Palo Verde Nuclear
Generating Station

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102-04562-SAB/TWN/CJJ
April 27, 2001

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

Dear Sir:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report for 2000

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2000.

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,

SAB/TNW/CJJ

Enclosure

cc: E. W. Merschoff (all w/o enclosure)
J. N. Donohew
J. H. Moorman
A. V. Godwin [ARRA] (with enclosure)

IE25
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NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2000

Prepared by: Louis Dimovsky Louis Dimovsky 3/29/01

Reviewed by: Larry D. Johnson 4/10/01

Approved by: [signature] 4/10/01

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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 2000, 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 one (1) local resident well. 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. Although there was one incidence of I-131 detected at one (1) air sample location (refer to Table 2.3 for a description of this event)**, there were no radiological impacts on the environment due to PVNGS operations in 2000.**

(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 2000. 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. 2000 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, sediment, and soil.

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 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 2000

REMP changes occurred as a result of the 2000 Land Use Census. Vegetation sample locations were changed to meet the requirements of the ODCM. Refer to Table 2.1 for a list of current sample locations.

One TLD location, site #41, was deleted as of June, 2000. This location was deleted since the school being monitored was closed. One of the existing supplemental TLD locations (site #5, also located at a local school) was designated as a required monitoring location.

2.3. REMP Discrepancy/Event Summary

During calendar year 2000, there were five (5) discrepancies/events with regard to ODCM requirements. Refer to Table 2.3 for more detail and any corrective actions taken.

- TLDs at site #34 were missing in the 1st quarter.
- Two (2) air samples were invalidated in the first quarter due to equipment malfunctions resulting in unknown sample volumes.
- Resident well sample at site #46 was unavailable the week of 12-26-00.
- On October 12, 2000 the ARRA notified APS that they identified I-131 in one of their air samples (site #29, west site boundary, 0.6 miles) at a concentration of 0.022 pCi/m^3. This occurred during the Unit 2 refueling outage with known elevated I-131 activity in the reactor coolant system.
- A mass flow meter (M&TE # EG-4218) was found to be out of tolerance.

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
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	E35	Rousseau Farming Co.
63	surface water	ONSITE	Evaporation Pond #2
64	vegetation (supplemental)	NNE2	Branch Residence

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			

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

TABLE 2.3 SUMMARY OF REMP DISCREPANCIES/EVENTS

Discrepancy/Event	Actions taken
1. TLDs at site #34 were missing in the 1st quarter.	TLDs are vandalized or stolen on occasion. No actions were taken and TLDs at this site were not missing the remainder of the year.
2. Two air samples (sites #29 and #40) were invalidated due to malfunction of the sample pumps the week of 2-22-00. The pumps seized some time during the sample period.	Air sample pumps were replaced and subsequent samples were valid.
3. Resident well sample at site #46 was unavailable the week of 12-26-00.	Well pump was out of service. Pump was restored to service the following week. No additional actions are necessary.
4. On October 12, 2000 the ARRA notified APS that they identified I-131 in one of their air samples (site #29, west site boundary, 0.6 miles) at a concentration of 0.022 pCi/m^3. This occurred during the Unit 2 refueling outage with known elevated I-131 activity in the reactor coolant system.	The APS air sample from site #29 (same location as ARRA) was originally counted to a minimum detectable activity (MDA) of $\leq$0.026 pCi/m^3. The sample was re-counted for four hours by gamma spectroscopy which resulted in an I-131 concentration of 0.022 pCi/m^3. The I-131 was attributed to opening of pressurizer/steam generator manways during the refueling outage. The I-131 was accounted for on gaseous effluent permits (via the plant vent). Discussion with ARRA personnel indicated that although they routinely count air sample media for I-131 using a gamma spectrometer with a detector efficiency of 30%, this particular detector was out of service. A 50% efficient detector was used to count samples this week, resulting in a lower than routine MDA (0.020 vs 0.035) (Note that the required sensitivity for this analysis is 0.07 pCi/m^3). No ODCM release or dose criteria were exceeded during this event. This event was discussed with NRC Region IV personnel. No further action is necessary.
5. A mass flow meter (M&TE #4218) was found to be out of tolerance. CRDR #2371856 was issued to evaluate and determine any corrective actions.	An evaluation of instrument usage (9-18-00 to 12-26-00) indicated air sample results to be conservative by a factor of 1/5th. Air sample data for this time period will not be corrected since the data reported was in the conservative direction (actual results are lower concentrations than reported).

FIGURE 2.1
REMP SAMPLE SITES
(0-10 MILES)

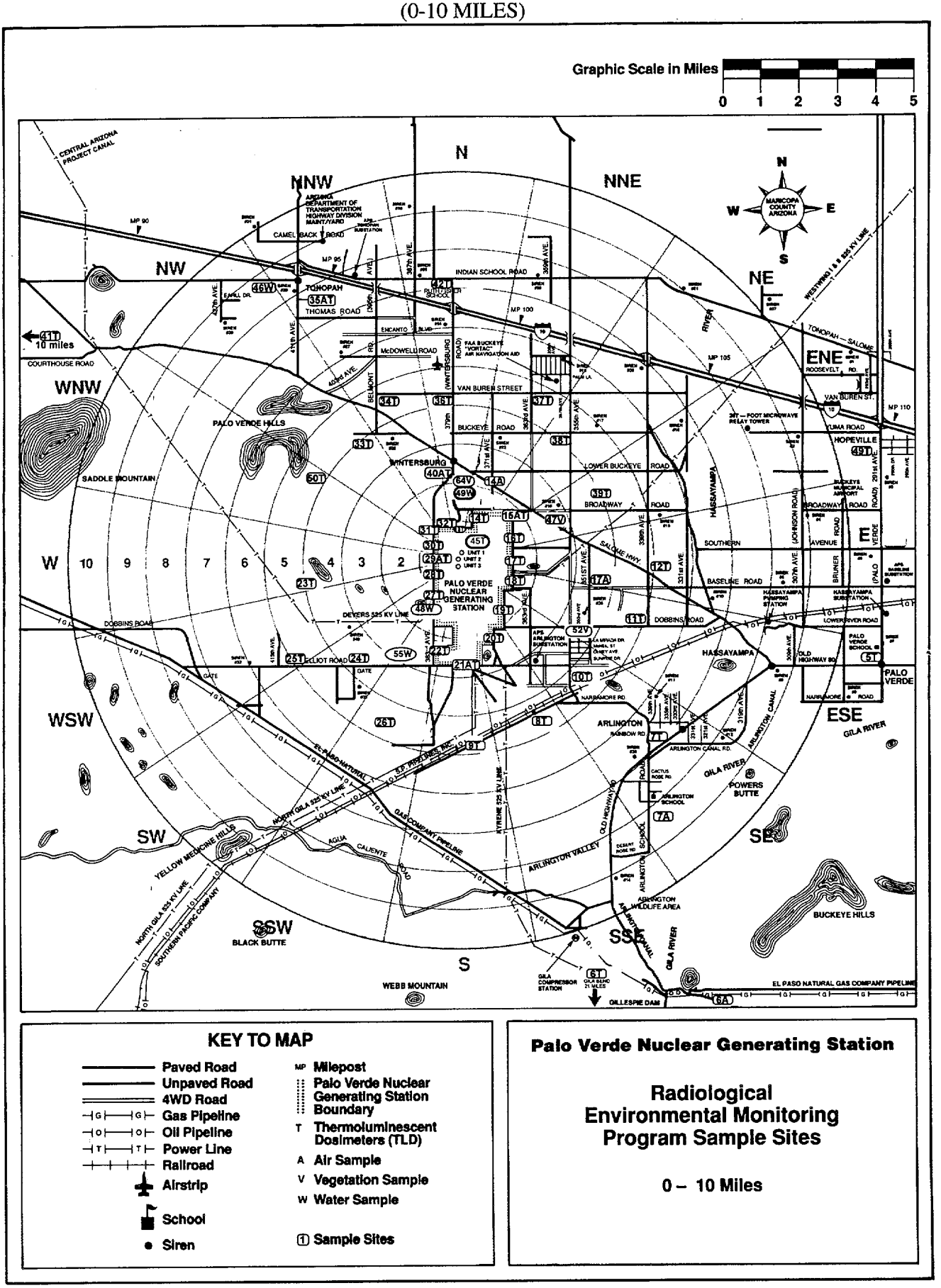
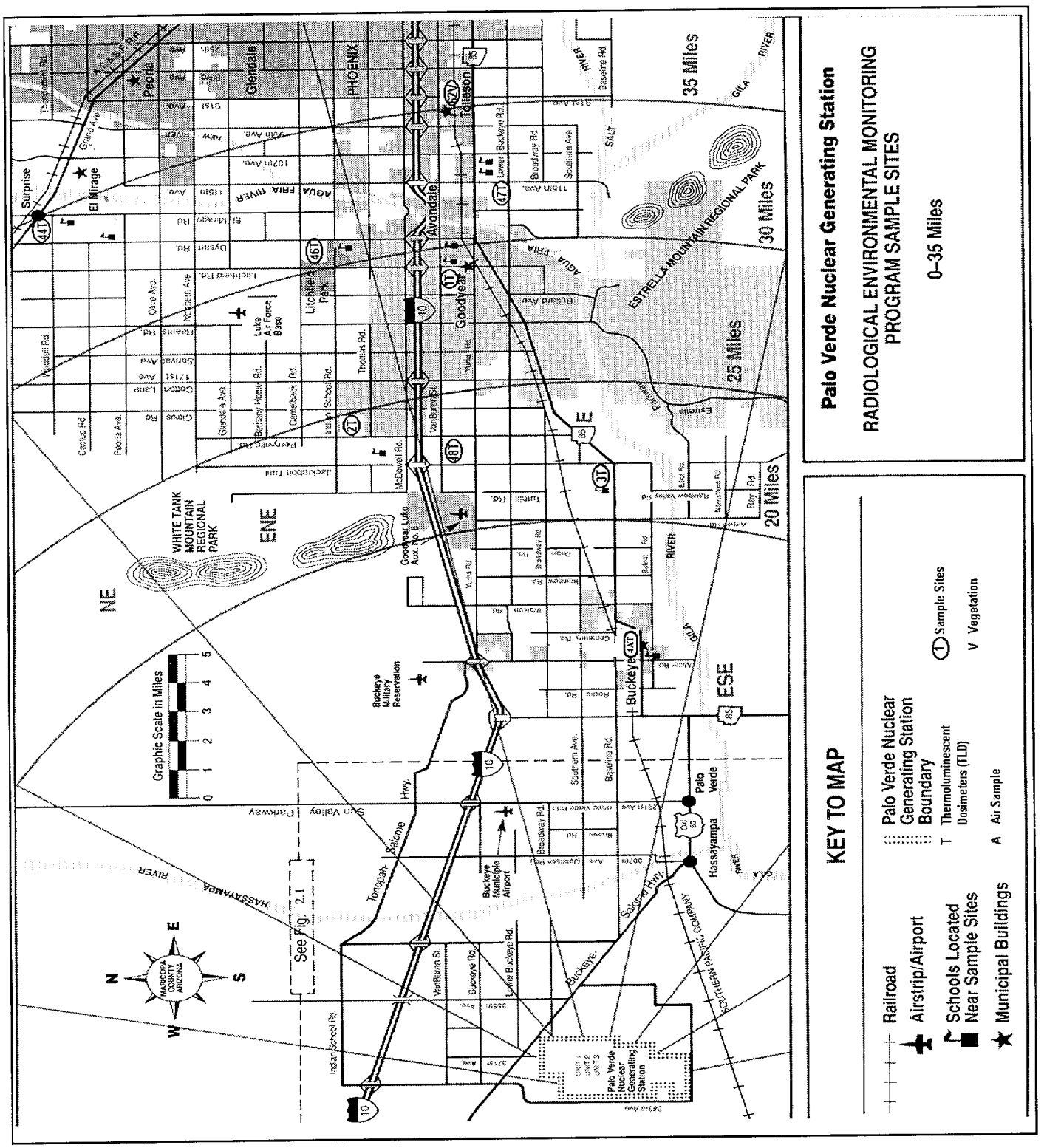


FIGURE 2.2
REMP SAMPLE SITES
(0-35 MILES)



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 2000 Land Use Census.

3.4. Air

Air samples were collected by APS using PVNGS procedures.

Air particulate filters and charcoal canisters were exchanged at ten (10) sites on a weekly basis. Particulate filters were analyzed for gross beta. Charcoal canisters 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 from the WRF centrifuge (whenever the plant was operational) and analyzed for gamma-emitters. Samples were collected using 1000 ml plastic bottles.

Cooling tower sludge from all three Units was disposed of in the WRF Landfill in 2000. 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 canister 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 1.81 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 16.3% 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-3801 Liquid Scintillation Counter is used for tritium determinations. The system background averages approximately 20 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.

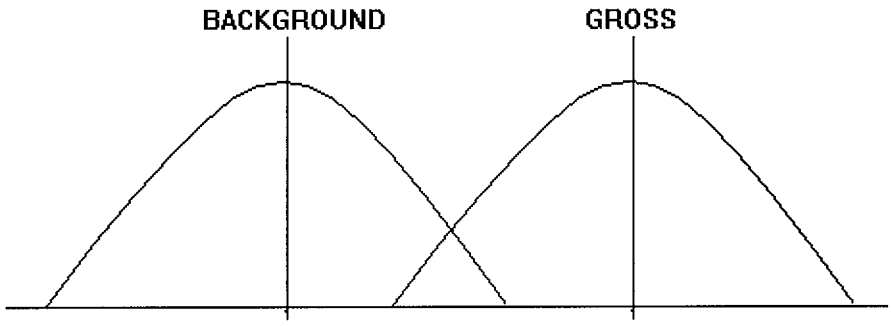
Occasionally the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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 REMP 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, conservative values are used in decay correction to allow for transit time and sample processing.

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 the 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.

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	0.008	
tritium	300		
Mn-54	11		
Fe-59	20		
Co-58	10		
Co-60	10		
Zn-65	24		
Zr-95	18		
Nb-95	10		
I-131	12 [a]	0.03 [b]	20
Cs-134	12	0.02 [b]	20
Cs-137	13	0.02 [b]	25
Ba-140	38		
La-140	11		

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 2000, 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	I-131	84	129	34.5	4	1.53	ACCEPT
			Ce-141	74	95	6.5	15	1.29	ACCEPT
			Cr-51	226	210	30.5	7	0.93	ACCEPT
			Cs-134	98	91	2.5	37	0.93	ACCEPT
			Cs-137	204	212	3.5	60	1.04	ACCEPT
			Mn-54	127	140	3	47	1.10	ACCEPT
			Fe-59	54	51	6	9	0.94	ACCEPT
			Zn-65	158	169	5	34	1.07	ACCEPT
			Co-58	111	112	3	37	1.01	ACCEPT
			Co-60	152	162	3	55	1.07	ACCEPT
	Tritium	pCi/liter	H-3	11400	9262	145	64	0.81	ACCEPT
	Gross Beta	pCi/liter		126	138	2.5	55	1.10	ACCEPT
Air	Iodine	pCi/canister	I-131	71	71	5.5	13	1.00	ACCEPT
	Gross Beta	pCi/filter		66	83	2.0	42	1.26	ACCEPT
	Mixed Gamma	pCi/filter	Cr-51	187	209	18.5	11	1.12	ACCEPT
			Mn-54	105	119	3	40	1.13	ACCEPT
			Fe-59	44	49	5	10	1.11	ACCEPT
			Co-58	92	94	3	31	1.02	ACCEPT
			Co-60	125	134	3.5	38	1.07	ACCEPT
			Zn-65	131	143	6	24	1.09	ACCEPT
			Cs-134	81	78	2.5	31	0.96	ACCEPT
			Cs-137	168	181	3	60	1.08	ACCEPT
			Ce-141	61	64	2.5	25	1.04	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

4th 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	376	383	11.5	33	1.02	ACCEPT
			Cr-51	532	635	73	9	1.19	ACCEPT
			Cs-134	90	89	4.5	20	0.99	ACCEPT
			Cs-137	210	210	6.5	32	1.00	ACCEPT
			Co-58	81	82	6.5	13	1.01	ACCEPT
			Mn-54	161	164	6.5	25	1.02	ACCEPT
			Fe-59	86	92	13.5	7	1.07	ACCEPT
			Zn-65	156	143	14	10	0.92	ACCEPT
			Co-60	194	185	6	31	0.95	ACCEPT
	Tritium	pCi/liter	H-3	10100	8839	136.5	65	0.88	ACCEPT
	Gross Beta	pCi/liter		260	298	3.5	85	1.15	ACCEPT
Air	Iodine	pCi/canister	I-131	64	63	5.5	11	0.98	ACCEPT
	Mixed Gamma	pCi/filter	Cr-51	297	345	35	10	1.16	ACCEPT
			Mn-54	90	97	6	16	1.08	ACCEPT
			Fe-59	48	72	11.5	6	1.50	ACCEPT
			Co-58	45	45	4.5	10	1.00	ACCEPT
			Co-60	108	112	7.5	15	1.04	ACCEPT
			Zn-65	87	101	9	11	1.16	ACCEPT
			Cs-134	50	46	4.5	10	0.92	ACCEPT
			Cs-137	117	133	8	17	1.14	ACCEPT
			Ce-141	210	221	12	18	1.05	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 2000 are presented in the following sections. Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. Although there was one incidence of I-131 detected at one (1) air sample location (refer to Table 2.3 for a description of this event), there were no radiological impacts on the environment due to PVNGS operations in 2000.

8.1. Air Particulates

Weekly gross beta results, in quarterly format, are presented in Tables 8.1 and 8.2 and depicted in graphs in Figures 8.1 and 8.2. Gross beta activity ranged from 0.011 to 0.098 pCi/m^3. The associated counting error ranged from 0.001 to 0.004 pCi/m^3. Mean quarterly activities are calculated using all weekly activities except those 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 1991-2000 gross beta in air results. As can be seen, the indicator sites trend consistently with the control site.

Table 8.3 displays the results of gamma spectroscopy on the quarterly composites. The results are summarized in Table 11.1. No Cs-134 or Cs-137 was observed.

8.2. Airborne Radioiodine

Tables 8.4 through 8.5 present the quarterly radioiodine results. There was one incidence of I-131 (0.022 pCi/m^3) detected at one (1) air sample location approximately 0.6 miles west of Unit 2. Refer to Table 2.3 for a description of this event.

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 5.8 pCi/liter (McArthur residence, December 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 and the Reservoir in two (2) of the monthly composite samples. The concentrations were 8 - 17 pCi/liter. Cs-137 was identified in two (2) samples from Evaporation Pond #2 at concentrations of 10 - 17 pCi/liter.

Tritium was routinely observed in Evaporation Ponds 1 and 2. The highest concentration in Evaporation Pond #1 was 1318 pCi/liter and the highest concentration in Evaporation Pond #2 was 1476 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 47 pCi/liter (week of December 19). 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. No gamma-emitting nuclides were detected in these samples. Tritium was detected in three of seven samples ranging from 669 to 860 pCi/liter. The tritium in this basin has been attributed to plant gaseous effluent releases.

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 310 to 1152 pCi/kg.

In-111 was also identified in the sludge on occasion. The highest In-111 concentration was 67 pCi/liter (week of Sept. 5). 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

Evaporation Pond #1 samples indicated no gamma-emitters. Evaporation Pond #2 samples indicated low levels of Cs-137 and Co-60. These radionuclides are evidently due to previous primary-to-secondary leaks that resulted in their transport to the onsite ponds and are consistent with previous results. Sample results can be found in Table 8.10.

8.7.3. Cooling Tower sludge

Sludge originating from Units 1, 2, and 3 was disposed of in the WRF landfill during 2000. 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	
7-21-00	1	595	Co-60	<MDA-304	(15 of 30 samples)
			Cs-137	<MDA-155	(11 of 30 samples)
7-21-00	2	595	Co-60	140-10200	(30 of 30 samples)
			Cs-137	<MDA-565	(21 of 30 samples)
2-17-00	3	595	Co-60	<MDA-925	(17 of 30 samples)
			Cs-137	<MDA-245	(4 of 30 samples)

8.8. Data Trends

Figures 8.1-8.4 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	27-Dec-99	4-Jan-00	0.048	0.041	0.058	0.051	0.043	0.046	0.043	0.055	0.051	0.038	0.047	13.5
2	4-Jan-00	11-Jan-00	0.050	0.036	0.042	0.029	0.039	0.045	0.042	0.032	0.039	0.040	0.039	15.4
3	11-Jan-00	18-Jan-00	0.059	0.063	0.072	0.056	0.058	0.053	0.062	0.062	0.055	0.045	0.059	12.2
4	18-Jan-00	25-Jan-00	0.058	0.060	0.063	0.041	0.044	0.045	0.042	0.053	0.047	0.044	0.050	16.3
5	25-Jan-00	1-Feb-00	0.031	0.032	0.035	0.033	0.033	0.029	0.028	0.033	0.030	0.011	0.030	23.2
6	1-Feb-00	8-Feb-00	0.058	0.060	0.059	0.041	0.057	0.055	0.054	0.058	0.057	0.050	0.055	10.3
7	8-Feb-00	15-Feb-00	0.028	0.028	0.028	0.026	0.026	0.027	0.026	0.029	0.026	0.021	0.027	8.4
8	15-Feb-00	22-Feb-00	0.025	0.024	0.028	0.022	0.024	0.019	0.021	(a)	0.020	(a)	0.023	12.9
9	22-Feb-00	29-Feb-00	0.017	0.021	0.019	0.019	0.019	0.017	0.015	0.018	0.016	0.017	0.018	9.8
10	29-Feb-00	7-Mar-00	0.020	0.019	0.023	0.020	0.019	0.018	0.020	0.019	0.019	0.017	0.019	8.1
11	7-Mar-00	14-Mar-00	0.027	0.028	0.030	0.027	0.028	0.031	0.024	0.029	0.026	0.023	0.027	9.1
12	14-Mar-00	20-Mar-00	0.034	0.036	0.036	0.033	0.033	0.035	0.034	0.033	0.034	0.035	0.034	3.4
13	20-Mar-00	27-Mar-00	0.027	0.026	0.028	0.028	0.028	0.026	0.023	0.027	0.027	0.022	0.026	8.0
	Mean		0.037	0.036	0.040	0.033	0.035	0.034	0.033	0.037	0.034	0.030	0.035	7.9

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	27-Mar-00	3-Apr-00	0.025	0.027	0.021	0.022	0.024	0.023	0.026	0.023	0.024	0.021	0.024	8.5
15	3-Apr-00	10-Apr-00	0.032	0.035	0.034	0.035	0.034	0.031	0.033	0.032	0.032	0.028	0.033	6.5
16	10-Apr-00	17-Apr-00	0.025	0.025	0.027	0.025	0.023	0.024	0.024	0.027	0.023	0.018	0.024	10.6
17	17-Apr-00	24-Apr-00	0.015	0.015	0.018	0.019	0.018	0.016	0.023	0.019	0.019	0.014	0.018	15.2
18	24-Apr-00	1-May-00	0.037	0.039	0.038	0.033	0.040	0.032	0.036	0.036	0.037	0.026	0.035	11.6
19	1-May-00	8-May-00	0.031	0.033	0.032	0.031	0.032	0.029	0.031	0.033	0.033	0.026	0.031	7.0
20	8-May-00	15-May-00	0.024	0.027	0.029	0.026	0.024	0.024	0.022	0.025	0.023	0.020	0.024	10.4
21	15-May-00	22-May-00	0.024	0.019	0.027	0.024	0.021	0.019	0.023	0.023	0.023	0.021	0.022	11.0
22	22-May-00	30-May-00	0.039	0.041	0.040	0.037	0.044	0.039	0.039	0.043	0.040	0.036	0.040	6.1
23	30-May-00	5-Jun-00	0.030	0.021	0.030	0.026	0.038	0.028	0.030	0.034	0.030	0.025	0.029	16.1
24	5-Jun-00	12-Jun-00	0.030	0.033	0.033	0.033	0.036	0.035	0.032	0.036	0.028	0.028	0.032	9.1
25	12-Jun-00	19-Jun-00	0.018	0.032	0.029	0.032	0.031	0.025	0.025	0.023	0.034	0.026	0.028	18.1
26	19-Jun-00	26-Jun-00	0.021	0.022	0.024	0.021	0.024	0.023	0.021	0.021	0.021	0.018	0.022	8.2
	Mean		0.027	0.028	0.029	0.028	0.030	0.027	0.028	0.029	0.028	0.024	0.028	6.3

(a) Sample results were invalid as it was not possible to determine actual sample pump run times. See Table 2.3.

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	26-Jun-00	3-Jul-00	0.023	0.023	0.023	0.022	0.028	0.024	0.019	0.027	0.028	0.022	0.024	12.2
28	3-Jul-00	10-Jul-00	0.025	0.027	0.027	0.021	0.023	0.027	0.024	0.023	0.028	0.021	0.025	10.5
29	10-Jul-00	17-Jul-00	0.022	0.020	0.025	0.025	0.025	0.021	0.025	0.026	0.027	0.022	0.024	9.9
30	17-Jul-00	24-Jul-00	0.031	0.029	0.029	0.023	0.038	0.033	0.026	0.024	0.032	0.025	0.029	16.1
31	24-Jul-00	1-Aug-00	0.030	0.041	0.037	0.044	0.041	0.036	0.038	0.044	0.045	0.036	0.039	12.0
32	1-Aug-00	8-Aug-00	0.036	0.036	0.037	0.038	0.041	0.037	0.036	0.038	0.034	0.035	0.037	5.3
33	8-Aug-00	15-Aug-00	0.039	0.038	0.036	0.038	0.040	0.038	0.038	0.036	0.037	0.029	0.037	8.2
34	15-Aug-00	21-Aug-00	0.046	0.039	0.041	0.035	0.040	0.042	0.040	0.041	0.039	0.034	0.040	8.6
35	21-Aug-00	28-Aug-00	0.024	0.036	0.035	0.035	0.037	0.030	0.033	0.036	0.035	0.027	0.033	13.3
36	28-Aug-00	5-Sep-00	0.033	0.032	0.030	0.028	0.030	0.032	0.029	0.031	0.030	0.024	0.030	8.6
37	5-Sep-00	11-Sep-00	0.037	0.033	0.036	0.034	0.033	0.033	0.030	0.036	0.037	0.031	0.034	7.2
38	11-Sep-00	18-Sep-00	0.039	0.038	0.040	0.035	0.042	0.037	0.036	0.039	0.039	0.031	0.038	8.1
39	18-Sep-00	25-Sep-00	0.030	0.031	0.029	0.029	0.028	0.030	0.028	0.032	0.029	0.026	0.029	5.8
	Mean		0.032	0.033	0.033	0.031	0.034	0.032	0.031	0.033	0.034	0.028	0.032	5.6

4th 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 (%)
40	25-Sep-00	2-Oct-00	0.029	0.035	0.040	0.035	0.035	0.035	0.033	0.036	0.033	0.030	0.034	9.1
41	2-Oct-00	10-Oct-00	0.030	0.032	0.033	0.035	0.034	0.031	0.033	0.035	0.035	0.028	0.033	7.3
42	10-Oct-00	16-Oct-00	0.029	0.030	0.028	0.026	0.024	0.028	0.025	0.028	0.025	0.026	0.027	7.3
43	16-Oct-00	23-Oct-00	0.028	0.031	0.032	0.029	0.027	0.028	0.029	0.033	0.031	0.033	0.030	7.3
44	23-Oct-00	30-Oct-00	0.017	0.017 (a)	0.018	0.016	0.015	0.016	0.016	0.018	0.016	0.016	0.016	6.2
45	30-Oct-00	6-Nov-00	0.035	0.041	0.035	0.033	0.032	0.032	0.033	0.034	0.031	0.035	0.034	8.2
46	6-Nov-00	14-Nov-00	0.029	0.030	0.031	0.030	0.030	0.030	0.027	0.033	0.029	0.031	0.030	5.2
47	14-Nov-00	20-Nov-00	0.044	0.047	0.049	0.041	0.042	0.041	0.041	0.044	0.037	0.041	0.043	8.0
48	20-Nov-00	27-Nov-00	0.065	0.060	0.064	0.058	0.065	0.051	0.060	0.067	0.050	0.062	0.060	9.6
49	27-Nov-00	4-Dec-00	0.062	0.083	0.078	0.069	0.074	0.074	0.069	0.080	0.072	0.073	0.073	8.2
50	4-Dec-00	11-Dec-00	0.085	0.098	0.089	0.083	0.085	0.089	0.075	0.092	0.088	0.078	0.086	7.7
51	11-Dec-00	18-Dec-00	0.032	0.027	0.037	0.031	0.033	0.032	0.035	0.034	0.034	0.035	0.033	8.3
52	18-Dec-00	26-Dec-00	0.044	0.045	0.047	0.039	0.043	0.037	0.041	0.042	0.038	0.043	0.042	7.6
	Mean		0.041	0.047	0.045	0.040	0.041	0.040	0.040	0.044	0.040	0.041	0.042	5.7
	Annual Average		***0.034***	***0.036***	***0.037***	***0.033***	***0.035***	***0.033***	***0.033***	***0.036***	***0.034***	***0.031***	***0.034***	***5.2***

(a) sample location inaccessible on 10-30-00 due to local flooding. Sample was collected on 10-31-00.

TABLE 8.3 GAMMA IN AIR FILTER COMPOSITES

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

QUARTER ENDPOINT	NUCLIDE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
27-Mar-00	Cs-134	<0.0014	<0.0018	<0.0028	<0.0021	<0.0020	<0.0017	<0.0016	<0.0016	<0.0018	<0.0013
	Cs-137	<0.0019	<0.0016	<0.0018	<0.0020	<0.0018	<0.0016	<0.0020	<0.0013	<0.0021	<0.0017
26-Jun-00	Cs-134	<0.0017	<0.0023	<0.0018	<0.0022	<0.0018	<0.0018	<0.0020	<0.0018	<0.0018	<0.0023
	Cs-137	<0.0015	<0.0015	<0.0018	<0.0017	<0.0016	<0.0017	<0.0016	<0.0015	<0.0019	<0.0015
25-Sep-00	Cs-134	<0.0017	<0.0020	<0.0021	<0.0018	<0.0015	<0.0022	<0.0019	<0.0014	<0.0015	<0.0020
	Cs-137	<0.0015	<0.0017	<0.0016	<0.0019	<0.0017	<0.0016	<0.0018	<0.0018	<0.0016	<0.0017
26-Dec-00	Cs-134	<0.0026	<0.0016	<0.0019	<0.0018	<0.0019	<0.0014	<0.0019	<0.0021	<0.0023	<0.0016
	Cs-137	<0.0016	<0.0017	<0.0015	<0.0012	<0.0020	<0.0012	<0.0020	<0.0018	<0.0019	<0.0012

TABLE 8.4 RADIOIODINE IN AIR 1st - 2nd QUARTER

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

1st Quarter

				(control)		required LLD <0.070						
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*
1	27-Dec-99	4-Jan-00	<0.022	<0.017	<0.021	<0.022	<0.022	<0.024	<0.022	<0.020	<0.017	<0.020
2	4-Jan-00	11-Jan-00	<0.030	<0.028	<0.035	<0.031	<0.028	<0.035	<0.030	<0.031	<0.028	<0.031
3	11-Jan-00	18-Jan-00	<0.027	<0.026	<0.028	<0.032	<0.031	<0.022	<0.022	<0.032	<0.035	<0.022
4	18-Jan-00	25-Jan-00	<0.027	<0.025	<0.024	<0.026	<0.027	<0.028	<0.034	<0.029	<0.039	<0.025
5	25-Jan-00	1-Feb-00	<0.023	<0.018	<0.023	<0.030	<0.023	<0.025	<0.022	<0.029	<0.014	<0.029
6	1-Feb-00	8-Feb-00	<0.029	<0.023	<0.054	<0.019	<0.022	<0.026	<0.033	<0.021	<0.031	<0.022
7	8-Feb-00	15-Feb-00	<0.019	<0.020	<0.027	<0.030	<0.031	<0.027	<0.033	<0.021	<0.017	<0.022
8	15-Feb-00	22-Feb-00	<0.025	<0.027	<0.024	<0.028	<0.022	<0.029	<0.028	(a)	<0.034	(a)
9	22-Feb-00	29-Feb-00	<0.024	<0.041	<0.029	<0.028	<0.023	<0.018	<0.027	<0.028	<0.025	<0.031
10	29-Feb-00	7-Mar-00	<0.033	<0.025	<0.028	<0.027	<0.024	<0.027	<0.022	<0.025	<0.027	<0.024
11	7-Mar-00	14-Mar-00	<0.030	<0.028	<0.022	<0.029	<0.017	<0.011	<0.027	<0.030	<0.027	<0.025
12	14-Mar-00	20-Mar-00	<0.027	<0.029	<0.027	<0.022	<0.031	<0.026	<0.028	<0.025	<0.022	<0.039
13	20-Mar-00	27-Mar-00	<0.018	<0.024	<0.033	<0.035	<0.027	<0.026	<0.036	<0.032	<0.033	<0.025

2nd Quarter

				(control)		required LLD <0.070						
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*
14	27-Mar-00	3-Apr-00	<0.019	<0.019	<0.020	<0.028	<0.022	<0.021	<0.028	<0.021	<0.018	<0.025
15	3-Apr-00	10-Apr-00	<0.032	<0.024	<0.027	<0.027	<0.026	<0.019	<0.028	<0.024	<0.023	<0.026
16	10-Apr-00	17-Apr-00	<0.028	<0.030	<0.024	<0.018	<0.025	<0.022	<0.029	<0.021	<0.024	<0.019
17	17-Apr-00	24-Apr-00	<0.025	<0.019	<0.033	<0.031	<0.025	<0.037	<0.021	<0.032	<0.031	<0.026
18	24-Apr-00	1-May-00	<0.024	<0.027	<0.018	<0.022	<0.022	<0.028	<0.024	<0.028	<0.029	<0.023
19	1-May-00	8-May-00	<0.028	<0.026	<0.020	<0.026	<0.025	<0.027	<0.029	<0.020	<0.028	<0.025
20	8-May-00	15-May-00	<0.026	<0.019	<0.029	<0.025	<0.023	<0.029	<0.025	<0.026	<0.020	<0.029
21	15-May-00	22-May-00	<0.027	<0.026	<0.028	<0.024	<0.027	<0.027	<0.027	<0.028	<0.029	<0.033
22	22-May-00	30-May-00	<0.017	<0.023	<0.020	<0.022	<0.020	<0.026	<0.018	<0.019	<0.026	<0.016
23	30-May-00	5-Jun-00	<0.016	<0.024	<0.025	<0.023	<0.027	<0.020	<0.021	<0.030	<0.023	<0.023
24	5-Jun-00	12-Jun-00	<0.025	<0.020	<0.021	<0.017	<0.018	<0.021	<0.024	<0.017	<0.023	<0.019
25	12-Jun-00	19-Jun-00	<0.023	<0.015	<0.024	<0.018	<0.024	<0.015	<0.021	<0.017	<0.017	<0.017
26	19-Jun-00	26-Jun-00	<0.018	<0.026	<0.019	<0.020	<0.023	<0.018	<0.021	<0.021	<0.019	<0.026

(a) Sample results were invalid as it was not possible to determine actual sample pump run times. See Table 2.3.

TABLE 8.5 RADIOIODINE IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

				(control)		required LLD <0.070						
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*
27	26-Jun-00	3-Jul-00	<0.022	<0.018	<0.030	<0.018	<0.025	<0.017	<0.029	<0.020	<0.027	<0.020
28	3-Jul-00	10-Jul-00	<0.023	<0.030	<0.024	<0.029	<0.024	<0.020	<0.032	<0.025	<0.021	<0.018
29	10-Jul-00	17-Jul-00	<0.027	<0.020	<0.027	<0.026	<0.017	<0.021	<0.023	<0.025	<0.030	<0.023
30	17-Jul-00	24-Jul-00	<0.028	<0.028	<0.023	<0.026	<0.025	<0.026	<0.027	<0.022	<0.021	<0.023
31	24-Jul-00	1-Aug-00	<0.024	<0.022	<0.019	<0.023	<0.028	<0.024	<0.026	<0.021	<0.024	<0.019
32	1-Aug-00	8-Aug-00	<0.025	<0.019	<0.022	<0.025	<0.018	<0.024	<0.022	<0.025	<0.026	<0.022
33	8-Aug-00	15-Aug-00	<0.026	<0.020	<0.021	<0.031	<0.034	<0.026	<0.021	<0.034	<0.031	<0.020
34	15-Aug-00	21-Aug-00	<0.043	<0.025	<0.040	<0.026	<0.021	<0.024	<0.025	<0.023	<0.029	<0.029
35	21-Aug-00	28-Aug-00	<0.022	<0.017	<0.028	<0.025	<0.020	<0.022	<0.021	<0.026	<0.020	<0.021
36	28-Aug-00	5-Sep-00	<0.021	<0.020	<0.027	<0.022	<0.024	<0.027	<0.024	<0.015	<0.026	<0.019
37	5-Sep-00	11-Sep-00	<0.028	<0.034	<0.028	<0.034	<0.025	<0.034	<0.027	<0.024	<0.025	<0.029
38	11-Sep-00	18-Sep-00	<0.020	<0.020	<0.020	<0.021	<0.019	<0.014	<0.021	<0.024	<0.021	<0.023
39	18-Sep-00	25-Sep-00	<0.020	<0.026	<0.027	<0.022	<0.029	<0.021	<0.031	<0.019	<0.026	<0.026

4th Quarter

				(control)		required LLD <0.070						
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*
40	25-Sep-00	2-Oct-00	<0.022	<0.022	<0.020	<0.016	<0.022	<0.024	<0.022	<0.027	<0.024	<0.023
41	2-Oct-00	10-Oct-00	<0.016	<0.021	<0.019	<0.018	<0.021	<0.015	<0.022	<0.026 (a)	<0.022	<0.019
42	10-Oct-00	16-Oct-00	<0.017	<0.020	<0.016	<0.018	<0.019	<0.016	<0.017	<0.018	<0.019	<0.017
43	16-Oct-00	23-Oct-00	<0.013	<0.012	<0.013	<0.011	<0.012	<0.013	<0.015	<0.017	<0.014	<0.014
44	23-Oct-00	30-Oct-00	<0.015	<0.016 (b)	<0.015	<0.018	<0.016	<0.016	<0.018	<0.019	<0.019	<0.017
45	30-Oct-00	6-Nov-00	<0.013	<0.019	<0.016	<0.013	<0.017	<0.016	<0.014	<0.014	<0.016	<0.015
46	6-Nov-00	14-Nov-00	<0.022	<0.021	<0.018	<0.022	<0.020	<0.024	<0.021	<0.019	<0.016	<0.023
47	14-Nov-00	20-Nov-00	<0.023	<0.032	<0.023	<0.023	<0.022	<0.027	<0.023	<0.024	<0.027	<0.023
48	20-Nov-00	27-Nov-00	<0.029	<0.022	<0.022	<0.026	<0.025	<0.028	<0.023	<0.029	<0.027	<0.027
49	27-Nov-00	4-Dec-00	<0.018	<0.023	<0.024	<0.024	<0.022	<0.023	<0.024	<0.018	<0.026	<0.023
50	4-Dec-00	11-Dec-00	<0.020	<0.032	<0.021	<0.037	<0.026	<0.021	<0.027	<0.029	<0.024	<0.033
51	11-Dec-00	18-Dec-00	<0.030	<0.014	<0.028	<0.024	<0.030	<0.030	<0.026	<0.036	<0.023	<0.021
52	18-Dec-00	26-Dec-00	<0.022	<0.019	<0.023	<0.018	<0.031	<0.025	<0.029	<0.022	<0.026	<0.027

(a) The Arizona Radiation Regulatory Agency (ARRA) notified APS that they identified I-131 at this location in the concentration of 0.022 pCi/m^3. This sample was recounted for 4 hours with a result of 0.022 pCi/m^3. The I-131 activity was determined to be a result of a Unit 2 release (opening of pressurizer/steam generator manways) during a refueling outage at Unit 2 with elevated I-131 activity. The release was accounted for via the plant vent and included on a gaseous effluent release permit. See additional discussion in Section 2 of this report.

(b) Sample location inaccessible on 10-30-00 due to local flooding. Sample was collected on 10-31-00.

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)*	NONE AVAILABLE				
BRANCH RESIDENCE (SITE #64)	NONE AVAILABLE				
ROUSSEAU FARMS (SITE #62)*	red cabbage	14-Jan-00	<17	<20	<16
	purple cabbage	14-Jan-00	<23	<41	<31
	turnip greens	14-Jan-00	<21	<24	<17
	cabbage	11-Feb-00	<20	<19	<24
	mustard greens	11-Feb-00	<19	<24	<20
	turnip greens	11-Feb-00	<24	<27	<25
	green cabbage	17-Mar-00	<14	<16	<16
	red cabbage	17-Mar-00	<20	<28	<27
	cabbage	14-Apr-00	<13	<17	<14
	collard greens	16-Nov-00	<14	<17	<14
	kale	16-Nov-00	<18	<25	<22
	mustard greens	16-Nov-00	<26	<36	<27
	cabbage	13-Dec-00	<27	<42	<35
	mustard greens	13-Dec-00	<25	<36	<31
	kale	13-Dec-00	<30	<39	<32
HALLMAN RESIDENCE (SITE #52)*	NONE AVAILABLE				

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) *	25-Jan-00	<9	<11	<21	<9	<21	<12	<19	<11	<11	<10	<37	<13		4.1 ± 2.5
	29-Feb-00	<11	<10	<20	<10	<26	<12	<19	<10	<11	<11	<39	<11		3.6 ± 1.7
	27-Mar-00	<9	<11	<18	<10	<22	<11	<18	<12	<13	<10	<38	<11	<283	3.2 ± 1.7
	24-Apr-00	<11	<10	<21	<10	<23	<11	<15	<11	<11	<11	<38	<14		5.7 ± 1.7
	30-May-00	<12	<12	<21	<13	<24	<11	<20	<10	<14	<11	<42	<11		5.4 ± 1.7
	26-Jun-00	<11	<11	<18	<9	<21	<10	<17	<12	<12	<11	<39	<11	<286	5.0 ± 1.8
	24-Jul-00	<12	<11	<22	<11	<21	<13	<20	<11	<15	<12	<37	<10		3.4 ± 1.7
	28-Aug-00	<10	<9	<19	<7	<21	<10	<17	<10	<10	<11	<41	<8		<2.5
	25-Sep-00	<10	<10	<22	<10	<22	<11	<21	<10	<13	<11	<40	<10	<298	<2.6
	30-Oct-00	<10	<10	<18	<11	<20	<10	<17	<11	<13	<11	<35	<10		<2.9
	27-Nov-00	<10	<9	<23	<11	<24	<11	<18	<11	<14	<11	<37	<9		<3.4
	18-Dec-00 (a)	<7	<7	<19	<10	<14	<8	<13	<14	<9	<7	<28	<13	<298	5.8 ± 1.8
GAVETTE RESIDENCE (SITE #55)	25-Jan-00	<8	<10	<17	<14	<23	<11	<17	<9	<10	<10	<39	<12		4.9 ± 1.7
	29-Feb-00	<11	<9	<21	<9	<20	<10	<18	<9	<12	<10	<36	<8		5.1 ± 1.8
	27-Mar-00	<9	<10	<14	<8	<21	<10	<19	<9	<10	<11	<36	<10	<281	4.3 ± 1.7
	24-Apr-00	<10	<11	<21	<11	<24	<11	<22	<12	<13	<11	<41	<12		4.6 ± 1.7
	30-May-00	<11	<10	<22	<10	<24	<11	<20	<10	<10	<10	<36	<11		5.6 ± 1.7
	26-Jun-00	<10	<10	<18	<12	<19	<11	<17	<12	<11	<10	<36	<10	<284	3.1 ± 1.7
	24-Jul-00	<9	<8	<18	<9	<19	<11	<18	<10	<12	<12	<35	<11		<2.7
	28-Aug-00	<9	<9	<20	<11	<20	<12	<18	<10	<12	<12	<40	<9		4.7 ± 2.6
	25-Sep-00	<11	<9	<19	<9	<22	<12	<19	<10	<12	<11	<37	<9	<298	<2.6
	30-Oct-00	<12	<10	<21	<12	<19	<10	<19	<12	<12	<11	<41	<13		<3.8
	27-Nov-00	<10	<9	<22	<11	<23	<8	<19	<12	<12	<12	<37	<11		<3.4
	26-Dec-00	<9	<8	<15	<10	<18	<9	<15	<8	<9	<9	<24	<12	<296	4.0 ± 1.7

(a) Resident well out of service the week of 12-26-00. Last sample for month and quarter is 12-18-00.

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)*	25-Jan-00	<10	<10	<21	<12	<27	<10	<19	<11	<11	<11	<40	<10		4.8 ± 2.0
	29-Feb-00	<11	<9	<19	<11	<20	<9	<17	<10	<13	<11	<35	<10		<3.2
	27-Mar-00	<9	<10	<20	<12	<20	<10	<17	<11	<10	<11	<36	<9	<281	3.6 ± 2.0
	24-Apr-00	<11	<9	<21	<9	<24	<11	<19	<11	<12	<11	<36	<11		5.0 ± 2.0
	30-May-00	<12	<11	<23	<7	<27	<10	<18	<10	<13	<10	<38	<11		4.7 ± 2.0
	26-Jun-00	<10	<11	<22	<13	<22	<10	<18	<11	<14	<11	<32	<13	<282	<3.3
	24-Jul-00	<11	<8	<24	<9	<22	<10	<17	<11	<11	<11	<38	<8		<3.4
	28-Aug-00	<8	<10	<19	<10	<24	<11	<18	<11	<12	<11	<36	<11		<3.3
	25-Sep-00	<10	<12	<21	<11	<24	<11	<18	<10	<10	<11	<35	<11	<296	<3.3
	30-Oct-00	<11	<9	<15	<11	<25	<10	<19	<10	<11	<10	<33	<8		<2.9
	27-Nov-00	<11	<12	<19	<10	<24	<11	<19	<12	<11	<11	<37	<11		4.0 ± 1.8
	26-Dec-00	<11	<8	<18	<11	<23	<10	<17	<10	<13	<10	<33	<10	<293	5.5 ± 2.2
CHOWANEC RESIDENCE (SITE #49) *	25-Jan-00	<11	<10	<18	<10	<22	<11	<16	<10	<12	<12	<35	<8		<2.3
	29-Feb-00	<10	<9	<18	<12	<21	<10	<15	<11	<10	<9	<32	<10		<2.5
	27-Mar-00	<11	<11	<19	<12	<25	<11	<21	<12	<13	<10	<40	<9	<285	<2.4
	24-Apr-00	<9	<10	<19	<8	<22	<10	<19	<11	<13	<9	<36	<10		<2.3
	30-May-00	<9	<8	<23	<9	<21	<11	<16	<11	<13	<11	<39	<11		3.1 ± 1.5
	26-Jun-00	<10	<9	<22	<12	<28	<10	<24	<11	<13	<11	<43	<13	<286	<2.4
	24-Jul-00	<8	<11	<20	<10	<19	<11	<16	<11	<12	<11	<40	<11		<2.5
	28-Aug-00	<10	<10	<19	<10	<20	<11	<19	<11	<13	<11	<37	<12		<2.5
	25-Sep-00	<9	<10	<20	<11	<24	<11	<20	<10	<13	<11	<37	<10	<298	<2.5
	30-Oct-00	<10	<9	<17	<10	<21	<11	<20	<10	<11	<13	<38	<10		<2.7
	27-Nov-00	<10	<9	<22	<12	<23	<11	<16	<11	<12	<11	<37	<10		<3.3
	26-Dec-00	<12	<11	<23	<12	<26	<10	<21	<11	<13	<10	<37	<9	<296	3.4 ± 1.6

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)*	24-Jan-00	<11	<11	<23	<11	<25	<15	<21	<11	<12	<11	<37	<12	<284
	24-Apr-00	<10	<11	<22	<12	<25	<15	<19	<13	<12	<11	<39	<10	<288
	24-Jul-00	<10	<10	<21	<12	<25	<13	<19	<11	<13	<10	<41	<12	<276
	30-Oct-00	<10	<10	<24	<11	<25	<13	<18	<13	<14	<11	<40	<12	<292
WELL 34abb (Site #58)*	24-Jan-00	<10	<11	<23	<9	<25	<14	<17	<11	<13	<11	<35	<15	<284
	24-Apr-00	<13	<13	<23	<14	<29	<15	<19	<13	<12	<13	<45	<11	<290
	24-Jul-00	<13	<10	<23	<13	<26	<12	<21	<11	<13	<13	<42	<13	<285
	30-Oct-00	<12	<13	<22	<13	<26	<13	<23	<12	<14	<12	<43	<11	<296

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) *	25-Jan-00	<11	<10	<19	<11	<21	<10	<16	<11	<11	<10	<38	<3	
	29-Feb-00	<9	<10	<20	<9	<18	<11	<16	<9	<12	<10	<33	<9	
	27-Mar-00	<9	<10	<16	<11	<22	<10	<16	<12	<11	<10	<35	<9	<285
	24-Apr-00	<11	<10	<25	<14	<22	<11	<18	<12	<12	<13	<43	<12	
	30-May-00	<10	<10	<20	<9	<23	<11	<18	<12	<11	<12	<35	<12	
	26-Jun-00	<10	<11	<21	<10	<24	<12	<18	<13	<11	<12	<36	<10	<287
	24-Jul-00	<10	<9	<18	<9	<24	<10	<15	<8	<10	<12	<35	<12	
	28-Aug-00	<10	<9	<19	<8	<24	<10	<17	<13	<11	<10	<38	<9	
	25-Sep-00	<10	<10	<20	<12	<21	<10	<16	<11	<11	<11	<39	<10	<296
	30-Oct-00	<11	<11	<21	<11	<21	<10	<19	<13	<13	<11	<35	<13	
	27-Nov-00	<11	<11	<21	<11	<22	<11	<16	8 ± 3	<11	<12	<34	<9	
	26-Dec-00	<10	<12	<18	<8	<24	<12	<18	17 ± 13	<13	<11	<48	<14	<296
EVAP POND 1 (Site #59) *	25-Jan-00	<9	<11	<24	<12	<22	<11	<17	<9	<13	<12	<39	<11	
	29-Feb-00	<10	<13	<25	<13	<28	<12	<21	9 ± 8	<12	<12	<41	<14	
	27-Mar-00	<10	<9	<23	<11	<26	<11	<20	<10	<13	<13	<36	<11	618 ± 180
	24-Apr-00	<11	<11	<23	<11	<21	<11	<19	<12	<12	<13	<34	<13	
	30-May-00	<9	<10	<24	<14	<24	<11	<19	<14	<12	<11	<39	<11	
	26-Jun-00	<10	<10	<22	<10	<28	<11	<16	<12	<12	<10	<39	<11	1314 ± 162
	24-Jul-00	<11	<9	<21	<10	<22	<10	<18	<13	<10	<11	<37	<12	
	28-Aug-00	<11	<12	<25	<11	<26	<10	<20	<11	<13	<13	<32	<9	
	25-Sep-00	<11	<11	<23	<13	<24	<11	<18	<13	<13	<14	<38	<12	821 ± 185
	30-Oct-00	<11	<13	<25	<11	<28	<11	<20	<12	<13	<12	<36	<12	
	27-Nov-00	<12	<11	<25	<14	<24	<13	<19	<15	<15	<13	<44	<14	
	26-Dec-00	<11	<11	<23	<11	<29	<12	<21	17 ± 11	<13	<13	<34	<10	1318 ± 166
EVAP POND 2 (Site #63) *	25-Jan-00	<10	<10	<24	<10	<25	<11	<16	<11	<13	<13	<33	<10	
	29-Feb-00	<11	<11	<19	<12	<25	<11	<19	<10	<12	<13	<33	<7	
	27-Mar-00	<10	<10	<21	<12	<23	<10	<16	<11	<12	<14	<29	<10	1391 +/- 189
	24-Apr-00	<9	<10	<22	<10	<19	<10	<16	<11	<13	<14	<38	<11	
	30-May-00	<11	<11	<23	<13	<25	<11	<17	<10	<11	<12	<37	<11	
	26-Jun-00	<10	<11	<23	<11	<30	<12	<18	<12	<13	10 ± 7	<38	<10	1212 ± 158
	24-Jul-00	<10	<11	<21	<11	<24	<11	<19	<11	<13	<14	<38	<8	
	28-Aug-00	<11	<9	<23	<13	<30	<10	<21	<11	<13	<14	<39	<11	
	25-Sep-00	<14	<13	<25	<13	<29	<13	<21	<12	<13	<13	<38	<12	1425 ± 195
	30-Oct-00	<11	<9	<23	<7	<26	<11	<21	<11	<13	<14	<37	<10	
	27-Nov-00	<10	<12	<24	<11	<26	<13	<21	<12	<13	<15	<41	<10	
	26-Dec-00	<9	<8	<18	<12	<22	<8	<14	<7	<10	17 ± 8	<25	<10	1476 ± 165

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	4-Jan-00	<10	<11	<21	<13	<20	<11	<18	16 ± 9	<13	<10	<37	<8	
	11-Jan-00	<11	<11	<21	<10	<28	<11	<18	29 ± 13	<11	<11	<41	<11	
	19-Jan-00	<9	<10	<16	<11	<20	<10	<17	17 ± 10	<10	<10	<29	<10	
	26-Jan-00	<11	<9	<21	<10	<21	<11	<19	32 ± 12	<13	<12	<35	<11	<292
	1-Feb-00	<10	<11	<22	<11	<25	<10	<17	35 ± 14	<12	<11	<38	<12	
	15-Feb-00	<8	<11	<18	<9	<22	<10	<18	26 ± 14	<10	<10	<33	<12	
	22-Feb-00	<10	<10	<19	<9	<20	<10	<17	20 ± 11	<13	<12	<32	<11	
	29-Feb-00	<10	<9	<22	<11	<25	<11	<22	23 ± 10	<10	<10	<36	<10	<285
	7-Mar-00	<9	<9	<20	<11	<21	<7	<16	30 ± 9	<12	<10	<34	<6	
	14-Mar-00	<10	<11	<19	<9	<23	<11	<18	15 ± 10	<12	<11	<34	<10	
	21-Mar-00	<9	<9	<19	<10	<24	<10	<17	24 ± 9	<12	<12	<32	<9	
	28-Mar-00	<10	<9	<16	<10	<23	<9	<17	41 ± 13	<9	<11	<37	<9	<290
	4-Apr-00	<11	<10	<19	<8	<18	<10	<16	13 ± 9	<11	<12	<35	<11	
	11-Apr-00	<9	<8	<18	<11	<23	<10	<15	9 ± 8	<12	<10	<36	<10	
	17-Apr-00	<9	<10	<18	<11	<22	<9	<17	34 ± 10	<10	<11	<36	<11	<297
	2-May-00	<9	<9	<21	<11	<22	<9	<19	<12	<11	<11	<31	<9	
	9-May-00	<11	<10	<20	<13	<22	<12	<17	15 ± 10	<13	<11	<39	<14	
	16-May-00	<11	<9	<19	<11	<19	<9	<16	<11	<12	<10	<37	<9	
	22-May-00	<10	<12	<23	<13	<25	<11	<21	<13	<13	<12	<36	<11	
	30-May-00	<9	<10	<22	<11	<24	<10	<19	<13	<12	<12	<36	<13	<313
	6-Jun-00	<12	<10	<20	<9	<19	<10	<14	<11	<11	<10	<32	<9	
	13-Jun-00	<12	<10	<22	<13	<25	<11	<17	46 ± 15	<11	<11	<38	<12	
	20-Jun-00	<9	<9	<22	<10	<23	<9	<16	26 ± 10	<10	<10	<34	<12	
	27-Jun-00	<11	<10	<24	<13	<24	<12	<19	36 ± 11	<14	<11	<36	<10	<295
	4-Jul-00	<9	<10	<22	<9	<26	<10	<16	<13	<12	<11	<35	<10	
	11-Jul-00	<11	<9	<21	<10	<20	<11	<17	20 ± 8	<12	<11	<37	<10	
	18-Jul-00	<11	<10	<22	<13	<24	<11	<15	16 ± 9	<12	<12	<39	<10	
	25-Jul-00	<10	<10	<20	<11	<23	<11	<19	12 ± 8	<11	<11	<35	<11	<278

** 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 **
WRF INFLUENT (continued)	1-Aug-00	<9	<9	<23	<10	<21	<10	<18	29 ± 12	<11	<10	<39	<9	
	8-Aug-00	<9	<9	<22	<8	<22	<10	<18	24 ± 12	<10	<11	<40	<9	
	15-Aug-00	<9	<10	<17	<9	<21	<7	<19	38 ± 10	<12	<9	<33	<12	
	22-Aug-00	<11	<11	<22	<13	<19	<12	<22	<13	<12	<11	<34	<11	
	29-Aug-00	<9	<10	<21	<9	<27	<11	<17	12 ± 9	<13	<11	<37	<9	<296
	5-Sep-00	<11	<11	<20	<8	<20	<9	<16	17 ± 10	<11	<10	<36	<9	
	12-Sep-00	<9	<10	<20	<9	<22	<11	<16	<13	<11	<12	<38	<14	
	19-Sep-00	<10	<9	<21	<11	<18	<10	<16	17 ± 8	<13	<9	<38	<8	
	26-Sep-00	<11	<10	<21	<11	<17	<11	<18	<13	<11	<10	<34	<9	<306
	3-Oct-00	<10	<11	<20	<11	<23	<9	<17	29 ± 11	<11	<10	<36	<10	
	10-Oct-00	<13	<9	<21	<13	<29	<12	<19	24 ± 10	<13	<12	<37	<12	
	17-Oct-00	<10	<9	<22	<9	<22	<10	<16	23 ± 11	<12	<11	<37	<12	
	23-Oct-00	<10	<11	<21	<12	<23	<9	<17	23 ± 11	<12	<11	<38	<9	<296
	7-Nov-00	<11	<11	<18	<9	<20	<10	<22	45 ± 12	<14	<10	<32	<11	
	14-Nov-00	<11	<12	<17	<10	<22	<10	<15	27 ± 11	<11	<12	<40	<12	
	20-Nov-00	<11	<10	<18	<13	<18	<10	<18	23 ± 11	<12	<10	<34	<6	
	28-Nov-00	<9	<9	<24	<12	<21	<8	<20	14 ± 10	<12	<11	<38	<9	<313
	5-Dec-00	<9	<11	<20	<11	<25	<9	<17	14 ± 9	<12	<12	<35	<9	
	11-Dec-00	<10	<8	<22	<13	<24	<9	<19	22 ± 15	<13	<10	<42	<9	
	19-Dec-00	<11	<8	<20	<10	<20	<11	<19	47 ± 11	<13	<10	<33	<12	
	26-Dec-00	<9	<9	<23	<11	<22	<12	<20	44 ± 13	<13	<11	<40	<11	<304
	** Monthly composite													
SEDIMENT. BASIN #2	7-Mar-00	<11	<11	<21	<11	<28	<11	<18	<10	<12	<12	<35	<9	<298
	14-Mar-00	<10	<11	<21	<9	<24	<11	<18	<11	<11	<11	<38	<14	<300
	20-Mar-00	<10	<10	<18	<13	<25	<9	<17	<11	<13	<11	<38	<12	<302
	27-Mar-00	<11	<10	<18	<10	<23	<11	<15	<10	<12	<10	<32	<11	597 ± 183
	3-Apr-00	<9	<10	<17	<10	<21	<10	<16	<10	<11	<11	<37	<6	860 ± 179
	23-Oct-00	<10	<9	<17	<10	<21	<10	<18	<10	<10	<10	<38	<9	669 ± 196
	6-Nov-00	<10	<10	<18	<11	<26	<10	<16	<10	<13	<9	<32	<9	<293

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	4-Jan-00	704 ± 62	<24	<16	
	11-Jan-00	544 ± 63	<23	<26	
	19-Jan-00	513 ± 57	<24	<15	
	26-Jan-00	661 ± 61	<22	<19	21 ± 17
	1-Feb-00	1050 ± 85	<35	<30	
	8-Feb-00	745 ± 67	<22	<33	
	15-Feb-00	536 ± 61	<31	<21	
	22-Feb-00	668 ± 40	<14	<10	51 ± 17
	29-Feb-00	547 ± 37	<13	<14	30 ± 12
	7-Mar-00	386 ± 66	<20	<29	
	14-Mar-00	510 ± 53	<27	<21	
	21-Mar-00	390 ± 43	<32	<21	
	28-Mar-00	508 ± 22	<9	<7	23 ± 8
	4-Apr-00	667 ± 42	<16	<12	18 ± 11
	11-Apr-00	666 ± 62	<20	<29	65 ± 25
	17-Apr-00	869 ± 68	<18	<16	44 ± 19
	25-Apr-00	606 ± 59	<28	<27	
	2-May-00	356 ± 49	<26	<20	
	9-May-00	432 ± 58	<35	<19	49 ± 21
	16-May-00	410 ± 51	<20	<27	48 ± 19
	22-May-00	353 ± 51	<14	<10	
	30-May-00	565 ± 63	<23	<30	36 ± 29
	6-Jun-00	562 ± 63	<25	<22	
	13-Jun-00	589 ± 58	<25	<28	
	20-Jun-00	973 ± 61	<28	<22	62 ± 27
	27-Jun-00	664 ± 43	<16	<14	29 ± 19
	4-Jul-00	486 ± 38	<14	<13	
	11-Jul-00	361 ± 44	<24	<21	20 ± 16
	18-Jul-00	412 ± 49	<21	<25	33 ± 21
	25-Jul-00	424 ± 47	<20	<25	
	1-Aug-00	627 ± 65	<28	<27	
	8-Aug-00	495 ± 54	<17	<22	
	15-Aug-00	882 ± 68	<15	<22	
	22-Aug-00	650 ± 61	<26	<12	
	29-Aug-00	463 ± 59	<25	<28	
	5-Sep-00	357 ± 50	<18	<21	67 ± 30
	12-Sep-00	374 ± 50	<23	<19	
	19-Sep-00	695 ± 65	<26	<19	
	26-Sep-00	310 ± 49	<33	<27	
	3-Oct-00	310 ± 33	<19	<17	
	10-Oct-00	581 ± 55	<33	<17	
	17-Oct-00	900 ± 72	<20	<19	
	23-Oct-00	762 ± 67	<19	<13	
	31-Oct-00	506 ± 38	<18	<13	
	7-Nov-00	393 ± 48	<25	<22	
	14-Nov-00	1134 ± 50	<11	<14	42 ± 14
	20-Nov-00	1152 ± 75	<17	<16	
	28-Nov-00	731 ± 61	<16	<18	
	5-Dec-00	646 ± 58	<24	<11	
	12-Dec-00	719 ± 64	<22	<20	
	19-Dec-00	627 ± 59	<31	<25	
	26-Dec-00	860 ± 77	<20	<24	

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)	1-Dec-00	<8	<8	<17	<11	<20	<9	<15	<8	<9	<10	<27	<7
(E)		<7	<7	<17	<10	<21	<8	<15	<8	<9	<11	<27	<7
EVAP POND 1 (S)		<9	<8	<17	<10	<21	<9	<16	<8	<10	<10	<32	<6
(W)		<9	<9	<18	<12	<20	<9	<15	<9	<10	<10	<28	<7
(C)		<9	<9	<19	<11	<23	<10	<14	<9	<10	<11	<31	<7
(N)	1-Dec-00	<11	<10	<26	40 +/- 15	<21	<11	<17	<8	<14	27 +/- 12	<33	<9
(E)		<10	<10	<22	27 +/- 13	<21	<11	<18	<9	<14	26 +/- 11	<35	<9
EVAP POND 2 (S)		<10	<8	<17	<15	<23	<9	<13	<8	<11	19 +/- 11	<30	<10
(W)		<9	<8	<17	<15	<21	<9	<15	<7	<10	32 +/- 9	<25	<7
(C)		<13	<11	<22	35 +/- 18	<24	<11	<20	<10	<14	25 +/- 8	<36	<9

FIGURE 8.1 HISTORICAL GROSS BETA IN AIR 1990-2000 (WEEKLY SYSTEM AVERAGES)

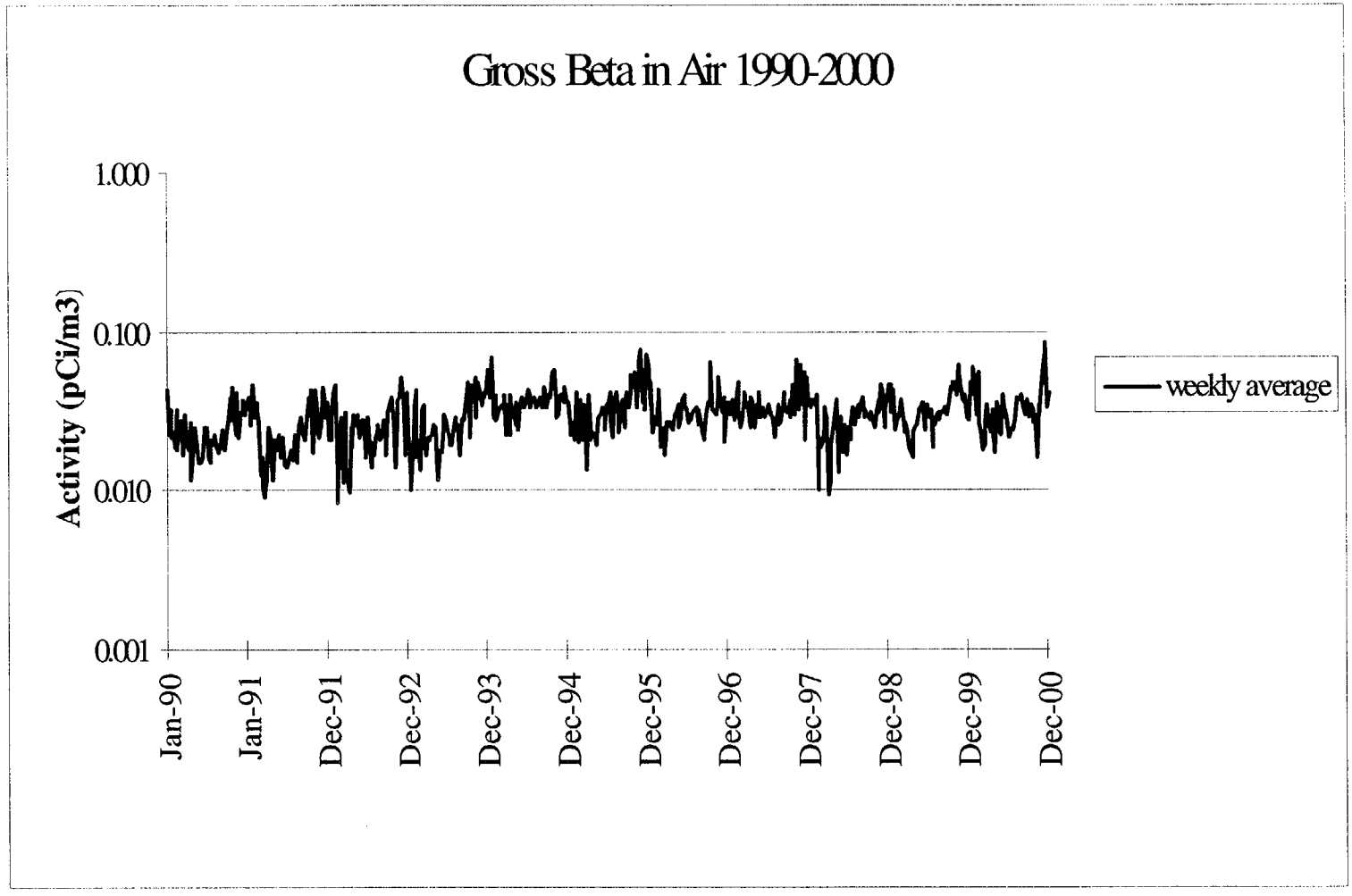


FIGURE 8.2 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP

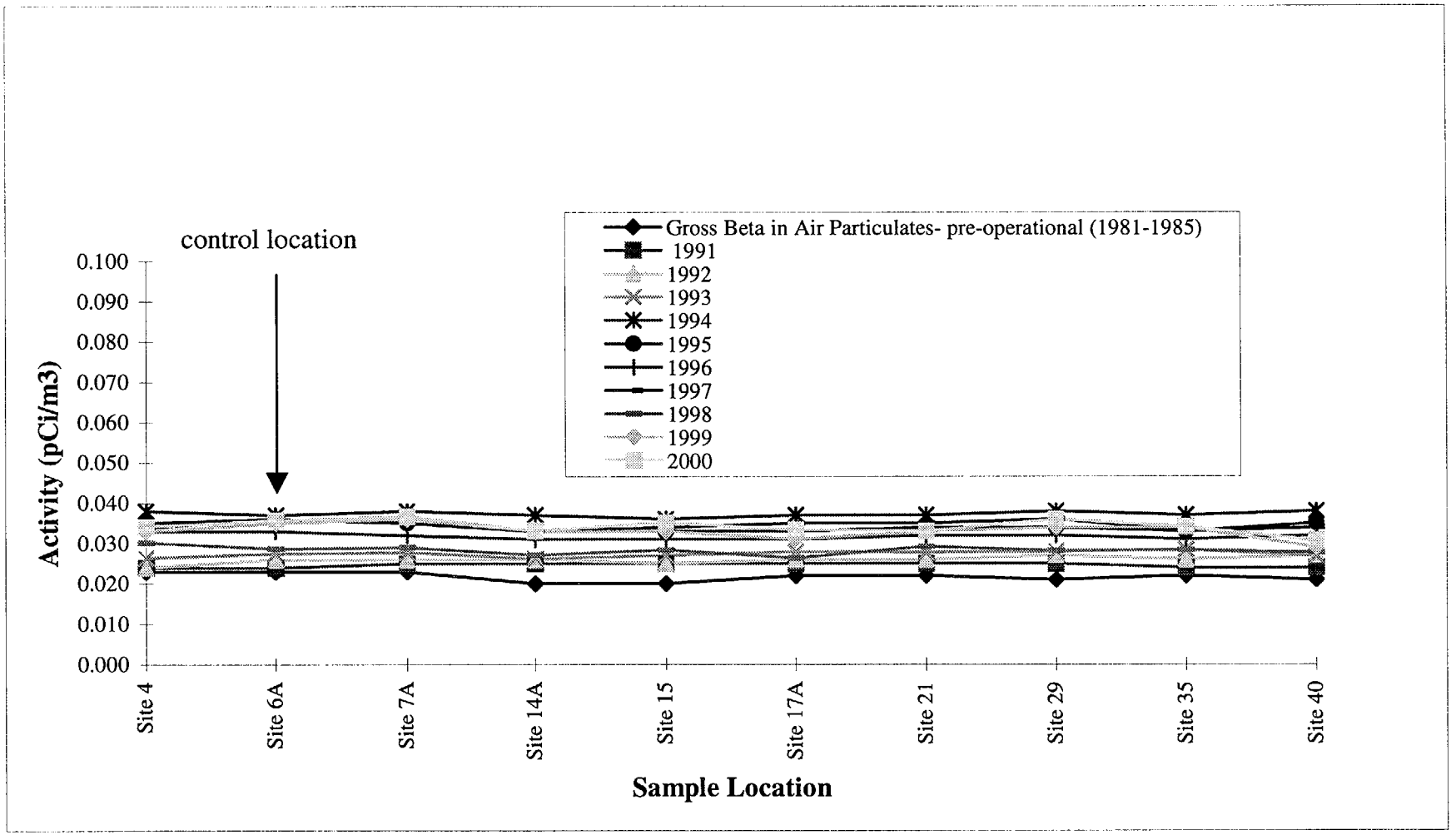
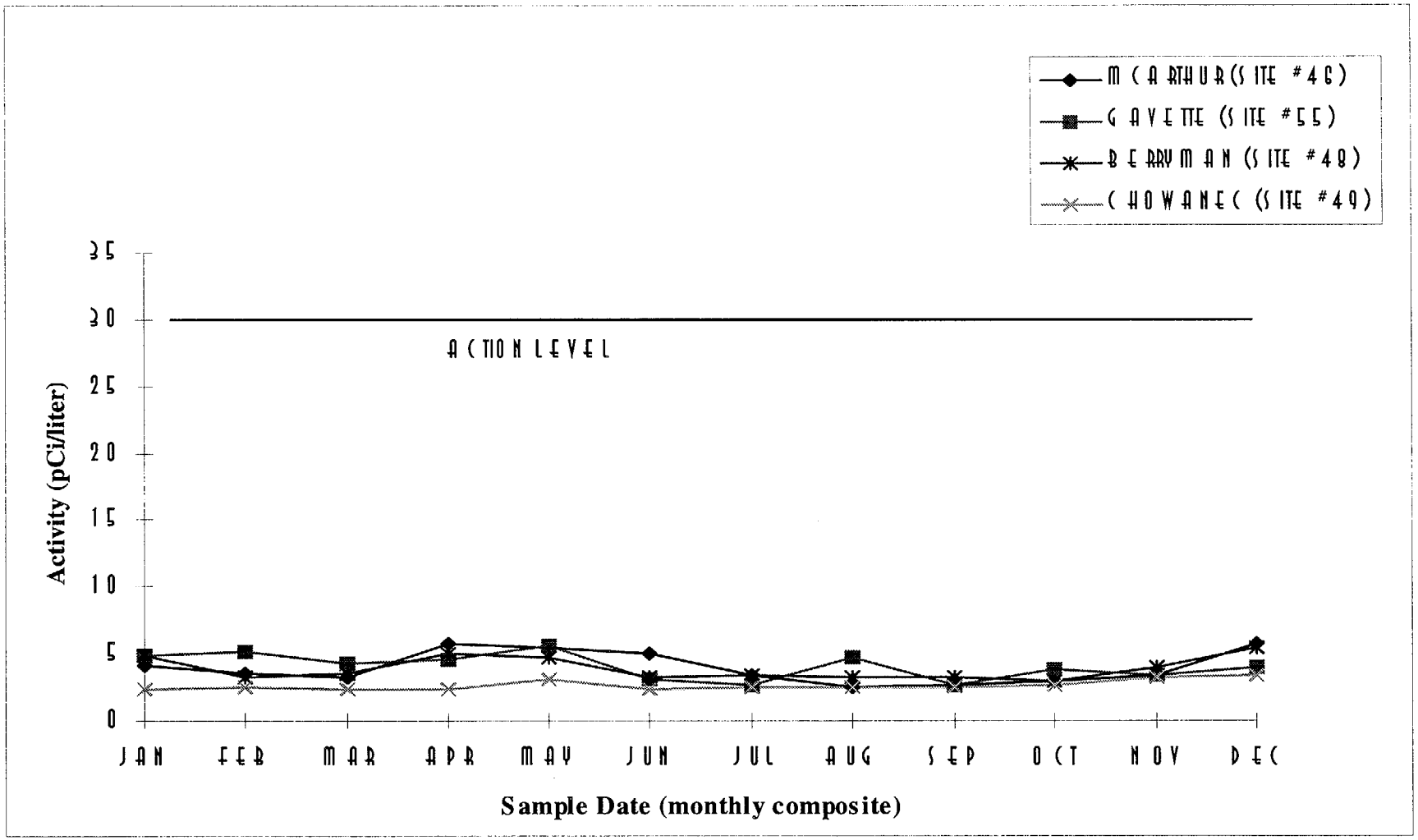
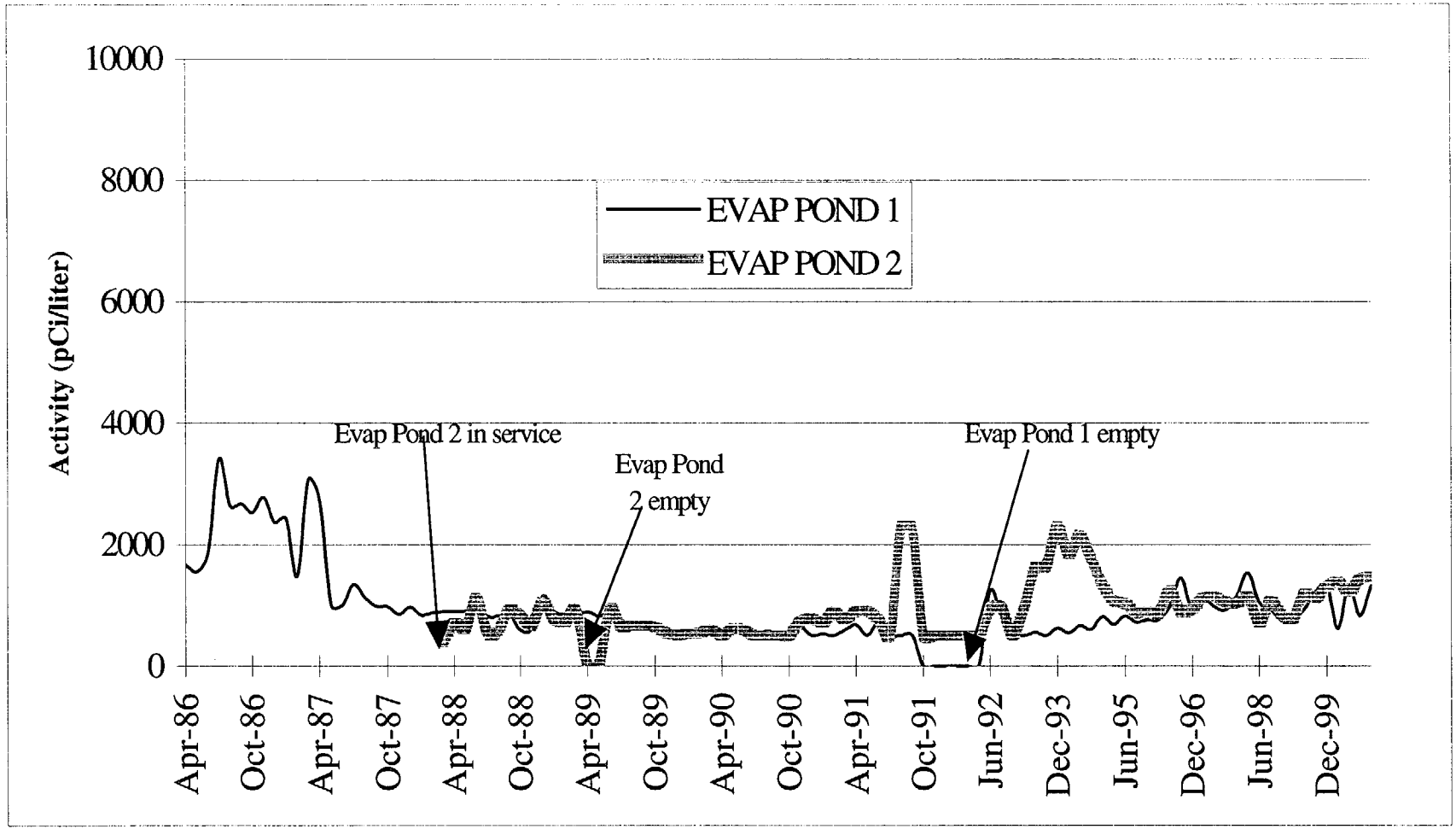


FIGURE 8.3 GROSS BETA IN DRINKING WATER



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

FIGURE 8.4 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-nine locations from one to thirty-five miles from the PVNGS. The TLD located at site #41 was deleted as of June, 2000 since the school at this location is now closed. TLD locations are shown in Figures 2.1 and 2.2. TLD locations are described in Table 9.1. TLD results for 2000 are presented in Table 9.2. TLD results for 1985 through 2000 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2000 as compared to the pre-operational TLD results (excluding indicator location #43 that was 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
41	WNW20	Harquahala Valley School

TABLE 9.1 TLD SITE LOCATIONS

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

TLD SITE	LOCATION	LOCATION DESCRIPTION
42	N8	Ruth Fisher School
44*	ENE35	El Mirage
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 2000 ENVIRONMENTAL TLD RESULTS

units are mrem/std qtr

TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Average
1	22.6	22.9	22.4	23.4	22.8
2	21.4	20.5	20.9	20.8	20.9
3	23.1	20.8	20.7	23.0	21.9
4	21.4	22.5	20.9	22.4	21.8
5	21.4	21.7	21.5	22.5	21.8
6 (control)	26.6	24.7	26.8	26.5	26.2
7	25.1	23.8	23.5	24.4	24.2
8	22.1	21.8	22.0	24.3	22.6
9	27.3	27.8	27.0	27.1	27.3
10	23.5	22.1	21.5	23.1	22.6
11	24.5	24.7	22.5	25.0	24.2
12	21.7	21.1	22.2	22.9	22.0
13	23.7	23.5	24.0	24.7	24.0
14	24.0	23.4	23.4	24.7	23.9
15	23.1	23.1	23.1	23.0	23.1
16	21.3	20.2	20.3	21.0	20.7
17	23.3	22.0	22.2	23.3	22.7
18	22.3	22.0	21.9	22.4	22.2
19	24.3	23.4	22.8	24.2	23.7
20	23.6	22.7	22.3	22.8	22.9
21	24.1	23.2	22.4	24.8	23.6
22	26.8	24.2	24.5	26.0	25.4
23	22.9	21.0	20.7	22.4	21.8
24	21.2	20.4	19.5	21.5	20.7
25	21.2	22.0	22.0	22.1	21.8
26	26.5	24.7	25.4	25.6	25.6
27	25.2	25.8	25.8	27.5	26.1
28	24.4	24.1	24.5	24.5	24.4
29	24.6	24.7	23.6	24.2	24.3
30	24.0	25.4	23.2	25.2	24.5
31	22.1	21.3	20.2	21.9	21.4
32	22.7	23.8	23.1	26.2	24.0
33	25.0	24.7	23.5	24.3	24.4
34	missing	25.9	25.9	25.7	25.8
35	28.9	28.3	28.1	29.6	28.7
36	24.0	22.3	23.5	22.9	23.2
37	21.8	22.1	20.3	22.4	21.7
38	26.5	24.9	24.6	26.9	25.7
39	22.3	21.6	22.3	23.1	22.3
40	23.2	23.1	22.9	23.7	23.2
41	25.8	25.9	deleted	deleted	25.9
42	25.1	24.0	24.8	25.3	24.8
44 (control)	20.1	18.9	18.4	19.1	19.1
45 (transit control)	5.4	5.1	5.1	5.6	5.3
46	25.6	24.4	23.9	24.4	24.6
47	22.8	22.3	20.9	21.9	22.0
48	22.2	22.9	22.0	22.2	22.3
49	21.2	21.2	21.5	21.1	21.3
50	17.4	17.7	17.5	18.9	17.9

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES

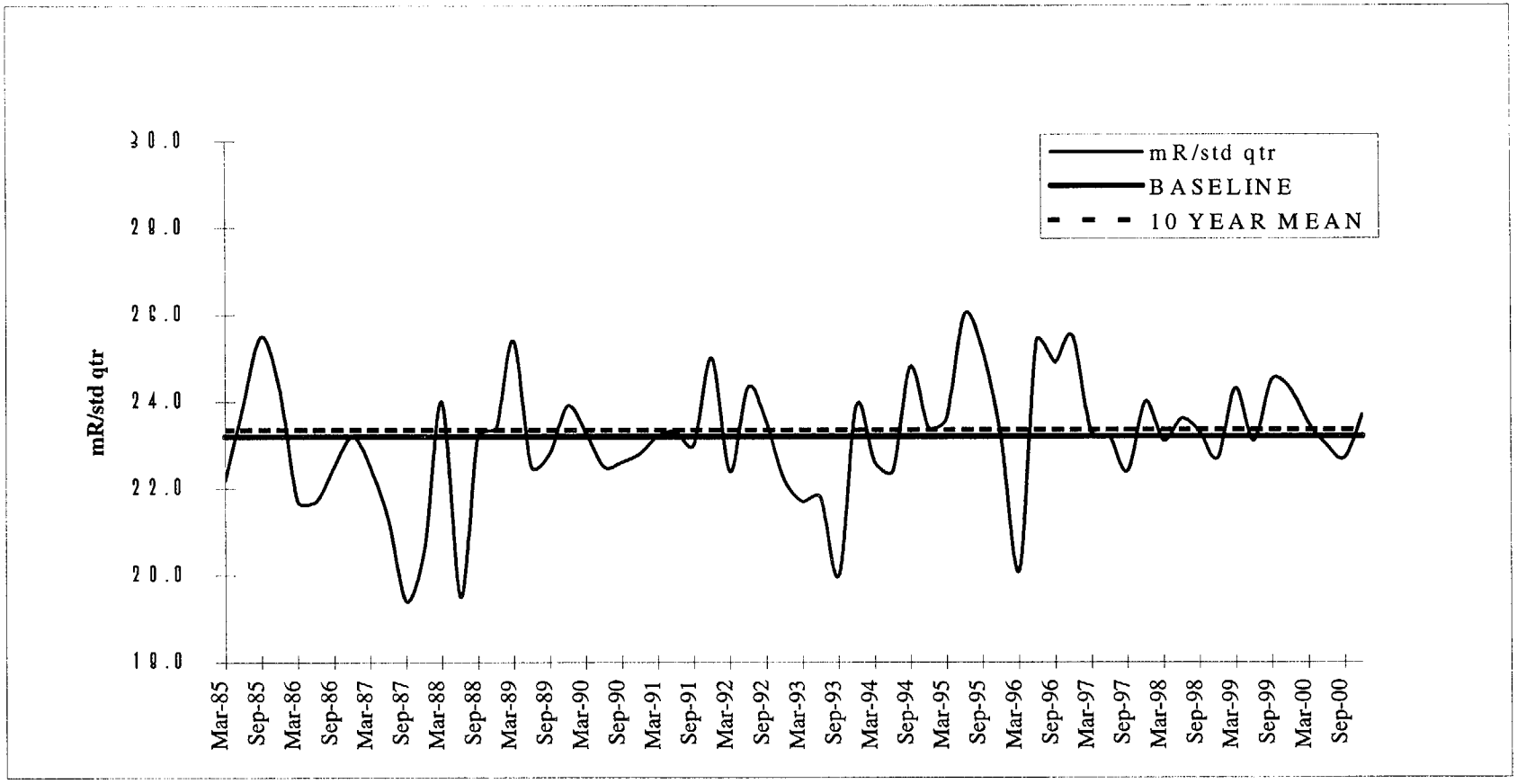
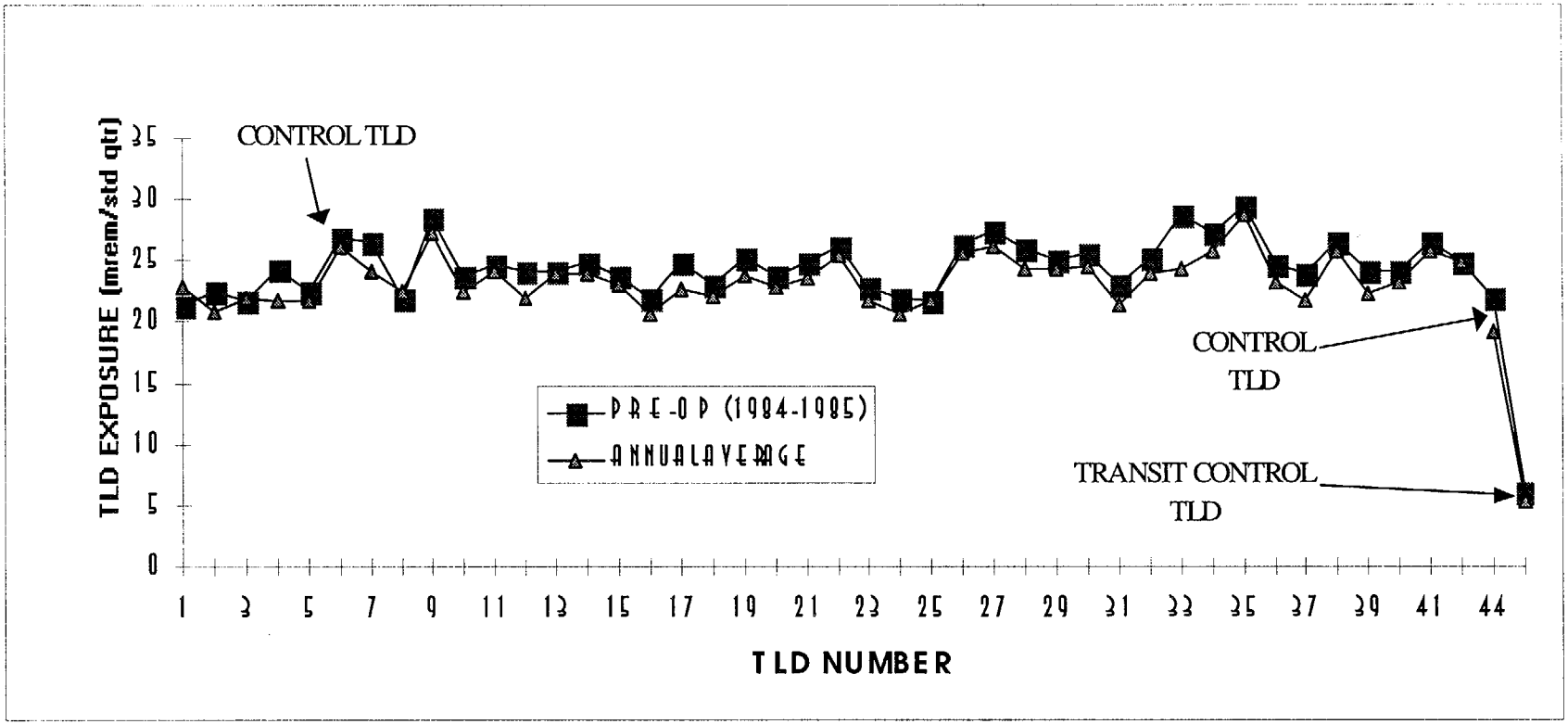


FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2000



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 a five mile radius of the mid-line of Unit 2 containment in April-June, 2000.

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 within a five-mile radius of PVNGS.

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 five (5) changes in nearest resident status. Refer to Table 10.1 for specific location changes.

Milking Animal

Goats were located in the NNE and NE sectors and cows were located in the ENE sector. Dose calculations indicated the highest dose to be 0.310 mrem (highest dose was infant thyroid). 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 three (3) changes in nearest garden status. New gardens were located in the NNE and NE sectors. The garden previously located in the ENE sector is not in use. One of the new gardens was added to the REMP as a new sample location (replaced one of the existing locations). This new garden was chosen based on higher dose potential.

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

TABLE 10.1 2000 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 1999
N	1.79	NONE	NONE	5.19E-02	NONE
NNE	1.66	**1.68**	3.78 (goats)	8.83E-02 (resident) 4.21E-01 (garden) 1.28E-01 (milk)	**GARDEN**
NE	2.16	**3.91**	**3.91 (goats)**	1.23E-01 (resident) 2.73E-01 (garden) 3.10E-01 (milk)	**GARDEN** **MILK ANIMAL**
ENE	**2.87**	**NONE**	**3.59 (cows)**	7.98E-02 (resident) 1.75E-01 (milk)	**RESIDENT** **GARDEN** **MILK ANIMAL**
E	**2.81**	NONE	NONE	1.07E-01	**RESIDENT**
ESE	3.44	3.78	NONE	8.32E-02 (resident) 3.57E-01 (garden)	NONE
SE	4.18	NONE	NONE	1.17E-01	NONE
SSE	4.21	NONE	NONE	2.42E-01	NONE
S	4.67	NONE	NONE	3.01E-01	NONE
SSW	4.17	NONE	NONE	1.80E-01	NONE
SW	1.40	3.92	NONE	1.69E-01 (resident) 2.76E-01 (garden)	NONE
WSW	**0.75**	NONE	NONE	1.03E-01	**RESIDENT**
W	**2.71**	NONE	NONE	2.23E-02	**RESIDENT**
WNW	NONE	NONE	NONE	Not applicable	NONE
NW	**1.73**	NONE	NONE	2.27E-02	**RESIDENT**
NNW	2.64	4.70	NONE	1.64E-02 (resident) 3.10E-02 (garden)	NONE

COMMENTS:

Dose calculations were performed using the GASPAR code and 1999 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 2000 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 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.

Although there was one incidence of I-131 detected at one (1) air sample location (refer to Table 2.3 for a description of this event), there were no radiological impacts on the environment due to PVNGS operations in 2000.

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 2000

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 - 193	NA	23.3 (181/181) 17.4 - 29.6	Site #35 8 miles 335°	28.7 (4/4) 28.1 - 29.6	22.6 (8/8) 18.4 - 26.8	0
Air Particulates (pCi/m^3)	Gross Beta - 518	0.010	0.034 (466/466) 0.011 - 0.092	Site #7A 8 miles 140°	0.037 (52/52) 0.018 - 0.089	0.036 (52/52) 0.015 - 0.098	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. - 518 I-131	0.07	0.022 (1/518) 0.022 - 0.022	Site #29 0.6 miles 270°	0.022 (1/51) 0.022 - 0.022	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 15 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 2000

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
	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	4.2 (24/48) 3.1 - 5.8	Site #48 1 mile 225°	4.6 (6/12) 3.6 - 5.5	NA	0
	Tritium - 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 49						
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 2000

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 (4/36) 8 - 17	Site #59 Onsite 180°	13 (2/12) 9 - 17	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	14 (2/36) 10-17	Site #63 Onsite 180°	14 (2/12) 10-17	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Tritium - 12	3000	1197 (8/12) 618 - 1476	Site #63 Onsite 180°	1376 (4/4) 1212 - 1476	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. 1985-1999 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.

13. APPENDIX A- Corrections to the 1999 Annual Radiological Environmental Operating Report

Bottom sediment samples were taken in Evaporation Ponds 1 and 2 in 1999 and analyzed for gamma-emitters. The results of the analyses were inadvertently omitted from Table 8.10 of the 1999 AREOR. These data are presented here as a correction to that report.

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)	19-Nov-99	<11	<10	<23	<11	<25	<10	<17	<9	<12	<10	<32	<9
(E)	19-Nov-99	<10	<11	<29	<16	<26	<13	<17	<11	<13	<15	<36	<10
EVAP POND 1 (S)	19-Nov-99	<8	<8	<19	<12	<20	<8	<14	<9	<10	<11	<31	<5
(W)	19-Nov-99	<10	<10	<25	<13	<25	<13	<22	<11	<13	<14	<42	<11
(C)	19-Nov-99	<11	<11	<26	<13	<27	<12	<19	<10	<12	<12	<34	<12
(N)	19-Nov-99	<10	<9	<19	34 +/- 13	<22	<8	<15	<8	<12	21 +/- 11	<32	<9
(E)	19-Nov-99	<7	<7	<16	42 +/- 13	<21	<8	<13	<8	<10	15 +/- 9	<29	<8
EVAP POND 2 (S)	19-Nov-99	<9	<10	<19	35 +/- 12	<20	<9	<13	<8	<12	17 +/- 14	<33	<7
(W)	19-Nov-99	<10	<9	<18	40 +/- 12	<23	<9	<16	<9	<11	19 +/- 11	<27	<7
(C)	19-Nov-99	<8	<9	<20	52 +/- 12	<22	<9	<14	<9	<11	25 +/- 9	<29	<8