.023	0.020	0.021	0.022	0.021	0.021	6.3
16	9-Apr-01	16-Apr-01	0.020	0.027	0.025	0.024	0.026	0.024	0.023	0.028	0.027	0.024	0.025	9.5
17	16-Apr-01	23-Apr-01	0.025	0.020	0.027	0.025	0.026	0.022	0.026	0.024	0.028	0.026	0.025	9.6
18	23-Apr-01	30-Apr-01	0.029	0.029	0.032	0.031	0.034	0.032	0.031	0.032	0.032	0.030	0.031	5.0
19	30-Apr-01	7-May-01	0.020	0.027	0.029	0.029	0.030	0.028	0.028	0.033	0.032	0.031	0.029	12.5
20	7-May-01	14-May-01	0.040	0.044	0.044	0.039	0.042	0.041	0.041	0.041	0.043	0.039	0.041	4.4
21	14-May-01	21-May-01	0.027	0.027	0.027	0.023	0.029	0.026	0.026	0.026	0.031	0.026	0.027	7.8
22	21-May-01	29-May-01	0.035	0.037	0.036	0.025	0.038	0.036	0.032	0.035	0.038	0.030	0.034	12.0
23	29-May-01	5-Jun-01	0.030	0.033	0.034	0.035	0.036	0.033	0.027	0.031	0.041	0.031	0.033	11.5
24	5-Jun-01	11-Jun-01	0.032	0.032	0.033	0.028	0.034	0.033	0.031	0.033	0.039	0.032	0.033	8.4
25	11-Jun-01	18-Jun-01	0.029	0.029	0.028	0.025	0.028	0.029	0.027	0.027	0.026	0.027	0.028	4.9
26	18-Jun-01	25-Jun-01	0.033	0.036	0.035	0.034	0.038	0.037	0.032	0.036	0.036	0.033	0.035	5.6
	Mean		0.028	0.030	0.031	0.028	0.032	0.030	0.029	0.030	0.033	0.029	0.030	4.8

(a) Sample results invalidated as it was not possible to determine actual sample pump run times.

TABLE 8.2 PARTICULATE GROSS BETA IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *
units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
27	25-Jun-01	2-Jul-01	0.032	0.037	0.034	0.035	0.034	0.034	0.031	0.035	0.036	0.033	0.034	5.3
28	2-Jul-01	9-Jul-01	0.029	0.030	0.026	0.028	0.032	0.033	0.030	0.032	0.033	0.028	0.030	7.9
29	9-Jul-01	16-Jul-01	0.029	0.030	0.030	0.029	0.028	0.029	0.025	0.032	0.030	0.031	0.029	6.4
30	16-Jul-01	23-Jul-01	0.028	0.027	0.028	0.027	0.028	0.028	0.029 (a)	0.027	0.028	0.027	0.028	2.4
31	23-Jul-01	30-Jul-01	0.023	0.025	0.022	0.021	0.023	0.021	0.026	0.022	0.022	0.024	0.023	7.3
32	30-Jul-01	6-Aug-01	0.025	0.025	0.023	0.021	0.025	0.020	0.025	0.026	0.027	0.026	0.024	9.3
33	6-Aug-01	13-Aug-01	0.030 (b)	0.029 (b)	0.031 (b)	0.032	0.029	0.028	0.028	0.034	0.033	0.034	0.031	7.6
34	13-Aug-01	20-Aug-01	0.033	0.036	0.030	0.032	0.030	0.031	0.030	0.031	0.035	0.032	0.032	6.6
35	20-Aug-01	27-Aug-01	0.029	0.037	0.035	0.033	0.032	0.030	0.029	0.031	0.035	0.030	0.032	8.7
36	27-Aug-01	4-Sep-01	0.026	0.026	0.023	0.028	0.027	0.025	0.025	0.025	0.027	0.026	0.026	5.4
37	4-Sep-01	10-Sep-01	0.030	invalid (c)	0.028	0.035	0.036	0.032	0.032	0.031	0.035	0.036	0.033	8.7
38	10-Sep-01	17-Sep-01	0.024	0.026	0.024	0.025	0.027	0.024	0.028	0.028	0.026	0.028	0.026	6.5
39	17-Sep-01	24-Sep-01	0.033	0.031	0.030	0.030	0.030	0.031	0.030	0.032	0.030	0.032	0.031	3.6
	Mean		0.028	0.030	0.028	0.029	0.029	0.028	0.028	0.030	0.031	0.030	0.029	3.2

4th Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
40	24-Sep-01	1-Oct-01	0.046	0.049	0.048	0.041	0.047	0.049	0.039	0.051	0.047	0.043	0.046	8.3
41	1-Oct-01	8-Oct-01	0.037	0.039	0.034	0.037	0.035	0.039	0.038	0.037	0.039	0.038	0.037	4.6
42	8-Oct-01	15-Oct-01	0.038	0.040	0.039	0.037	0.035	0.036	invalid (d)	0.035	0.034	0.035	0.037	5.7
43	15-Oct-01	23-Oct-01	0.044	0.058	0.055	0.055	0.052	0.054	0.062	0.057	0.059	0.054	0.055	8.8
44	23-Oct-01	29-Oct-01	0.044	0.049	0.047	0.045	0.044	0.045	0.033	0.036	0.051	0.045	0.044	12.5
45	29-Oct-01	6-Nov-01	0.039	0.036	0.038	0.036	0.035	0.035	0.035	0.035 (f)	0.039 (f)	0.037 (f)	0.035 (f)	4.5
46	6-Nov-01	13-Nov-01	0.048	0.048	0.051	0.045	0.049	0.050	0.045	0.051	0.050	0.043	0.048	5.8
47	13-Nov-01	19-Nov-01	0.041	0.036	0.039	0.033	0.038	0.034	0.038	0.037	0.041	0.033	0.037	8.1
48	19-Nov-01	26-Nov-01	0.044	0.041	0.044	0.039	0.043	invalid (e)	0.042	0.042	0.043	0.039	0.042	4.5
49	26-Nov-01	3-Dec-01	0.035	0.039	0.041	0.032	0.035	0.039	0.032	0.030	0.037	0.035	0.036	10.0
50	3-Dec-01	11-Dec-01	0.024	0.023	0.026	0.022	0.023	0.023	0.028	0.023	0.025	0.020	0.024	9.3
51	11-Dec-01	18-Dec-01	0.034	0.033	0.033	0.030	0.031	0.028	0.033	0.033	0.027	0.029	0.031	7.9
52	18-Dec-01	26-Dec-01	0.037	0.036	0.040	0.032	0.031	0.031	0.037	0.031	0.032	0.033	0.034	9.5
	Mean		0.039	0.041	0.041	0.037	0.038	0.039	0.039	0.039	0.040	0.037	0.039	3.5
	Annual Average		***0.033***	***0.033***	***0.034***	***0.032***	***0.034***	***0.033***	***0.032***	***0.033***	***0.035***	***0.032***	***0.033***	***2.9***

(a) Site #21 samples were collected on 7-24-01.
(b) Site #4, 6A, and 7A samples were collected on 8-14-01.
(c) Sample results invalidated due to ETM malfunction.
(d) No power at sample location upon arrival.
(e) Sample head was broken off some time during sample period.
(f) Site #21, 29, 35 and 40 samples were collected on 11-5-01.

TABLE 8.3 GAMMA IN AIR FILTER COMPOSITES

ODCM required samples denoted by *
units are pCi/m^3

QUARTER ENDPOINT	NUCLIDE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
26-Mar-01	Cs-134	<0.0021	<0.0033	<0.0018	<0.0027	<0.0019	<0.0026	<0.0019	<0.0020	<0.0021	<0.0014
	Cs-137	<0.0013	<0.0021	<0.0017	<0.0026	<0.0021	<0.0025	<0.0018	<0.0030	<0.0020	<0.0014
25-Jun-01	Cs-134	<0.0016	<0.0014	<0.0018	<0.0014	<0.0016	<0.0014	<0.0018	<0.0014	<0.0018	<0.0012
	Cs-137	<0.0017	<0.0011	<0.0020	<0.0012	<0.0015	<0.0013	<0.0016	<0.0012	<0.0017	<0.0013
24-Sep-01	Cs-134	<0.0021	<0.0037	<0.0013	<0.0020	<0.0016	<0.0024	<0.0026	<0.0019	<0.0032	<0.0025
	Cs-137	<0.0018	<0.0017	<0.0015	<0.0017	<0.0030	<0.0017	<0.0017	<0.0018	<0.0024	<0.0019
26-Dec-01	Cs-134	<0.0013	<0.0018	<0.0032	<0.0021	<0.0018	<0.0023	<0.0027	<0.0023	<0.0023	<0.0029
	Cs-137	<0.0012	<0.0011	<0.0022	<0.0014	<0.0028	<0.0016	<0.0041	<0.0019	<0.0021	<0.0026

Quarterly sample results include all samples except those determined to be invalid.

TABLE 8.4 RADIOIODINE IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *
units are pCi/m^3

1st Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
					required LLD <0.070							
1	26-Dec-00	2-Jan-01	<0.033	<0.023	<0.021	<0.028	<0.029	<0.039	<0.029	<0.029	<0.030	<0.031
2	2-Jan-01	8-Jan-01	<0.024	invalid (a)	<0.030	<0.026	<0.029	<0.038	<.0029	<0.032	<0.038	<0.039
3	8-Jan-01	16-Jan-01	<0.025	<0.027	<0.026	<0.015	<0.022	<0.021	<0.020	<0.025	<0.025	<0.025
4	16-Jan-01	22-Jan-01	<0.029	<0.043	<0.025	<0.035	<0.022	<0.029	<0.043	<0.035	<0.037	<0.034
5	22-Jan-01	29-Jan-01	<0.028	<0.026	<0.028	<0.030	<0.032	<0.027	<0.032	<0.034	<0.032	<0.032
6	29-Jan-01	5-Feb-01	<0.023	<0.029	<0.028	<0.037	<0.028	<0.025	<0.033	<0.030	<0.025	<0.024
7	5-Feb-01	12-Feb-01	<0.025	<0.029	<0.025	<0.032	<0.028	<0.023	<0.027	<0.032	<0.031	<0.034
8	12-Feb-01	19-Feb-01	<0.023	<0.028	<0.026	<0.021	<0.028	<0.029	<0.026	<0.030	<0.024	<0.021
9	19-Feb-01	26-Feb-01	<0.029	<0.029	<0.025	<0.029	<0.031	<0.026	<0.032	<0.032	<0.031	<0.028
10	26-Feb-01	5-Mar-01	<0.019	<0.040	<0.031	<0.024	<0.031	<0.026	<0.025	<0.022	<0.025	<0.027
11	5-Mar-01	12-Mar-01	<0.025	<0.025	<0.027	<0.021	<0.026	<0.017	<0.022	<0.025	<0.028	<0.023
12	12-Mar-01	19-Mar-01	<0.025	<0.027	<0.020	<0.025	<0.021	<0.026	<0.020	<0.032	invalid (a)	<0.023
13	19-Mar-01	26-Mar-01	<0.025	<0.023	<0.027	<0.024	<0.024	<0.030	<0.030	<0.021	<0.033	<0.026

2nd Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
					required LLD <0.070							
14	26-Mar-01	2-Apr-01	<0.023	<0.034	<0.021	<0.026	<0.024	<0.032	<0.025	<0.028	<0.027	<0.029
15	2-Apr-01	9-Apr-01	<0.024	<0.024	<0.022	<0.032	<0.028	<0.031	<0.023	<0.023	<0.024	<0.028
16	9-Apr-01	16-Apr-01	<0.024	<0.028	<0.022	<0.025	<0.028	<0.026	<0.023	<0.024	<0.024	<0.023
17	16-Apr-01	23-Apr-01	<0.028	<0.023	<0.025	<0.025	<0.022	<0.027	<0.021	<0.025	<0.024	<0.025
18	23-Apr-01	30-Apr-01	<0.024	<0.026	<0.032	<0.031	<0.027	<0.029	<0.023	<0.033	<0.031	<0.031
19	30-Apr-01	7-May-01	<0.023	<0.029	<0.029	<0.027	<0.019	<0.029	<0.020	<0.025	<0.023	<0.023
20	7-May-01	14-May-01	<0.029	<0.026	<0.022	<0.024	<0.030	<0.028	<0.035	<0.023	<0.024	<0.029
21	14-May-01	21-May-01	<0.025	<0.024	<0.026	<0.022	<0.028	<0.025	<0.020	<0.030	<0.026	<0.024
22	21-May-01	29-May-01	<0.023	<0.023	<0.019	<0.026	<0.021	<0.024	<0.024	<0.025	<0.017	<0.027
23	29-May-01	5-Jun-01	<0.021	<0.025	<0.025	<0.029	<0.025	<0.024	<0.023	<0.024	<0.027	<0.029
24	5-Jun-01	11-Jun-01	<0.029	<0.029	<0.032	<0.029	<0.032	<0.032	<0.033	<0.030	<0.023	<0.034
25	11-Jun-01	18-Jun-01	<0.028	<0.028	<0.025	<0.026	<0.029	<0.031	<0.028	<0.024	<0.025	<0.026
26	18-Jun-01	25-Jun-01	<0.030	<0.024	<0.024	<0.023	<0.024	<0.024	<0.026	<0.025	<0.031	<0.021

(a) Sample results invalidated as it was not possible to determine actual sample pump run times.

TABLE 8.5 RADIOIODINE IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
						required LLD <0.070						
27	25-Jun-01	2-Jul-01	<0.030	<0.024	<0.021	<0.027	<0.024	<0.024	<0.023	<0.026	<0.021	<0.024
28	2-Jul-01	9-Jul-01	<0.022	<0.021	<0.026	<0.021	<0.025	<0.022	<0.021	<0.022	<0.026	<0.024
29	9-Jul-01	16-Jul-01	<0.019	<0.028	<0.021	<0.024	<0.023	<0.027	<0.022	<0.024	<0.024	<0.028
30	16-Jul-01	23-Jul-01	<0.019	<0.031	<0.026	<0.024	<0.032	<0.026	<0.025 (a)	<0.022	<0.024	<0.022
31	23-Jul-01	30-Jul-01	<0.023	<0.020	<0.024	<0.023	<0.020	<0.027	<0.033	<0.022	<0.023	<0.024
32	30-Jul-01	6-Aug-01	<0.027	<0.031	<0.029	<0.031	<0.030	<0.021	<0.031	<0.030	<0.031	<0.030
33	6-Aug-01	13-Aug-01	<0.024 (b)	<0.021 (b)	<0.027 (b)	<0.023	<0.027	<0.025	<0.025	<0.030	<0.029	<0.031
34	13-Aug-01	20-Aug-01	<0.029	<0.028	<0.025	<0.022	<0.031	<0.022	<0.028	<0.024	<0.031	<0.028
35	20-Aug-01	27-Aug-01	<0.019	<0.028	<0.022	<0.022	<0.026	<0.025	<0.022	<0.025	<0.021	<0.018
36	27-Aug-01	4-Sep-01	<0.022	<0.021	<0.019	<0.024	<0.023	<0.017	<0.022	<0.024	<0.020	<0.022
37	4-Sep-01	10-Sep-01	<0.038	invalid (c)	<0.033	<0.035	<0.033	<0.032	<0.031	<0.038	<0.031	<0.035
38	10-Sep-01	17-Sep-01	<0.026	<0.026	<0.030	<0.026	<0.024	<0.020	<0.030	<0.024	<0.023	<0.027
39	17-Sep-01	24-Sep-01	<0.022	<0.028	<0.021	<0.034	<0.026	<0.027	<0.028	<0.026	<0.029	<0.031

4th Quarter

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
						required LLD <0.070						
40	24-Sep-01	1-Oct-01	<0.034	<0.019	<0.030	<0.027	<0.027	<0.024	<0.033	<0.026	<0.027	<0.030
41	1-Oct-01	8-Oct-01	<0.025	<0.023	<0.029	<0.022	<0.024	<0.029	<0.026	<0.029	<0.031	<0.027
42	8-Oct-01	15-Oct-01	<0.026	<0.029	<0.025	<0.025	<0.023	<0.024	invalid (d)	<0.025	<0.027	<0.026
43	15-Oct-01	23-Oct-01	<0.020	<0.021	<0.019	<0.017	<0.028	<0.024	<0.035	<0.023	<0.022	<0.023
44	23-Oct-01	29-Oct-01	<0.028	<0.030	<0.026	<0.030	<0.027	<0.030	<0.038	<0.031	<0.029	<0.030
45	29-Oct-01	6-Nov-01	<0.025	<0.019	<0.024	<0.021	<0.018	<0.021	<0.032 (f)	<0.022 (f)	<0.022 (f)	<0.030 (f)
46	6-Nov-01	13-Nov-01	<0.031	<0.023	<0.028	<0.025	<0.033	<0.030	<0.024	<0.020	<0.029	<0.020
47	13-Nov-01	19-Nov-01	<0.024	<0.028	<0.024	<0.035	<0.039	<0.026	<0.029	<0.029	<0.021	<0.025
48	19-Nov-01	26-Nov-01	<0.025	<0.027	<0.025	<0.033	<0.037	invalid (e)	<0.035	<0.025	<0.028	<0.025
49	26-Nov-01	3-Dec-01	<0.019	<0.022	<0.025	<0.025	<0.026	<0.029	<0.021	<0.026	<0.020	<0.031
50	3-Dec-01	11-Dec-01	<0.024	<0.017	<0.019	<0.022	<0.018	<0.023	<0.019	<0.024	<0.020	<0.022
51	11-Dec-01	18-Dec-01	<0.028	<0.021	<0.021	<0.027	<0.029	<0.027	<0.023	<0.023	<0.027	<0.027
52	18-Dec-01	26-Dec-01	<0.020	<0.025	<0.020	<0.019	<0.023	<0.015	<0.027	<0.014	<0.029	<0.017

(a) Site #21 samples were collected on 7-24-01.

(b) Site #4, 6A, and 7A samples were collected on 8-14-01.

(c) Sample results invalidated due to ETM malfunction.

(d) No power at sample location upon arrival.

(e) Sample head was broken off some time during sample period.

(f) Site #21, 29, 35 and 40 samples were collected on 11-5-01.

TABLE 8.6 VEGETATION

ODCM required samples denoted by *
units are pCi/kg, wet

LOCATION	TYPE	DATE COLLECTED	<60 I-131	<60 Cs-134	<80 Cs-137
STEAGALL RESIDENCE (SITE #47)*	NO SAMPLES AVAILABLE				
BRANCH RESIDENCE (SITE #64)	kale	18-May-01	<25	<25	<26
	collards	13-Jul-01	<21	<22	<26
ROUSSEAU FARMS (SITE #62)*	purple cabbage	11-Jan-01	<17	<20	<18
	mustard greens	11-Jan-01	<18	<26	<20
	turnip greens	11-Jan-01	<28	<25	<33
	mustard greens	16-Feb-01	<16	<25	<17
	green cabbage	16-Feb-01	<17	<24	<20
	turnip greens	16-Feb-01	<23	<33	<29
	collards	16-Mar-01	<18	<26	<21
	mustard greens	16-Mar-01	<18	<25	<24
	cabbage	16-Mar-01	<17	<16	<17
	green cabbage	20-Apr-01	<18	<21	<22
DUNCAN FAMILY FARMS	green cabbage	19-Oct-01	<19	<23	<22
	green cabbage	15-Nov-01	<18	<26	<23
	red cabbage	15-Nov-01	<19	<23	<21
	endive	15-Nov-01	<19	<21	<18
	red cabbage	13-Dec-01	<15	<24	<22
	green cabbage	13-Dec-01	<20	<22	<21
	escarole (endive)	13-Dec-01	<18	<23	<21
HALLMAN RESIDENCE (SITE #52)*	spinach	18-May-01	<25	<34	<35
	green lettuce	18-May-01	<19	<27	<21
	curly lettuce	18-May-01	<23	<41	<26

TABLE 8.7 DRINKING WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 QTRLY Tritium	<4.0 Gross Beta
McARTHUR RESIDENCE (SITE #46) *	29-Jan-01	<11	<11	<23	<9	<25	<11	<18	<11	<10	<10	<36	<14		<3.1
	26-Feb-01	<10	<8	<21	<10	<24	<12	<17	<10	<13	<10	<33	<14		3.6 ± 1.7
	26-Mar-01	<14	<9	<22	<13	<27	<11	<20	<10	<14	<10	<38	<12	<282	3.3 ± 1.7
	30-Apr-01	<11	<10	<21	<12	<25	<10	<19	<9	<10	<12	<37	<11		<2.9
	29-May-01	<8	<8	<17	<9	<20	<10	<15	<7	<10	<9	<24	<9		4.2 ± 1.7
	25-Jun-01	<10	<10	<20	<9	<23	<11	<16	<11	<10	<10	<35	<11	<280	<2.7
	30-Jul-01	<10	<10	<20	<11	<22	<11	<18	<11	<10	<11	<37	<11		3.1 ± 1.8
	27-Aug-01	<10	<9	<16	<10	<25	<10	<18	<10	<11	<11	<39	<9		<2.9
	25-Sep-01	<8	<10	<21	<12	<21	<12	<19	<10	<12	<10	<36	<9	<264	<2.9
	29-Oct-01	<11	<10	<22	<10	<21	<11	<19	<10	<11	<9	<43	<11		2.8 ± 1.7
	26-Nov-01	<7	<6	<16	<8	<17	<8	<11	<8	<9	<7	<27	<9		<2.9
	26-Dec-01	<9	<9	<16	<9	<18	<9	<15	<8	<10	<9	<28	<8	<277	5.3 ± 1.7
GAVETTE RESIDENCE (SITE #55)	29-Jan-01	<6	<7	<14	<8	<22	<8	<11	<7	<9	<8	<27	<7		<3.1
	26-Feb-01	<11	<10	<21	<10	<21	<10	<18	<10	<11	<10	<38	<13		3.8 ± 1.8
	26-Mar-01	<10	<11	<18	<12	<24	<10	<20	<10	<12	<10	<35	<12	<284	2.8 ± 1.7
	30-Apr-01 (a)	<7	<7	<16	<8	<17	<8	<12	<13	<8	<8	<37	<10		<2.9
	29-May-01	<9	<10	<21	<11	<23	<11	<18	<10	<12	<11	<34	<9		2.8 ± 1.6
	25-Jun-01	<9	<8	<16	<10	<16	<9	<15	<8	<10	<8	<24	<9	<277 (a)	3.6 ± 1.7
	30-Jul-01	<8	<7	<19	<7	<21	<7	<14	<9	<9	<8	<28	<11		3.1 ± 1.8
	27-Aug-01	<9	<8	<17	<9	<16	<9	<15	<7	<10	<10	<27	<10		<2.9
	25-Sep-01	<9	<9	<18	<9	<18	<9	<16	<7	<10	<9	<28	<10	<264	<3.0
	29-Oct-01	<7	<8	<16	<10	<18	<8	<13	<7	<9	<9	<26	<11		3.3 ± 1.7
	26-Nov-01	<8	<8	<17	<8	<19	<8	<13	<7	<9	<8	<27	<10		<2.9
	26-Dec-01	<7	<8	<15	<8	<16	<8	<13	<8	<9	<7	<27	<8	<275	4.8 ± 1.7

(a) Weekly well sample not taken on 4-30-01 as it was out of service. Composite did not include a sample from this date.

TABLE 8.7 DRINKING WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 QTRLY Tritium	<4.0 Gross Beta
BERRYMAN RESIDENCE (SITE #48)*	29-Jan-01	<10	<11	<19	<10	<22	<12	<17	<11	<13	<10	<33	<8		3.8 ± 1.6
	26-Feb-01	<9	<7	<17	<8	<18	<9	<16	<7	<9	<9	<27	<9		<3.4
	26-Mar-01	<12	<13	<27	<13	<26	<14	<18	<10	<13	<11	<39	<15	<282	<3.3
	30-Apr-01	<11	<9	<22	<9	<21	<11	<17	<10	<11	<10	<36	<11		6.3 ± 2.5
	29-May-01	<11	<10	<21	<13	<26	<12	<18	<10	<13	<11	<40	<11		3.7 ± 2.1
	25-Jun-01	<10	<11	<19	<10	<22	<10	<16	<10	<13	<11	<32	<11	<277	<3.4
	30-Jul-01	<9	<10	<19	<11	<23	<10	<15	<9	<13	<11	<34	<8		<3.4
	27-Aug-01	<10	<9	<20	<12	<21	<11	<20	<10	<12	<11	<35	<10		<3.7
	25-Sep-01	<11	<8	<20	<9	<25	<11	<18	<9	<11	<12	<33	<10	<261	<3.7
	29-Oct-01	<8	<10	<21	<10	<20	<10	<17	<11	<12	<10	<32	<11		<3.3
	26-Nov-01	<9	<8	<15	<9	<21	<9	<14	<8	<10	<8	<29	<9		<3.6
	26-Dec-01	<7	<8	<16	<9	<17	<9	<14	<6	<9	<9	<28	<12	<277	4.5 ± 2.0
CHOWANEC RESIDENCE (SITE #49) *	29-Jan-01	<7	<8	<14	<7	<18	<8	<14	<8	<8	<7	<30	<8		<3.0
	26-Feb-01	<9	<8	<15	<9	<18	<9	<14	<7	<9	<8	<29	<10		11.3 ± 2.0
	26-Mar-01	<11	<10	<19	<10	<22	<11	<19	<10	<12	<10	<35	<12	<279	<2.5
	30-Apr-01	<9	<11	<21	<10	<19	<10	<18	<9	<11	<11	<34	<12		<2.8
	29-May-01	<9	<10	<22	<12	<21	<12	<17	<11	<12	<11	<32	<13		<2.3
	25-Jun-01	<9	<8	<20	<10	<25	<10	<17	<11	<11	<11	<33	<8	<281	<2.6
	30-Jul-01	<11	<10	<19	<10	<22	<11	<18	<10	<11	<10	<39	<12		<2.6
	27-Aug-01	<8	<6	<16	<7	<15	<8	<13	<7	<9	<7	<27	<12		<2.8
	25-Sep-01	<6	<6	<17	<9	<18	<8	<12	<7	<10	<8	<26	<10	<262	<2.8
	29-Oct-01	<7	<8	<17	<9	<16	<8	<15	<7	<8	<8	<23	<8		<2.5
	26-Nov-01	<10	<10	<21	<10	<22	<11	<16	<10	<12	<11	<34	<13		<2.8
	26-Dec-01	<8	<7	<15	<8	<18	<7	<14	<8	<8	<8	<27	<8	<277	<2.3

TABLE 8.8 GROUNDWATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Tritium
WELL 27ddc (Site #57)*	29-Jan-01	<11	<10	<20	<12	<22	<13	<18	<11	<12	<10	<36	<14	<292
	30-Apr-01	<7	<8	<16	<10	<18	<8	<11	<8	<9	<9	<27	<11	<266
	30-Jul-01	<10	<10	<22	<10	<21	<13	<19	<10	<12	<9	<35	<12	<266
	29-Oct-01	<12	<11	<21	<11	<26	<13	<18	<12	<13	<12	<38	<15	<269
WELL 34abb (Site #58)*	29-Jan-01	<10	<10	<21	<10	<21	<12	<18	<11	<10	<10	<34	<14	<280
	30-Apr-01	<11	<12	<24	<13	<25	<13	<16	<12	<12	<11	<35	<14	<265
	30-Jul-01	<8	<9	<20	<8	<24	<11	<16	<8	<10	<10	<32	<13	<263
	29-Oct-01	<8	<8	<20	<12	<16	<12	<15	<9	<10	<9	<34	<12	<269

TABLE 8.9 SURFACE WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<3000 Tritium
RESERVOIR (Site #60) *	29-Jan-01	<7	<8	<16	<7	<20	<8	<14	10 ± 6	<8	<8	<23	<9	
	26-Feb-01	<7	<7	<19	<9	<21	<8	<14	14 ± 8	<8	<8	<25	<12	
	26-Mar-01	<10	<10	<25	<9	<29	<11	<19	20 ± 8	<13	<11	<37	<13	<284
	30-Apr-01	<9	<7	<13	<8	<16	<9	<11	<7	<8	<8	<29	<11	
	29-May-01	<8	<8	<16	<9	<18	<8	<15	12 ± 8	<10	<9	<25	<10	
	25-Jun-01	<8	<7	<15	<9	<17	<8	<13	<9	<8	<8	<28	<9	<262
	30-Jul-01	<7	<9	<15	<10	<18	<9	<15	<9	<9	<8	<29	<11	
	27-Aug-01	<10	<10	<20	<10	<20	<11	<16	<11	<13	<10	<34	<10	
	24-Sep-01	<10	<9	<19	<12	<24	<10	<16	<11	<12	<9	<34	<12	<264
	29-Oct-01	<10	<9	<20	<10	<24	<10	<18	<11	<12	<11	<35	<11	
	26-Nov-01	<10	<10	<19	<12	<24	<10	<20	<11	<12	<11	<36	<8	
	26-Dec-01	<8	<7	<16	<8	<16	<7	<13	<9	<8	<8	<26	<8	<277
EVAP POND 1 (Site #59) *	29-Jan-01	<9	<8	<15	<10	<20	<8	<15	9 ± 7	<8	<7	<29	<10	
	26-Feb-01	<9	<10	<25	<10	<28	<10	<20	17 ± 13	<13	<11	<36	<11	
	26-Mar-01	<10	<10	<22	<10	<26	<12	<18	<12	<11	<12	<35	<8	1105 ± 160
	30-Apr-01	<9	<8	<21	<12	<18	<9	<14	<8	<8	<10	<29	<10	
	29-May-01	<11	<11	<21	<12	<23	<11	<20	8 ± 9	<10	<13	<37	<7	
	25-Jun-01	<9	<10	<24	<10	<24	<11	<17	<12	<12	<11	<37	<9	1464 ± 182
	30-Jul-01	<9	<7	<23	<11	<21	<10	<13	<9	<10	<10	<26	<11	
	27-Aug-01	<9	<8	<22	<10	<19	<9	<15	<9	<10	<9	<31	<9	
	25-Sep-01	<11	<10	<22	<13	<23	<11	<17	<10	<12	<12	<32	<10	1563 ± 159
	29-Oct-01	<9	<9	<19	<8	<23	<8	<14	<7	<10	<10	<29	<9	
	26-Nov-01	<9	<9	<19	<12	<22	<9	<13	<8	<11	<8	<27	<12	
	26-Dec-01	<8	<8	<17	<8	<20	<8	<14	<8	<10	<9	<29	<8	1102 ± 180
EVAP POND 2 (Site #63) *	29-Jan-01	<8	<8	<18	<9	<18	<8	<13	<8	<9	17 + 8	<27	<6	
	26-Feb-01	<11	<10	<27	<13	<28	<11	<17	<11	<13	11 ± 10	<37	<8	
	26-Mar-01	<12	<10	<25	<13	<26	<12	<20	<11	<14	<14	<42	<12	1579 ± 159
	30-Apr-01	<8	<8	<21	<10	<22	<9	<17	<8	<11	<12	<27	<11	
	29-May-01	<8	<8	<20	<12	<22	<9	<15	<8	<11	<12	<30	<9	
	25-Jun-01	<8	<9	<20	<11	<23	<10	<14	<8	<11	<13	<25	<13	1261 ± 179
	30-Jul-01	<9	<9	<21	<10	<23	<10	<15	<10	<10	<12	<30	<11	
	27-Aug-01	<11	<11	<22	<11	<29	<11	<20	<11	<14	<14	<37	<10	
	25-Sep-01	<9	<7	<23	<11	<21	<9	<16	<8	<9	19 ± 9	<30	<11	2414 ± 163
	29-Oct-01	<11	<11	<25	<13	<25	<11	<19	<9	<12	<14	<39	<10	
	26-Nov-01	<9	<10	<22	<11	<27	<11	<17	<11	<12	19 ± 9	<35	<9	
	26-Dec-01	<9	<9	<23	<13	<26	<10	<15	<8	<12	<14	<34	<12	1193 ± 179

TABLE 8.9 SURFACE WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium
WRF INFLUENT	2-Jan-01	<11	<11	<21	<11	<22	<11	<20	28 ± 10	<11	<11	<42	<14	
	9-Jan-01	<10	<11	<18	<11	<25	<12	<22	35 ± 11	<13	<11	<39	<11	
	16-Jan-01	<7	<8	<16	<8	<20	<8	<12	24 ± 8	<8	<8	<27	<10	
	23-Jan-01	<8	<7	<14	<10	<19	<9	<11	48 ± 10	<7	<8	<27	<11	
	30-Jan-01	<11	<11	<21	<15	<20	<12	<22	50 ± 12	<12	<10	<40	<11	<278**
	6-Feb-01	<8	<8	<14	<8	<16	<9	<14	61 ± 10	<9	<9	<27	<8	
	13-Feb-01	<7	<8	<17	<9	<16	<8	<15	24 ± 9	<9	<7	<25	<9	
	20-Feb-01	<11	<10	<17	<11	<21	<11	<16	18 ± 10	<10	<10	<33	<10	
	27-Feb-01	<10	<10	<17	<11	<24	<9	<17	32 ± 13	<11	<11	<37	<10	<298**
	6-Mar-01	<8	<7	<15	<8	<18	<7	<15	53 ± 10	<9	<9	<23	<10	
	13-Mar-01	<9	<11	<17	<10	<23	<11	<17	55 ± 11	<12	<10	<34	<10	
	20-Mar-01	<10	<9	<19	<11	<20	<10	<19	50 ± 12	<12	<10	<40	<11	
	27-Mar-01	<11	<10	<23	<10	<21	<11	<16	28 ± 13	<10	<10	<35	<10	<291**
	2-Apr-01	<11	<11	<20	<9	<21	<11	<18	17 ± 12	<12	<12	<39	<13	
	10-Apr-01	<8	<9	<20	<9	<21	<10	<17	26 ± 14	<13	<11	<36	<11	
	16-Apr-01	<8	<8	<16	<8	<17	<8	<15	13 ± 10	<9	<8	<31	<10	
	30-Apr-01	<10	<10	<20	<11	<24	<10	<17	33 ± 13	<11	<11	<38	<11	<273**
	8-May-01	<10	<9	<19	<10	<23	<10	<16	16 ± 9	<11	<11	<32	<8	
	15-May-01	<10	<9	<16	<11	<26	<9	<17	18 ± 10	<11	<10	<34	<9	
	22-May-01	<10	<10	<17	<9	<23	<10	<16	24 ± 10	<12	<10	<35	<9	
	29-May-01	<10	<10	<21	<11	<20	<10	<16	24 ± 10	<12	<12	<37	<12	<293**
	5-Jun-01	<11	<10	<21	<12	<23	<10	<18	14 ± 8	<11	<11	<33	<8	
	12-Jun-01	<11	<11	<20	<8	<21	<10	<18	38 ± 11	<10	<10	<33	<9	
	19-Jun-01	<10	<10	<20	<10	<21	<9	<16	41 ± 9	<10	<11	<29	<8	
	26-Jun-01	<11	<10	<21	<12	<19	<10	<19	41 ± 14	<13	<11	<39	<10	<276**
	2-Jul-01	<9	<9	<20	<11	<21	<10	<16	27 ± 10	<13	<11	<34	<9	
	10-Jul-01	<10	<10	<20	<12	<22	<10	<17	25 ± 9	<11	<9	<30	<11	
	17-Jul-01	<9	<9	<18	<10	<21	<9	<18	23 ± 9	<12	<10	<38	<10	
	24-Jul-01	<8	<8	<15	<9	<19	<8	<12	20 ± 7	<9	<8	<25	<11	
	31-Jul-01	<9	<10	<22	<11	<22	<11	<17	18 ± 9	<11	<11	<40	<11	<279**

** Monthly composite

TABLE 8.9 SURFACE WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium
	7-Aug-01	<10	<9	<18	<8	<22	<9	<17	13 ± 7	<12	<11	<37	<10	
	14-Aug-01	<10	<11	<17	<11	<22	<10	<16	20 ± 9	<12	<11	<36	<12	
WRF	21-Aug-01	<8	<8	<16	<10	<17	<8	<11	18 ± 6	<8	<7	<28	<8	
INFLUENT	28-Aug-01	<10	<9	<18	<11	<22	<10	<18	<12	<12	<11	<35	<10	<274**
(continued)	4-Sep-01	<10	<10	<21	<9	<22	<10	<17	<10	<11	<11	<37	<10	
	11-Sep-01	<9	<8	<20	<10	<20	<9	<15	12 ± 6	<10	<9	<28	<11	
	18-Sep-01	<10	<9	<21	<9	<26	<10	<17	17 ± 8	<11	<11	<32	<11	
	25-Sep-01	<9	<10	<18	<11	<20	<9	<15	<12	<12	<10	<33	<11	<270**
	2-Oct-01	<7	<8	<17	<9	<13	<8	<15	28 ± 8	<9	<9	<26	<9	
	9-Oct-01	<8	<8	<12	<9	<16	<9	<13	24 ± 7	<9	<8	<28	<8	
	16-Oct-01	<8	<7	<16	<7	<15	<8	<13	31 ± 9	<9	<8	<25	<8	
	30-Oct-01	<11	<10	<19	<9	<24	<11	<17	36 ± 11	<9	<11	<37	<10	<277**
	6-Nov-01	<10	<10	<20	<11	<24	<10	<17	20 ± 9	<13	<11	<36	<10	
	13-Nov-01	<9	<11	<21	<10	<22	<10	<16	22 ± 9	<12	<11	<35	<10	
	19-Nov-01	<11	<9	<18	<11	<20	<9	<16	35 ± 11	<11	<12	<32	<11	
	27-Nov-01	<8	<7	<14	<8	<17	<8	<12	10 ± 8	<8	<7	<29	<10	<278**
	4-Dec-01	<8	<8	<19	<11	<23	<9	<15	15 ± 11	<12	<11	<33	<12	
	11-Dec-01	<8	<8	<17	<10	<15	<8	<16	<9	<9	<7	<26	<9	
	18-Dec-01	<10	<9	<20	<12	<23	<12	<17	16 ± 9	<11	<10	<38	<11	
	24-Dec-01	<8	<8	<14	<7	<16	<8	<13	87 ± 13	<8	<8	<26	<6	
	31-Dec-01	<7	<7	<15	<8	<17	<8	<14	35 ± 11	<8	<8	<25	<9	<279**
		** Monthly composite												
	16-Jan-01	<9	<9	<24	<12	<20	<10	<17	<10	<14	<11	<34	<10	7064 ± 250 (b)
	12-Mar-01	<11	<10	<20	<13	<21	<11	<16	<10	<11	<10	<33	<10	<314
SEDIMENT.	19-Mar-01	<10	<10	<19	<11	<21	<10	<17	<11	<11	<10	<36	<8	<294
BASIN #2	26-Mar-01	<10	<9	<20	<10	<21	<11	<18	<11	<12	<11	<39	<10	378 ± 181
	2-Apr-01	<10	<10	<21	<11	<23	<10	<17	104 ± 17 (a)	<12	<9	<37	<13	1095 ± 180
	9-Jul-01	<10	<9	<20	<10	<23	<10	<19	<10	<11	<11	<34	<11	<269
	16-Jul-01	<9	<9	<19	<11	<23	<10	<18	<10	<11	<11	<34	<9	<304
	23-Jul-01	<10	<10	<17	<11	<23	<10	<17	<10	<12	<10	<37	<10	<284
	30-Jul-01	<8	<8	<15	<10	<20	<8	<12	<6	<10	<7	<22	<9	<280
	13-Aug-01	<11	<10	<18	<11	<27	<9	<17	<10	<11	<10	<35	<13	3625 ± 226
	20-Aug-01	<10	<9	<22	<10	<23	<10	<17	<11	<12	<10	<33	<10	1174 ± 185

(a) I-131 concentration was elevated due to U-1 cooling tower spill-over to site drainage ditches (see CRDR #2375410).
(b) Tritium concentration was elevated and was determined to be due to Unit BAC releases during periods of rainfall. (see CRDR #2355136).

TABLE 8.10 SLUDGE/SEDIMENT

ODCM required samples denoted by *
units are pCi/kg, wet

SAMPLE LOCATION	DATE COLLECTED	I-131	Cs-134	Cs-137	In-111
WRF CENTRIFUGE WASTE SLUDGE	2-Jan-01	663 ± 61	<36	<16	
	9-Jan-01	648 ± 62	<25	<28	
	16-Jan-01	510 ± 59	<19	<13	
	23-Jan-01	810 ± 70	<26	<27	
	30-Jan-01	707 ± 87	<18	<13	
	6-Feb-01	1551 ± 189	<22	<21	
	13-Feb-01	1444 ± 158	<20	<17	
	20-Feb-01	1098 ± 140	<29	<22	
	27-Feb-01	727 ± 97	<22	<11	
	6-Mar-01	928 ± 123	<18	<22	
	13-Mar-01	1167 ± 146	<23	<24	
	20-Mar-01	1417 ± 171	<24	<20	
	27-Mar-01	1760 ± 211	<28	<17	
	3-Apr-01	1078 ± 137	<25	<16	72 ± 24
	10-Apr-01	880 ± 122	<24	<20	
	16-Apr-01	753 ± 100	<12	<18	
	24-Apr-01	489 ± 72	<23	<26	
	30-Apr-01	686 ± 99	<24	<18	44 ± 31
	8-May-01	831 ± 121	<29	<37	28 ± 21
	15-May-01	319 ± 49	<28	<18	
	22-May-01	868 ± 111	<20	<20	63 ± 18
	29-May-01	569 ± 80	<29	<24	43 ± 23
	5-Jun-01	506 ± 71	<28	<22	36 ± 18
	12-Jun-01	525 ± 73	<20	<20	36 ± 15
	19-Jun-01	942 ± 120	<27	<10	
	26-Jun-01	1029 ± 131	<16	<22	
	2-Jul-01	1267 ± 154	<25	<21	
	10-Jul-01	1435 ± 160	<21	<19	
	17-Jul-01	1051 ± 119	<18	<19	
	24-Jul-01	1001 ± 114	<17	<21	31 ± 18
	31-Jul-01	1243 ± 139	<20	<15	
	7-Aug-01	913 ± 115	<10	<21	30 ± 18
	14-Aug-01	884 ± 102	<17	<17	70 ± 19
	21-Aug-01	659 ± 89	<17	<16	5 ± 14
	28-Aug-01	568 ± 77	<10	<20	26 ± 14
	4-Sep-01	523 ± 66	<22	<14	21 ± 12
	11-Sep-01	523 ± 73	<17	<24	
	18-Sep-01	463 ± 67	<19	<20	52 ± 21
	25-Sep-01	352 ± 54	<22	<17	24 ± 15
	2-Oct-01	685 ± 82	<20	<14	44 ± 15
	9-Oct-01	710 ± 92	<19	<18	20 ± 15
	16-Oct-01	793 ± 93	<15	<13	23 ± 14
	30-Oct-01	457 ± 66	<20	<16	24 ± 17
	6-Nov-01	893 ± 105	<18	<15	44 ± 34
	13-Nov-01	724 ± 86	<17	<16	49 ± 21
	19-Nov-01	1158 ± 141	<22	<18	67 ± 28
	27-Nov-01	1430 ± 177	<18	<18	70 ± 48
	4-Dec-01	825 ± 106	<23	<20	
	11-Dec-01	839 ± 98	<19	<14	75 ± 27
	18-Dec-01	662 ± 89	<19	<23	65 ± 22
	24-Dec-01	1144 ± 141	<24	<15	30 ± 20
	31-Dec-01	3154 ± 362	<25	<17	

TABLE 8.10 SLUDGE/SEDIMENT

ODCM required samples denoted by *
Units are pCi/kg, wet

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
(N)	14-Dec-01	<14	<12	<29	<24	<33	<16	<25	<13	<16	<15	<42	<10
(E)		<18	<18	<34	<25	<40	<15	<31	<12	<15	<20	<45	<21
EVAP POND 1 (S)		<13	<13	<27	<17	<27	<12	<21	<12	<16	<14	<47	<14
(W)		<17	<17	<38	<24	<30	<17	<24	<9	<14	<18	<40	<19
(C)		<18	<17	<30	<20	<38	<18	<29	<14	<19	<13	<46	<17
(N)	14-Dec-01	<9	<12	<26	<11	<26	<13	<18	<12	<13	<13	<36	<12
(E)		<15	<14	<27	<17	<37	<14	<29	<12	<21	<18	<40	<15
EVAP POND 2 (S)		<9	<11	<23	<10	<24	<10	<19	<10	<14	<14	<37	<11
(W)		<16	<12	<27	<11	<35	<12	<27	<10	<15	<18	<38	<13
(SW)		<13	<9	<24	<16	<31	<11	<22	<11	<13	<15	<42	<13

FIGURE 8.1 HISTORICAL GROSS BETA IN AIR (WEEKLY SYSTEM AVERAGES)

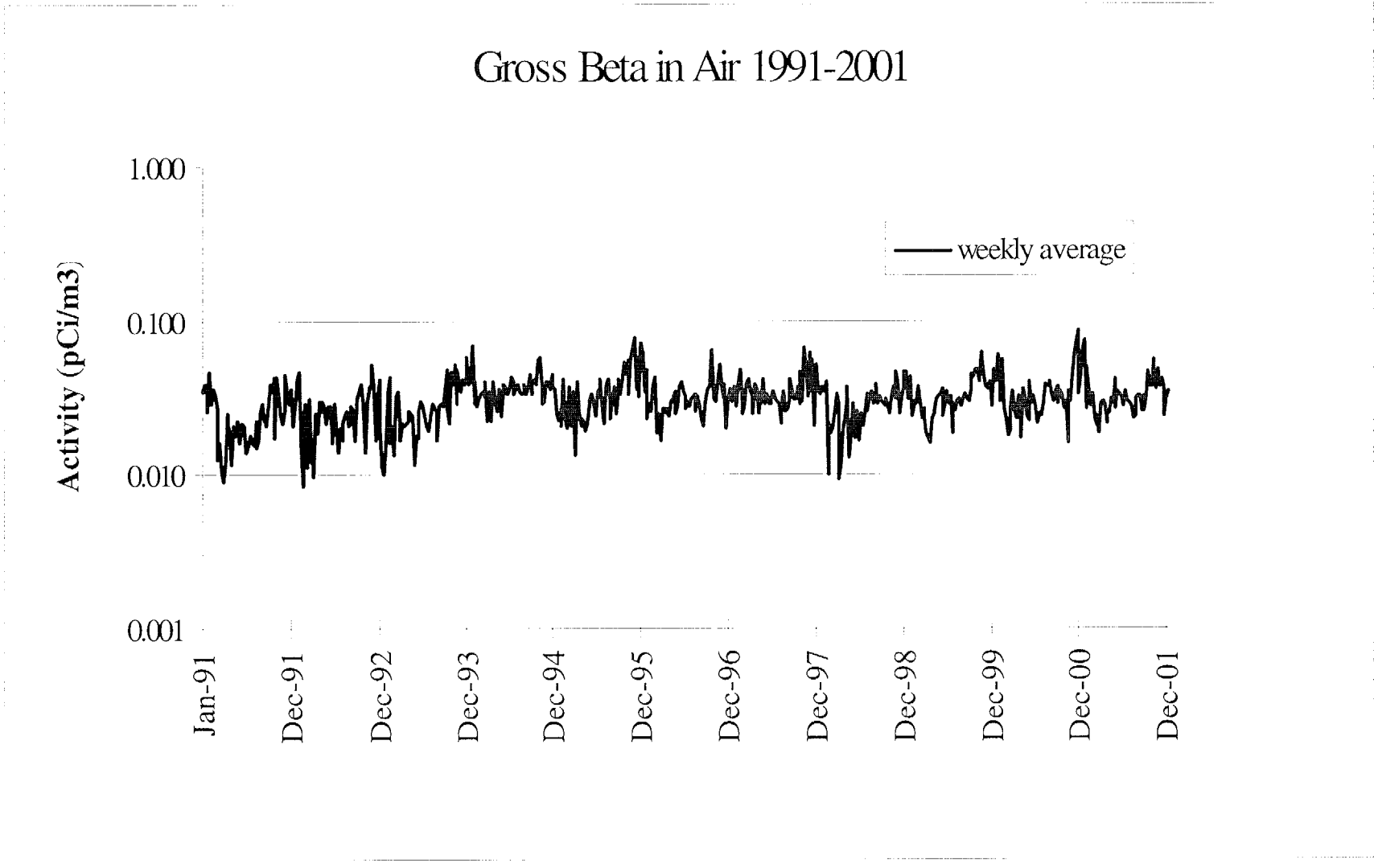


FIGURE 8.2 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP

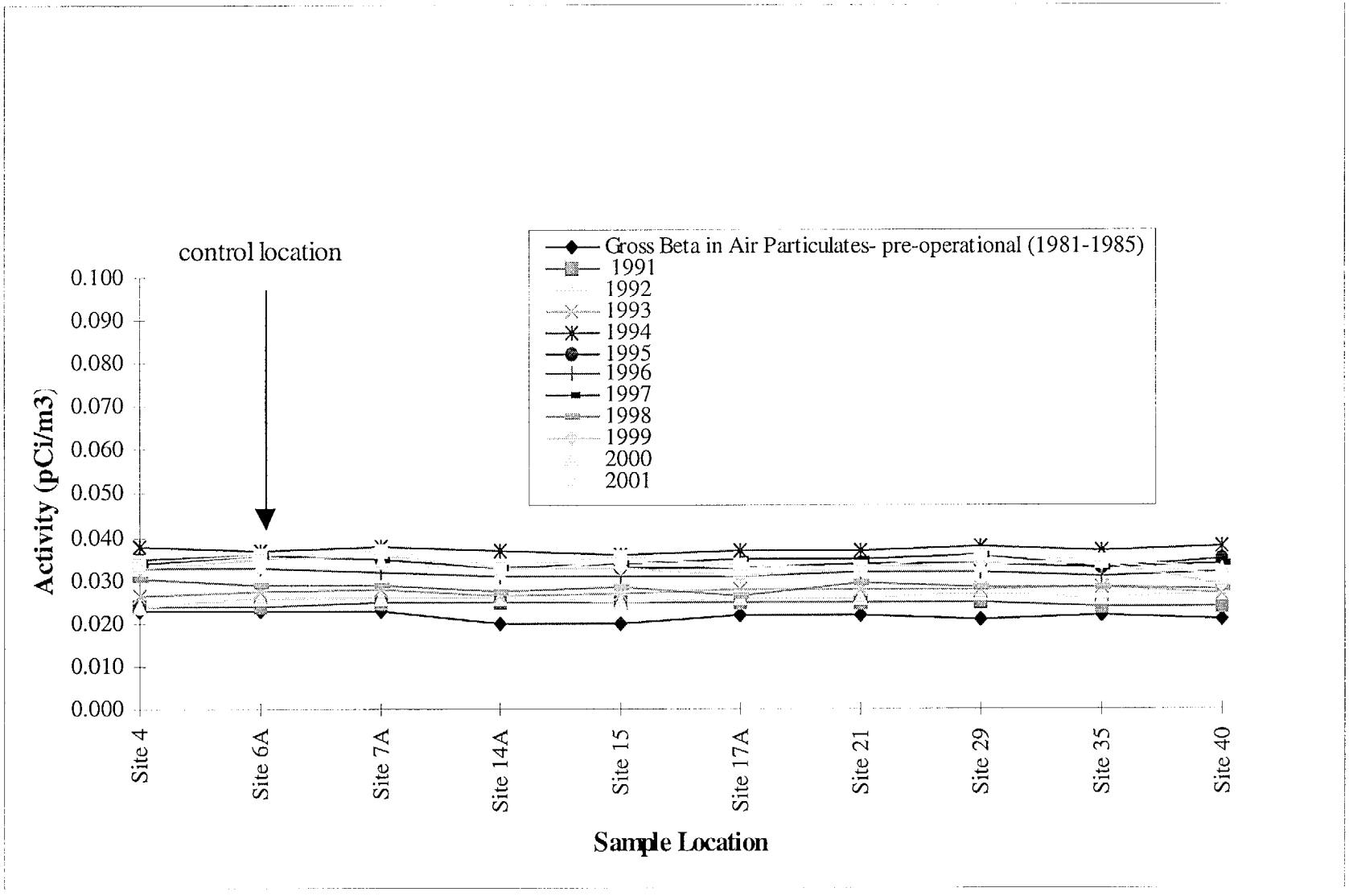
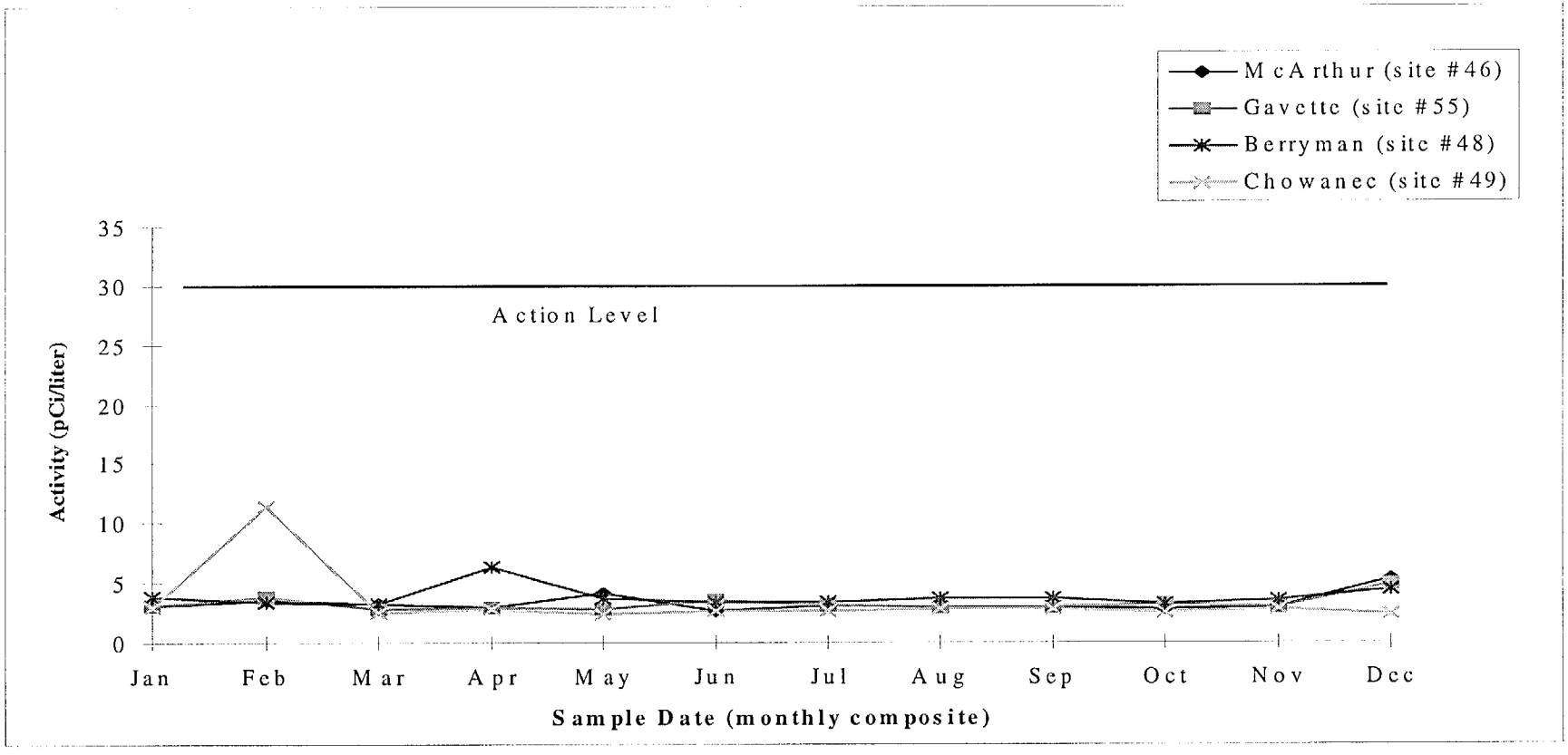


FIGURE 8.3 GROSS BETA IN DRINKING WATER



NOTES: MDA values plotted as activity (e.g. <2.3 is plotted as 2.3)

FIGURE 8.4 SOIL Cs-137 COMPARED TO ONSITE SEDIMENT BASIN #2

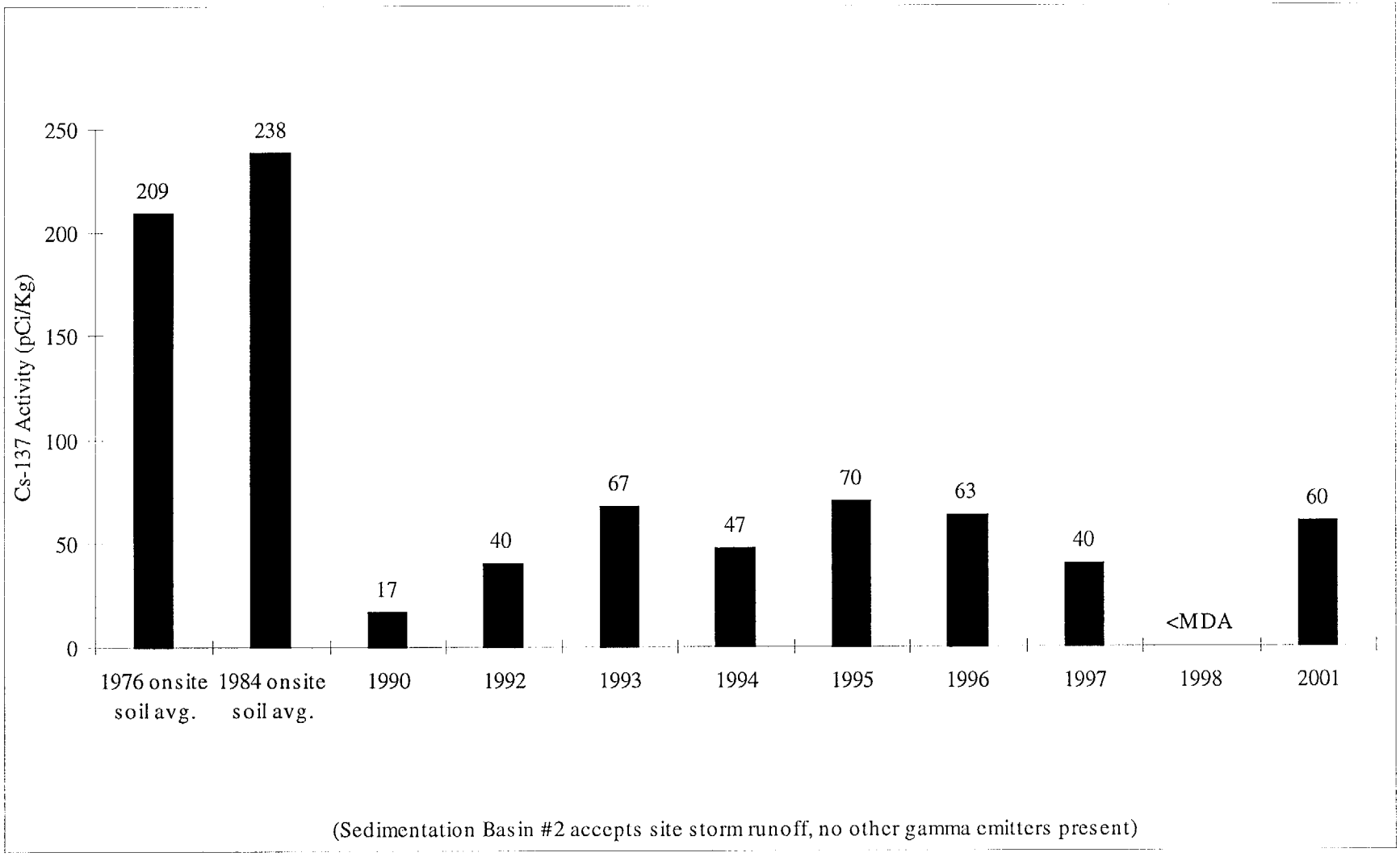
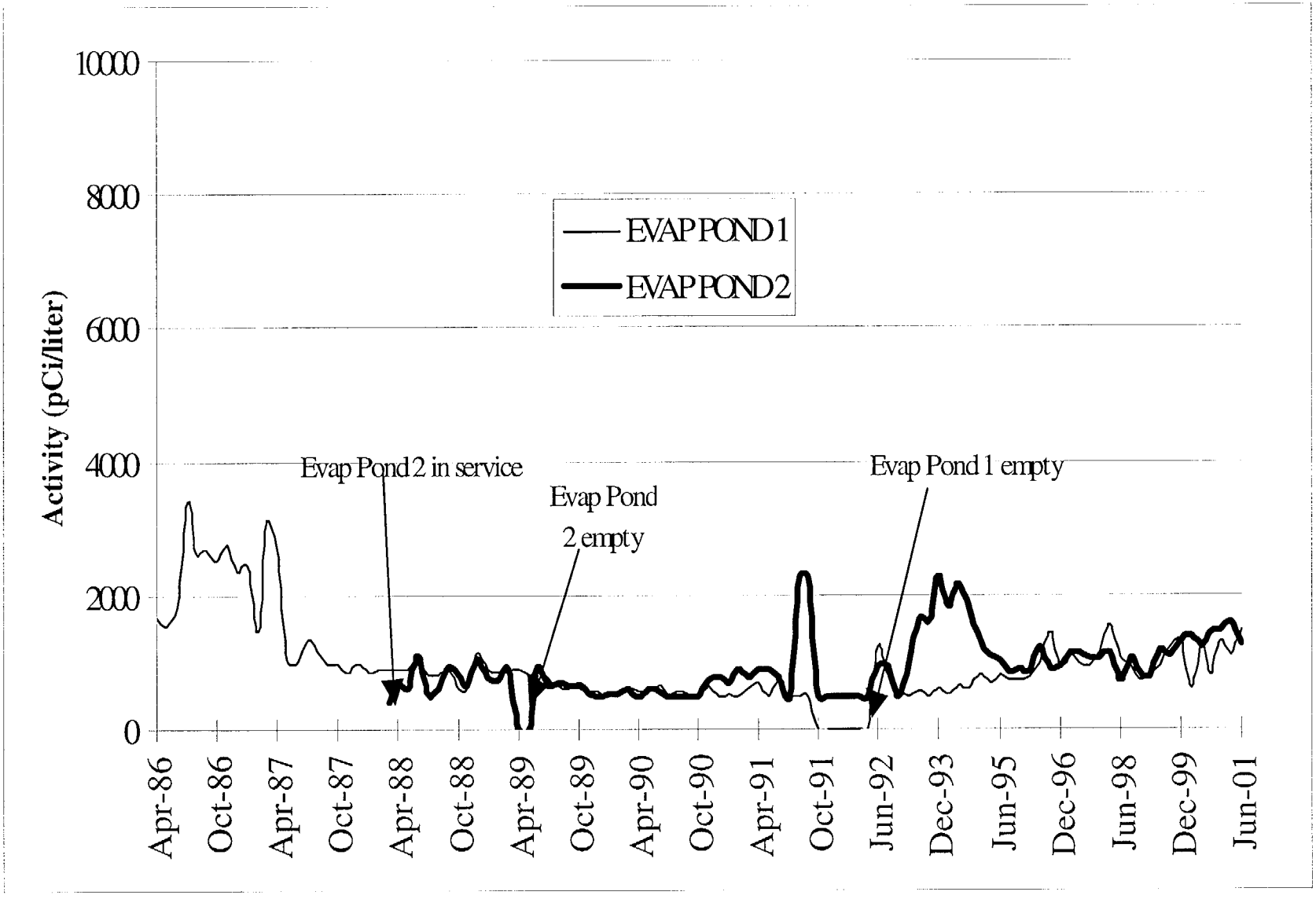


FIGURE 8.5 EVAPORATION POND TRITIUM ACTIVITY



9. Thermoluminescent Dosimeter (TLD) Results and Data

The environmental TLD used at PVNGS is the Panasonic Model 812 Dosimeter. The Model 812 is a multi-element dosimeter combining two elements of lithium borate and two elements of calcium sulfate under various filters.

Thermoluminescent dosimeters were placed in forty-eight locations from one to thirty-five miles from the PVNGS. TLD locations are shown in Figures 2.1 and 2.2. TLD locations are described in Table 9.1. TLD results for 2001 are presented in Table 9.2. TLD results for 1985 through 2001 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2001 as compared to the pre-operational TLD results (excluding indicator location #41 and 43 that were deleted and #46-50 due to no pre-op TLD at these locations for comparison). As can be seen, the site to site comparisons indicate a direct correlation with respect to pre-operational results. It is evident that the offsite dose, as measured by TLDs, has not changed since Palo Verde became operational.

TABLE 9.1 TLD SITE LOCATIONS

(distances and directions are relative to Unit 2 in miles)

TLD SITE	LOCATION	LOCATION DESCRIPTION
1	E30	Goodyear
2	ENE24	Scott-Libby School
3	E21	Liberty School
4	E16	Buckeye
5	ESE11	Palo Verde School
6*	SSE31	APS Gila Bend substation
7	SE7	Old US 80 and Arlington School Rd
8	SSE4	Southern Pacific Pipeline Rd.
9	S5	Southern Pacific Pipeline Rd.
10	SE5	355th Ave. and Elliot Rd.
11	ESE5	339th Ave. and Dobbins Rd.
12	E5	339th Ave. and Buckeye-Salome Rd.
13	N1	N site boundary
14	NNE2	NNE site boundary
15	NE2	NE site boundary, WRF access road
16	ENE2	ENE site boundary
17	E2	E site boundary
18	ESE2	ESE site boundary
19	SE2	SE site boundary
20	SSE2	SSE site boundary
21	S3	S site boundary
22	SSW3	SSW site boundary
23	W5	N of Elliot Rd
24	SW4	N of Elliot Rd
25	WSW5	N of Elliot Rd
26	SSW4	local farm
27	SW1	SW site boundary
28	WSW1	WSW site boundary
29	W1	W site boundary
30	WNW1	WNW site boundary
31	NW1	NW site boundary
32	NNW1	NNW site boundary
33	NW4	S of Buckeye Rd
34	NNW5	395th Ave. and Van Buren St.
35	NNW8	Tonopah
36	N5	Wintersburg Rd. and Van Buren St.
37	NNE5	363rd Ave. and Van Buren St.
38	NE5	355th Ave. and Buckeye Rd.
39	ENE5	343rd Ave. N of Broadway Rd.
40	N3	Wintersburg
42	N8	Ruth Fisher School
44*	ENE35	El Mirage

TABLE 9.1 TLD SITE LOCATIONS

(distances and directions are relative to Unit 2 in miles)

TLD SITE	LOCATION	LOCATION DESCRIPTION
45**	Onsite	Central Laboratory (lead pig)
46	ENE30	Litchfield Park School
47	E35	Littleton School
48	E24	Jackrabbit Trail
49	ENE11	Palo Verde Rd.
50	WNW5	S of Buckeye-Salome Rd.

* Site #6 and site #44 are the control locations.

** Site #45 is the transit control TLD (stored in lead pig).

TABLE 9.2 2001 ENVIRONMENTAL TLD RESULTS

units are mrem/std qtr

TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Average
1	21.7	21.9	23.0	23.7	22.6
2	20.3	19.3	20.8	22.1	20.6
3	23.7	MISSING	23.0	22.7	23.1
4	21.8	22.2	21.8	22.4	22.1
5	21.2	20.8	21.4	22.1	21.4
6 (control)	25.0	23.6	25.3	26.0	25.0
7	24.0	23.2	23.8	24.9	24.0
8	22.4	21.0	22.4	22.1	22.0
9	27.8	26.2	27.7	29.5	27.8
10	21.9	21.6	21.7	23.9	22.3
11	23.0	23.2	22.9	24.2	23.3
12	22.5	21.0	21.4	22.5	21.9
13	22.3	23.1	23.6	25.1	23.5
14	24.2	22.5	22.5	25.5	23.7
15	21.5	21.8	22.1	23.3	22.2
16	21.3	19.8	20.6	21.6	20.8
17	22.2	22.4	23.5	25.0	23.3
18	21.9	21.6	21.8	23.2	22.1
19	23.3	23.1	23.3	25.0	23.7
20	21.4	22.0	22.6	23.0	22.3
21	23.8	22.7	23.7	24.5	23.7
22	24.5	23.3	24.8	27.2	25.0
23	20.3	21.1	21.2	22.7	21.3
24	20.6	20.1	20.6	21.7	20.8
25	20.9	21.7	22.3	21.6	21.6
26	24.3	23.6	24.7	26.4	24.8
27	26.3	25.0	25.6	27.0	26.0
28	25.0	23.6	23.5	25.2	24.3
29	22.8	23.5	22.7	23.8	23.2
30	25.7	24.9	24.4	25.0	25.0
31	21.2	21.6	21.5	22.1	21.6
32	22.3	24.2	23.9	24.3	23.7
33	24.5	24.2	24.4	25.2	24.6
34	26.4	25.5	25.9	25.6	25.9
35	29.2	27.5	29.0	29.2	28.7
36	23.1	23.3	23.3	23.6	23.3
37	20.1	22.5	22.3	22.1	21.8
38	26.4	25.2	25.5	26.1	25.8
39	21.7	22.4	22.1	21.5	21.9
40	22.8	22.8	23.6	22.6	23.0
42	26.1	24.9	24.6	25.4	25.3
44 (control)	18.2	18.2	20.3	17.1	18.5
45 (transit control)	5.1	5.4	5.2	3.7	4.9
46	25.3	24.8	24.9	24.7	24.9
47	20.5	22.0	22.0	21.3	21.5
48	22.5	21.4	23.0	21.4	22.1
49	20.6	20.2	21.4	20.3	20.6
50	17.9	17.5	18.2	18.1	17.9

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES

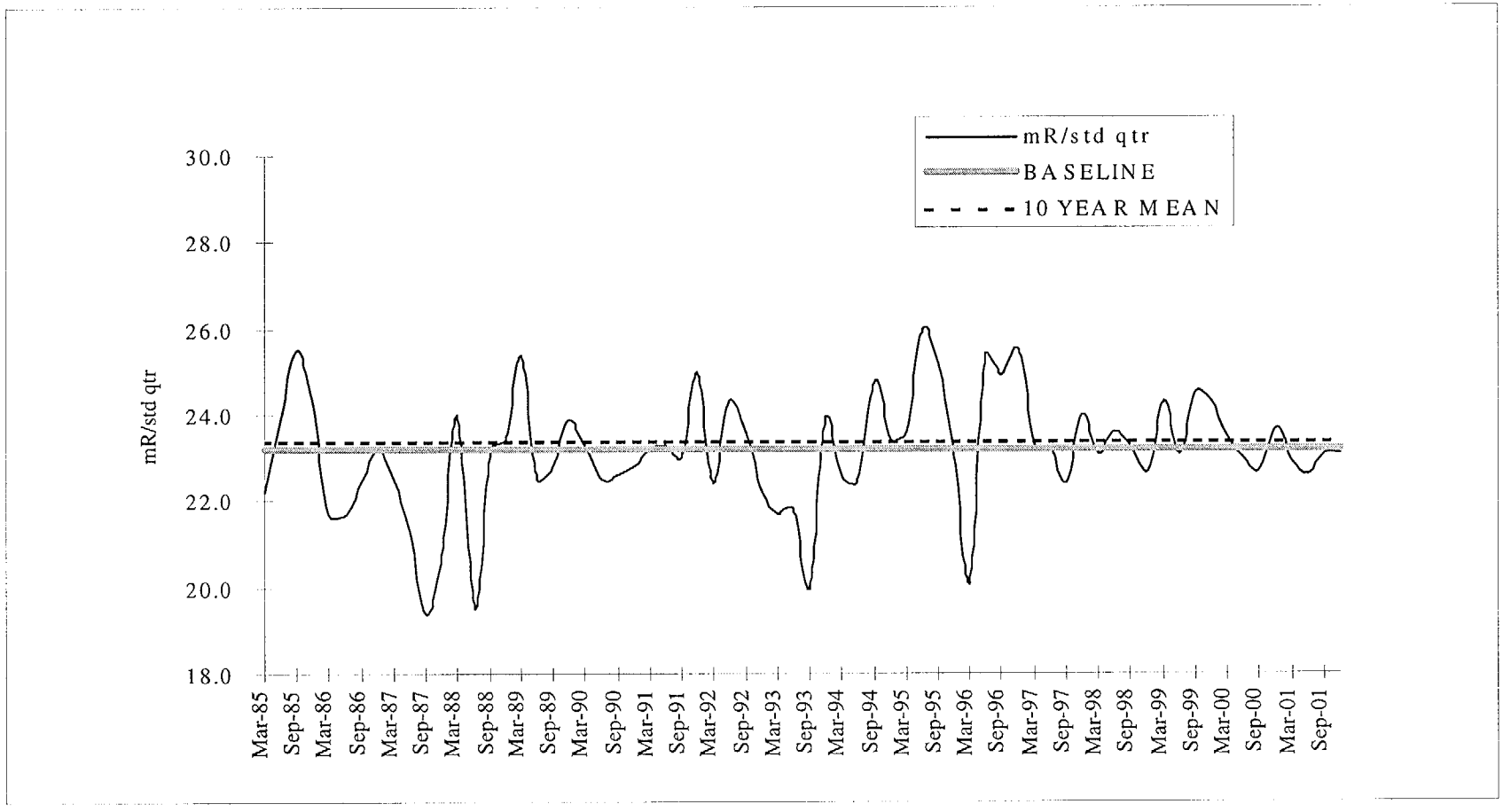
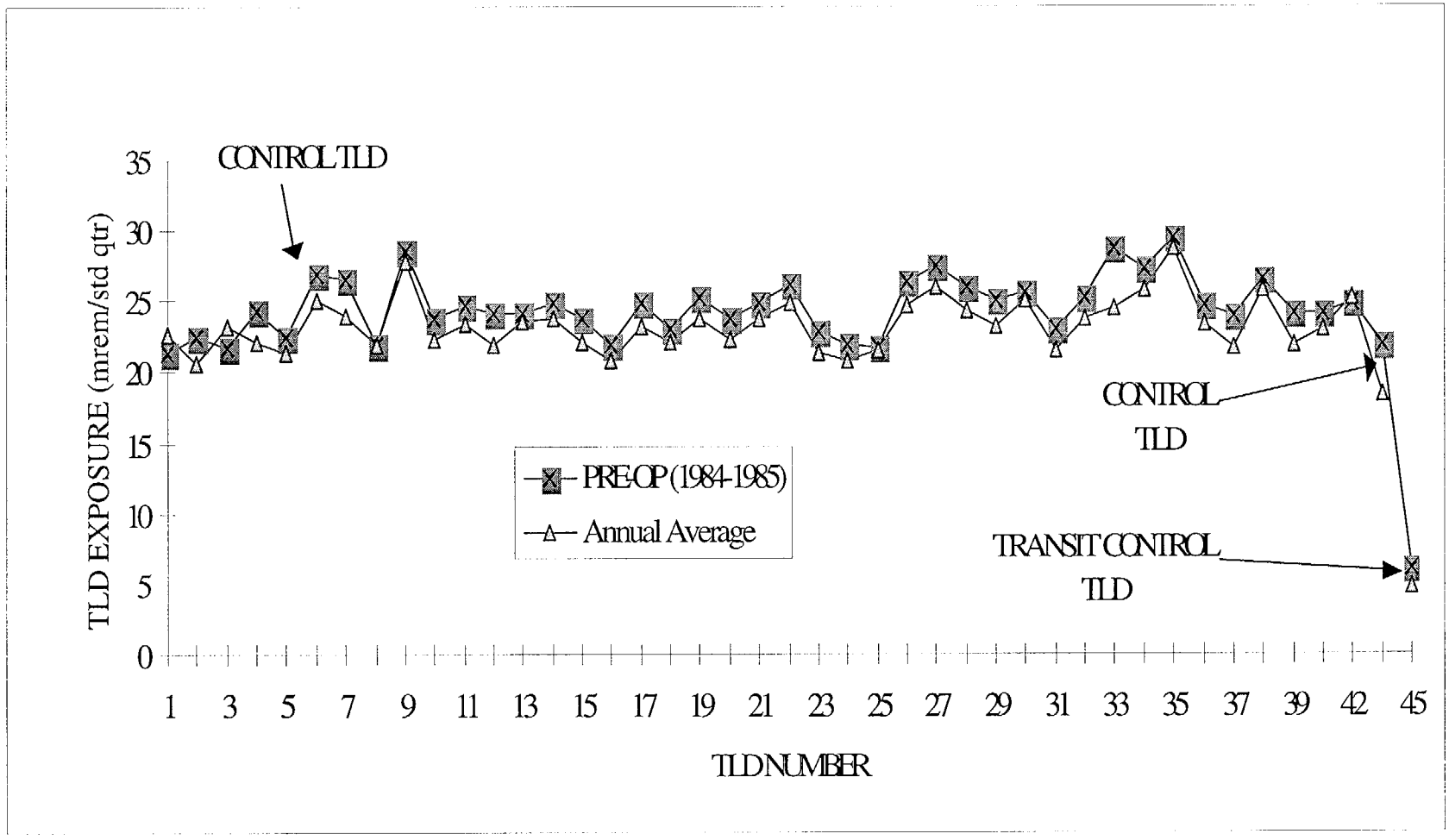


FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2001



TLD #41 monitoring location was deleted in June, 2000.
TLD #43 monitoring location was deleted in 1994.
TLDs #46-50 are not included since they were not included in the pre-op monitoring program.

10. Land Use Census

10.1. Introduction

In accordance with the PVNGS ODCM, Section 6.2, the annual Land Use Census was performed within five miles of Unit 2 containment in June-July, 2001.

Observations were made in each of the 16 meteorological sectors to determine the nearest milking animals, residences, and gardens of greater than 500 square feet. This census was completed by driving the roads and speaking with residents.

The results of the Land Use Census are presented in Table 10.1 and discussed below. The directions and distances listed are in sectors and miles from the Unit 2 containment.

10.2. Census Results

Nearest Resident

There were seven (7) changes in nearest resident status. Refer to Table 10.1 for specific location changes.

Milking Animal

Goats were located in the ENE, NNE and NE sectors. Dose calculations indicated the highest dose to be 0.703 mrem (milk animals with garden). Since the locations were all between 3 and 5 miles distant, and calculated doses were <1 mrem, milk sampling was not added to the REMP, as allowed by the ODCM.

Vegetable Gardens

There were seven (7) changes in nearest garden status. Dose calculations indicated the highest dose to be 0.482 mrem.

See Table 10.1 for a summary of the specific results and Table 2.1 for current sample locations.

TABLE 10.1 2001 LAND USE CENSUS

(Distances and directions are relative to Unit 2 in miles)

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST MILK ANIMAL (COW/GOAT)	CALCULATED DOSE (mrem)	CHANGE FROM 2000
N	**1.55**	**2.87**	NONE	7.00E-02 (RESIDENT) 1.42E-01 (GARDEN)	**RESIDENT GARDEN**
NNE	1.66	**2.05**	3.78 (goats)	1.32E-01 (RESIDENT) 4.19E-01 (GARDEN) 2.24E-01 (MILK)	**GARDEN**
NE	2.16	**3.14**	3.91 (goats)	1.79E-01 (RESIDENT) 4.81E-01 (GARDEN) 7.03E-01 (GARDEN/MILK)	**GARDEN**
ENE	2.87	**4.67**	**4.84 (goats)**	9.83E-02 (RESIDENT) 1.92E-01 (GARDEN) 2.94E-01 (MILK)	**GARDEN MILK**
E	2.81	**4.87**	NONE	1.16E-01 (RESIDENT) 1.78E-01 (GARDEN)	**GARDEN**
ESE	**3.18**	3.78	NONE	1.48E-01 (RESIDENT) 4.82E-01 (GARDEN)	**RESIDENT**
SE	4.18	NONE	NONE	1.41E-01	NONE
SSE	**NONE**	NONE	NONE		**RESIDENT**
S	4.67	NONE	NONE	3.69E-01	NONE
SSW	**NONE**	NONE	NONE		**RESIDENT**
SW	1.40	**NONE**	NONE	2.48E-01	**GARDEN**
WSW	0.75	NONE	NONE	1.64E-01	NONE
W	**0.70**	NONE	NONE	1.05E-01	**RESIDENT**
WNW	**2.67**	NONE	NONE	2.40E-02	**RESIDENT**
NW	**1.12**	NONE	NONE	6.01E-02	**RESIDENT**
NNW	2.64	**3.49**	NONE	3.27E-02 (RESIDENT) 1.06E-01 (GARDEN)	**GARDEN**

COMMENTS:

Dose calculations were performed using the GASPAR code and 2000 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual dose identified (organ, bone, total body, or skin).

11. Summary and Conclusions

The conclusions are based on a review of the radioassay results and background gamma radiation measurements for the 2001 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2001 are presented in Tables 8.1-8.10 and do not include observations of naturally occurring radionuclides, with the exception of gross beta in air and gross beta in drinking water. Table 11.1 summarizes the ODCM required samples and is in the format required by the NRC BTP on Environmental Monitoring.

I-131 concentrations identified on occasion in the Evaporation Ponds, WRF Influent, WRF Centrifuge sludge, and Reservoir are the result of offsite sources and appear in the effluent sewage from Phoenix. The levels of I-131 detected in these locations are consistent with levels identified in previous years.

Tritium concentrations identified in surface water onsite have been attributed to PVNGS gaseous effluent releases. These concentrations are consistent with historical values. The Radioactive Gaseous Effluent Release program accounts for tritium released via this pathway.

There were no observed radiological impacts on the environment due to PVNGS operations in 2001.

Natural background radiation levels are consistent with measurements reported in previous Pre-operational and Operational Radiological Environmental annual reports, References 1 and 2.

TABLE 11.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2001

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mrem/std. qtr.)	TLD - 191	NA	23.1 (178/178) 17.5 - 29.5	Site #35 8 miles 335°	28.7 (4/4) 27.5 - 29.2	21.8 (8/8) 17.1 - 26.0	0
Air Particulates (pCi/m^3)	Gross Beta - 515	0.010	0.033 (465/465) 0.014 - 0.084	Site #35 8 miles 335°	0.035 (51/51) 0.018 - 0.075	0.033 (50/50) 0.018 - 0.069	0
	Gamma Spec. Composite- 40						
	Cs-134	0.05	<LLD	NA	<LLD	<LLD	0
	Cs-137	0.06	<LLD	NA	<LLD	<LLD	0
Air Radioiodine (pCi/m^3)	Gamma Spec. - 515 I-131	0.07	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 22						
	I-131	60	<LLD	NA	<LLD	<LLD	0
	Cs-134	60	<LLD	NA	<LLD	<LLD	0
	Cs-137	80	<LLD	NA	<LLD	<LLD	0
Groundwater (pCi/liter)	Tritium - 8	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 8						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0

TABLE 11.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2001

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations	Location with Highest Annual Mean		Control Locations	Number of Nonroutine Reported Measurements
			Mean (f)[a] Range	Name Distance and Direction	Mean (f)[a] Range	Mean (f)[a] Range	
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
Groundwater	I-131	15	<LLD	NA	<LLD	NA	0
(pCi/liter)	Cs-134	15	<LLD	NA	<LLD	NA	0
-continued-	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Gross Beta - 48	4.0	5.8 (18/48) 2.8 - 11.3	Site #49 2 miles 0°	11.3 (1/12) 11.3 - 11.3	NA	0
	Tritium - 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 48						
Drinking Water	Mn-54	15	<LLD	NA	<LLD	NA	0
(pCi/liter)	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0

TABLE 11.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2001

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	Gamma Spec. - 36						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
Surface Water (pCi/liter)	I-131	15	13 (7/36) 8 - 20	Site #60 Onsite 67°	14 (4/12) 10 - 20	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	17 (4/36) 11-19	Site #63 Onsite 180°	17 (4/12) 11-19	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Tritium - 12	3000	1460 (8/12) 1102 - 2414	Site #63 Onsite 180°	1612 (4/4) 1193 - 2414	NA	0

(a) Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses. (f)

NOTE: Miscellaneous samples which are not listed on Tables 2.1 and 9.1 (not ODCM required) are not included on this table.

12. References

1. Pre-Operational Radiological Monitoring Program, Summary Report 1979-1985.
2. 1985-2000 Annual Radiological Environmental Operating Reports, Palo Verde Nuclear Generating Station.
3. Palo Verde Nuclear Generating Station Technical Specifications and the Technical Reference Manual (TRM).
4. Offsite Dose Calculation Manual, PVNGS Units 1, 2, and 3.
5. Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants.
6. Branch Technical Position, Revision 1, November 1979.