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102-04935-SAB/TNW/CJJ
April 29, 2003

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 2002

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2002.

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,

TNW 6/30/?? for
SA Bauer

SAB/TNW/CJJ/kg

Enclosure

cc: E. W. Merschoff (all w/o enclosure)
J. N. Donohew
N. L. Salgado

IE25

PALO VERDE

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2002

Prepared by: Digitally signed by: Drinovsky, Louis J(Z33699)
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Date: 04/16/2003 15:12:38
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Location: PVNGS

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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 2002, the following categories of samples were collected by APS:

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

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

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 approximately fifty (50) environmental TLD monitoring locations, eighteen (18) of which are duplicates of APS locations.

A comparison of pre-operational and operational data indicates no changes to environmental radiation levels. There were no radiological impacts on the environment due to PVNGS operations in 2002.

(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 2002. 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

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

2.1. 2002 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, goat milk, 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.l, 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 and Eberline Services (goat milk only).

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 2002

- Two (2) vegetation sample locations were changed
- Goat milk sampling/analysis was added
- One (1) air sample location was deleted

Refer to Table 2.1 for a description of all current sample locations, including changes in sample locations.

2.3. REMP Deviations/Abnormal Events Summary

During calendar year 2002, there were nine (9) deviations/abnormal events with regard to the monitoring program. Refer to Table 2.3 for more detail and any corrective actions taken.

- The as found flow rate at air sample site #4 for the week of 1-22-02 was abnormally low.
- Air sample data for the week of 3-18-02 indicated lower than expected results.
- Air sample data for the week of 4-22-02 indicated lower than expected results.
- Air sample data for the week of 7-16-02 from site #6A was invalid due to power loss.
- The as found flow rate at air sample site #40 for the week of 9-9-02 was abnormally low.
- Initial goat milk samples, obtained in September, were not analyzed by the vendor lab to meet the required LLD for La-140. One sample from November also did not meet the required LLD for La-140.
- The TLDs located at site #3 were missing in the 3rd quarter.
- Procedure 74RM-0EN09, Quarterly Radiological Environmental Sample Analysis Verification, requires a calculation when multiple radionuclides are present in a sample. The calculation for Evaporation Pond #2 in the second quarter exceeded the threshold value for investigation.
- The vendor lab that analyzed goat milk samples does not perform interlaboratory comparisons for I-131 in milk.

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 (deleted at end of year)
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	Branch residence (changed to McCoy Residence, ESE4, as of August, 2002)
48	Drinking water	SW1	Berryman residence
49	Drinking water	N2	Chowanec residence
51	Milk (b)	NE4	Painter residence-goats (new location)
52	Vegetation (b)	ESE4	Hallman residence (changed to Chowanec residence, N2, as of August, 2002)
53*	Milk (b)	ENE24	Barber residence-goats (new location)
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	ENE26	Duncan Family Farms
63	Surface water	ONSITE	Evaporation Pond #2

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*	*MILK*	*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	
51		M/AA					
52				M/AA			
53		M/AA					
55						W	
57					Q		
58					Q		
59							W
60							W
62				M/AA			
63							W

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

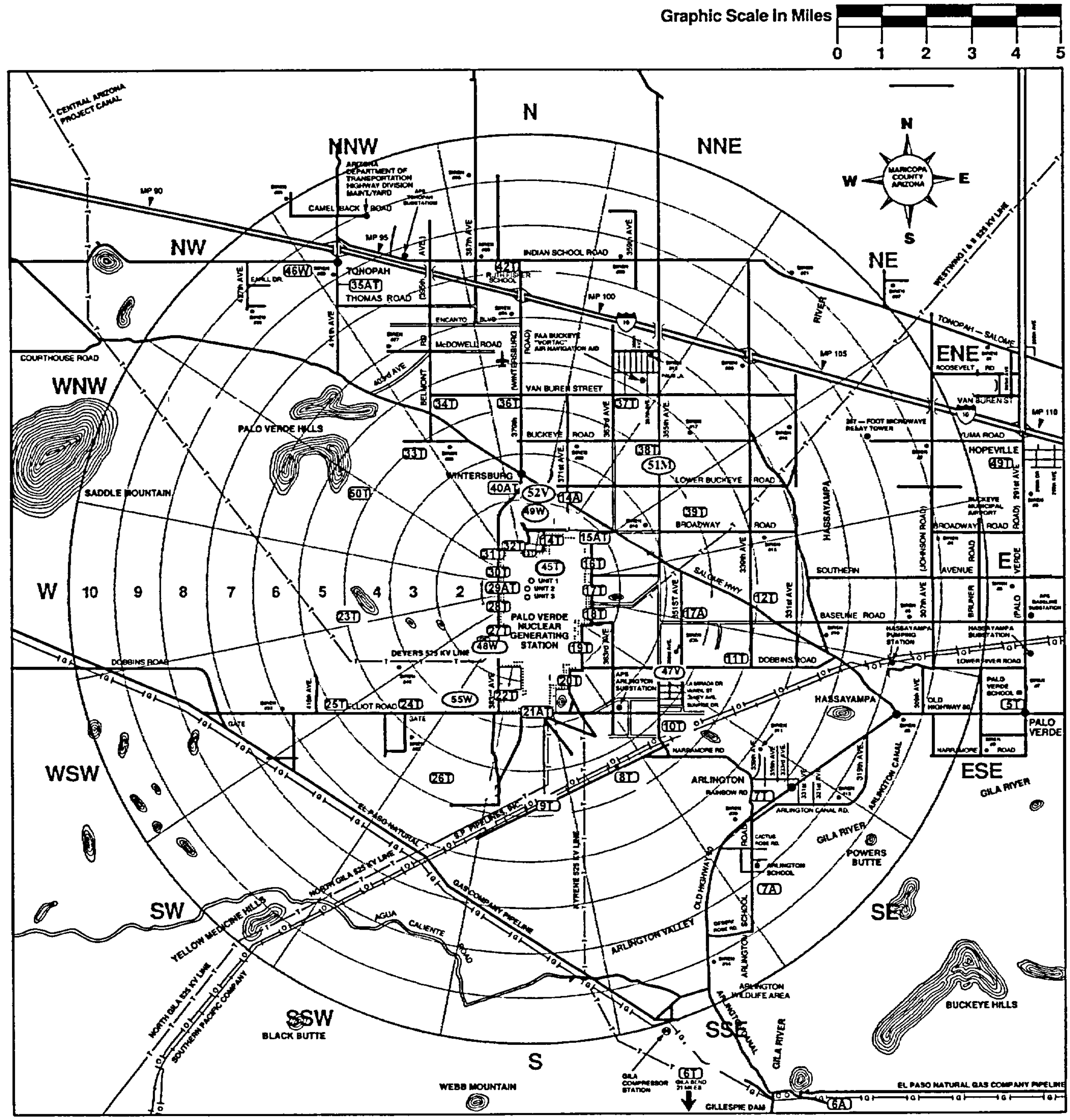
TABLE 2.3 SUMMARY OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. The as found flow rate at air sample site #4 for the week of 1-22-02 was abnormally low (13 SLPM).	1. Sample was invalidated due to low flow rate. Subsequent sample was normal and no further actions were deemed necessary.
2. Air sample data for the week of 3-18-02 indicated lower than expected results and a high percent relative standard deviation.	2. It was determined that the lower results were due to increased dust loading from windy/dusty conditions that week. No further actions are necessary.
3. Air sample data for the week of 4-22-02 indicated lower than expected results and a high percent relative standard deviation.	3. It was determined that the lower results were due to increased dust loading from windy/dusty conditions that week. It was further determined that when sample pumps were rebuilt in the 4th quarter of 2001, sample heads were changed from a horizontal to a vertical configuration, exacerbating the problem. CIR #2514063 documented the issue. Action taken was to restore all air sample heads to the previous horizontal position.
4. Air sample data for the week of 7-16-02 from site #6A was invalid due to power loss.	4. The power outage was due to storm damage. Power was restored and no further actions were necessary.
5. The as found flow rate at air sample site #40 for the week of 9-9-02 was abnormally low (21 SLPM).	5. Sample was invalidated due to low flow rate. Subsequent sample was normal and no further actions were deemed necessary.
6. Initial goat milk samples, obtained in September, were not analyzed by the vendor lab to meet the required LLD for La-140. One sample from November also did not meet the required LLD for La-140.	6. Vendor was notified and September samples were recounted for 63 hours, but still did not meet the required LLD of 15 pCi/liter. Subsequent samples from October met all LLD requirements. The November sample MDA was 15.8 pCi/liter, slightly above the required LLD. This was again discussed with the vendor to prevent future occurrences. The possibility of analyzing samples onsite is being considered.
	(continued on next page)

TABLE 2.3 SUMMARY OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event (continued)	**Actions taken (continued)**
7. The TLDs located at site #3 was missing in the 3rd quarter.	7. The TLDs were replaced and not missing in the 4th quarter. No further actions were necessary.
8. Procedure 74RM-0EN09, Quarterly Radiological Environmental Sample Analysis Verification, requires a calculation when multiple radionuclides are present in a sample. The calculation for Evaporation Pond #2 in the second quarter exceeded the threshold value for investigation.	8. The largest component of the calculation was the I-131 contribution. The I-131 in Evaporation Ponds has been proven to originate in the Phoenix sewage effluent and is not a plant effluent. No ODCM reporting levels were exceeded. The condition was evaluated in CRDR No. 2543013. No additional actions are required.
9. The vendor lab that analyzed goat milk samples beginning in September 2002 does not perform interlaboratory comparisons for I-131 in milk.	9. The existing Purchase Order requires that the lab analyze interlab comparison samples for all sample media types analyzed as part of the REMP. It was identified on 2-20-03 that this is not occurring. Discussion with lab personnel indicates that this radionuclide/matrix combination has not been available since the EPA PES program was discontinued several years ago. Eberline did analyze cross-checks that included I-131 in water. CRDR No. 2585801 was initiated to determine the appropriate corrective actions and is still open.

FIGURE 2.1
REMP SAMPLE SITES
(0-10 MILES)



KEY TO MAP

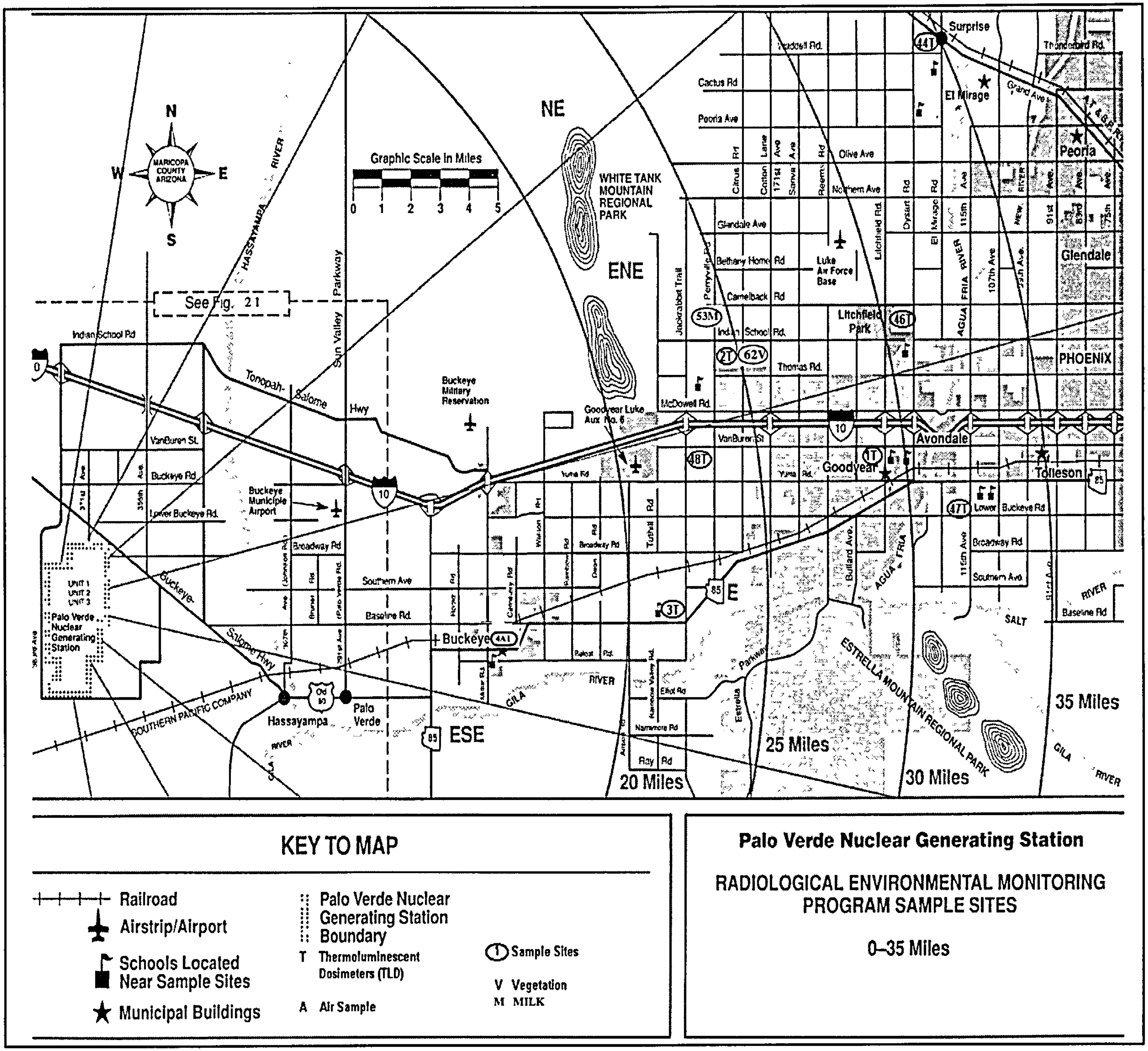
	Paved Road	MP	Milepost
	Unpaved Road		Palo Verde Nuclear Generating Station Boundary
	4WD Road	T	Thermoluminescent Dosimeters (TLD)
–G–	Gas Pipeline	A	Air Sample
–O–	Oil Pipeline	V	Vegetation Sample
–T–	Power Line	W	Water Sample
	Railroad	M	Milk Sample
	Airstrip	(1)	Sample Sites
	School		
•	Siren		

Palo Verde Nuclear Generating Station

Radiological Environmental Monitoring Program Sample Sites

0 – 10 Miles

FIGURE 2.2
REMP SAMPLE SITES
(0-35 MILES)



3. Sample Collection Program

APS personnel using PVNGS procedures collected all samples.

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 monthly, as available, and were analyzed for gamma-emitters.

3.3. Milk

The 2002 Land Use Census identified milk animals (goats) at a location that required sampling

Milk samples were collected monthly (beginning in September), as available, and were analyzed for gamma-emitters and low level I-131.

3.4. Air

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 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 Units 1 and 2 was disposed of in the WRF Sludge Landfill in 2002. 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. Milk

4.3.1. Gamma Spectroscopy

The sample is placed in a 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.

4.3.2. I-131 (Low-level)

The sample is reduced with sodium bisulfite and iodine is absorbed by anion resin. The iodine is eluted from the resin, extracted from the sample, and then back extracted and precipitated onto a filter. The precipitate is counted and the I-131 is quantified.

4.4. Vegetation

4.4.1. 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.

4.5. Sludge/Sediment

4.5.1. 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.

4.6. Water

4.6.1. 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.

4.6.2. 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.

4.6.3. 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.

4.7. Soil

4.7.1. 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 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.

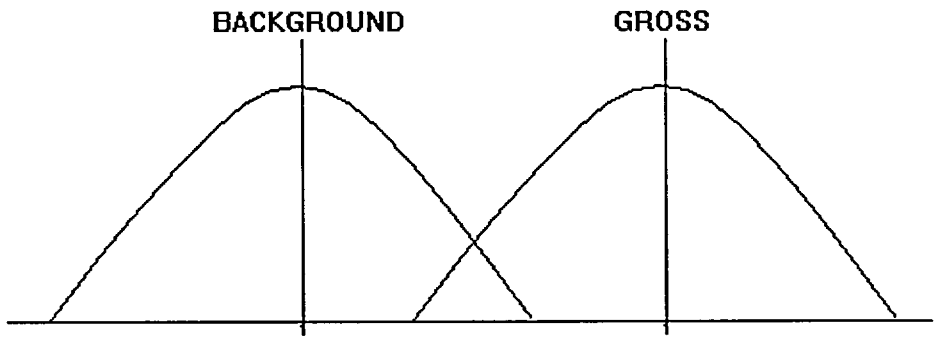
Occasionally the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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 deviations/abnormal 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.

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.

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)	MILK (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	VEGETATION (pCi/kg, wet)
gross beta	3		0.007	
Tritium	280			
Mn-54	11			
Fe-59	20			
Co-58	9			
Co-60	10			
Zn-65	22			
Zr-95	17			
Nb-95	11			
I-131	10 [a]	0.3	0.04 [b]	40
Cs-134	11	12	0.02 [b]	40
Cs-137	12	9	0.02 [b]	60
Ba-140	40	23		
La-140	10	11		

NOTES:

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

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 2002, 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 (Analytics and Environmental Resources Associates). Eberline, Inc. participates in the DOE-MAP program. Results for the interlaboratory comparison programs are presented in Table 7.1

It was identified in February, 2003, that Eberline Services did not perform interlaboratory cross-checks for I-131 in milk in 2002. This discrepancy has been documented in the corrective action process as CRDR No. 2585801.

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample Type	Analysis Type	Units	Nuclide	Known Value	PVNGS Value	1 sigma Error	Resolution *	Ratio	ACCEPT/REJECT
Water	Mixed Gamma E3429-111	pCi/liter	Ce-141	106	125	11.0	11	1.18	ACCEPT
			Cr-51	331	375	51.0	7	1.13	ACCEPT
			Cs-134	95	82	5.0	16	0.86	ACCEPT
			Cs-137	210	212	13.0	16	1.01	ACCEPT
			Co-58	133	127	9.0	14	0.95	ACCEPT
			Mn-54	136	143	9.0	16	1.05	ACCEPT
			Fe-59	69	80	11.0	7	1.16	ACCEPT
			Zn-65	171	174	12.0	15	1.02	ACCEPT
			Co-60	157	158	9.0	18	1.01	ACCEPT
	Tritium E3314-111	pCi/liter		11967	10286	150.0	69	0.86	ACCEPT
	Gross Beta E3428-111	pCi/liter		189	133	9.0	15	0.70	ACCEPT
Air	Iodine E3431-111	pCi/cartridge	I-131	96	87	11.0	8	0.91	ACCEPT
	Gross Beta E3430-111	pCi/filter		124	161	6.0	27	1.30	ACCEPT
	Mixed Gamma E3432-111	pCi/filter	Ce-141	63	79	12.0	7	1.25	ACCEPT
			Cr-51	196	181	27.0	7	0.92	ACCEPT
			Cs-134	56	52	4.0	13	0.93	ACCEPT
			Cs-137	125	139	8.0	17	1.11	ACCEPT
			Co-58	79	91	7.0	13	1.15	ACCEPT
			Mn-54	81	97	7.0	14	1.20	ACCEPT
			Fe-59	41	54	8.0	7	1.32	ACCEPT
			Zn-65	101	127	9.0	14	1.26	ACCEPT
			Co-60	93	108	6.0	18	1.16	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

Sample Type	Analysis Type	Units	Nuclide	Known Value	PVNGS Value	1 sigma Error	Resolution *	Ratio	ACCEPT/REJECT
Water	Mixed Gamma E3310-111	pCi/liter	Ce-141	214	214	14.0	15	1.00	ACCEPT
			Cr-51	304	339	55.0	6	1.12	ACCEPT
			Cs-134	176	158	9.0	18	0.90	ACCEPT
			Cs-137	169	179	11.0	16	1.06	ACCEPT
			Co-58	130	128	9.0	14	0.98	ACCEPT
			Mn-54	204	224	14.0	16	1.10	ACCEPT
			Fe-59	119	134	15.0	9	1.13	ACCEPT
			Zn-65	251	291	17.0	17	1.16	ACCEPT
			Co-60	199	196	10.0	20	0.98	ACCEPT
	Gross Beta E3309-111	pCi/liter		228	291	6.0	49	1.28	ACCEPT
	Gross Beta E3311-111	pCi/filter		82	88	1.0	88	1.07	ACCEPT
	Mixed Gamma E3313-111	pCi/filter	Ce-141	88	86	6.0	14	0.98	ACCEPT
			Cr-51	125	191	68.0	3	1.53	ACCEPT
			Cs-134	73	69	5.0	14	0.95	ACCEPT
			Cs-137	70	78	5.0	16	1.11	ACCEPT
			Co-58	53	63	5.0	13	1.19	ACCEPT
			Mn-54	84	98	6.0	16	1.17	ACCEPT
			Fe-59	49	52	9.0	6	1.06	ACCEPT
			Zn-65	103	123	7.0	18	1.19	ACCEPT
			Co-60	82	88	4.0	22	1.07	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

ERA RAD-48 Study Results...6/2002							
Sample Type	**Analysis Type**	**Nuclide**	**PVNGS Value**	**Certified Value**	**QC Acceptance Limits**	**PT Acceptance Limits**	**Results**
Water	Mixed Gamma	Co-60	59.6	59.7	53.9 - 65.5	51.0 - 68.4	ACCEPT
		Zn-65	87.8	78.9	69.8 - 88.0	65.2 - 92.6	ACCEPT
		Ba-133	67.6	69.3	61.3 - 77.3	57.3 -81.3	ACCEPT
		Cs-134	88.5	93.9	88.1 - 99.7	85.2 - 102.6	ACCEPT
		Cs-137	46.1	42.2	36.4 - 48.0	33.5 - 50.9	ACCEPT
ERA RAD-49 Study Results...7/2002							
Water	Gamma	I-131	32.8	29.8	26.3 - 33.3	24.6 -35.0	ACCEPT
ERA RAD-50 Study Results...8/2002							
Water	Gross Beta		27.5	21.9	16.1 - 27.7	13.2 - 30.6	ACCEPT
ERA RAD-51 Study Results...11/2002							
Water	Gamma	I-131	7.99	6.76	NA	3.3 - 10.2	ACCEPT
Water	Gross Beta		48.1	47	NA	38.3 - 55.7	ACCEPT
Water	Tritium		8731	10200	NA	8440 - 12000	ACCEPT

DOE-MAP				
Radionuclide	Known Value	Lab Result	Acceptable Range	Accept/Reject
(MAPEP-02-S9)				
Cs-134	2.33E+04	2.30E+04	1.63E+04-3.03E+04	ACCEPT
Cs-137	3.00E+03	2.81E+03	2.10E+03-3.90E+03	ACCEPT
Co-60	2.37E+03	2.33E+03	1.66E+03-3.07E+03	ACCEPT
Mn-54	1.48E+04	1.48E+04	1.03E+04-1.92E+04	ACCEPT
Zn-65	2.12E+04	2.29E+04	1.79E+03-2.84E+04	ACCEPT
(MAPEP-01-W9)				
Cs-134	7.70E+02	7.77E+02	5.39E+02-1.00E+03	ACCEPT
Cs-137	7.73E+03	7.33E+03	5.41E+03-1.00E+04	ACCEPT
Co-60	3.81E+03	3.82E+03	2.67E+03-4.95E+03	ACCEPT
Mn-54	6.65E+03	6.70E+03	4.65E+03-8.64E+03	ACCEPT
Zn-65	1.82E+03	2.00E+03	1.27E+03-2.36E+03	ACCEPT

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 2002 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 2002.

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 0.006 to 0.086 pCi/m^3. The associated counting error ranged from 0.001 to 0.004 pCi/m^3. Mean quarterly activity is calculated using weekly activity, normally 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 1991-2002 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. Milk

Table 8.7 presents gamma isotopic and low level I-131 data for the goat milk samples. No I-131 or other gamma-emitting nuclides were observed in any of the samples.

8.5. Drinking Water

Samples were analyzed for gross beta, tritium, and gamma-emitting nuclides. Results of these analyses are presented in Table 8.8. No tritium or gamma-emitting nuclides were detected in any samples. Gross beta activity ranged from less than detectable, to a high of 19.8 pCi/liter (Chowanec residence, October composite).

8.6. Groundwater

Groundwater samples were analyzed for tritium and gamma-emitting nuclides. Results obtained from the analysis of the samples are presented in Table 8.9.

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

8.7. 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 8.10. I-131 was observed in Evaporation Pond # 2 in one (1) of the monthly composite samples (12 pCi/liter) and two (2) of the Reservoir monthly composite samples (6 and 9 pCi/liter). The I-131 is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent. Low levels of Cs-137 (12 and 13 pCi/liter) were observed in Evaporation Pond #2 in two (2) 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 1177 pCi/liter and the highest concentration in Evaporation Pond #2 was 1143 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 8.10, demonstrate that I-131 was observed routinely. The highest I-131 concentration was 55 pCi/liter (week of January 15th). The results are consistent with assays from the previous years. None of the samples analyzed indicated the presence of tritium.

Table 8.10 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 tritium or gamma-emitting nuclides were observed in any of the three (3) samples.

8.8. Sludge and Sediment

8.8.1. 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 (52) samples ranging from 347 to 2000 pCi/kg.

In-111 was also identified in the sludge in forty-one (41) of the samples. This is about a 30% increase from previous years. The highest concentration was 120 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 8.11.

8.8.2. Evaporation Ponds #1 and #2 sediment

A set of ten (10) Evaporation Pond samples, five (5) from each pond, indicated low levels of Co-60 and Cs-137 in Evaporation Pond #2. The concentrations were consistent with historical values. Evaporation Pond #1 results were all <MDA. Sample results can be found in Table 8.11.

8.8.3. Cooling Tower sludge

Sludge originating from the Units 1 and 2 cooling towers and/or circulating water canals was disposed of in the WRF landfill during 2002. 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/liter) and fraction of samples above the MDA
1-2-02	2	319	Mn-54	<MDA-53 (1 of 32 samples)
			Co-60	987-2650 (32 of 32 samples)
			Cs-134	<MDA-48 (1 of 32 samples)
			Cs-137	<MDA-234 (30 of 32 samples)
			Sb-125	<MDA-117 (2 of 32 samples)
6-21-02 8-14-02 10-3-02	1 1 1	14 294 3	Co-60	<MDA-71 (12 of 32 samples)
			Cs-137	<MDA-65 (17 of 32 samples)
3-27-02	2	94	Mn-54	53-105 (30 of 30 samples)
			Co-60	1030-2550 (30 of 30 samples)
			Cs-134	186-1280 (30 of 30 samples)
			Cs-137	366-2670 (30 of 30 samples)

8.9. 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-01	2-Jan-02	0.060	0.060	0.062	0.055	0.055	0.046	0.038	0.058	0.053	0.056	0.054	13.4
2	2-Jan-02	8-Jan-02	0.042	0.039	0.041	0.033	0.035	0.035	0.034	0.036	0.031	0.034	0.036	9.9
3	8-Jan-02	14-Jan-02	0.049	0.044	0.046	0.040	0.037	0.040	0.037	0.043	0.038	0.040	0.041	9.7
4	14-Jan-02	22-Jan-02	invalid (a)	0.053	0.060	0.048	0.045	0.048	0.049	0.046	0.049	0.048	0.050	9.1
5	22-Jan-02	28-Jan-02	0.036	0.034	0.036	0.036	0.028	0.029	0.030	0.033	0.035	0.036	0.033	9.5
6	28-Jan-02	4-Feb-02	0.032	0.026	0.029	0.026	0.024	0.025	0.028	0.024	0.026	0.025	0.027	9.5
7	4-Feb-02	11-Feb-02	0.035	0.034	0.040	0.034	0.032	0.032	0.031	0.036	0.036	0.037	0.035	7.8
8	11-Feb-02	18-Feb-02	0.053	0.060	0.058	0.048	0.051	0.052	0.046 (b)	0.052	0.052	0.052	0.053	6.9
9	18-Feb-02	25-Feb-02	0.023	0.025	0.028	0.022	0.020	0.022	0.028	0.023	0.025	0.022	0.024	11.2
10	25-Feb-02	4-Mar-02	0.037	0.032	0.038	0.033	0.033	0.034	0.029	0.034	0.033	0.030	0.033	8.3
11	4-Mar-02	11-Mar-02	0.031	0.026	0.034	0.030	0.028	0.029	0.033	0.032	0.029	0.032	0.030	8.1
12	11-Mar-02	18-Mar-02 (c)	0.013	0.023	0.023	0.024	0.022	0.023	0.010	0.012	0.019	0.024	0.019	28.5
13	18-Mar-02	25-Mar-02	0.025	0.027	0.028	0.027	0.029	0.029	0.024	0.027	0.028	0.030	0.027	6.7
	Mean		0.036	0.037	0.040	0.035	0.034	0.034	0.031	0.035	0.035	0.036	0.035	6.8

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	25-Mar-02	1-Apr-02	0.033	0.029	0.034	0.033	0.031	0.029	0.030	0.032	0.031	0.026	0.031	7.8
15	1-Apr-02	9-Apr-02	0.029	0.030	0.032	0.031	0.031	0.032	0.029	0.034	0.034	0.034	0.032	6.2
16	9-Apr-02	15-Apr-02	0.036	0.033	0.036	0.039	0.035	0.031	0.035	0.035	0.035	0.031	0.035	7.0
17	15-Apr-02	22-Apr-02 (d)	0.020	0.024	0.027	0.013	0.017	0.013	0.006	0.027	0.007	0.008	0.016	49.8
18	22-Apr-02	29-Apr-02	0.027	0.023	0.025	0.024	0.026	0.024	0.021	0.018	0.021	0.023	0.023	11.5
19	29-Apr-02	6-May-02	0.031	0.028	0.031	0.029	0.030	0.028	0.029	0.031	0.035	0.029	0.030	6.9
20	6-May-02	13-May-02	0.017	0.034	0.029	0.029	0.033	0.032	0.032	0.029	0.032	0.028	0.030	16.4
21	13-May-02	20-May-02	0.030	0.030	0.033	0.030	0.030	0.031	0.029	0.032	0.033	0.033	0.031	4.9
22	20-May-02	28-May-02	0.024	0.022	0.023	0.025	0.025	0.024	0.023	0.024	0.023	0.023	0.024	4.1
23	28-May-02	3-Jun-02	0.035	0.034	0.035	0.033	0 034	0.034	0.034	0.036	0.036	0.032	0.034	3.6
24	3-Jun-02	10-Jun-02	0.039	0.040	0.044	0.039	0.042	0.043	0.041	0.041	0.041	0.033	0.040	7.5
25	10-Jun-02	17-Jun-02	0.028	0.029	0.029	0.028	0.029	0.029	0.027	0.029	0.030	0.028	0.029	2.9
26	17-Jun-02	24-Jun-02	0.028	0.025	0.027	0.027	0.027	0.027	0.026	0.028	0.025	0.027	0.027	4.0
	Mean		0.029	0.029	0.031	0.029	0.030	0.029	0.028	0.030	0.029	0.027	0.029	3.9

(a) As found flow rate was 13 SLPM so sample was invalidated per procedure. (b) Sample collected on 2-19-02 due to road construction.

(c) Increased dust loading this week resulted in some samples indicating lower than expected results.

(d) Increased dust loading this week due to construction and high winds/dusty conditions. CIR #2514063 documents condition and actions taken.

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	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
27	24-Jun-02	1-Jul-02	0.032	0.033	0.033	0.033	0.034	0.033	0.029	0.032	0.036	0.031	0.033	5.6
28	1-Jul-02	8-Jul-02	0.039	0.037	0.038	0.039	0.038	0.035	0.037	0.043	0.039	0.038	0.038	5.4
29	8-Jul-02	16-Jul-02	0.032	invalid (a)	0.033	0.036	0.037	0.035	0.036	0.040	0.037	0.039	0.036	7.1
30	16-Jul-02	23-Jul-02	0.028	0.020	0.024	0.024	0.026	0.023	0.030	0.027	0.025	0.025	0.025	11.0
31	23-Jul-02	30-Jul-02	0.024	0.021	0.024	0.026	0.027	0.025	0.017	0.026	0.022	0.027	0.024	13.2
32	30-Jul-02	5-Aug-02	0.030	0.030	0.027	0.029	0.036	0.026	0.028	0.031	0.030	0.029	0.030	9.2
33	5-Aug-02	12-Aug-02	0.026	0.024	0.023	0.026	0.028	0.026	0.023	0.028	0.026	0.028	0.026	7.5
34	12-Aug-02	19-Aug-02	0.036	0.034	0.036	0.039	0.038	0.036	0.039	0.039	0.038	0.037	0.037	4.5
35	19-Aug-02	26-Aug-02	0.031	0.029	0.032	0.031	0.030	0.026	0.030	0.030	0.031	0.030	0.030	5.4
36	26-Aug-02	3-Sep-02	0.034	0.029	0.033	0.027	0.033	0.032	0.037	0.035	0.032	0.027	0.032	10.4
37	3-Sep-02	9-Sep-02	0.039	0.041	0.037	0.040	0.043	0.039	0.042	0.038	0.039	invalid (b)	0.040	4.8
38	9-Sep-02	16-Sep-02	0.032	0.029	0.028	0.033	0.032	0.032	0.035	0.033	0.029	0.031	0.031	6.9
39	16-Sep-02	23-Sep-02	0.031	0.029	0.032	0.033	0.030	0.030	0.035	0.033	0.030	0.033	0.032	6.0
40	23-Sep-02	30-Sep-02	0.034	0.037	0.035	0.036	0.035	0.037	0.04	0.037	0.036	0.032	0.036	5.9
	Mean		0.032	0.030	0.031	0.032	0.033	0.031	0.033	0.034	0.032	0.031	0.032	3.4

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 (%)
41	30-Sep-02	7-Oct-02	0.030	0.034	0.036	0.031	0.031	0.036	0.031	0.038	0.038	0.035	0.034	9.0
42	7-Oct-02	14-Oct-02	0.040	0.041	0.040	0.040	0.041	0.039	0.045	0.042	0.038	0.033	0.040	7.7
43	14-Oct-02	21-Oct-02	0.049	0.048	0.042	0.049	0.049	0.051	0.051	0.050	0.047	0.050	0.049	5.4
44	21-Oct-02	28-Oct-02	0.041	0.041	0.036	0.040	0.038	0.036	0.042	0.038	0.037	0.032	0.038	8.0
45	28-Oct-02	4-Nov-02	0.050	0.051	0.046	0.047	0.049	0.048	0.052	0.054	0.050	0.049	0.050	4.8
46	4-Nov-02	12-Nov-02	0.039	0.034	0.037	0.037	0.035	0.035	0.037	0.034	0.035	0.036	0.036	4.4
47	12-Nov-02	18-Nov-02	0.027	0.027	0.026	0.027	0.024	0.026	0.027	0.027	0.025	0.024	0.026	4.8
48	18-Nov-02	25-Nov-02	0.042	0.046	0.042	0.040	0.039	0.039	0.042	0.044	0.039	0.042	0.042	5.6
49	25-Nov-02	2-Dec-02	0.045	0.040	0.042	0.044	0.041	0.042	0.042	0.044	0.042	0.041	0.042	3.7
50	2-Dec-02	9-Dec-02	0.054	0.052	0.052	0.055	0.055	0.053	0.054	0.056	0.055	0.051	0.054	3.0
51	9-Dec-02	16-Dec-02	0.080	0.086	0.076	0.077	0.077	0.076	0.078	0.081	0.077	0.078	0.079	3.9
52	16-Dec-02	23-Dec-02	0.026	0.023	0.027	0.024	0.023	0.019	0.030	0.024	0.023	0.022	0.024	12.4
53	23-Dec-02	30-Dec-02	0.037	0.038	0.038	0.037	0.034	0.034	0.037	0.039	0.035	0.037	0.037	4.7
	Mean		0.043	0.043	0.042	0.042	0.041	0.041	0.044	0.044	0.042	0.041	0.042	2.7
	Annual Average		***0.035***	***0.035***	***0.036***	***0.035***	***0.035***	***0.034***	***0.034***	***0.036***	***0.034***	***0.034***	***0.035***	***2.3***

(a) Sample invalidated due to power outage from storm.

(b) Sample invalidated due to as found flow rate too low.

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*
25-Mar-02	Cs-134	<0.0055	<0.0046	<0.0025	<0.0054	<0.0034	<0.0052	<0.0031	<0.0047	<0.0028	<0.0037
	Cs-137	<0.0056	<0.0044	<0.0024	<0.0039	<0.0026	<0.0011	<0.0023	<0.0011	<0.0022	<0.0031
24-Jun-02	Cs-134	<0.0035	<0.0027	<0.0027	<0.0035	<0.0034	<0.0016	<0.0026	<0.0029	<0.0027	<0.0032
	Cs-137	<0.0033	<0.0031	<0.0023	<0.0017	<0.0026	<0.0029	<0.0016	<0.0027	<0.0028	<0.0028
30-Sep-02	Cs-134	<0.0010	<0.0019	<0.0019	<0.0013	<0.0017	<0.0011	<0.0020	<0.0013	<0.0020	<0.0011
	Cs-137	<0.0011	<0.0017	<0.0014	<0.0012	<0.0017	<0.0012	<0.0017	<0.0014	<0.0019	<0.0011
30-Dec-02	Cs-134	<0.0029	<0.0047	<0.0042	<0.0034	<0.0041	<0.0027	<0.0014	<0.0027	<0.0041	<0.0030
	Cs-137	<0.0024	<0.0052	<0.0049	<0.0023	<0.0036	<0.0031	<0.0037	<0.0030	<0.0053	<0.0026

Quarterly sample composite 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

required LLD <0 070

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*
1	26-Dec-01	2-Jan-02	<0.022	<0.031	<0.037	<0.021	<0.028	<0.020	<0.030	<0.023	<0.030	<0.021
2	2-Jan-02	8-Jan-02	<0.030	<0.030	<0.035	<0.030	<0.031	<0.029	<0.031	<0.028	<0.032	<0.030
3	8-Jan-02	14-Jan-02	<0.033	<0.038	<0.025	<0.030	<0.023	<0.027	<0.037	<0.032	<0.035	<0.032
4	14-Jan-02	22-Jan-02	invalid (a)	<0.023	<0.023	<0.024	<0.020	<0.018	<0.023	<0.023	<0.027	<0.022
5	22-Jan-02	28-Jan-02	<0.033	<0.030	<0.033	<0.044	<0.028	<0.035	<0.029	<0.039	<0.033	<0.029
6	28-Jan-02	4-Feb-02	<0.020	<0.022	<0.016	<0.027	<0.027	<0.027	<0.028	<0.025	<0.025	<0.023
7	4-Feb-02	11-Feb-02	<0.025	<0.030	<0.031	<0.027	<0.037	<0.026	<0.035	<0.023	<0.035	<0.027
8	11-Feb-02	18-Feb-02	<0.027	<0.025	<0.034	<0.030	<0.027	<0.026	<0.022 (b)	<0.024	<0.024	<0.024
9	18-Feb-02	25-Feb-02	<0.030	<0.034	<0.039	<0.024	<0.028	<0.027	<0.045	<0.030	<0.042	<0.027
10	25-Feb-02	4-Mar-02	<0.027	<0.026	<0.032	<0.043	<0.029	<0.028	<0.040	<0.032	<0.046	<0.030
11	4-Mar-02	11-Mar-02	<0.029	<0.024	<0.025	<0.025	<0.046	<0.030	<0.025	<0.018	<0.031	<0.036
12	11-Mar-02	18-Mar-02	<0.028	<0.026	<0.026	<0.025	<0.024	<0.028	<0.028	<0.027	<0.026	<0.027
13	18-Mar-02	25-Mar-02	<0.029	<0.020	<0.033	<0.028	<0.037	<0.014	<0.054	<0.026	<0.029	<0.027

2nd Quarter

required LLD <0 070

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*
14	25-Mar-02	1-Apr-02	<0.038	<0.030	<0.034	<0.035	<0.029	<0.038	<0.030	<0.032	<0.028	<0.037
15	1-Apr-02	9-Apr-02	<0.034	<0.020	<0.025	<0.020	<0.029	<0.027	<0.029	<0.020	<0.034	<0.025
16	9-Apr-02	15-Apr-02	<0.025	<0.045	<0.052	<0.035	<0.033	<0.054	<0.027	<0.026	<0.032	<0.032
17	15-Apr-02	22-Apr-02	<0.022	<0.020	<0.026	<0.026	<0.035	<0.031	<0.035	<0.025	<0.035	<0.025
18	22-Apr-02	29-Apr-02	<0.033	<0.025	<0.028	<0.029	<0.028	<0.045	<0.028	<0.046	<0.023	<0.034
19	29-Apr-02	6-May-02	<0.033	<0.032	<0.033	<0.039	<0.034	<0.026	<0.029	<0.023	<0.043	<0.026
20	6-May-02	13-May-02	<0.036	<0.026	<0.047	<0.035	<0.032	<0.028	<0.044	<0.040	<0.026	<0.023
21	13-May-02	20-May-02	<0.031	<0.018	<0.035	<0.026	<0.020	<0.023	<0.043	<0.026	<0.043	<0.025
22	20-May-02	28-May-02	<0.024	<0.041	<0.026	<0.026	<0.029	<0.023	<0.026	<0.019	<0.035	<0.023
23	28-May-02	3-Jun-02	<0.041	<0.031	<0.030	<0.036	<0.034	<0.037	<0.035	<0.046	<0.036	<0.038
24	3-Jun-02	10-Jun-02	<0.034	<0.038	<0.027	<0.039	<0.037	<0.030	<0.035	<0.021	<0.040	<0.029
25	10-Jun-02	17-Jun-02	<0.036	<0.032	<0.025	<0.031	<0.037	<0.032	<0.032	<0.025	<0.034	<0.026
26	17-Jun-02	24-Jun-02	<0.030	<0.032	<0.034	<0.024	<0.035	<0.026	<0.038	<0.027	<0.034	<0.035

(a) As found flow rate was 13 SLPM so sample was invalidated per procedure. (b) Sample collected on 2-19-02 due to road construction.

TABLE 8.5 RADIOIODINE IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

required LLD <0 070

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*
27	24-Jun-02	1-Jul-02	<0.031	<0.022	<0.032	<0.036	<0.025	<0.034	<0.037	<0.042	<0.043	<0.036
28	1-Jul-02	8-Jul-02	<0.026	<0.036	<0.022	<0.042	<0.034	<0.025	<0.028	<0.023	<0.047	<0.031
29	8-Jul-02	16-Jul-02	<0.031	invalid (a)	<0.022	<0.025	<0.023	<0.034	<0.036	<0.030	<0.023	<0.028
30	16-Jul-02	23-Jul-02	<0.037	<0.035	<0.034	<0.025	<0.038	<0.024	<0.020	<0.030	<0.033	<0.025
31	23-Jul-02	30-Jul-02	<0.038	<0.037	<0.031	<0.029	<0.033	<0.037	<0.040	<0.023	<0.043	<0.023
32	30-Jul-02	5-Aug-02	<0.037	<0.040	<0.036	<0.044	<0.045	<0.029	<0.035	<0.034	<0.031	<0.032
33	5-Aug-02	12-Aug-02	<0.036	<0.026	<0.040	<0.040	<0.040	<0.037	<0.025	<0.037	<0.029	<0.037
34	12-Aug-02	19-Aug-02	<0.039	<0.024	<0.034	<0.026	<0.041	<0.036	<0.030	<0.025	<0.031	<0.027
35	19-Aug-02	26-Aug-02	<0.037	<0.037	<0.036	<0.037	<0.045	<0.039	<0.037	<0.016	<0.040	<0.029
36	26-Aug-02	3-Sep-02	<0.033	<0.026	<0.034	<0.023	<0.031	<0.019	<0.031	<0.021	<0.031	<0.021
37	3-Sep-02	9-Sep-02	<0.036	<0.050	<0.029	<0.026	<0.036	<0.056	<0.056	<0.033	<0.048	invalid (b)
38	9-Sep-02	16-Sep-02	<0.029	<0.037	<0.039	<0.039	<0.017	<0.041	<0.042	<0.041	<0.037	<0.031
39	16-Sep-02	23-Sep-02	<0.035	<0.021	<0.047	<0.026	<0.036	<0.030	<0.034	<0.043	<0.037	<0.041
40	23-Sep-02	30-Sep-02	<0.043	<0.052	<0.034	<0.024	<0.034	<0.040	<0.025	<0.027	<0.044	<0.041

4th Quarter

required LLD <0 070

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*
41	30-Sep-02	7-Oct-02	<0.030	<0.029	<0.031	<0.036	<0.040	<0.044	<0.039	<0.029	<0.031	<0.032
42	7-Oct-02	14-Oct-02	<0.026	<0.040	<0.033	<0.031	<0.070	<0.033	<0.063	<0.058	<0.052	<0.053
43	14-Oct-02	21-Oct-02	<0.029	<0.036	<0.041	<0.032	<0.044	<0.027	<0.043	<0.025	<0.047	<0.027
44	21-Oct-02	28-Oct-02	<0.030	<0.028	<0.028	<0.026	<0.041	<0.032	<0.048	<0.036	<0.046	<0.036
45	28-Oct-02	4-Nov-02	<0.026	<0.027	<0.036	<0.046	<0.027	<0.049	<0.030	<0.040	<0.028	<0.031
46	4-Nov-02	12-Nov-02	<0.028	<0.027	<0.024	<0.029	<0.023	<0.038	<0.027	<0.038	<0.031	<0.031
47	12-Nov-02	18-Nov-02	<0.048	<0.035	<0.042	<0.050	<0.061	<0.051	<0.035	<0.036	<0.032	<0.045
48	18-Nov-02	25-Nov-02	<0.044	<0.023	<0.026	<0.041	<0.034	<0.033	<0.040	<0.022	<0.021	<0.036
49	25-Nov-02	2-Dec-02	<0.032	<0.030	<0.041	<0.045	<0.025	<0.039	<0.029	<0.030	<0.029	<0.017
50	2-Dec-02	9-Dec-02	<0.050	<0.034	<0.040	<0.037	<0.041	<0.027	<0.042	<0.031	<0.043	<0.034
51	9-Dec-02	16-Dec-02	<0.031	<0.037	<0.032	<0.040	<0.042	<0.035	<0.030	<0.053	<0.033	<0.033
52	16-Dec-02	23-Dec-02	<0.054	<0.030	<0.026	<0.030	<0.048	<0.030	<0.028	<0.039	<0.039	<0.028
53	23-Dec-30	30-Dec-02	<0.039	<0.052	<0.031	<0.045	<0.022	<0.035	<0.026	<0.039	<0.027	<0.037

(a) Sample invalidated due to power outage from storm.

(b) Sample invalidated due to as found flow rate too low.

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
HALLMAN/ CHOWANEC RESIDENCES (Site #52)*	NO SAMPLES AVAILABLE				
DUNCAN FAMILY FARMS (Site #62)*	green cabbage	17-Jan-02	<20	<25	<25
	savoy cabbage	17-Jan-02	<21	<32	<24
	purple cabbage	17-Jan-02	<22	<24	<24
	green cabbage	15-Feb-02	<20	<21	<22
	savoy cabbage	15-Feb-02	<21	<20	<23
	red cabbage	15-Feb-02	<25	<31	<29
	green cabbage	13-Mar-02	<21	<26	<25
	purple cabbage	13-Mar-02	<24	<30	<27
	savoy cabbage	13-Mar-02	<22	<28	<25
	green cabbage	10-Apr-02	<15	<25	<16
	purple cabbage	10-Apr-02	<14	<18	<18
	green cabbage	15-May-02	<23	<29	<24
	green cabbage	16-Oct-02	<38	<36	<38
	red cabbage	16-Oct-02	<28	<38	<50
	lettuce	13-Nov-02	<46	<35	<61
	green cabbage	13-Nov-02	<38	<45	<63
	savoy cabbage	13-Nov-02	<40	<32	<47
	green cabbage	13-Dec-02	<27	<41	<45
	purple cabbage	13-Dec-02	<34	<40	<45
	lettuce	13-Dec-02	<55	<50	<62
BRANCH/ MCCOY RESIDENCES (Site #47)*	NO SAMPLES AVAILABLE				

TABLE 8.7 MILK

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<1 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140
PAINTER GOATS (Site #51)*	18-Sep-02	<0.6	<4	<3	<32	<17 (a)
	16-Oct-02	<0.2	<6	<5	<11	<7
	20-Nov-02	<0.4	<10	<9	<25	<16 (a)
	18-Dec-02	<0.2	<12	<9	<23	<11
BARBER GOATS (Site #53)*	18-Sep-02	<0.4	<5	<4	<49	<22 (a)
	16-Oct-02	<0.2	<6	<5	<13	<6
	20-Nov-02	<0.3	<11	<9	<30	<14
		no sample in December				

(a) La-140 LLD not met due to delay time between sample collection and analysis at vendor laboratory.

TABLE 8.8 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) *	28-Jan-02	<7	<8	<19	<9	<18	<8	<14	<6	<9	<9	<24	<9		4.2 +/- 1.6
	25-Feb-02	<8	<7	<16	<9	<22	<9	<14	<8	<9	<9	<25	<11		<2.9
	25-Mar-02	<9	<9	<21	<10	<26	<10	<17	<10	<12	<10	<34	<10	<271	3.1 +/- 1.8
	29-Apr-02	<9	<9	<22	<11	<23	<10	<17	<10	<12	<10	<33	<11		<3.0
	28-May-02	<11	<9	<19	<11	<21	<11	<18	<10	<11	<12	<36	<10		4.4 +/- 1.6
	24-Jun-02	<11	<9	<23	<11	<22	<11	<17	<10	<12	<10	<36	<12	<261	3.8 +/- 1.6
	30-Jul-02	<11	<10	<18	<9	<22	<11	<16	<10	<11	<10	<36	<8		<3.0
	26-Aug-02	<10	<10	<23	<11	<23	<12	<16	<10	<12	<11	<37	<12		<3.0
	30-Sep-02	<9	<11	<21	<11	<19	<10	<18	<11	<9	<10	<36	<12	<280	<2.8
	28-Oct-02	<13	<12	<26	<11	<29	<12	<22	<11	<11	<13	<43	<15		<2.6
	25-Nov-02	<10	<11	<21	<11	<21	<11	<18	<10	<9	<12	<37	<14		<3.0
	30-Dec-02	<8	<10	<23	<14	<29	<11	<20	<9	<12	<11	<40	<13	<278	3.8 +/- 1.4
GAVETTE RESIDENCE (SITE #55)	28-Jan-02	<10	<10	<21	<11	<25	<11	<16	<10	<12	<9	<38	<10		3.0 +/- 1.6
	25-Feb-02	<9	<8	<17	<10	<16	<8	<14	<7	<8	<10	<27	<9		<2.9
	25-Mar-02	<10	<11	<19	<9	<22	<11	<17	<10	<11	<10	<38	<10	<267	4.1 +/- 1.8
	29-Apr-02	<9	<7	<18	<9	<21	<8	<14	<7	<8	<8	<25	<12		<3.0
	28-May-02	<10	<9	<22	<11	<22	<10	<18	<10	<12	<11	<34	<10		2.5 +/- 1.6
	24-Jun-02	<9	<8	<17	<9	<19	<11	<14	<8	<10	<11	<32	<10	<262	4.4 +/- 1.6
	30-Jul-02	<7	<9	<16	<11	<20	<7	<12	<7	<7	<8	<27	<13		<3.1
	26-Aug-02	<10	<10	<20	<13	<23	<10	<18	<11	<12	<10	<32	<12		<3.1
	30-Sep-02	<7	<8	<15	<9	<15	<9	<11	<7	<7	<8	<29	<10	<279	<2.9
	28-Oct-02	<12	<11	<25	<15	<26	<13	<20	<12	<10	<13	<41	<13		5.0 +/- 1.8
	25-Nov-02	<11	<11	<24	<10	<24	<13	<17	<11	<10	<11	<40	<15		<3.1
	30-Dec-02	<13	<12	<24	<12	<30	<15	<19	<12	<11	<14	<44	<14	<283	5.3 +/- 1.6

TABLE 8.8 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
	28-Jan-02	<7	<8	<15	<9	<15	<8	<14	<7	<9	<8	<28	<8		3.3 +/- 2.0
	25-Feb-02	<7	<8	<14	<7	<15	<9	<15	<7	<10	<8	<28	<10		<3.6
	25-Mar-02	<7	<8	<17	<8	<17	<8	<15	<7	<9	<7	<25	<9	<275	<3.5
	29-Apr-02	<11	<9	<19	<10	<21	<11	<17	<10	<11	<10	<35	<12		<3.8
BERRYMAN	28-May-02	<8	<7	<17	<9	<22	<8	<15	<8	<9	<8	<24	<10		3.6 +/- 2.1
RESIDENCE	24-Jun-02	<10	<11	<21	<12	<22	<12	<20	<12	<13	<10	<40	<12	<262	5.9 +/- 2.1
(SITE #48)*	30-Jul-02	<10	<10	<21	<11	<21	<10	<16	<11	<13	<11	<36	<11		<3.4
	26-Aug-02	<9	<8	<16	<8	<16	<8	<14	<6	<9	<9	<28	<11		<3.8
	30-Sep-02	<10	<10	<15	<11	<23	<11	<16	<9	<9	<11	<34	<8	<280	<3.6
	28-Oct-02	<15	<11	<30	<15	<27	<13	<25	<12	<14	<14	<47	<12		<3.4
	25-Nov-02	<11	<10	<19	<15	<19	<11	<18	<8	<10	<10	<33	<15		<3.9
	30-Dec-02	<12	<12	<21	<12	<28	<11	<20	<11	<12	<10	<30	<15	<279	6.0 +/- 1.9
	28-Jan-02	<10	<9	<18	<12	<22	<10	<16	<9	<10	<10	<31	<11		<2.3
	25-Feb-02	<10	<11	<22	<12	<23	<10	<15	<10	<11	<10	<36	<13		<2.7
	25-Mar-02	<11	<10	<20	<10	<23	<10	<18	<11	<11	<12	<37	<10	<276	<2.7
	29-Apr-02	<8	<8	<16	<9	<19	<9	<14	<7	<8	<8	<24	<9		<2.9
CHOWANEC	28-May-02	<8	<7	<14	<9	<15	<8	<14	<7	<10	<9	<27	<10		2.7 +/- 1.5
RESIDENCE	24-Jun-02	<10	<10	<21	<10	<26	<10	<18	<10	<13	<12	<35	<12	<264	2.7 +/- 1.5
(SITE #49) *	30-Jul-02	<9	<10	<22	<11	<24	<11	<16	<11	<14	<10	<33	<12		<2.9
	26-Aug-02	<7	<9	<18	<9	<18	<8	<14	<7	<9	<9	<25	<11		<2.9
	30-Sep-02	<6	<7	<11	<8	<16	<7	<12	<8	<6	<8	<23	<9	<280	<2.7
	28-Oct-02	<9	<9	<21	<15	<20	<11	<17	<7	<11	<10	<29	<11		19.8 +/- 2.3 (a)
	25-Nov-02	<9	<11	<18	<7	<22	<10	<18	<9	<9	<12	<30	<15		<2.9
	30-Dec-02	<11	<14	<23	<13	<30	<13	<23	<12	<11	<13	<46	<12	<279	2.7 +/- 1.4

(a) This value is abnormally high. The sample was re-counted with similar results. Sample data were reviewed and no apparent cause for the increase could be identified. This value is below the action level of 30 pCi/liter.

TABLE 8.9 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)*	28-Jan-02	<7	<8	<17	<9	<17	<9	<13	<10	<9	<8	<31	<10	<273
	29-Apr-02	<11	<10	<22	<10	<25	<13	<21	<12	<12	<12	<42	<13	<271
	30-Jul-02	<12	<13	<24	<13	<26	<15	<21	<11	<13	<12	<41	<14	<265
	28-Oct-02	<13	<12	<22	<12	<26	<14	<24	<15	<11	<12	<44	<15	<274
WELL 34abb (Site #58)*	28-Jan-02	<12	<10	<21	<13	<25	<13	<19	<11	<13	<13	<42	<13	<276
	29-Apr-02	<9	<11	<22	<11	<25	<12	<17	<12	<13	<11	<43	<12	<273
	30-Jul-02	<10	<9	<20	<12	<20	<11	<15	<9	<11	<11	<33	<14	<264
	28-Oct-02	<11	<12	<25	<12	<24	<13	<18	<11	<10	<11	<40	<15	<277

TABLE 8.10 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) *	28-Jan-02	<10	<10	<18	<10	<21	<11	<19	<11	<10	<10	<36	<9	
	25-Feb-02	<10	<9	<19	<10	<23	<9	<16	<12	<12	<11	<35	<13	
	25-Mar-02	<6	<7	<12	<9	<18	<8	<14	<9	<8	<9	<26	<8	<276
	29-Apr-02	<10	<9	<22	<8	<22	<10	<18	<12	<12	<11	<38	<12	
	28-May-02	<7	<7	<15	<9	<18	<7	<13	8 +/- 6	<9	<8	<25	<11	
	24-Jun-02	<10	<10	<21	<10	<19	<11	<17	<12	<12	<10	<37	<11	<266
	30-Jul-02	<7	<8	<16	<9	<20	<9	<14	9 +/- 6	<9	<8	<26	<8	
	26-Aug-02	<11	<10	<20	<11	<24	<11	<17	<11	<12	<10	<36	<10	
	30-Sep-02	<10	<9	<19	<10	<18	<11	<16	<13	<9	<10	<38	<11	<281
	28-Oct-02	<15	<14	<26	<14	<26	<12	<16	<13	<13	<14	<43	<8	
	25-Nov-02	<7	<10	<18	<10	<23	<10	<17	<8	<10	<10	<32	<15	
	30-Dec-02	<14	<12	<25	<14	<28	<14	<21	<13	<11	<14	<41	<15	<282
EVAP POND 1 (Site #59) *	28-Jan-02	<7	<9	<22	<10	<22	<10	<14	<8	<10	<9	<29	<11	
	25-Feb-02	<9	<9	<18	<9	<19	<8	<13	<8	<10	<10	<29	<11	
	25-Mar-02	<10	<10	<21	<12	<25	<10	<19	<12	<12	<10	<34	<10	1072 +/- 177
	29-Apr-02	<8	<9	<25	<10	<20	<8	<14	<8	<11	<9	<27	<10	
	28-May-02	<9	<7	<21	<10	<23	<8	<13	<7	<11	<9	<26	<10	
	24-Jun-02	<9	<9	<21	<10	<25	<8	<15	<8	<10	<10	<32	<13	1177 +/- 171
	30-Jul-02	<9	<9	<19	<12	<22	<9	<16	<7	<10	<9	<27	<11	
	26-Aug-02	<11	<11	<23	<12	<24	<11	<20	<11	<12	<12	<37	<10	
	30-Sep-02	<8	<9	<20	<8	<21	<9	<15	<8	<7	<8	<35	<12	808 +/- 178
	28-Oct-02	<10	<10	<21	<15	<28	<9	<20	<9	<8	<13	<36	<12	
	25-Nov-02	<14	<15	<29	<13	<30	<13	<25	<13	<11	<12	<38	<12	
	30-Dec-02	<12	<12	<27	<13	<28	<15	<19	<11	<10	<13	<42	<10	838 +/- 184
EVAP POND 2 (Site #63) *	28-Jan-02	<10	<10	<25	<10	<25	<11	<19	<14	<12	<12	<43	<11	
	25-Feb-02	<12	<9	<26	<12	<24	<11	<18	<13	<12	<14	<39	<10	
	25-Mar-02	<9	<9	<19	<11	<22	<8	<17	<9	<11	<11	<25	<10	950 +/- 178
	29-Apr-02	<10	<11	<25	<12	<28	<12	<19	<13	<13	13 +/- 9	<36	<11	
	28-May-02	<10	<11	<25	<12	<24	<12	<17	<12	<13	<15	<36	<11	
	24-Jun-02	<10	<11	<23	<11	<24	<11	<20	12 +/- 10	<14	<13	<41	<11	1065 +/- 168
	30-Jul-02	<8	<8	<19	<8	<18	<8	<14	<10	<9	<10	<29	<8	
	26-Aug-02	<11	<9	<28	<13	<27	<11	<19	<13	<13	<13	<42	<7	
	30-Sep-02	<9	<9	<19	<10	<21	<9	<16	<11	<8	12 +/- 8	<32	<10	931 +/- 181
	28-Oct-02	<12	<13	<26	<12	<27	<13	<21	<12	<13	<17	<37	<15	
	25-Nov-02	<13	<12	<27	<15	<28	<13	<20	<11	<11	<15	<39	<12	
	30-Dec-02	<11	<10	<23	<15	<23	<11	<18	<10	<9	<13	<35	<11	1143 +/- 189

TABLE 8.10 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	8-Jan-02	<8	<7	<16	<10	<18	<8	<14	18 +/- 7	<8	<8	<25	<10	
	15-Jan-02	<10	<10	<19	<9	<22	<10	<18	55 +/- 11	<12	<12	<34	<8	
	22-Jan-02	<10	<11	<18	<9	<21	<10	<17	45 +/- 13	<10	<10	<32	<10	
	29-Jan-02	<9	<8	<17	<9	<16	<8	<15	36 +/- 10	<10	<8	<25	<12	<280
	5-Feb-02	<7	<7	<15	<8	<17	<8	<12	26 +/- 8	<9	<8	<25	<7	
	12-Feb-02	<10	<9	<21	<10	<20	<11	<17	36 +/- 14	<12	<11	<38	<10	
	18-Feb-02	<10	<11	<24	<10	<25	<11	<18	31 +/- 10	<14	<12	<40	<11	
	26-Feb-02	<9	<9	<21	<10	<19	<10	<17	36 +/- 12	<11	<10	<37	<9	<270
	5-Mar-02	<9	<10	<19	<11	<21	<10	<16	34 +/- 12	<11	<10	<37	<8	
	12-Mar-02	<11	<10	<19	<11	<24	<12	<17	28 +/- 10	<11	<10	<34	<10	
	18-Mar-02	<9	<10	<18	<9	<20	<10	<18	14 +/- 9	<11	<10	<37	<11	
	26-Mar-02	<9	<10	<19	<11	<23	<11	<16	29 +/- 10	<12	<10	<34	<9	<285
	2-Apr-02	<9	<8	<20	<10	<21	<9	<17	29 +/- 11	<11	<12	<34	<7	
	16-Apr-02	<8	<7	<12	<9	<16	<8	<14	44 +/- 10	<8	<8	<27	<9	
	22-Apr-02	<12	<10	<21	<12	<23	<10	<19	31 +/- 10	<12	<12	<37	<10	
	30-Apr-02	<12	<9	<20	<11	<23	<11	<17	37 +/- 12	<12	<10	<32	<12	<280
	7-May-02	<11	<9	<17	<12	<20	<10	<18	26 +/- 9	<13	<11	<33	<12	
	14-May-02	<10	<9	<19	<12	<20	<11	<18	39 +/- 13	<11	<12	<35	<11	
	21-May-02	<11	<9	<18	<9	<24	<8	<16	45 +/- 11	<11	<11	<35	<10	
	28-May-02	<11	<10	<20	<12	<23	<10	<18	46 +/- 11	<12	<10	<36	<10	<279
	3-Jun-02	<9	<8	<18	<9	<19	<8	<13	36 +/- 10	<9	<8	<26	<9	
	11-Jun-02	<10	<9	<20	<8	<22	<10	<16	38 +/- 11	<13	<10	<33	<11	
	17-Jun-02	<10	<10	<22	<11	<23	<11	<14	28 +/- 8	<11	<10	<34	<9	
	24-Jun-02	<12	<10	<21	<9	<22	<10	<19	17 +/- 11	<13	<10	<35	<11	<275
	1-Jul-02	<8	<8	<20	<9	<21	<8	<15	24 +/- 8	<8	<8	<27	<10	
	8-Jul-02	<10	<10	<24	<9	<20	<10	<16	42 +/- 10	<11	<11	<33	<11	
	16-Jul-02	<10	<9	<21	<11	<24	<11	<15	47 +/- 11	<11	<10	<38	<10	
	23-Jul-02	<8	<7	<16	<11	<22	<8	<13	15 +/- 8	<9	<8	<25	<10	
	30-Jul-02	<9	<10	<20	<11	<21	<11	<18	22 +/- 10	<10	<10	<34	<10	<274

** Monthly composite

TABLE 8.10 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)	5-Aug-02	<10	<8	<18	<10	<21	<11	<16	38 +/- 11	<12	<10	<30	<12	
	13-Aug-02	<9	<9	<18	<12	<21	<10	<18	26 +/- 13	<12	<10	<34	<7	
	20-Aug-02	<10	<11	<18	<11	<21	<11	<15	23 +/- 10	<11	<10	<35	<9	
	27-Aug-02	<10	<9	<19	<11	<24	<10	<17	26 +/- 10	<11	<10	<35	<9	<277
	3-Sep-02	<10	<10	<22	<12	<24	<11	<18	9 +/- 8	<12	<10	<34	<10	
	10-Sep-02	<7	<7	<12	<8	<16	<7	<12	15 +/- 8	<6	<8	<27	<10	
	17-Sep-02	<10	<10	<21	<11	<16	<10	<18	31 +/- 10	<11	<13	<27	<14	
	24-Sep-02	<9	<9	<17	<11	<24	<10	<18	16 +/- 10	<11	<12	<32	<14	
	30-Sep-02	<8	<8	<16	<8	<18	<8	<13	37 +/- 9	<7	<9	<29	<10	<289
	7-Oct-02	<9	<10	<18	<7	<22	<9	<15	30 +/- 9	<8	<10	<35	<10	
	22-Oct-02	<11	<13	<24	<12	<29	<12	<24	22 +/- 14	<13	<15	<43	<14	
	29-Oct-02	<12	<11	<23	<12	<29	<12	<16	13 +/- 10	<10	<9	<40	<13	<285
	5-Nov-02	<12	<12	<20	<8	<26	<11	<20	14 +/- 10	<11	<12	<35	<15	
	12-Nov-02	<8	<9	<20	<11	<18	<8	<13	13 +/- 9	<9	<9	<29	<9	
	19-Nov-02	<11	<10	<20	<11	<20	<9	<17	<11	<9	<10	<34	<11	
	25-Nov-02	<15	<13	<21	<15	<28	<14	<23	20 +/- 10	<12	<13	<49	<13	<290
	3-Dec-02	<12	<13	<26	<15	<24	<13	<23	<14	<13	<13	<42	<15	
	10-Dec-02	<13	<13	<25	<13	<29	<12	<23	11 +/- 11	<11	<12	<41	<11	
	17-Dec-02	<13	<13	<26	<14	<27	<11	<21	22 +/- 11	<12	<13	<38	<11	
	23-Dec-02	<13	<11	<22	<12	<29	<11	<21	54 +/- 17	<13	<17	<47	<11	
	30-Dec-02	<12	<11	<25	<13	<29	<14	<22	19 +/- 11	<12	<13	<43	<14	
SEDIMENT. BASIN #2	16-Jul-02	<8	<8	<15	<9	<17	<8	<13	<9	<7	<8	<24	<12	<282
	28-Oct-02	<15	<12	<25	<13	<28	<13	<21	<12	<11	<15	<45	<14	<292
	2-Dec-02	<14	<13	<26	<13	<30	<13	<21	<14	<11	<14	<47	<13	<299

** Monthly composite

TABLE 8.11 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	8-Jan-02	1599 +/- 175	<17	<17	
	15-Jan-02	1418 +/- 170	<18	<23	16 +/- 21
	22-Jan-02	1904 +/- 224	<23	<21	30 +/- 23
	29-Jan-02	1812 +/- 197	<16	<13	36 +/- 26
	5-Feb-02	1417 +/- 172	<22	<19	52 +/- 29
	12-Feb-02	758 +/- 90	<24	<15	
	18-Feb-02	1582 +/- 191	<23	<13	50 +/- 23
	26-Feb-02	1199 +/- 146	<22	<16	
	5-Mar-02	1307 +/- 158	<19	<22	
	12-Mar-02	1066 +/- 132	<9	<10	42 +/- 24
	18-Mar-02	912 +/- 117	<25	<18	27 +/- 27
	26-Mar-02	945 +/- 120	<19	<18	53 +/- 23
	2-Apr-02	1203 +/- 146	<22	<15	34 +/- 21
	16-Apr-02	1004 +/- 115	<18	<15	55 +/- 21
	22-Apr-02	1594 +/- 191	<16	<18	104 +/- 30
	30-Apr-02	1518 +/- 168	<15	<18	37 +/- 12
	7-May-02	1072 +/- 132	<23	<20	
	14-May-02	1163 +/- 142	<22	<13	64 +/- 23
	21-May-02	1280 +/- 155	<23	<14	36 +/- 21
	28-May-02	1920 +/- 229	<20	<24	120 +/- 41
	3-Jun-02	1447 +/- 161	<17	<18	33 +/- 30
	11-Jun-02	1644 +/- 194	<17	<22	80 +/- 22
	17-Jun-02	1099 +/- 137	<26	<17	34 +/- 26
	24-Jun-02	787 +/- 103	<22	<33	54 +/- 24
	1-Jul-02	905 +/- 114	<26	<19	26 +/- 21
	8-Jul-02	1657 +/- 198	<17	<18	83 +/- 31
	16-Jul-02	2000 +/- 232	<17	<17	45 +/- 27
	23-Jul-02	1033 +/- 127	<15	<21	21 +/- 16
	30-Jul-02	931 +/- 107	<18	<13	35 +/- 18
	5-Aug-02	969 +/- 122	<18	<20	41 +/- 20
	13-Aug-02	1166 +/- 131	<20	<17	53 +/- 19
	20-Aug-02	926 +/- 119	<17	<20	28 +/- 26
	27-Aug-02	1118 +/- 138	<17	<22	41 +/- 28
	3-Sep-02	802 +/- 92	<17	<13	30 +/- 18
	10-Sep-02	622 +/- 73	<8	<6	29 +/- 13
	17-Sep-02	1072 +/- 127	<21	<21	45 +/- 25
	24-Sep-02	1177 +/- 157	<31	<32	25 +/- 26
	30-Sep-02	1688 +/- 179	<14	<16	67 +/- 28
	7-Oct-02	1059 +/- 116	<13	<14	56 +/- 19
	22-Oct-02	494 +/- 80	<19	<28	
	29-Oct-02	431 +/- 65	<17	<20	55 +/- 25
	5-Nov-02	347 +/- 63	<26	<26	69 +/- 28
	12-Nov-02	629 +/- 92	<23	<19	33 +/- 19
	19-Nov-02	504 +/- 81	<21	<25	25 +/- 27
	25-Nov-02	373 +/- 66	<29	<20	
	3-Dec-02	559 +/- 89	<32	<36	56 +/- 26
	9-Dec-02	680 +/- 181	<22	<20	64 +/- 31
	17-Dec-02	638 +/- 93	<20	<23	11 +/- 12
	23-Dec-02	897 +/- 122	<28	<34	
	30-Dec-02	1540 +/- 186	<30	<25	

TABLE 8.11 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)	22-Nov-02	<29	<17	<44	<45	<55	<24	<44	<19	<25	<36	<79	<34
(E)		<18	<14	<49	<36	<57	<21	<29	<17	<18	<27	<40	<21
EVAP POND 1 (S)		<25	<19	<38	<25	<54	<25	<38	<21	<17	<21	<72	<15
(W)		<25	<24	<58	<23	<51	<24	<32	<20	<28	<29	<79	<35
(C)		<17	<15	<30	<22	<44	<16	<23	<14	<13	<14	<56	<18
(N)	22-Nov-02	<22	<18	<57	<35	<57	<28	<36	<17	<19	22 +/- 17	<68	<22
(E)		<22	<20	<43	<31	<60	<24	<41	<18	<18	<30	<73	<8
EVAP POND 2 (S)		<19	<15	<39	<31	<51	<19	<34	<15	<20	<25	<57	<20
(W)		<21	<19	<45	51 +/- 21	<41	<23	<36	<16	<16	36 +/- 15	<64	<18
(C)		<14	<16	<36	<22	<46	<18	<26	<14	<15	20 +/- 16	<54	<14

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

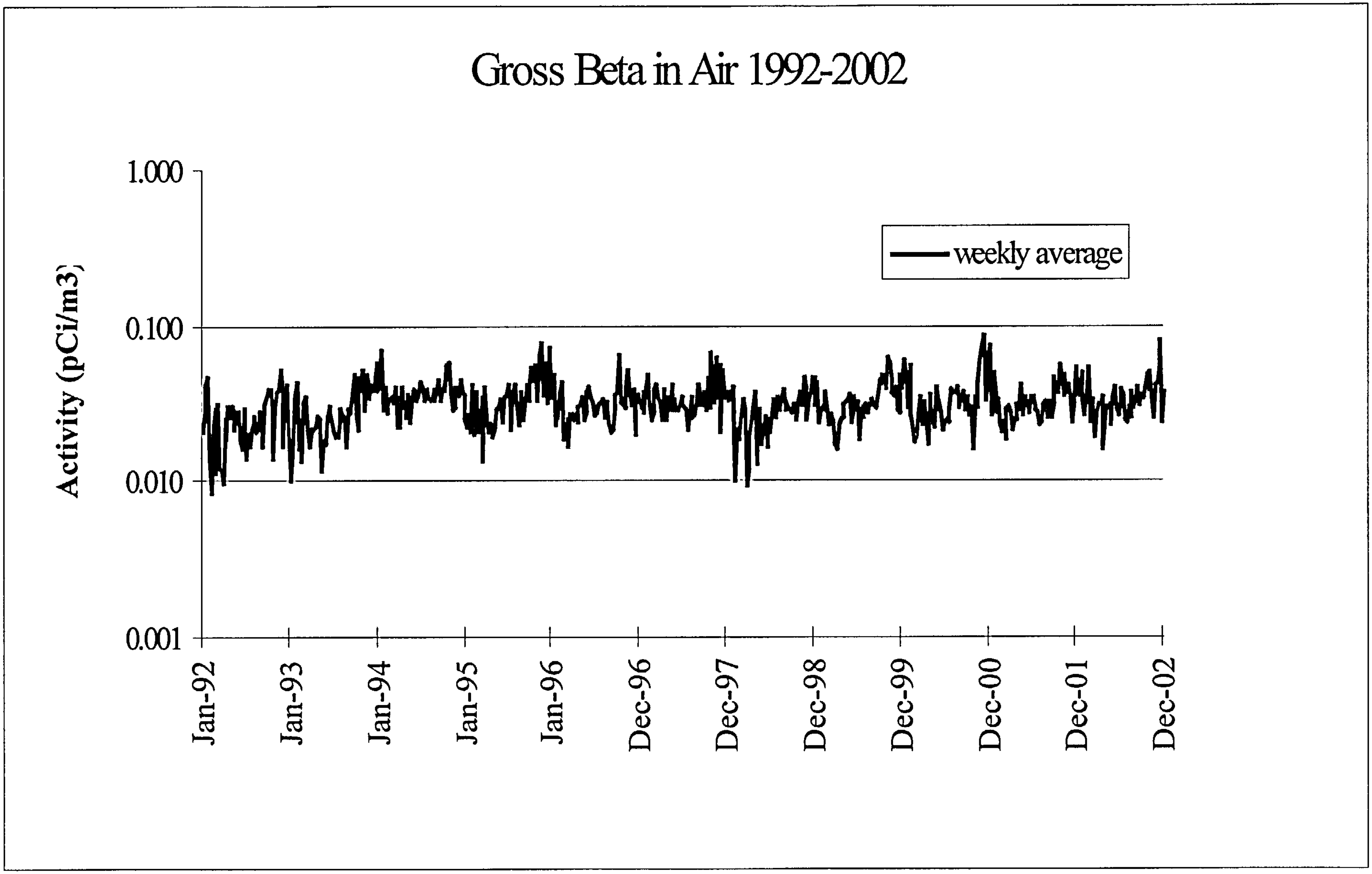


FIGURE 8.2 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP

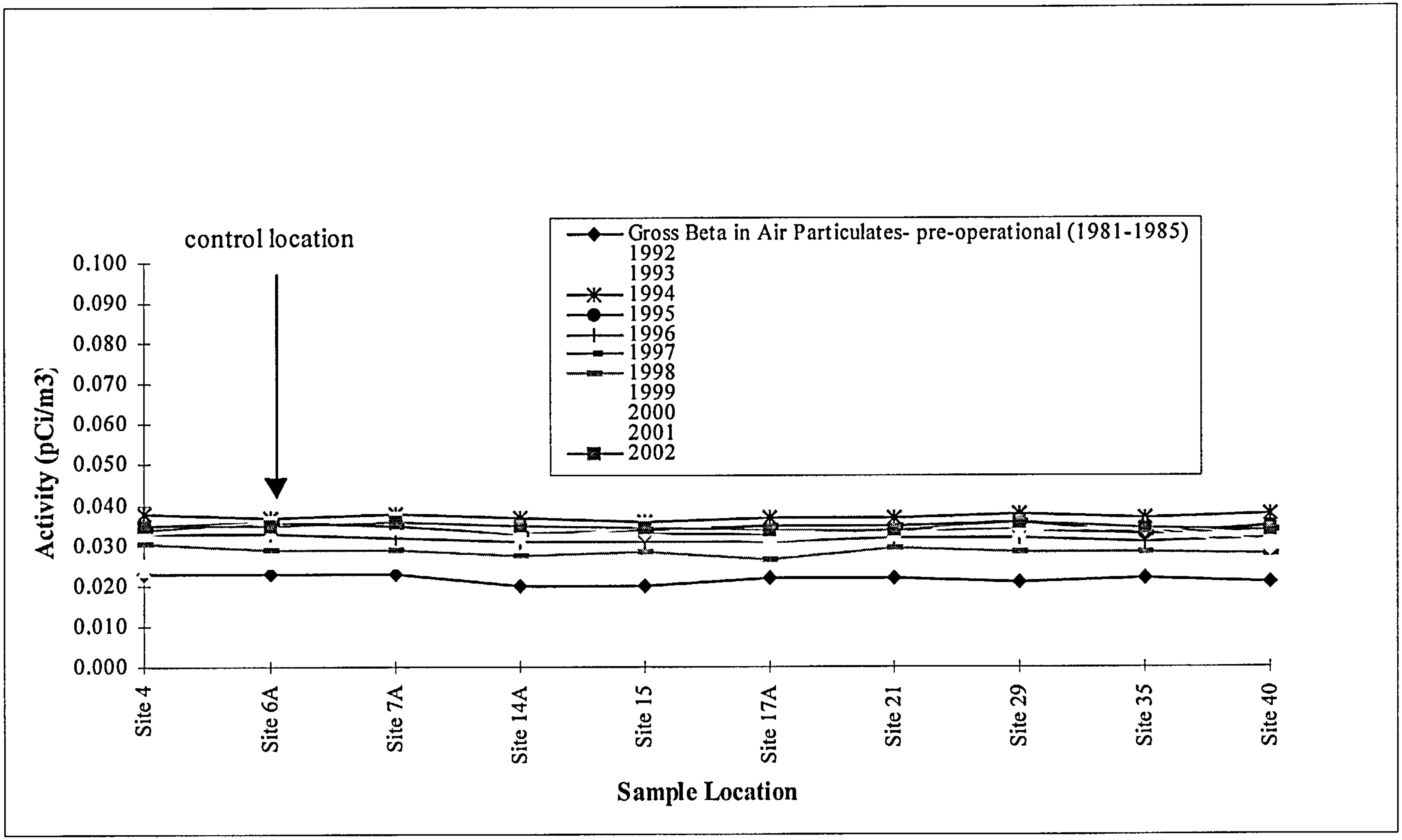
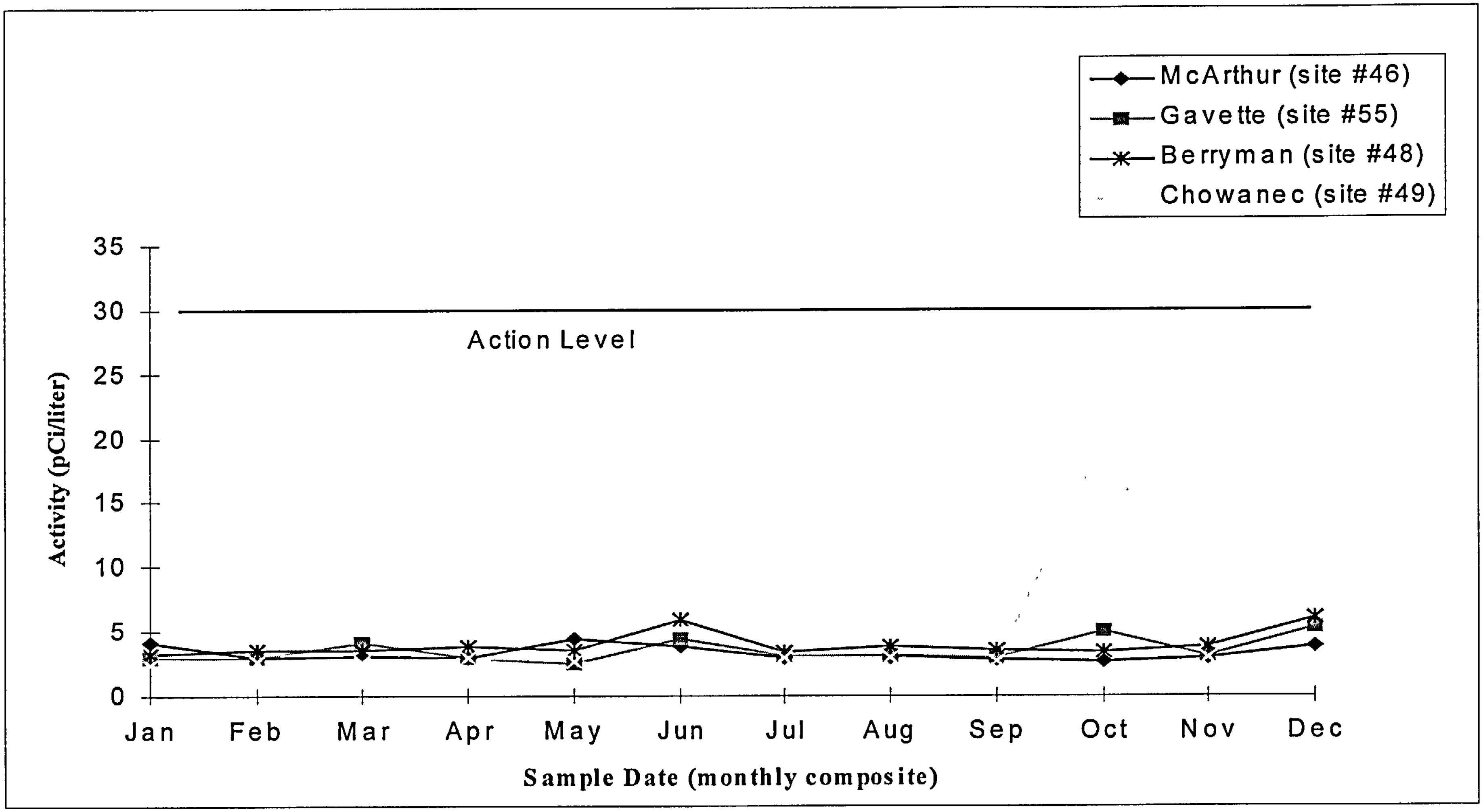


FIGURE 8.3 GROSS BETA IN DRINKING WATER



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

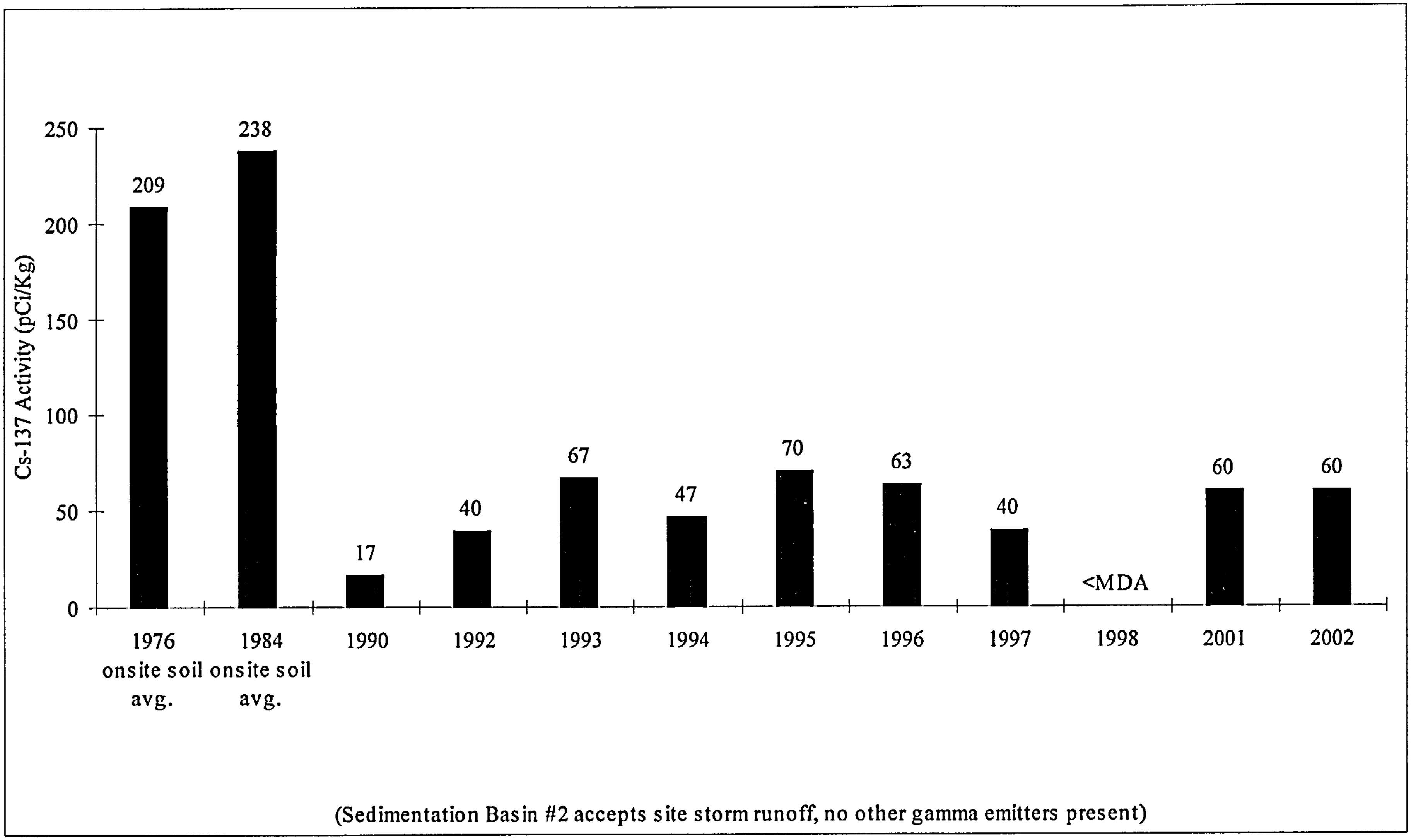
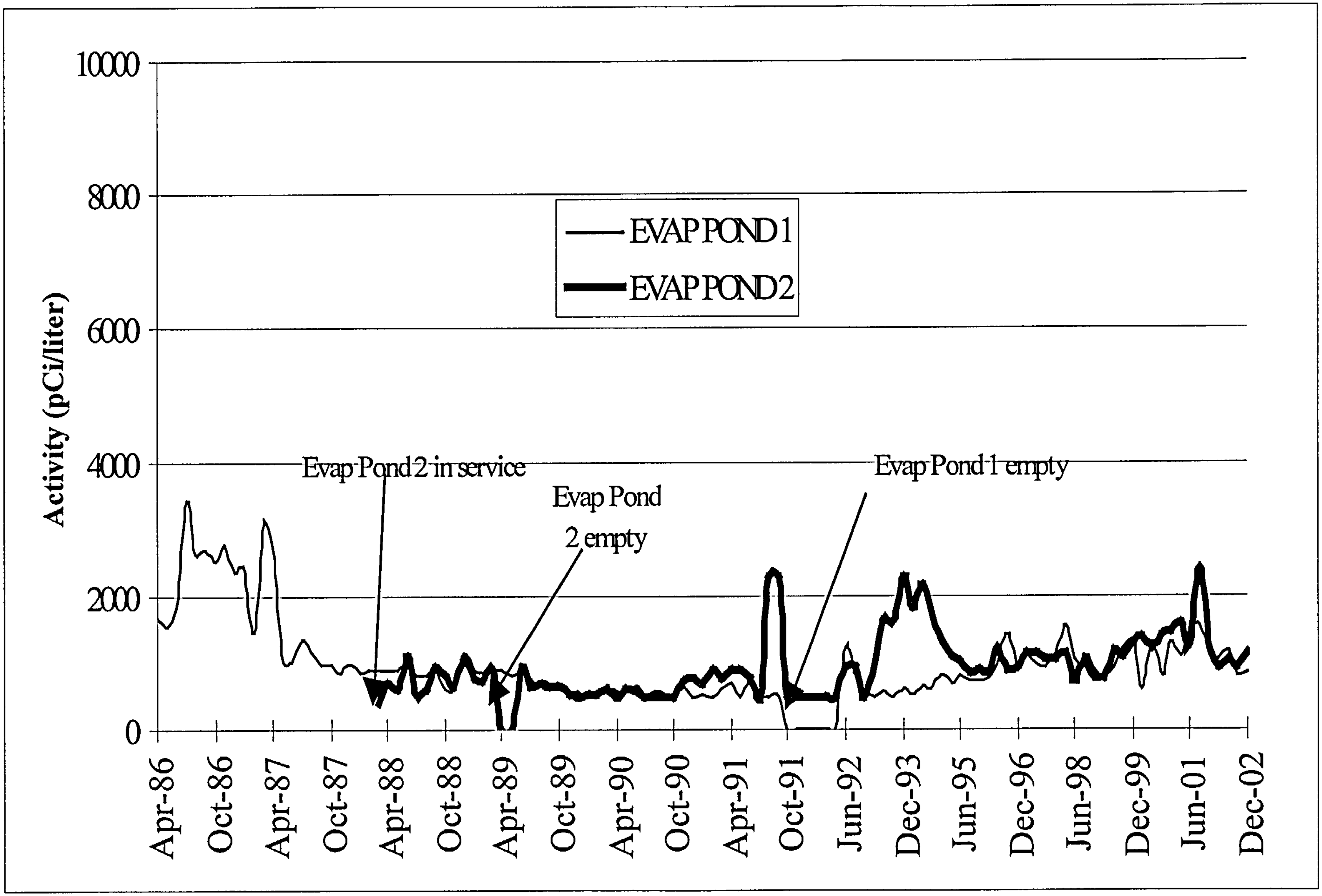


FIGURE 8.5 EVAPORATION POND TRITIUM ACTIVITY



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 2002 are presented in Table 9.2. TLD results for 1985 through 2002 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2002 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 2002 ENVIRONMENTAL TLD RESULTS

units are mrem/std qtr

TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	2002 Average
1	22.7	23.7	24.0	24.2	23.7
2	21.3	21.9	20.8	21.5	21.4
3	23.2	22.3	missing	23.2	22.9
4	22.6	22.5	21.8	22.6	22.4
5	21.6	21.6	20.9	22.5	21.7
6 (control)	25.7	26.2	25.2	26.2	25.8
7	24.2	24.5	24.0	26.5	24.8
8	22.6	22.9	22.3	22.8	22.7
9	27.7	29.3	27.8	28.0	28.2
10	23.4	23.7	23.0	23.9	23.5
11	24.0	24.4	23.5	24.2	24.0
12	22.2	22.4	22.9	22.5	22.5
13	24.6	24.7	24.1	24.6	24.5
14	23.9	24.6	24.1	25.0	24.4
15	22.8	24.0	23.3	23.2	23.3
16	22.0	21.7	21.4	21.7	21.7
17	23.6	23.9	24.7	23.6	24.0
18	22.6	23.2	22.7	23.5	23.0
19	24.7	25.4	24.4	24.9	24.9
20	23.5	23.3	23.2	22.9	23.2
21	25.4	24.4	24.0	24.5	24.6
22	25.5	25.5	25.0	25.6	25.4
23	22.7	22.9	22.3	23.1	22.8
24	22.9	22.0	21.7	22.6	22.3
25	24.0	23.0	23.8	22.7	23.4
26	25.9	25.0	26.2	26.0	25.8
27	26.3	27.5	26.5	27.1	26.9
28	24.8	26.0	25.0	26.0	25.5
29	24.7	25.3	24.9	24.4	24.8
30	25.5	25.0	24.7	24.9	25.0
31	23.3	22.6	21.9	23.1	22.7
32	24.6	24.2	24.6	24.5	24.5
33	24.9	25.2	24.8	24.9	25.0
34	27.0	27.2	26.1	27.1	26.9
35	28.3	29.3	29.2	28.9	28.9
36	25.3	24.7	24.0	24.4	24.6
37	24.1	23.2	23.6	23.4	23.6
38	26.4	27.7	26.9	27.1	27.0
39	22.9	23.6	23.3	23.0	23.2
40	24.6	24.3	24.0	24.0	24.2
42	27.7	25.3	25.6	25.7	26.1
44 (control)	18.7	20.1	19.7	19.9	19.6
45 (transit control)	5.5	5.3	5.4	5.2	5.4
46	25.6	26.4	25.1	26.3	25.9
47	21.8	22.4	22.4	22.8	22.4
48	22.9	23.9	24.0	24.2	23.8
49	22.2	21.7	22.0	21.8	21.9
50	18.1	18.8	18.8	19.2	18.7

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES

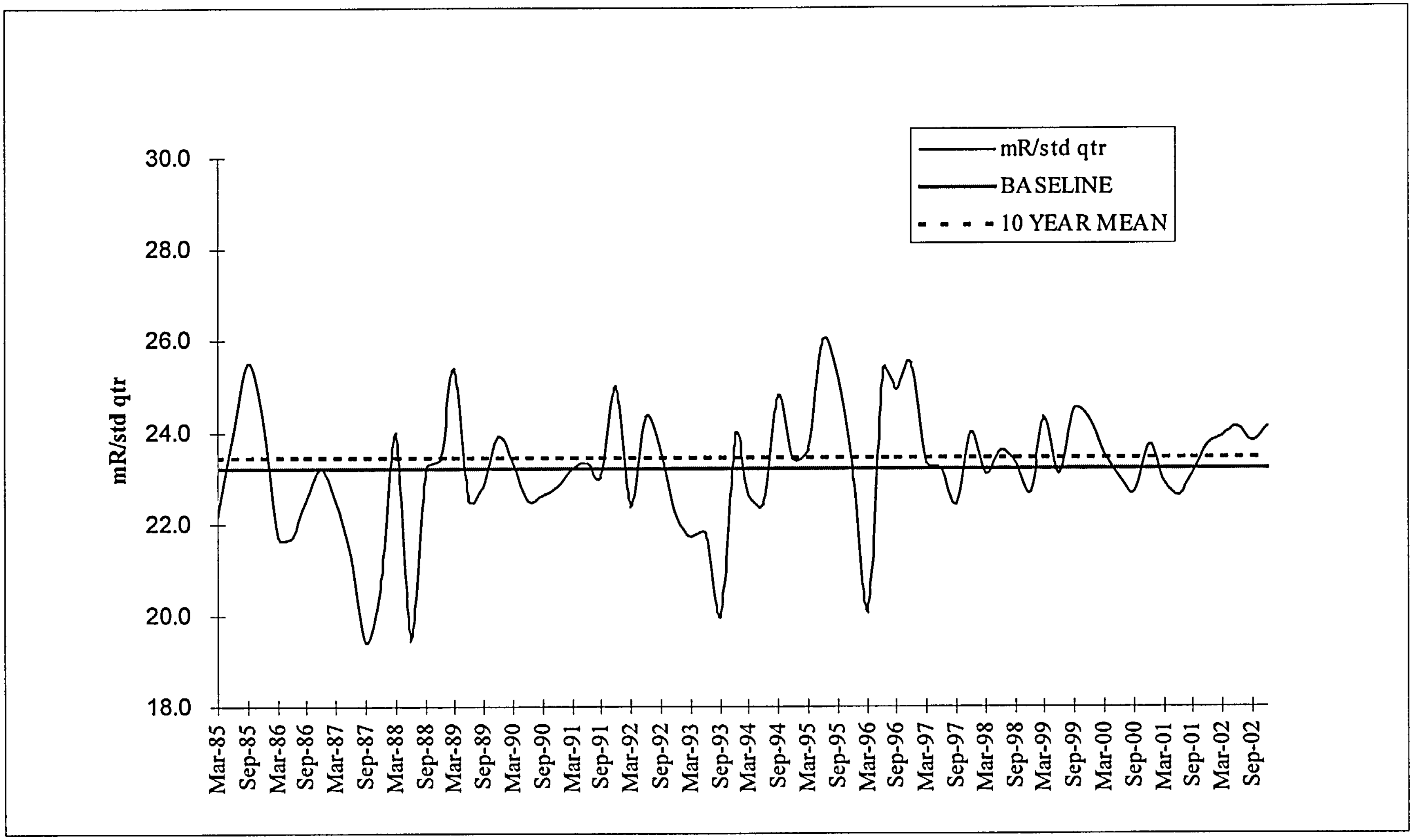
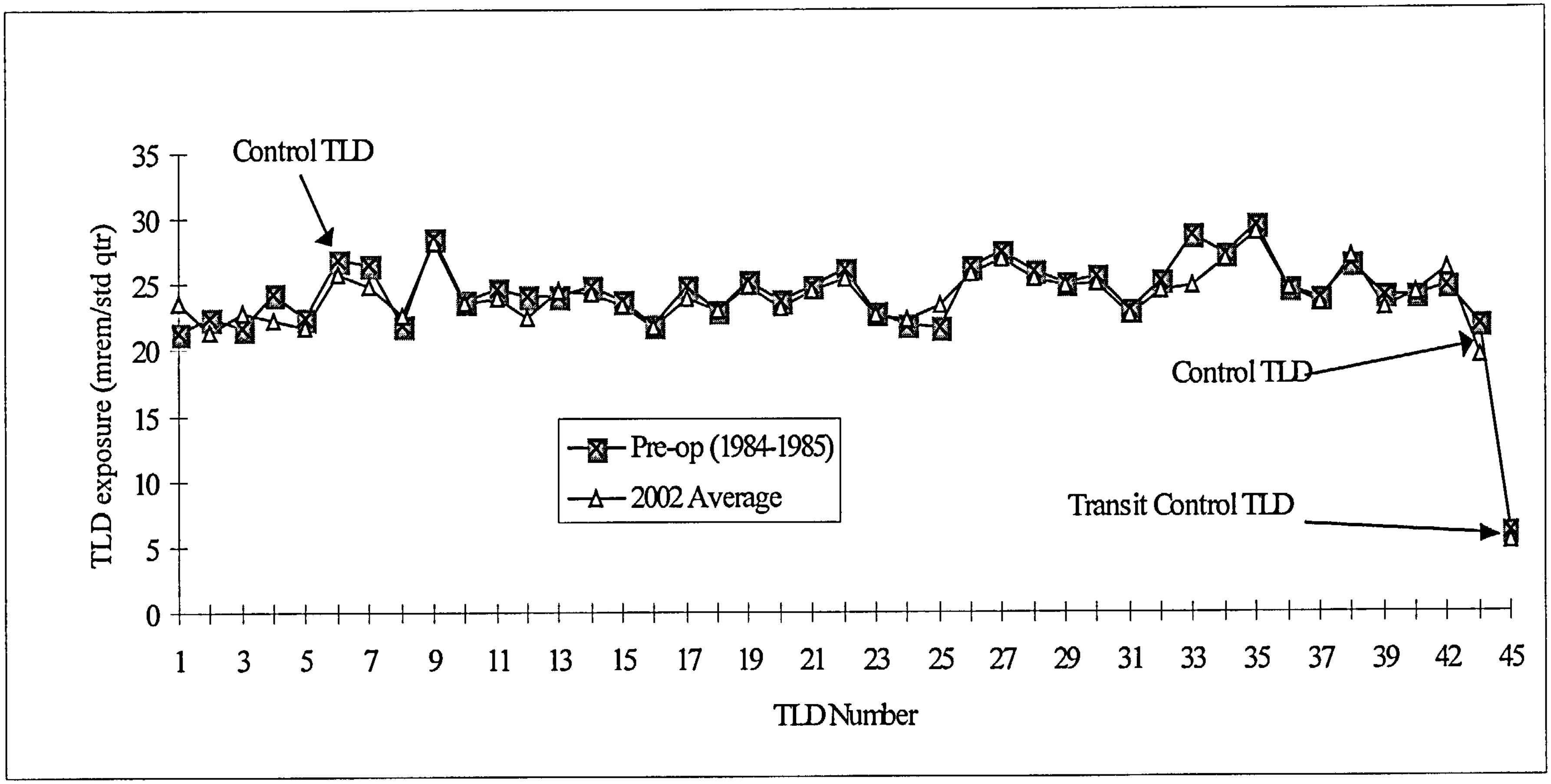


FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2002



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, 2002.

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

<u>Nearest Resident</u>

There were three (3) changes in nearest resident status. Refer to Table 10.1 for specific location changes.

<u>Milk Animal</u>

Goats were located in the ENE, NNE and NE sectors. Dose calculations indicated the highest dose to be 1.24 mrem. Since the locations were all between 3 and 5 miles distant, and the calculated dose was >1 mrem (in the NE sector), goat milk sampling was added to the REMP in accordance with the ODCM requirements.

<u>Vegetable Gardens</u>

There were three (3) changes in nearest garden status. Dose calculations indicated the highest dose to be 0.540 mrem.

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

TABLE 10.1 2002 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 2001
N	1.55	**1.79**	NONE	Resident 8.01E-02 Garden 3.78E-01	**GARDEN**
NNE	1.66	2.05	3.78	Resident 1.15E-01 Garden 3.49E-01 Milk 4.54E-01	
NE	2.16	3.14	3.91	Resident 1.82E-01 Garden 5.40E-01 Milk 1.24E+00	
ENE	2.87	4.67	4.84	Resident 8.12E-02 Garden 1.62E-01 Milk 3.85E-01	
E	2.81	**4.79**	NONE	Resident 1.52E-01 Garden 2.43E-01	**GARDEN**
ESE	**3.17**	**3.85**	NONE	Resident 1.45E-01 Garden 4.94E-01	**RESIDENT** **GARDEN**
SE	**4.10**	NONE	NONE	Resident 1.70E-01	**RESIDENT**
SSE	NONE	NONE	NONE	NA	
S	4.67	NONE	NONE	Resident 3.70E-01	
SSW	NONE	NONE	NONE	NA	
SW	1.39	NONE	NONE	Resident 3.14E-01	
WSW	0.75	NONE	NONE	Resident 1.43E-01	
W	0.70	NONE	NONE	Resident 1.12E-01	
WNW	2.67	NONE	NONE	Resident 2.82E-02	
NW	1.12	NONE	NONE	Resident 6.24E-02	
NNW	**1.30**	3.49	NONE	Resident 7.04E-02 Garden 1.58E-01	**RESIDENT**

COMMENTS:

Dose calculations were performed using the GASPAR code and 2001 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). Bolded data indicate changes from the previous year.

11. Summary and Conclusions

The conclusions are based on a review of the radioassay results and background gamma radiation measurements for the 2002 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2002 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 Gaseous Radioactive Effluent Tracking System accounts for tritium released via this pathway.

There were no observed radiological impacts on the environment due to PVNGS operations in 2002.

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 2002

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	24.0 (179/179) 18.1 – 29.3	Site #35 8 miles 335°	28.9 (4/4) 28.3 – 29.3	22.7 (8/8) 18.7 – 26.2	0
Air Particulates (pCi/m^3)	Gross Beta - 527	0.010	0.035 (475/475) 0.006 - 0.081	Site #7A 8 miles 140°	0.036 (53/53) 0.023 - 0.076	0.035 (51/51) 0.020 - 0.086	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. - 527 I-131	0.07	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 20						
	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 2002

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	Location with Highest Annual Mean Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Groundwater (pCi/liter) -continued-	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
Drinking Water (pCi/liter)	Gross Beta - 48	4.0	4.9 (19/48) 2.7 - 19.8	Site #49 2 miles 0°	7.0 (4/12) 2.7 - 19.8	NA	0
	Tritium - 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 48						
	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
	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 2002

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	Location with Highest Annual Mean: 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	10 (3/36) 8 - 12	Site #63 Onsite 180°	12 (1/12) 12 - 12	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	13 (2/36) 12 - 13	Site #63 Onsite 180°	13 (2/12) 12 - 13	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Tritium - 12	3000	998 (8/12) 808 - 1177	Site #63 Onsite 180°	1022 (4/4) 931 - 1143	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 2002

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	Location with Highest Annual Mean: Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Milk (pCi/liter)	Radiochemical – 7						
	I-131	1	<LLD	NA	<LLD	<LLD	0
	Gamma Spec. - 7						
	Cs-134	15	<LLD	NA	<LLD	<LLD	0
	Cs-137	18	<LLD	NA	<LLD	<LLD	0
	Ba-140	60	<LLD	NA	<LLD	<LLD	0
	La-140	15	<LLD	NA	<LLD	<LLD	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. 1985-2001 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. NRC Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, 1979.