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Palo Verde Nuclear Generating Station

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102-04111–JML/AKK/SAB/CJJ
April 9, 1998

U.S. Nuclear Regulatory Commission
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Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, & 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report for 1997

Enclosed please find a copy of the Annual Radiological Environmental Operating Report for 1997. This report covers operation of PVNGS Units 1, 2, and 3 during 1997, and is being submitted pursuant to PVNGS Technical Specification 6.9.1.7. No commitments are being made to the NRC in this letter.

Should you have any questions, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

James M. Levine

JML/AKK/SAB/CJJ

Enclosure

cc: E. W. Merschoff
K. E. Perkins
M. B. Fields
J. H. Moorman
A. V. Godwin (ARRA)

C001/,

ENCLOSURE

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 1997

FOR

PALO VERDE NUCLEAR GENERATING STATION

PALO VERDE

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 1997

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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 in the vicinity of PVNGS and analyzed for radionuclide concentrations.

During 1997, 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: Reservoir, Evaporation Ponds 1 and 2, Sheppard well, well 27ddc, and well 34abb. Additionally, ARRA performs air sampling at seven locations identical to APS sampling locations and places TLDs at eighteen locations identical to APS. ARRA reports the results of their comparisons in a separate report on an annual basis.

Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. There were no observed radiological impacts on the environment due to PVNGS operations in 1997.

(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 environmental radiological 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 in accordance with 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 the US Nuclear Regulatory Commission (USNRC) in their Reactor Assessment Branch Technical Position, Revision 1, November 1979.

This report contains the measurements and findings for 1997. 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 radiation 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 One occurred May 25, 1985. Initial criticality for Units Two and Three 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 of PVNGS.

2.1. 1997 PVNGS Radiological Environmental Monitoring Program

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

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

Background gamma radiation measurements are performed by APS using TLDs at forty-nine locations near PVNGS.

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

2.2. Radiological Environmental Monitoring Program Changes for 1997

TLD site #45 was moved to an onsite location. This is a supplemental TLD used as a 'transit control' TLD to monitor field exposure of all TLDs while enroute to or from the field locations. This TLD is stored in a lead pig after all field TLDs are placed in their field locations.

Supplemental vegetation site #64 was deleted as the resident no longer gardens.

The interlaboratory comparison program was changed to allow use of EPA provided samples, where possible.

Table 2.1 SAMPLE COLLECTION LOCATIONS

SAMPLE SITE #	SAMPLE TYPE	LOCATION (a)	LOCATION DESCRIPTION
4	air	E16	APS Office, 615 N. 4th St., Buckeye
6A*	air	SSE13	Old US 80, Gila Bend Side of Gillespie Bridge
7A	air	SE8	Arlington School, 16351 S. Arlington School Rd.
14A	air	NNE2	371st Ave. and Buckeye-Salome Rd.
15	air	NE2	NE Site Boundary
17A	air	E4	351st Ave., South of Buckeye-Salome Rd.
21	air	S3	S Site Boundary
29	air	W1	W Site Boundary
35	air	NNW8	Fire Station, 40901 W. Osborn Rd., Tonopah
40	air	N3	Transmission Rd., South of Trailer Park, Wintersburg
46	drinking water	NW9	McArthur Residence, 41701 W. Indian School Rd., Tonopah
47	vegetation	ENE3	Adams Residence, 355th Ave. and Buckeye-Salome Rd.
48	drinking water	SSW4	Sheppard Farm, 13202 S. 383rd Ave.
49	drinking water	N2	Chowanec Residence, 375th Ave. South of Buckeye-Salome Rd.
52	vegetation	NNE3	Payne Residence, 3515 South 375th Ave.
55	drinking water	SW3	Gavette Residence, 39326 W. Elliot Rd.
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	Tolleson Produce Co., 91st Ave. and Van Buren St., Tolleson
63	surface water	ONSITE	Evaporation Pond #2
65	vegetation	ENE4	Hommel Residence, 35026 W. Broadway Rd.

NOTES:

* Designates a control site

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

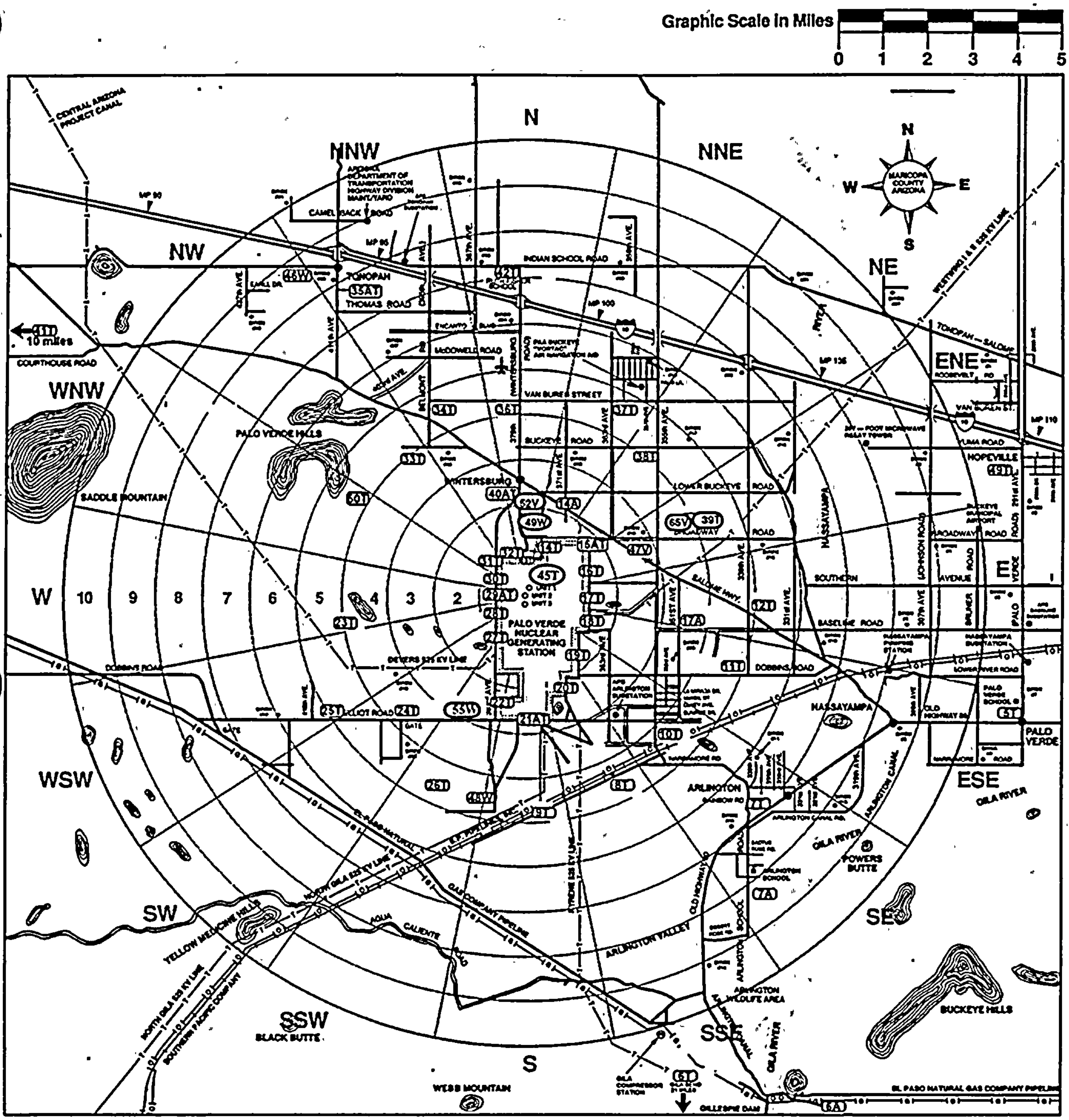
Those air sample sites designated with the letter 'A' are sites which have the same site number as a TLD location, but are not in the same location (e.g. site #6 TLD location is different from site #6A air sample location; site #4 TLD location is the same as site #4 air sample location)

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
65			M/AA			

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

FIGURE 2.1
REMP SAMPLE SITES
(0-10 MILES)



KEY TO MAP

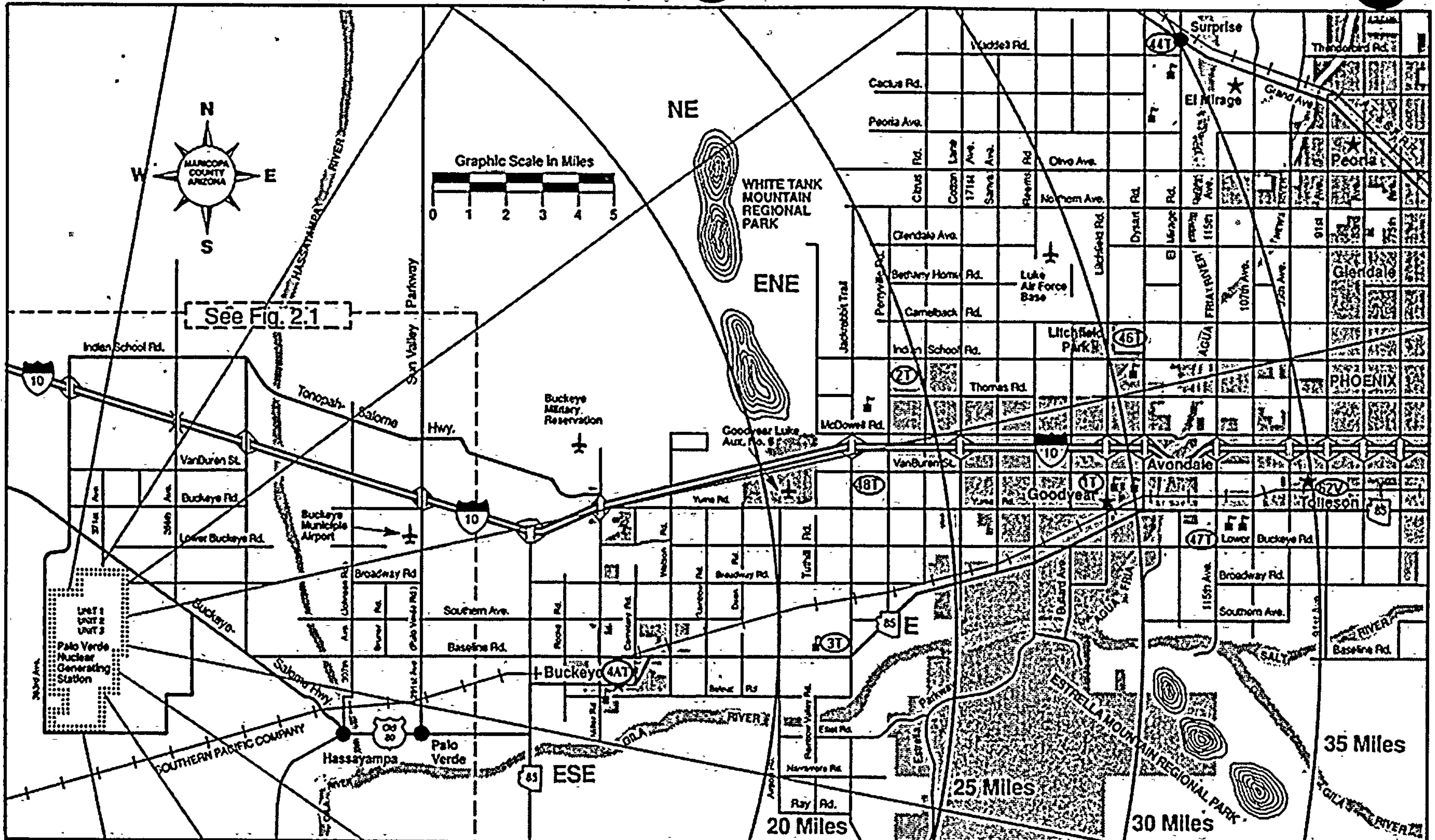
Paved Road	Milepost
Unpaved Road	Palo Verde Nuclear Generating Station Boundary
4WD Road	Thermoluminescent Dosimeters (TLD)
Gas Pipeline	Air Sample
Oil Pipeline	Vegetation Sample
Power Line	Water Sample
Railroad	Sample Sites
Airstrip	
School	
Siren	

Palo Verde Nuclear Generating Station

Radiological Environmental Monitoring Program Sample Sites

0 – 10 Miles

FIGURE 2.2
REMP SAMPLE SITES
(0-35 MILES)



KEY TO MAP

- Railroad
- Airstrip/Airport
- Schools Located Near Sample Sites
- Municipal Buildings
- Palo Verde Nuclear Generating Station Boundary
- T Thermoluminescent Dosimeters (TLD)
- A Air Sample
- (1) Sample Sites
- V Vegetation

Palo Verde Nuclear Generating Station

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SAMPLE SITES

0–35 Miles

3. Sample Collection Program

3.1. Water

Water samples were collected by APS using PVNGS procedures.

Weekly samples were collected from the Reservoir, Evaporation Pond #1, Evaporation Pond #2, and four 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 are 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 is sampled as a weekly composite at the onsite Water Reclamation Facility and analyzed for gamma emitters. A monthly composite is 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 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 as a result of the annual land use census, an evaluation will be initiated to consider re-establishing a milk sample program.

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 Water Reclamation Facility (WRF) centrifuge and analyzed for gamma emitters. Samples were collected using 1000 ml plastic bottles.

Cooling tower sludge samples were not obtained in 1997 as no cooling tower sludge was disposed of in the onsite landfill.

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.

Sediment samples were collected from Sedimentation Basin #2 and analyzed for gamma emitters. Samples were collected using 1000 ml plastic bottles.

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 50 mm 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 an intrinsic Ge or Ge(Li) detector. The resulting spectrum is analyzed by computer and specific nuclides, if present, are identified and quantified.

4.2. Airborne Radioiodine

The charcoal canister is counted on a multichannel analyzer equipped with an intrinsic Ge or Ge(Li) 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 an intrinsic Ge or Ge(Li) detector. The resulting spectrum is analyzed by computer and specific nuclides, 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 an intrinsic Ge or Ge(Li) detector. The resulting spectrum is analyzed by computer and specific nuclides, if present, are identified and quantified.

4.5. Water

4.5.1. Gamma Spectroscopy

The sample is measured, placed in a one liter plastic marinelli beaker, and counted on a multichannel analyzer equipped with an intrinsic Ge or Ge(Li) detector. The resulting spectrum is analyzed by computer and specific nuclides 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 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.

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. 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 which are greater than the Minimum Detectable Activity (MDA) (*a posteriori* LLD) are reported as positive activity with its associated 2σ counting error. All results which are less than 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.

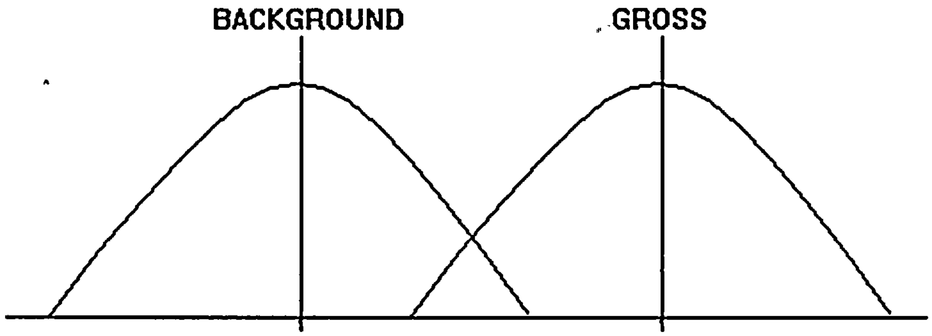
Occasionally the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

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

In these instances, the contributing factors will be noted in the table where the data are presented.

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 final 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. But 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.

[illegible]

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 nuclides 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.

[illegible]

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 performed in 1997 since no milk animals have been located within 5 miles of PVNGS.

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 performed in 1997 since no milk animals have been located within 5 miles of PVNGS.

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	10		
Fe-59	22		
Co-58	10		
Co-60	10		
Zn-65	24		
Zr-95	18		
Nb-95	10		
I-131	12 **	0.02	25
Cs-134	10	0.02	22
Cs-137	11	0.03	24
Ba-140	40		
La-140	10		

<u>NOTES:</u>

** Low level I-131 is not required since there is no drinking water pathway.

Milk sampling was not performed in 1997 since no milk animals have been located within 5 miles of PVNGS.

7. Interlaboratory Comparison Program

7.1. Quality Control Program

APS maintains an extensive QA/QC Program which 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 1997, 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 cross check program using vendor supplied blind radionuclide samples and/or EPA supplied samples. All interlaboratory results in 1997 were acceptable. Results for the interlaboratory comparison program are presented in Table 7.1.

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

(all results in pCi/l unless otherwise annotated)

Type	Nuclide/ Analysis	EPA Known Value	PVNGS Value	Normalized Deviation of Known	Accept/Reject [a]
Water (9-19-97)	I-131	10.0	12.0	0.58	Accept
Gamma in Water (11-7-97)	Co-60	27.0	28.7	0.58	Accept
	Zn-65	75.0	79.7	1.01	Accept
	Cs-134	10.0	10.7	0.23	Accept
	Cs-137	74.0	75.7	0.58	Accept
	Ba-133	99.0	88.3	-1.85	Accept
Blind Water (10-21-97)	gross beta	143.4	127.3	-1.30	Accept
	Cs-134	41.0	38.0	-1.04	Accept
	Cs-137	34.0	36.3	0.81	Accept
	Co-60	10.0	11.7	0.58	Accept
Water (8-8-97)	tritium	11010	9460	-2.44	Accept

Notes:

(a) Acceptance criteria is $-3.0 \leq N \leq 3.0$ (where N is the Normalized Deviation of Known)

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

(all results in pCi/l unless otherwise annotated)

Type	Nuclide/ Analysis	PVNGS Value	Uncertainty (1 sigma)	Known Value	Resolution (APS)	Ratio (PVNGS/ Known)	Accept/Reject
Air Filter (pCi/filter)	Ce-141	56	1.5	61	37	0.92	Accept
	Cr-51	249	16	241	16	1.03	Accept
	Cs-134	68	2.3	81	30	0.84	Accept
	Cs-137	80	2.2	85	36	0.94	Accept
	Co-58	47	2.3	48	20	0.98	Accept
	Mn-54	71	2.6	70	27	1.01	Accept
	Fe-59	88	6.2	94	14	0.94	Accept
	Zn-65	154	6.9	156	22	0.99	Accept
	Co-60	143	3.4	156	42	0.92	Accept
Air (pCi/filter)	gross beta	214	1	187	214	1.14	Accept
Air (pCi/canister)	I-131	44	2	41	22	1.07	Accept
Water	gross beta	148	2	144	74	1.03	Accept
Water	Ce-141	255	6	251	43	1.02	Accept
	Cr-51	430	31	419	14	1.03	Accept
	Cs-134	142	3	155	47	0.92	Accept
	Cs-137	132	5	123	26	1.07	Accept
	Co-58	85	4	86	21	0.99	Accept
	Mn-54	207	5	190	41	1.09	Accept
	Fe-59	178	10	155	18	1.15	Accept
	Zn-65	202	8	179	25	1.13	Accept
	Co-60	200	5	190	40	1.05	Accept
	I-131	38	7	25	5	1.52	Accept

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 and Radiological Environmental Monitoring"

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, Be-7). Gross beta results for drinking water and air are due to natural background. **Gamma emitting radionuclides 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 1997 are presented in the following sections. Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. There were no observed radiological impacts on the environment due to PVNGS operations in 1997.

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 0.016 to 0.075 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 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 1991-1997 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. No radioiodine was detected in any of the samples.

8.3. Vegetation

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

8.4. Drinking Water

Samples were analyzed for gross beta, tritium, and gamma emitting nuclides. Results of these analyses are presented in Table 8.7. No tritium or gamma-emitting nuclides were detected in any samples. Gross beta activity ranged from less than detectable, to a high of 10.8 ± 2.4 pCi/l (Sheppard farm, April 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. Low levels of I-131 were detected in the Reservoir in three of twelve monthly composite samples. Ranges of activity were 11 - 13 pCi/l. The I-131 is introduced into the site's circulating water systems via radiopharmaceutical discharges into the Phoenix sewage system (refer to Section 11 of the 1988 AREOR for a detailed explanation). Cs-137 was observed in Evaporation Pond # 2 in two of twelve monthly composite samples. The concentrations were 11 - 13 pCi/l.

Tritium was routinely observed in Evaporation Ponds 1 and 2. The highest concentration in Evaporation Pond #1 was 1157 ± 191 pCi/l and the highest concentration in Evaporation Pond #2 was 1129 ± 194 pCi/l. Tritium was also present in one of the quarterly composite samples from the Reservoir at a concentration of 311 ± 181 pCi/liter. The tritium has been attributed to plant gaseous effluent releases.

Water Reclamation Facility (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 60 ± 12 pCi/l (week of February 18th). 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 water from site runoff and was dry for about one-half of the year. No gamma emitting nuclides were detected in these samples. Tritium was detected in nine of seventeen samples ranging from 1106 - 3419 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 Water Reclamation Facility (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 forty-eight samples ranging from 465 - 4517 pCi/kg.

In-111 was also identified in the sludge on occasion. The highest In-111 concentration was 117 ± 28 pCi/l (week of December 24th). 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. Sedimentation Basin #2 sediment

Sedimentation Basin #2 sediment samples were analyzed by gamma spectroscopy. Cs-137 was detected in Sedimentation Basin #2 sediment and it is consistent with pre-operational levels in soil. Sample results can be found in Table 8.10.

8.7.3. Evaporation Ponds #1 and #2 sediment

Evaporation Ponds #1 and #2 sediment samples were collected in 1997. Evaporation Pond #1 samples indicated one of fifteen samples contained Co-60. Evaporation Pond #2 samples indicated low levels of Cs-134, Cs-137, and Co-60. These radionuclides are evidently due to previous primary-to-secondary leaks which resulted in their transport to the onsite ponds and are consistent with previous results. Sample results can be found in Table 8.10.

8.7.4. Cooling Tower sludge

No sludge was removed from the cooling towers in 1997.

8.8. Summary of Results

Sample data are presented in graphic form in Figures 8.1-8.5. When practical, comparisons to pre-operational data are displayed. A summary of the sample results is presented in Table 11.1.

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	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
1	30-Dec-96	7-Jan-97	0.035	0.033	0.035	0.031	0.032	0.033	0.032	0.032	0.030	0.031	0.032	5.1
2	7-Jan-97	14-Jan-97	0.029	0.030	0.034	0.029	0.030	0.029	0.029	0.030	0.025	0.030	0.030	7.4
3	14-Jan-97	21-Jan-97	0.032	0.040	0.037	0.036	0.036	0.039	0.040	0.039	0.038	0.040	0.038	6.7
4	21-Jan-97	28-Jan-97	0.028	0.028	0.028	0.026	0.026	0.028	0.029	0.028	0.026	0.027	0.027	3.9
5	28-Jan-97	4-Feb-97	0.038	0.043	0.040	0.038	0.036	0.038	0.038	0.040	0.037	0.037	0.039	5.2
6	4-Feb-97	11-Feb-97	0.050	0.050	0.050	0.048	0.047	0.046	0.048	0.053	0.045	0.043	0.048	6.1
7	11-Feb-97	18-Feb-97	0.031	0.033	0.032	0.028	0.029	0.030	0.028	0.032	0.030	0.029	0.030	5.8
8	18-Feb-97	25-Feb-97	0.026	0.026	0.026	0.022	0.023	0.027	0.026	0.024	0.025	0.023	0.025	6.8
9	25-Feb-97	3-Mar-97	0.028	0.029	0.029	0.028	0.027	0.027	0.026	0.029	0.027	0.027	0.028	3.8
10	3-Mar-97	11-Mar-97	0.038	0.042	0.038	0.037	0.040	0.039	0.039	0.037	0.032	0.039	0.038	6.8
11	11-Mar-97	18-Mar-97	0.040	0.044	0.043	0.042	0.041	0.041	0.040	0.040	0.041	0.041	0.041	3.2
12	18-Mar-97	25-Mar-97	0.033	0.037	0.036	0.035	0.033	0.034	0.037	0.037	0.031	0.034	0.035	5.9
13	25-Mar-97	1-Apr-97	0.034	0.032	0.033	0.030	0.031	0.031	0.033	0.035	0.032	0.030	0.032	5.2
	Mean		0.034	0.036	0.035	0.033	0.033	0.034	0.034	0.035	0.032	0.033	0.034	3.5

2nd 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 (%)
14	1-Apr-97	8-Apr-97	0.027	0.025	0.025	0.024	0.025	0.026	0.026	0.026	0.022	0.025	0.025	5.5
15	8-Apr-97	15-Apr-97	0.037	0.042	0.038	0.036	0.037	0.038	0.036	0.041	0.038	0.039	0.038	5.2
16	15-Apr-97	23-Apr-97	0.034	0.038	0.036	0.034	0.037	0.035	0.036	invalid (a)	0.036	0.037	0.036	3.8
17	23-Apr-97	29-Apr-97	0.025	0.025	0.028	0.024	0.025	0.023	0.029	0.026	0.024	0.022	0.025	8.5
18	29-Apr-97	6-May-97	0.037	0.036	0.033	0.031	0.033	0.036	0.038	0.036	0.028	0.035	0.034	8.9
19	6-May-97	13-May-97	0.027	0.027	0.028	0.028	0.027	0.031	0.030	0.030	0.030	0.026	0.028	6.0
20	13-May-97	20-May-97	0.043	0.039	0.042	0.041	0.043	0.041	0.040	0.047	0.038	0.045	0.042	6.5
21	20-May-97	27-May-97	0.027	0.028	0.028	0.027	0.030	0.030	0.028	0.029	0.028	0.029	0.028	3.8
22	27-May-97	3-Jun-97	0.035	0.035	0.033	0.031	0.036	0.032	0.035	0.033	0.033	0.032	0.034	4.9
23	3-Jun-97	10-Jun-97	0.027	0.029	0.028	0.028	0.031	0.031	0.027	0.029	0.027	0.030	0.029	5.5
24	10-Jun-97	17-Jun-97	0.030	0.034	0.027	0.028	0.029	0.031	0.029	0.028	0.027	0.031	0.029	7.4
25	17-Jun-97	24-Jun-97	0.029	0.031	0.031	0.030	0.031	0.034	0.030	0.033	0.034	0.030	0.031	5.6
26	24-Jun-97	1-Jul-97	0.034	0.036	0.030	0.033	0.033	0.040	0.035	0.038	0.032	0.034	0.035	8.5
	Mean		0.032	0.033	0.031	0.030	0.032	0.033	0.032	0.033	0.031	0.032	0.032	2.9

(a) Sample result low (0.020). Recounted sample with same result (0.018). Investigation unable to determine cause so sample result was invalidated.

TABLE 8.2 PARTICULATE GRO[illegible]TA IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

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 (%)
3rd Quarter														
27	1-Jul-97	8-Jul-97	0.024	0.033	0.033	0.031	0.029	0.035	0.032	0.033	0.032	0.033	0.032	9.7
28	8-Jul-97	15-Jul-97	0.030	0.026	0.026	0.029	0.030	0.032	0.032	0.035	0.029	0.028	0.030	9.4
29	15-Jul-97	22-Jul-97	0.026	0.029	0.028	0.032	0.028	0.030	0.026	0.031	0.031	0.031	0.029	7.4
30	22-Jul-97	29-Jul-97	0.021	0.023	0.020	0.022	0.023	0.023	0.024	0.021	0.021	0.022	0.022	5.7
31	29-Jul-97	5-Aug-97	0.028	0.027	0.027	0.027	0.029	0.027	0.025	0.028	0.028	0.028	0.027	3.9
32	5-Aug-97	12-Aug-97	0.031	0.033	0.036	0.032	0.034	0.035	0.036	0.034	0.035	0.034	0.034	4.8
33	12-Aug-97	20-Aug-97	0.025	0.026	0.027	0.027	0.025	0.027	0.024	0.028	0.027	0.027	0.026	4.8
34	20-Aug-97	26-Aug-97	0.026	0.029	0.027	0.028	0.026	0.028	0.024	0.026	0.026	0.030	0.027	6.5
35	26-Aug-97	2-Sep-97	0.030	0.032	0.029	0.031	0.032	0.032	0.028	0.033	0.032	0.028	0.031	6.0
36	2-Sep-97	9-Sep-97	0.042	0.044	0.042	0.043	0.040	0.043	0.045	0.042	0.038	0.040	0.042	5.0
37	9-Sep-97	16-Sep-97	0.036	0.040	0.036	0.035	0.034	0.035	0.035	0.042	0.036	0.035	0.036	7.0
38	16-Sep-97	23-Sep-97	0.032	0.034	0.032	0.030	0.029	0.032	0.033	0.036	0.029	0.029	0.032	7.5
39	23-Sep-97	30-Sep-97	0.030	0.032	0.033	0.029	0.030	0.032	0.034	0.033	0.031	0.029	0.031	5.6
	Mean		0.029	0.031	0.030	0.030	0.030	0.032	0.031	0.032	0.030	0.030	0.031	2.9

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 (%)
4th Quarter														
40	30-Sep-97	8-Oct-97	0.036	0.038	0.037	0.036	0.035	0.039	0.040	0.040	0.033	0.036	0.037	6.1
41	8-Oct-97	14-Oct-97	0.030	0.028	0.027	0.029	0.028	0.029	0.031	0.030	0.027	0.028	0.029	4.7
42	14-Oct-97	21-Oct-97	0.050	0.050	0.051	0.041	0.048	0.045	0.047	0.047	0.042	0.043	0.046	7.6
43	21-Oct-97	28-Oct-97	0.026	0.027	0.030	0.029	0.029	0.029	0.028	0.031	0.031	0.036	0.030	9.3
44	28-Oct-97	4-Nov-97	0.065	0.075	0.069	0.061	0.061	0.068	0.066	0.074	0.057	0.056	0.065	10.0
45	4-Nov-97	12-Nov-97	0.044	0.052	0.059	0.050	0.048	0.056	0.053	0.050	0.048	0.050	0.051	8.4
46	12-Nov-97	18-Nov-97	0.034	0.039	0.037	0.030	0.027	0.033	0.032	0.034	0.029	0.032	0.033	11.0
47	18-Nov-97	24-Nov-97	0.061	0.065	0.065	0.056	0.058	0.063	0.061	0.059	0.058	0.063	0.061	5.1
48	24-Nov-97	1-Dec-97	0.036	0.040	0.034	0.030	0.035	0.038	0.035	0.040	0.029	0.035	0.035	10.4
49	1-Dec-97	8-Dec-97	0.051	0.057	0.054	0.056	0.053	0.055	0.057	0.059	0.053	0.058	0.055	4.6
50	8-Dec-97	15-Dec-97	0.016	0.024	0.022	0.018	0.019	0.024	0.024	0.024	0.020	0.020	0.021	13.9
51	15-Dec-97	23-Dec-97	0.051	0.055	invalid (a)	0.050	0.052	0.050	0.050	0.052	0.052	0.051	0.051	3.1
52	23-Dec-97	29-Dec-97	0.036	0.038	0.038	0.034	0.033	0.029	0.038	0.036	0.032	0.032	0.035	9.0
	Mean		0.041	0.045	0.044	0.040	0.040	0.043	0.043	0.044	0.039	0.042	0.042	4.7
	Annual Average		*0.034*	*0.036*	*0.035*	*0.033*	*0.034*	*0.035*	*0.035*	*0.036*	*0.033*	*0.034*	*0.035*	*3.2*

(a) Sample invalidated due to pump malfunction

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*
1-Apr-97	Cs-134	<0.0016	<0.0017	<0.0015	<0.0017	<0.0015	<0.0019	<0.0014	<0.0013	<0.0012	<0.0013
	Cs-137	<0.0014	<0.0017	<0.0017	<0.0018	<0.0017	<0.0018	<0.0017	<0.0014	<0.0017	<0.0012
24-Jun-97	Cs-134	<0.0020	<0.0020	<0.0012	<0.0017	<0.0013	<0.0013	<0.0017	<0.0013 (b)	<0.0020	<0.0015
	Cs-137	<0.0020	<0.0021	<0.0014	<0.0022	<0.0014	<0.0019	<0.0016	<0.0013 (b)	<0.0013	<0.0016
30-Sep-97	Cs-134	<0.0013	<0.0015	<0.0015	<0.0012	<0.0011	<0.0013	<0.0014	<0.0016	<0.0017	<0.0016
	Cs-137	<0.0012	<0.0013	<0.0019	<0.0013	<0.0019	<0.0013	<0.0016	<0.0015	<0.0017	<0.0016
29-Dec-97	Cs-134	<0.0021	<0.0018	<0.0025 (a)	<0.0022	<0.0017	<0.0024	<0.0024	<0.0022	<0.0019	<0.0020
	Cs-137	<0.0022	<0.0018	<0.0022 (a)	<0.0016	<0.0016	<0.0015	<0.0013	<0.0020	<0.0018	<0.0019

(a) Composite sample did not include the weekly sample from 12-23-97 due to invalidation caused by equipment malfunction

(b) Composite sample did not include the weekly sample from 4-23-97 due to invalidation of sample result

TABLE 8.4 RADIOIODIN[illegible]AIR 1st - 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m³

1st Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	required LLD <0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
1	30-Dec-96	7-Jan-97	<0.016	<0.019	<0.020	<0.018	<0.017	<0.016	<0.013	<0.018	<0.018	<0.018
2	7-Jan-97	14-Jan-97	<0.016	<0.016	<0.022	<0.020	<0.017	<0.022	<0.025	<0.021	<0.020	<0.017
3	14-Jan-97	21-Jan-97	<0.021	<0.018	<0.019	<0.018	<0.020	<0.018	<0.022	<0.019	<0.018	<0.020
4	21-Jan-97	28-Jan-97	<0.014	<0.020	<0.019	<0.016	<0.020	<0.022	<0.016	<0.019	<0.019	<0.020
5	28-Jan-97	4-Feb-97	<0.020	<0.020	<0.022	<0.020	<0.021	<0.022	<0.018	<0.020	<0.022	<0.022
6	4-Feb-97	11-Feb-97	<0.021	<0.021	<0.023	<0.019	<0.019	<0.019	<0.021	<0.022	<0.020	<0.020
7	11-Feb-97	18-Feb-97	<0.022	<0.016	<0.021	<0.018	<0.022	<0.020	<0.017	<0.015	<0.019	<0.022
8	18-Feb-97	25-Feb-97	<0.025	<0.016	<0.016	<0.019	<0.019	<0.018	<0.022	<0.019	<0.022	<0.015
9	25-Feb-97	3-Mar-97	<0.017	<0.027	<0.018	<0.024	<0.022	<0.020	<0.024	<0.025	<0.022	<0.025
10	3-Mar-97	11-Mar-97	<0.012	<0.015	<0.016	<0.013	<0.013	<0.015	<0.015	<0.014	<0.014	<0.015
11	11-Mar-97	18-Mar-97	<0.018	<0.016	<0.015	<0.018	<0.017	<0.019	<0.017	<0.019	<0.018	<0.019
12	18-Mar-97	25-Mar-97	<0.013	<0.018	<0.023	<0.017	<0.020	<0.018	<0.019	<0.016	<0.017	<0.018
13	25-Mar-97	1-Apr-97	<0.020	<0.018	<0.018	<0.019	<0.018	<0.016	<0.018	<0.018	<0.025	<0.016

2nd Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	required LLD <0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
14	1-Apr-97	8-Apr-97	<0.014	<0.018	<0.017	<0.020	<0.018	<0.016	<0.016	<0.016	<0.024	<0.018
15	8-Apr-97	15-Apr-97	<0.017	<0.020	<0.022	<0.018	<0.016	<0.019	<0.017	<0.020	<0.019	<0.016
16	15-Apr-97	23-Apr-97	<0.012	<0.019	<0.017	<0.017	<0.018	<0.017	<0.017	<0.018	<0.022	<0.019
17	23-Apr-97	29-Apr-97	<0.024	<0.023	<0.023	<0.023	<0.022	<0.023	<0.016	<0.029	<0.019	<0.021
18	29-Apr-97	6-May-97	<0.023	<0.016	<0.023	<0.016	<0.020	<0.020	<0.018	<0.019	<0.016	<0.020
19	6-May-97	13-May-97	<0.017	<0.016	<0.017	<0.019	<0.017	<0.019	<0.018	<0.017	<0.018	<0.012
20	13-May-97	20-May-97	<0.020	<0.016	<0.016	<0.015	<0.018	<0.020	<0.025	<0.017	<0.019	<0.015
21	20-May-97	27-May-97	<0.021	<0.024	<0.020	<0.020	<0.021	<0.017	<0.022	<0.019	<0.023	<0.021
22	27-May-97	3-Jun-97	<0.020	<0.015	<0.018	<0.018	<0.019	<0.017	<0.016	<0.016	<0.023	<0.021
23	3-Jun-97	10-Jun-97	<0.016	<0.014	<0.018	<0.017	<0.016	<0.016	<0.015	<0.018	<0.014	<0.020
24	10-Jun-97	17-Jun-97	<0.024	<0.025	<0.023	<0.023	<0.025	<0.025	<0.021	<0.024	<0.021	<0.024
25	17-Jun-97	24-Jun-97	<0.020	<0.022	<0.022	<0.019	<0.025	<0.023	<0.023	<0.024	<0.022	<0.026
26	24-Jun-97	1-Jul-97	<0.021	<0.025	<0.021	<0.026	<0.021	<0.015	<0.029	<0.023	<0.024	<0.022

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	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
27	1-Jul-97	8-Jul-97	<0.020	<0.020	<0.020	<0.020	<0.022	<0.021	<0.018	<0.019	<0.023	<0.027
28	8-Jul-97	15-Jul-97	<0.018	<0.023	<0.018	<0.023	<0.025	<0.018	<0.021	<0.028	<0.025	<0.017
29	15-Jul-97	22-Jul-97	<0.017	<0.019	<0.025	<0.021	<0.025	<0.019	<0.022	<0.020	<0.023	<0.020
30	22-Jul-97	29-Jul-97	<0.021	<0.021	<0.019	<0.021	<0.023	<0.022	<0.018	<0.023	<0.021	<0.026
31	29-Jul-97	5-Aug-97	<0.023	<0.018	<0.017	<0.018	<0.018	<0.017	<0.017	<0.027	<0.019	<0.020
32	5-Aug-97	12-Aug-97	<0.020	<0.024	<0.018	<0.020	<0.025	<0.019	<0.023	<0.018	<0.021	<0.020
33	12-Aug-97	20-Aug-97	<0.016	<0.017	<0.019	<0.020	<0.022	<0.016	<0.016	<0.021	<0.020	<0.023
34	20-Aug-97	26-Aug-97	<0.024	<0.024	<0.030	<0.029	<0.025	<0.016	<0.024	<0.029	<0.030	<0.034
35	26-Aug-97	2-Sep-97	<0.023	<0.026	<0.022	<0.025	<0.028	<0.031	<0.020	<0.022	<0.022	<0.025
36	2-Sep-97	9-Sep-97	<0.023	<0.024	<0.021	<0.023	<0.021	<0.024	<0.023	<0.022	<0.021	<0.026
37	9-Sep-97	16-Sep-97	<0.020	<0.020	<0.029	<0.021	<0.020	<0.020	<0.023	<0.026	<0.030	<0.031
38	16-Sep-97	23-Sep-97	<0.022	<0.022	<0.023	<0.022	<0.022	<0.020	<0.024	<0.022	<0.024	<0.023
39	23-Sep-97	30-Sep-97	<0.019	<0.022	<0.019	<0.024	<0.025	<0.022	<0.022	<0.022	<0.020	<0.027

4th Quarter

required LLD <0.070

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*
40	30-Sep-97	8-Oct-97	<0.019	<0.019	<0.022	<0.020	<0.019	<0.015	<0.017	<0.019	<0.025	<0.021
41	8-Oct-97	14-Oct-97	<0.020	<0.024	<0.020	<0.023	<0.023	<0.024	<0.027	<0.024	<0.027	<0.029
42	14-Oct-97	21-Oct-97	<0.022	<0.029	<0.024	<0.027	<0.025	<0.014	<0.023	<0.026	<0.025	<0.024
43	21-Oct-97	28-Oct-97	<0.025	<0.023	<0.026	<0.031	<0.028	<0.022	<0.026	<0.031	<0.030	<0.031
44	28-Oct-97	4-Nov-97	<0.026	<0.024	<0.024	<0.021	<0.026	<0.018	<0.020	<0.023	<0.027	<0.025
45	4-Nov-97	12-Nov-97	<0.022	<0.019	<0.019	<0.021	<0.019	<0.024	<0.021	<0.023	<0.024	<0.020
46	12-Nov-97	18-Nov-97	<0.028	<0.024	<0.029	<0.023	<0.029	<0.027	<0.027	<0.027	<0.029	<0.031
47	18-Nov-97	24-Nov-97	<0.027	<0.029	<0.027	<0.029	<0.023	<0.031	<0.026	<0.027	<0.028	<0.029
48	24-Nov-97	1-Dec-97	<0.020	<0.025	<0.028	<0.028	<0.021	<0.024	<0.025	<0.025	<0.021	<0.028
49	1-Dec-97	8-Dec-97	<0.021	<0.018	<0.020	<0.026	<0.025	<0.021	<0.022	<0.024	<0.021	<0.024
50	8-Dec-97	15-Dec-97	<0.022	<0.010	<0.022	<0.010	<0.025	<0.013	<0.023	<0.012	<0.018	<0.013
51	15-Dec-97	23-Dec-97	<0.012	<0.011	invalid (a)	<0.013	<0.014	<0.012	<0.013	<0.011	<0.012	<0.014
52	23-Dec-97	29-Dec-97	<0.022	<0.024	<0.023	<0.025	<0.029	<0.024	<0.026	<0.026	<0.026	<0.028

(a) Sample invalidated due to pump malfunction

TABLE 8.6 VEGETATION

ODCM required samples denoted by *
units are pCi/kg

LOCATION	TYPE	DATE COLLECTED	<60 I-131	<60 Cs-134	<80 Cs-137
ADAMS RESIDENCE (SITE #47)*	Lettuce	4-Jun-97	<23	<22	<24
	Swiss Chard	4-Jun-97	<30	<23	<27
PAYNE RESIDENCE (SITE #52)*	Collard greens	15-Apr-97	<20	<19	<18
	Turnip greens	15-Apr-97	<22	<21	<26
	Collard greens	8-May-97	<23	<21	<27
	Mustard greens	8-May-97	<20	<20	<22
	Turnip greens	4-Jun-97	<12	<13	<15
	Mustard greens	4-Jun-97	<15	<12	<17
	Collard greens	4-Jun-97	<27	<25	<25
	Collard greens	2-Jul-97	<23	<22	<21
	Turnip greens	2-Jul-97	<20	<17	<20
	Swiss Chard	2-Jul-97	<19	<19	<24
	Collard greens	8-Aug-97	<17	<17	<21
	Mustard greens	8-Aug-97	<21	<24	<27
	Swiss Chard	8-Aug-97	<18	<15	<21
TOLLESON PRODUCE CO. (Site #62)*	Bok choy	8-Jan-97	<10	<10	<10
	Chinese cabbage	8-Jan-97	<16	<17	<19
	Chinese cabbage	5-Feb-97	<18	<20	<22
	Bok choy	5-Feb-97	<19	<16	<19
	Spinach	5-Feb-97	<23	<19	<23
	Swiss chard	4-Mar-97	<17	<18	<19
	Spinach	4-Mar-97	<19	<19	<21
	Chinese cabbage	4-Mar-97	<18	<15	<16
	Cabbage	3-Apr-97	<17	<14	<17
	Cabbage	8-May-97	<16	<17	<18
	Bok choy	6-Nov-97	<20	<24	<23
	Mustard greens	6-Nov-97	<31	<30	<36
	Collard greens	6-Nov-97	<26	<22	<24
	Collard greens	4-Dec-97	<12	<18	<18
	Turnip greens	4-Dec-97	<14	<15	<17
	Mustard greens	4-Dec-97	<25	<22	<21
HOMMEL RESIDENCE (Site #65)	Spinach	4-Mar-97	<25	<21	<29
	Mustard greens	4-Mar-97	<23	<19	<22
	Cabbage	4-Mar-97	<24	<23	<26
PADILLA RESIDENCE	Spinach	8-May-97	<26	<27	<30

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
	28-Jan-97	<10	<11	<23	<9	<23	<10	<19	<12	<10	<11	<37	<9		3.8 +/- 1.6
	25-Feb-97	<11	<10	<20	<10	<24	<12	<18	<12	<11	<10	<42	<11		3.3 +/- 1.6
	25-Mar-97	<11	<10	<20	<12	<23	<10	<19	<12	<10	<12	<40	<12	<294	3.5 +/- 1.7
	29-Apr-97	<10	<12	<20	<13	<22	<10	<21	<11	<9	<9	<39	<11		3.2 +/- 1.6
McARTHUR	27-May-97	<10	<11	<21	<10	<25	<12	<18	<11	<10	<12	<36	<11		3.9 +/- 1.6
RESIDENCE	24-Jun-97	<12	<9	<23	<10	<26	<11	<20	<11	<11	<13	<38	<11	<295	<2.5
(SITE #46) *	29-Jul-97	<10	<10	<19	<11	<22	<12	<19	<11	<9	<11	<38	<10		3.0 +/- 1.6
	26-Aug-97	<12	<10	<22	<12	<22	<11	<19	<13	<10	<12	<46	<8		<2.6
	30-Sep-97	<11	<10	<22	<9	<21	<10	<17	<11	<9	<8	<38	<9	<288	<2.6
	28-Oct-97	<10	<9	<17	<10	<23	<11	<16	<10	<9	<10	<34	<11		4.3 +/- 1.2
	24-Nov-97	<9	<10	<18	<9	<20	<9	<16	<9	<9	<8	<31	<12		3.6 +/- 1.7
	29-Dec-97	<8	<8	<16	<11	<15	<9	<13	<9	<9	<9	<29	<10	<291	3.2 +/- 1.6
	28-Jan-97	<11	<11	<22	<9	<26	<11	<16	<12	<10	<11	<36	<10		3.5 +/- 1.6
	25-Feb-97	<9	<10	<17	<11	<24	<12	<19	<13	<11	<11	<43	<10		3.0 +/- 1.6
	25-Mar-97	<11	<11	<16	<12	<26	<12	<20	<12	<10	<13	<38	<12	<294	4.3 +/- 1.8
	29-Apr-97	<11	<13	<19	<9	<30	<11	<20	<13	<9	<12	<47	<14		3.5 +/- 1.7
GAVETTE	27-May-97	<9	<9	<21	<10	<25	<11	<18	<11	<10	<12	<37	<10		2.6 +/- 1.5
RESIDENCE	24-Jun-97	<10	<9	<22	<8	<22	<10	<22	<11	<9	<10	<37	<13	<298	3.3 +/- 1.6
(SITE #55)	29-Jul-97	<10	<10	<26	<12	<24	<11	<17	<13	<10	<12	<46	<12		4.5 +/- 1.6
	26-Aug-97	<12	<12	<19	<11	<21	<11	<17	<12	<11	<11	<43	<12		3.0 +/- 1.6
	30-Sep-97	<9	<9	<20	<9	<19	<10	<16	<12	<9	<10	<36	<8	<289	3.6 +/- 1.7
	28-Oct-97	<10	<10	<15	<10	<21	<11	<17	<10	<10	<11	<35	<11		5.4 +/- 1.7
	24-Nov-97	<9	<8	<13	<7	<24	<11	<15	<10	<9	<8	<36	<8		3.2 +/- 1.7
	29-Dec-97	<7	<8	<15	<6	<14	<7	<12	<8	<7	<7	<27	<6	<293	2.8 +/- 1.6

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
SHEPPARD RESIDENCE (SITE #48) *	28-Jan-97	<11	<12	<22	<10	<22	<10	<17	<11	<9	<9	<37	<12		7.7 +/- 2.1
	25-Feb-97	<10	<9	<18	<10	<27	<11	<15	<12	<9	<11	<41	<12		6.1 +/- 2.1
	25-Mar-97	<10	<9	<21	<10	<20	<10	<20	<12	<9	<10	<42	<12	<290	4.7 +/- 2.2
	29-Apr-97	<11	<11	<21	<12	<22	<10	<19	<11	<9	<10	<39	<9		10.8 +/- 2.4
	27-May-97	<12	<10	<17	<13	<20	<10	<18	<11	<10	<11	<36	<12		4.8 +/- 1.9
	24-Jun-97	<12	<9	<20	<9	<23	<10	<16	<10	<10	<11	<37	<13	<295	3.4 +/- 1.9
	29-Jul-97	<9	<8	<17	<9	<19	<9	<17	<10	<9	<9	<32	<10		4.1 +/- 1.9
	26-Aug-97	<10	<11	<20	<11	<23	<10	<19	<11	<10	<10	<35	<9		6.9 +/- 2.2
	30-Sep-97	<9	<9	<17	<10	<23	<9	<16	<11	<8	<9	<34	<10	<289	6.2 +/- 2.1
	(a)														
	24-Nov-97	<7	<6	<14	<8	<15	<9	<15	<8	<8	<9	<28	<10		7.3 +/- 2.3
	29-Dec-97	<6	<8	<14	<9	<17	<8	<16	<9	<8	<6	<34	<11	(b)	7.5 +/- 2.2
CHOWANEC RESIDENCE (SITE #49) *	28-Jan-97	<11	<11	<21	<14	<27	<10	<20	<11	<11	<11	<38	<9		<2.3
	25-Feb-97	<10	<9	<23	<9	<17	<11	<18	<12	<10	<12	<39	<11		<2.4
	25-Mar-97	<12	<10	<18	<10	<22	<10	<18	<13	<10	<11	<40	<9	<297	<2.2
	29-Apr-97	<11	<10	<21	<11	<23	<11	<20	<11	<10	<12	<37	<10		<2.4
	28-May-97	<10	<10	<21	<12	<27	<10	<16	<10	<11	<11	<42	<8		<2.4
	24-Jun-97	<10	<9	<21	<10	<22	<10	<16	<11	<10	<11	<35	<9	<299	<2.4
	29-Jul-97	<11	<10	<19	<11	<21	<10	<18	<12	<10	<11	<40	<11		<2.2
	26-Aug-97	<10	<9	<20	<13	<19	<12	<20	<14	<9	<11	<37	<10		<2.4
	30-Sep-97	<9	<8	<20	<11	<21	<10	<16	<10	<9	<10	<41	<10	<290	<2.5
	28-Oct-97	<9	<9	<17	<10	<22	<9	<16	<10	<10	<11	<34	<12		<2.4
	24-Nov-97	<8	<8	<18	<10	<20	<8	<13	<9	<9	<7	<29	<9		2.2 +/- 1.3
	29-Dec-97	<8	<8	<12	<8	<14	<7	<13	<8	<7	<8	<27	<6	<288	<2.4

(a) Sample from well not available part of October so monthly composite was not performed

(b) Quarterly composite only included grab samples from 8 weeks due to the well being out of service for several weeks and one weekly grab sample discarded prior to analysis. This one event is considered a minor human performance oversight and no further action to prevent recurrence is necessary

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)*	28-Jan-97	<13	<9	<22	<13	<26	<13	<22	<14	<11	<13	<44	<15	<367
	30-Apr-97	<10	<10	<23	<12	<20	<12	<16	<12	<10	<11	<39	<12	<308
	29-Jul-97	<11	<10	<26	<13	<24	<12	<18	<14	<10	<10	<41	<9	<298
	28-Oct-97	<9	<10	<21	<10	<25	<11	<16	<11	<11	<10	<38	<13	<293
WELL 34abb (Site #58)*	28-Jan-97	<10	<11	<21	<12	<22	<11	<18	<13	<11	<13	<38	<13	<367
	29-Apr-97	<12	<11	<22	<11	<22	<12	<20	<13	<11	<11	<42	<13	<306
	29-Jul-97	<10	<11	<24	<14	<26	<12	<19	<12	<10	<11	<46	<13	<298
	28-Oct-97	<11	<10	<21	<11	<22	<14	<16	<11	<10	<10	<37	<12	<291

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) *	28-Jan-97	<9	<11	<19	<9	<24	<11	<20	<10	<10	<11	<36	<9	
	25-Feb-97	<10	<11	<20	<10	<25	<11	<17	<14	<10	<11	<42	<7	
	25-Mar-97	<10	<10	<19	<9	<21	<11	<19	<11	<9	<12	<37	<10	311 +/- 181
	29-Apr-97	<9	<10	<20	<10	<23	<10	<18	<12	<10	<11	<37	<12	
	27-May-97	<9	<10	<19.	<10	<22	<9	<17	<11	<9	<9	<38	<9	
	24-Jun-97	<9	<11	<17	<10	<25	<10	<18	<11	<9	<11	<34	<13	<300
	29-Jul-97	<12	<11	<19	<11	<22	<10	<17	<11	<10	<10	<36	<9	
	26-Aug-97	<10	<9	<19	<11	<23	<11	<18	11 +/- 10	<10	<11	<35	<10	
	30-Sep-97	<9	<9	<20	<10	<19	<9	<17	<12	<9	<10	<33	<9	<289
	28-Oct-97	<12	<11	<21	<11	<26	<10	<19	13 +/- 9	<9	<11	<41	<12	
	24-Nov-97	<9	<7	<13	<9	<17	<8	<15	12 +/- 7	<8	<8	<32	<9	
	29-Dec-97	<7	<7	<12	<7	<16	<7	<14	<8	<8	<7	<26	<7	<301
EVAP POND 1 (Site #59) *	28-Jan-97	<10	<12	<19	<12	<22	<10	<20	<10	<11	<11	<31	<11	
	25-Feb-97	<10	<11	<21	<12	<25	<11	<19	<13	<9	<12	<38	<14	
	25-Mar-97	<11	<10	<23	<11	<26	<11	<17	<11	<10	<11	<36	<10	1103 +/- 192
	29-Apr-97	<10	<10	<24	<10	<20	<11	<18	<12	<10	<11	<40	<10	
	27-May-97	<13	<10	<23	<12	<21	<11	<19	<10	<10	<12	<39	<10	
	24-Jun-97	<11	<10	<21	<14	<25	<12	<18	<10	<10	<10	<34	<9	971 +/- 192
	29-Jul-97	<10	<11	<21	<10	<27	<11	<19	<12	<9	<12	<41	<9	
	26-Aug-97	<11	<11	<23	<11	<25	<11	<20	<13	<10	<11	<36	<11	
	30-Sep-97	<10	<9	<20	<13	<20	<9	<15	<10	<9	<11	<34	<8	922 +/- 185
	28-Oct-97	<11	<12	<23	<12	<27	<12	<19	<11	<11	<12	<37	<12	
	24-Nov-97	<8	<7	<18	<10	<20	<10	<16	<10	<8	<9	<32	<5	
	29-Dec-97	<7	<8	<13	<8	<16	<7	<13	<8	<8	<9	<27	<10	1157 +/- 191
EVAP POND 2 (Site #63) *	28-Jan-97	<10	<9	<20	<11	<23	<9	<15	<9	<9	13 +/- 9	<35	<7	
	25-Feb-97	<11	<11	<21	<11	<25	<11	<19	<12	<11	<10	<41	<10	
	25-Mar-97	<11	<9	<21	<12	<28	<11	<19	<12	<12	<14	<41	<12	1118 +/- 192
	29-Apr-97	<11	<10	<24	<12	<21	<10	<18	<11	<11	<12	<36	<11	
	27-May-97	<11	<11	<21	<11	<24	<11	<20	<11	<12	<12	<41	<10	
	24-Jun-97	<10	<10	<27	<14	<26	<11	<20	<11	<11	<13	<35	<13	1129 +/- 194
	29-Jul-97	<11	<11	<25	<15	<23	<10	<18	<12	<10	<14	<36	<9	
	26-Aug-97	<11	<11	<21	<10	<24	<10	<20	<11	<11	<14	<39	<11	
	30-Sep-97	<10	<9	<19	<11	<24	<10	<17	<11	<10	<13	<34	<10	1045 +/- 186
	28-Oct-97	<10	<11	<24	<12	<22	<10	<19	<10	<11	<12	<31	<11	
	24-Nov-97	<8	<9	<20	<8	<23	<9	<17	<9	<9	<11	<24	<8	
	29-Dec-97	<8	<8	<15	<12	<16	<8	<13	<8	<10	11 +/- 7	<28	<10	1037 +/- 191

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	7-Jan-97	<9	<10	<17	<7	<18	<10	<18	<12	<9	<11	<37	<11	
	14-Jan-97	<8	<10	<21	<11	<19	<12	<16	<12	<10	<11	<42	<12	
	21-Jan-97	<11	<10	<18	<10	<26	<10	<20	16 +/- 14	<10	<11	<45	<10	
	28-Jan-97	<11	<10	<22	<10	<18	<9	<19	26 +/- 15	<10	<12	<37	<12	<370 **
	5-Feb-97	<12	<8	<20	<10	<22	<10	<16	19 +/- 8	<9	<11	<36	<9	
	11-Feb-97	<11	<10	<22	<11	<28	<10	<17	58 +/- 12	<11	<10	<36	<13	
	18-Feb-97	<11	<10	<21	<11	<20	<8	<17	60 +/- 12	<10	<10	<37	<11	
	12-Mar-97	<11	<8	<22	<11	<25	<12	<19	44 +/- 12	<9	<11	<37	<9	
	18-Mar-97	<9	<11	<23	<10	<24	<10	<19	45 +/- 12	<10	<11	<42	<10	<305 **
	1-Apr-97	<9	<11	<18	<10	<23	<10	<18	18 +/- 10	<9	<12	<36	<14	
	8-Apr-97	<11	<11	<24	<11	<20	<10	<19	45 +/- 14	<9	<11	<39	<8	
	15-Apr-97	<10	<12	<20	<10	<24	<10	<19	29 +/- 11	<10	<10	<40	<10	
	23-Apr-97	<10	<10	<17	<11	<25	<11	<19	<15	<10	<10	<39	<13	
	29-Apr-97	<13	<11	<23	<9	<26	<10	<17	37 +/- 12	<10	<11	<45	<13	<314 **
	6-May-97	<12	<9	<21	<10	<26	<10	<19	<11	<10	<11	<39	<13	
	14-May-97	<13	<12	<20	<13	<23	<11	<22	31 +/- 9	<11	<12	<39	<9	
	20-May-97	<9	<12	<24	<9	<25	<11	<18	23 +/- 12	<8	<10	<41	<12	
	27-May-97	<10	<10	<23	<13	<27	<9	<18	27 +/- 13	<10	<11	<40	<10	<305 **
	6-Jun-97	<9	<10	<19	<9	<23	<11	<19	43 +/- 9	<10	<12	<36	<10	
	10-Jun-97	<10	<11	<24	<11	<21	<12	<17	25 +/- 11	<9	<10	<40	<13	
	17-Jun-97	<11	<9	<22	<13	<22	<9	<19	24 +/- 11	<8	<12	<40	<8	
	24-Jun-97	<10	<10	<21	<10	<20	<10	<17	30 +/- 13	<9	<10	<38	<12	<307 **
	2-Jul-97	<11	<10	<19	<11	<23	<10	<17	33 +/- 12	<11	<12	<33	<9	
	8-Jul-97	<12	<11	<22	<15	<29	<11	<19	14 +/- 10	<10	<11	<45	<12	
	17-Jul-97	<10	<11	<18	<11	<22	<11	<17	18 +/- 11	<9	<11	<41	<12	
	23-Jul-97	<10	<13	<22	<12	<25	<9	<16	24 +/- 13	<10	<11	<37	<9	
	30-Jul-97	<9	<10	<19	<9	<18	<10	<18	37 +/- 15	<11	<12	<39	<10	<298 **
	5-Aug-97	<11	<10	<21	<11	<20	<11	<19	26 +/- 10	<10	<10	<41	<13	
	12-Aug-97	<9	<10	<24	<12	<24	<11	<17	19 +/- 13	<9	<11	<34	<12	
	20-Aug-97	<10	<11	<17	<9	<26	<10	<18	43 +/- 15	<9	<10	<36	<8	
	27-Aug-97	<11	<11	<18	<13	<28	<12	<21	72 +/- 14	<11	<12	<46	<12	<295 **

** 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 (cont'd)	3-Sep-97	<10	<9	<25	<11	<23	<10	<17	29 +/- 14	<9	<11	<39	<10	[redacted]
	9-Sep-97	<11	<11	<23	<12	<25	<9	<20	<14	<10	<10	<35	<10	
	23-Sep-97	<10	<12	<22	<13	<24	<11	<21	25 +/- 16	<10	<12	<39	<11	
	1-Oct-97	<11	<10	<25	<10	<28	<11	<17	28 +/- 11	<10	<11	<39	<12	<300 **
	22-Oct-97	<12	<11	<24	<14	<22	<11	<17	15 +/- 9	<9	<11	<39	<11	[redacted]
	28-Oct-97	<10	<9	<26	<10	<27	<12	<16	19 +/- 13	<10	<12	<50	<14	<304 **
	5-Nov-97	<10	<10	<20	<8	<27	<11	<18	37 +/- 13	<9	<11	<39	<11	[redacted]
	10-Nov-97	<10	<10	<22	<10	<26	<13	<20	36 +/- 14	<10	<11	<46	<11	
	18-Nov-97	<11	<8	<20	<12	<27	<12	<20	<14	<10	<13	<39	<11	
	25-Nov-97	<10	<9	<19	<12	<22	<11	<19	33 +/- 12	<10	<11	<35	<13	
	2-Dec-97	<9	<10	<20	<9	<25	<11	<15	<14	<10	<11	<42	<9	
	16-Dec-97 (a)	<11	<11	<22	<10	<20	<11	<18	<12	<12	<10	<35	<12	
	24-Dec-97	<10	<10	<22	<10	<25	<11	<15	40 +/- 16	<12	<8	<48	<11	
	31-Dec-97	<7	<8	<17	<9	<18	<9	<13	<13	<9	<7	<34	<8	<295 **
SEDIMENT. BASIN #2	28-Feb-97	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2227 +/- 257
	3-Mar-97	<11	<11	<18	<11	<22	<9	<17	<12	<9	<12	<39	<13	N/A
	12-Aug-97	<11	<9	<17	<12	<22	<9	<19	<9	<9	<11	<38	<8	<307
	20-Aug-97	<10	<11	<19	<11	<26	<10	<15	<11	<10	<10	<39	<8	<280
	26-Aug-97	<10	<10	<22	<9	<23	<11	<19	<14	<9	<12	<43	<7	<274
	2-Sep-97	<10	<9	<23	<12	<24	<10	<18	<12	<10	<9	<40	<10	1427 +/- 193
	9-Sep-97	<11	<10	<19	<12	<23	<10	<20	<12	<11	<11	<41	<8	1106 +/- 188
	16-Sep-97	<10	<10	<22	<8	<21	<11	<18	<12	<10	<12	<44	<11	1673 +/- 195
	23-Sep-97	<9	<11	<23	<10	<23	<11	<20	<18	<9	<11	<50	<17	1459 +/- 196
	30-Sep-97	<12	<9	<22	<13	<23	<10	<18	<11	<9	<10	<41	<12	<295
	8-Oct-97	<10	<10	<19	<12	<25	<11	<18	<12	<11	<11	<39	<16	<292
	14-Oct-97	<10	<10	<22	<10	<21	<10	<20	<12	<10	<11	<39	<11	<299
	21-Oct-97	<10	<11	<18	<13	<24	<9	<18	<12	<9	<11	<38	<13	<300
	28-Oct-97	<8	<8	<17	<11	<18	<8	<16	<10	<10	<8	<29	<11	<302
	8-Dec-97	<10	<10	<25	<12	<24	<11	<19	<12	<13	<11	<40	<12	1764 +/- 199
	15-Dec-97	<8	<6	<16	<8	<15	<8	<13	<8	<7	<7	<27	<7	2131 +/- 204
	23-Dec-97	<8	<8	<16	<8	<16	<8	<14	<13	<8	<9	<36	<12	1273 +/- 191
	29-Dec-97	<5	<6	<16	<7	<18	<8	<13	<15	<9	<7	<43	<11	3419 +/- 216

** monthly composite

(a) Sample also contained Tc-99m at 10 +/- 8 pCi/liter, a radiopharmaceutical

TABLE 8.10 SLUDGE/SEDIMENT

ODCM required samples denoted by *

units are pCi/kg

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	In-111
WRF CENTRIFUGE WASTE SLUDGE	7-Jan-97	<8	<7	<16	<9	<19	<8	<14	854 +/- 28	<7	<8	<29	<12	
	14-Jan-97	<9	<7	<17	<9	<17	<8	<14	636 +/- 24	<8	<10	<32	<7	33 +/- 13
	21-Jan-97	<7	<7	<15	<7	<16	<8	<11	576 +/- 24	<6	<7	<27	<8	16 +/- 11
	28-Jan-97	<8	<8	<16	<6	<19	<9	<13	465 +/- 22	<7	<8	<28	<12	
	5-Feb-97	<8	<8	<17	<10	<19	<9	<16	507 +/- 22	<7	<9	<32	<9	
	11-Feb-97	<8	<7	<18	<9	<16	<8	<13	1413 +/- 34	<9	<8	<31	<8	33 +/- 12
	18-Feb-97	<8	<9	<17	<8	<19	<8	<13	2390 +/- 44	<8	<9	<31	<7	56 +/- 14
	5-Mar-97	<8	<8	<13	<9	<15	<8	<13	876 +/- 27	<7	<9	<31	<8	49 +/- 10
	12-Mar-97	<8	<7	<19	<7	<22	<9	<13	1092 +/- 32	<8	<9	<34	<10	13 +/- 10
	18-Mar-97	<7	<9	<19	<9	<18	<10	<17	799 +/- 29	<8	<9	<34	<9	
	25-Mar-97	<8	<9	<19	<9	<20	<10	<15	857 +/- 30	<8	<9	<35	<11	
	1-Apr-97	<12	<13	<31	<14	<27	<15	<23	602 +/- 34	<12	<15	<56	<14	
	8-Apr-97	<8	<8	<17	<9	<17	<9	<13	865 +/- 29	<8	<8	<32	<10	41 +/- 15
	15-Apr-97	<8	<8	<14	<9	<17	<9	<16	825 +/- 28	<8	<8	<30	<10	29 +/- 13
	23-Apr-97	<10	<10	<14	<12	<20	<9	<17	742 +/- 28	<8	<9	<37	<8	
	29-Apr-97	<8	<7	<16	<8	<18	<9	<16	880 +/- 30	<7	<7	<30	<8	
	6-May-97	<8	<8	<17	<9	<20	<9	<15	1038 +/- 34	<8	<9	<37	<10	
	14-May-97	<9	<9	<19	<10	<17	<9	<14	1203 +/- 31	<8	<8	<27	<8	18 +/- 9
	20-May-97	<8	<9	<16	<9	<21	<9	<13	859 +/- 29	<8	<9	<32	<10	
	27-May-97	<8	<7	<15	<9	<17	<8	<13	1254 +/- 32	<7	<6	<29	<8	
	6-Jun-97	<9	<6	<14	<11	<18	<9	<12	1304 +/- 32	<7	<9	<27	<10	
	10-Jun-97	<9	<7	<17	<9	<16	<8	<14	891 +/- 29	<7	<8	<27	<12	
	17-Jun-97	<8	<8	<13	<9	<17	<8	<13	1544 +/- 38	<8	<9	<31	<8	16 +/- 12
	24-Jun-97	<8	<8	<17	<8	<20	<9	<15	1427 +/- 39	<7	<9	<34	<9	
	2-Jul-97	<9	<8	<17	<9	<22	<10	<15	1321 +/- 34	<9	<10	<31	<8	15 +/- 11
	8-Jul-97	<11	<10	<18	<13	<22	<11	<17	1658 +/- 44	<9	<10	<40	<9	25 +/- 17
	17-Jul-97	<8	<9	<16	<9	<19	<9	<14	934 +/- 29	<8	<9	<28	<8	24 +/- 13
	23-Jul-97	<8	<7	<15	<9	<17	<8	<13	1260 +/- 32	<8	<8	<31	<8	35 +/- 9
	30-Jul-97	<7	<8	<15	<9	<18	<7	<13	2112 +/- 44	<7	<8	<31	<9	
	5-Aug-97	<9	<7	<14	<9	<19	<7	<12	1991 +/- 42	<9	<8	<30	<8	23 +/- 13
	12-Aug-97	<8	<9	<17	<9	<16	<9	<14	1581 +/- 39	<7	<9	<31	<9	73 +/- 16
	20-Aug-97	<8	<8	<16	<9	<18	<9	<14	4517 +/- 63	<9	<9	<33	<8	20 +/- 19
	27-Aug-97	<9	<9	<19	<8	<16	<9	<14	2706 +/- 59	<7	<9	<39	<8	
	3-Sep-97	<9	<8	<16	<9	<18	<9	<15	2147 +/- 44	<7	<9	<32	<9	52 +/- 15
	9-Sep-97	<9	<7	<16	<9	<20	<9	<15	1852 +/- 42	<8	<8	<33	<9	55 +/- 16
	23-Sep-97	<7	<9	<19	<8	<18	<8	<14	2546 +/- 51	<7	<8	<31	<10	46 +/- 22

TABLE 8.10 SLUDGE/SEDIMENT

ODCM required samples denoted by *

units are pCi/kg

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	In-111
WRF CENTRIFUGE WASTE SLUDGE (cont'd)	1-Oct-97	<8	<9	<14	<7	<20	<7	<14	3165 +/- 52	<8	<8	<31	<11	35 +/- 16
	22-Oct-97	<8	<9	<15	<8	<18	<7	<13	591 +/- 26	<8	<8	<33	<9	17 +/- 10
	28-Oct-97	<8	<8	<19	<9	<19	<9	<16	1430 +/- 45	<8	<9	<41	<12	
	3-Nov-97	<9	<8	<18	<9	<19	<10	<13	1702 +/- 43	<8	<10	<35	<11	41 +/- 21
	10-Nov-97	<8	<9	<18	<10	<20	<11	<16	2319 +/- 59	<8	<8	<44	<13	
	18-Nov-97	<9	<8	<14	<11	<18	<9	<12	1123 +/- 32	<8	<8	<32	<8	42 +/- 14
	25-Nov-97	<12	<10	<20	<8	<19	<13	<18	850 +/- 33	<10	<11	<37	<10	
	2-Dec-97	<6	<6	<14	<7	<11	<7	<11	1192 +/- 35	<6	<8	<27	<8	19 +/- 13
	9-Dec-97	<8	<8	<16	<11	<19	<10	<16	952 +/- 30	<9	<10	<33	<9	103 +/- 13
	17-Dec-97	<5	<5	<10	<5	<11	<6	<9	510 +/- 20	<7	<6	<19	<6	19 +/- 7
	24-Dec-97	<10	<9	<19	<13	<26	<10	<18	1065 +/- 39	<10	<9	<41	<14	117 +/- 28
	31-Dec-97	<11	<10	<20	<12	<19	<11	<15	1150 +/- 35	<12	<10	<38	<10	16 +/- 12
SEDIMENTATION BASIN #2 (North)	5-Dec-97	<16	<14	<35	<16	<37	<19	<30	<21	<20	22 +/- 12	<62	<15	
SEDIMENTATION BASIN #2 (Center)	5-Dec-97	<27	<25	<59	<30	<65	<33	<46	<32	<35	40 +/- 24	<99	<34	

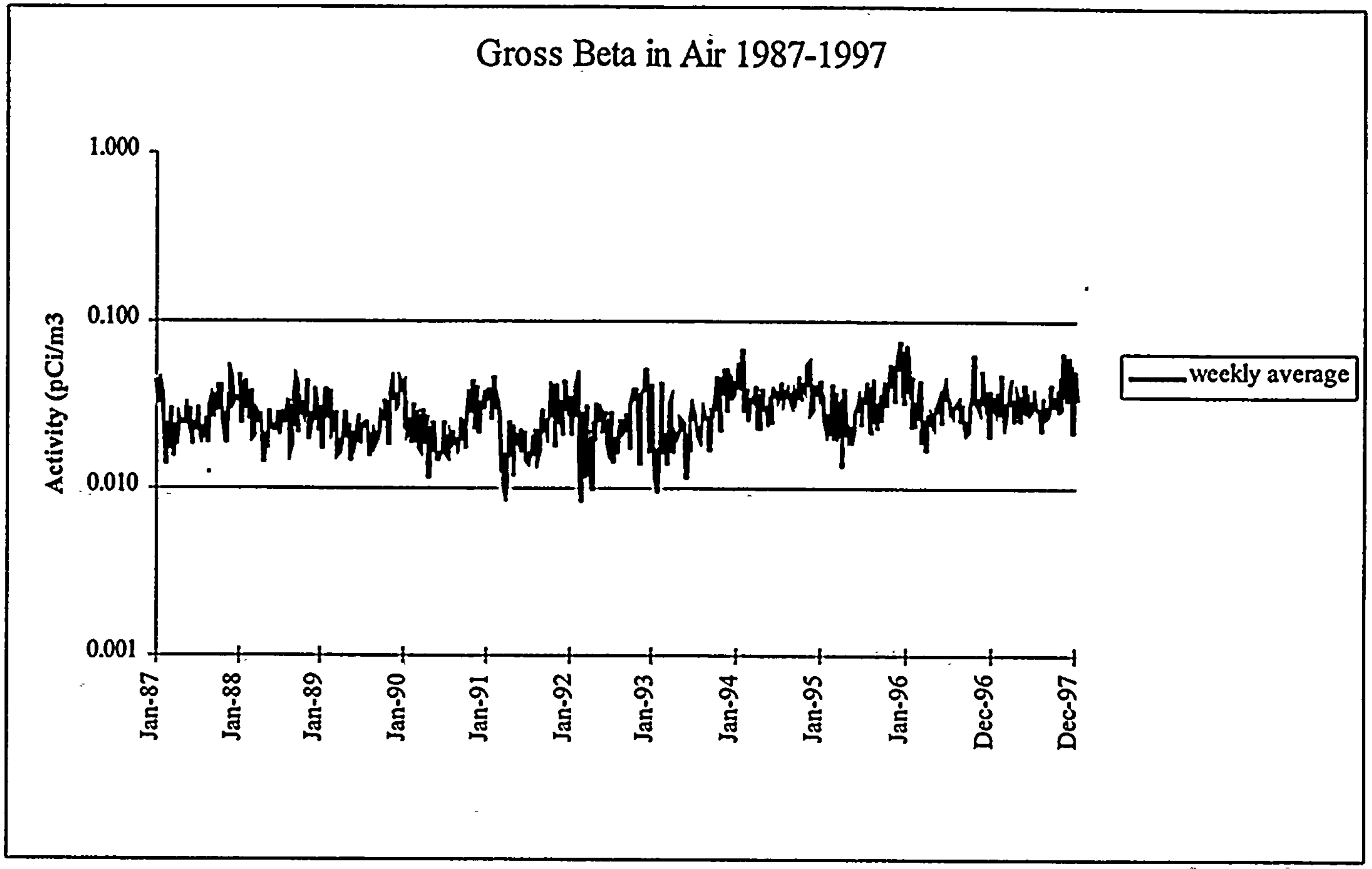
TABLE 8.10 SLUDGE/SEDIMENT

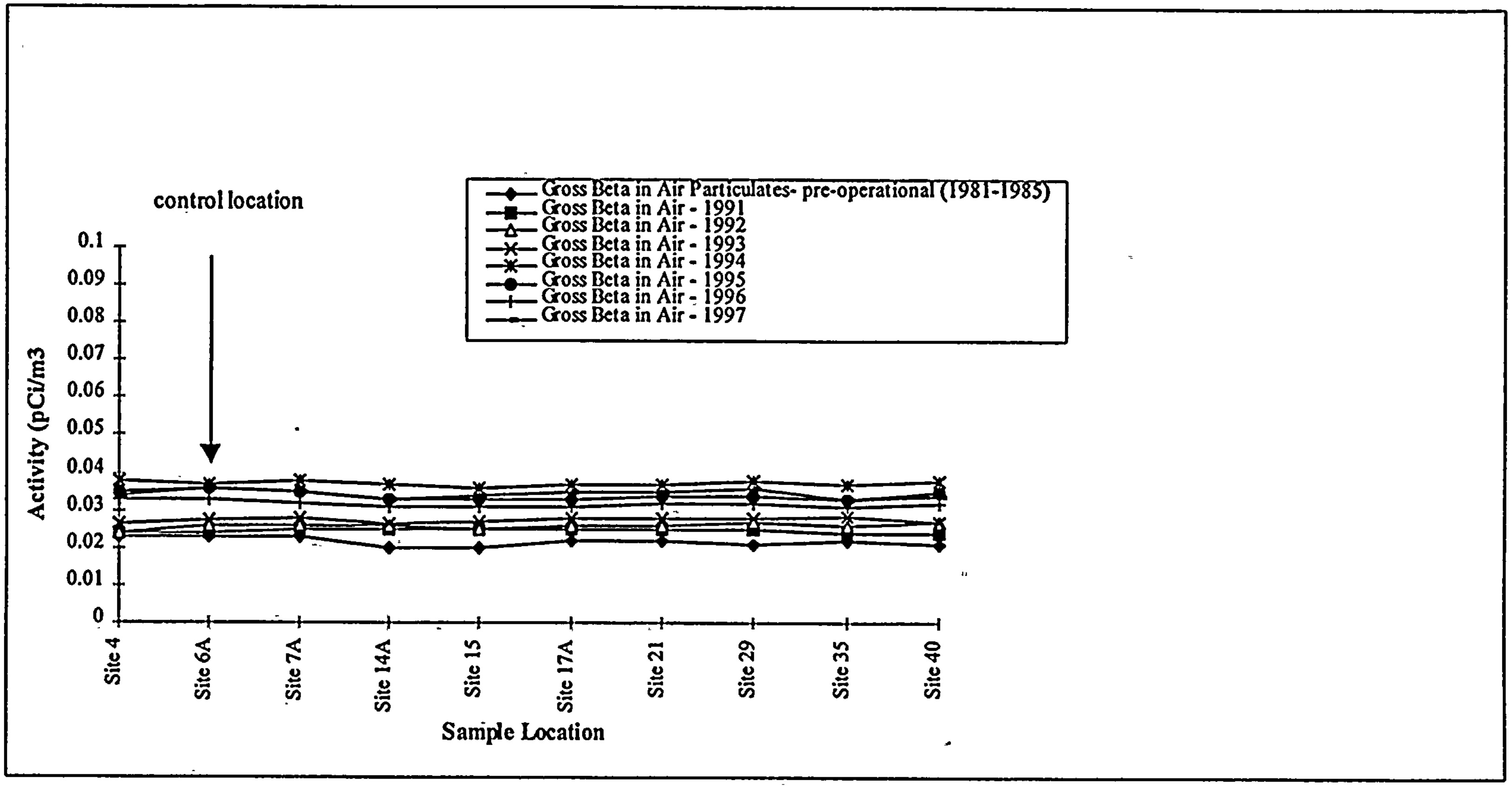
ODCM required samples denoted by *

units are pCi/kg

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
EVAP POND 1 (C)	21-Mar-97	<10	<10	<24	<14	<25	<14	<21	<19	<9	<11	<50	<11
(W)		<11	<10	<24	<12	<24	<11	<20	<26	<10	<12	<62	<16
(S)		<11	<11	<23	<12	<24	<12	<21	<29	<10	<11	<64	<18
(E)		<11	<11	<25	23 +/- 10	<23	<13	<19	<23	<8	<11	<61	<17
(N)		<11	<9	<19	<11	<23	<10	<19	<10	<9	<12	<30	<12
(C)	12-Jun-97	<10	<11	<28	<12	<24	<16	<20	<58	<9	<10	<100	<26
(W)		<10	<12	<30	<12	<26	<19	<23	<99	<9	<10	<152	<38
(S)		<11	<12	<29	<12	<23	<16	<23	<92	<9	<9	<130	<42
(E)		<10	<12	<28	<12	<23	<17	<21	<51	<9	<11	<100	<28
(N)		<12	<11	<27	<12	<24	<16	<21	<53	<9	<11	<104	<36
(S)	18-Sep-97	<11	<12	<31	<13	<31	<17	<23	<88	<9	<11	<128	<39
(W)		<11	<13	<25	<13	<21	<15	<22	<58	<9	<12	<99	<23
(C)		<9	<10	<21	<12	<21	<12	<18	<28	<9	<10	<67	<22
(N)		<10	<10	<27	<13	<28	<13	<18	<31	<8	<10	<67	<20
(E)		<11	<13	<32	<12	<24	<18	<23	<105	<9	<11	<156	<48
EVAP POND 2 (NW)	21-Mar-97	<16	<15	<37	114 +/- 20	<35	<16	<26	<38	<14	31 +/- 19	<92	<24
(C)		<11	<10	<24	24 +/- 11	<25	<13	<18	<26	<10	20 +/- 9	<62	<19
(E)		<11	<11	<22	22 +/- 9	<22	<12	<21	<31	<11	16 +/- 10	<79	<18
(NE)		<12	<15	<36	<16	<33	<15	<23	<37	<12	<16	<92	<22
(W)		<12	<11	<29	<19	<26	<13	<21	<31	<11	28 +/- 11	<76	<16
(C)	12-Jun-97	<11	<13	<31	19 +/- 9	<24	<17	<23	<100	<10	27 +/- 11	<139	<31
(E)		<12	<15	<31	86 +/- 16	<29	<16	<25	<113	<10	29 +/- 11	<143	<43
(S)		<12	<12	<32	40 +/- 14	<29	<18	<21	<98	<11	<15	<152	<37
(W)	18-Sep-97	<13	<15	<38	83 +/- 17	<28	<19	<22	<212	<11	31 +/- 12	<257	<58
(N)		<12	<15	<40	65 +/- 12	<26	<17	<26	<148	<12	<14	<187	<57
(C)		<11	<15	<33	64 +/- 13	<31	<23	<30	<165	<10	<16	<216	<45
(E)		<11	<14	<47	59 +/- 14	<30	<21	<29	<211	<11	19 +/- 11	<235	<67
(S)		<14	<14	<37	47 +/- 18	<30	<25	<30	<279	9 +/- 7	<15	<309	<91

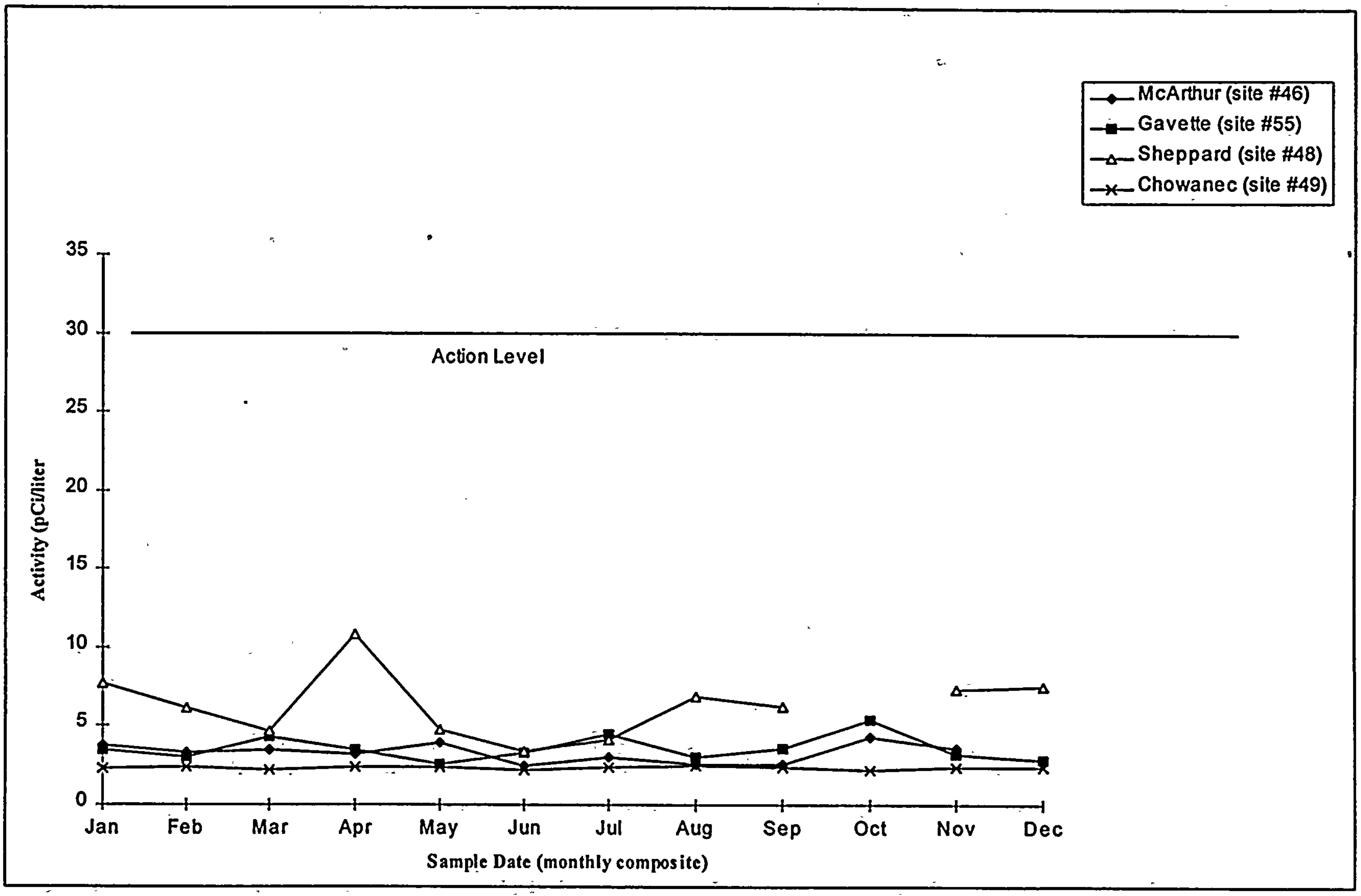
FIGURE 8.1 HISTORICAL GROSS BETA IN AIR 1987-1997 (WEEKLY SYSTEM AVERAGES)





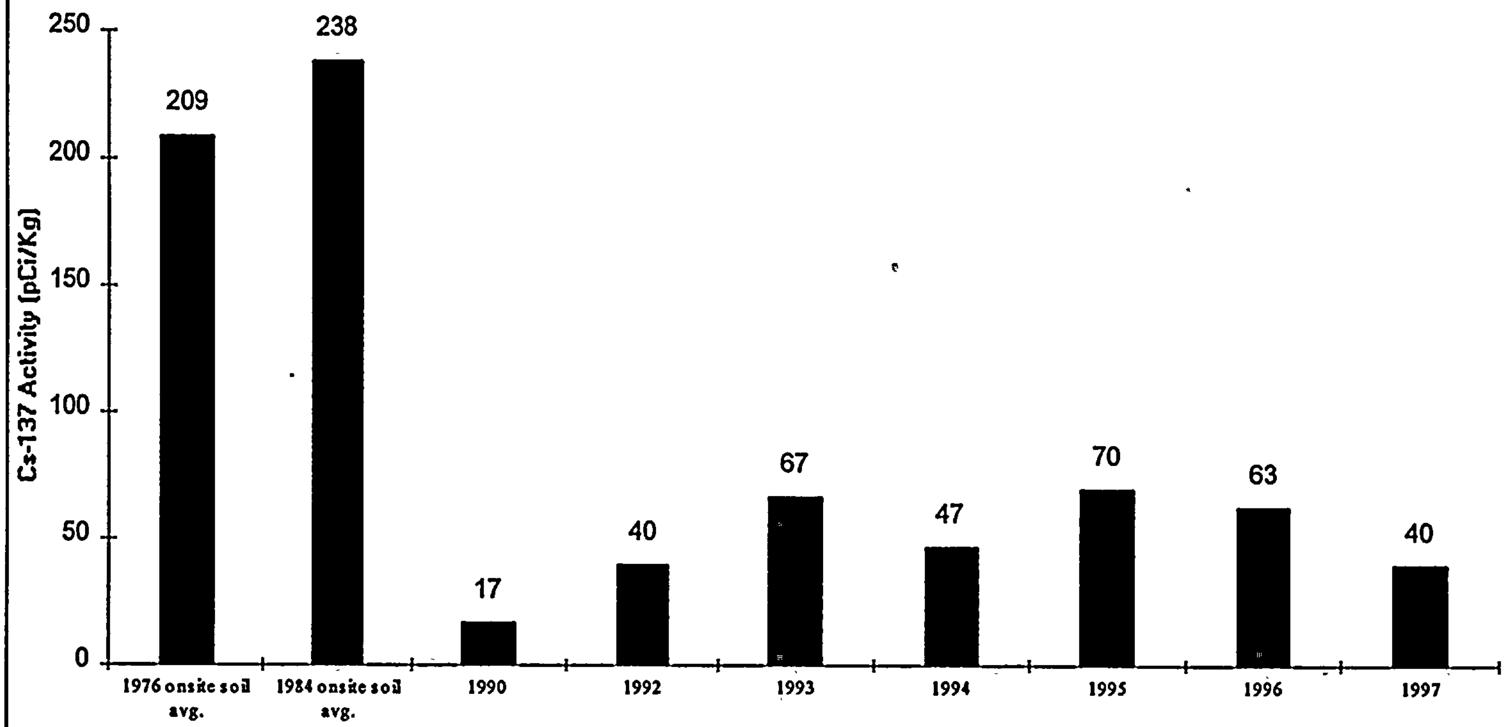
The 1994-1997 data trend higher. This is evidently the result of changing to the onsite central chemistry laboratory as our analyzing laboratory in 1994, which has shown a consistently high bias. The indicator locations trended well with the control location. Additionally, the central laboratory showed satisfactory results for interlaboratory comparison samples. No action is warranted since gross beta in air is trended and compared to action levels on an ongoing basis.

FIGURE 8.3 GROSS BE[illegible] DRINKING WATER



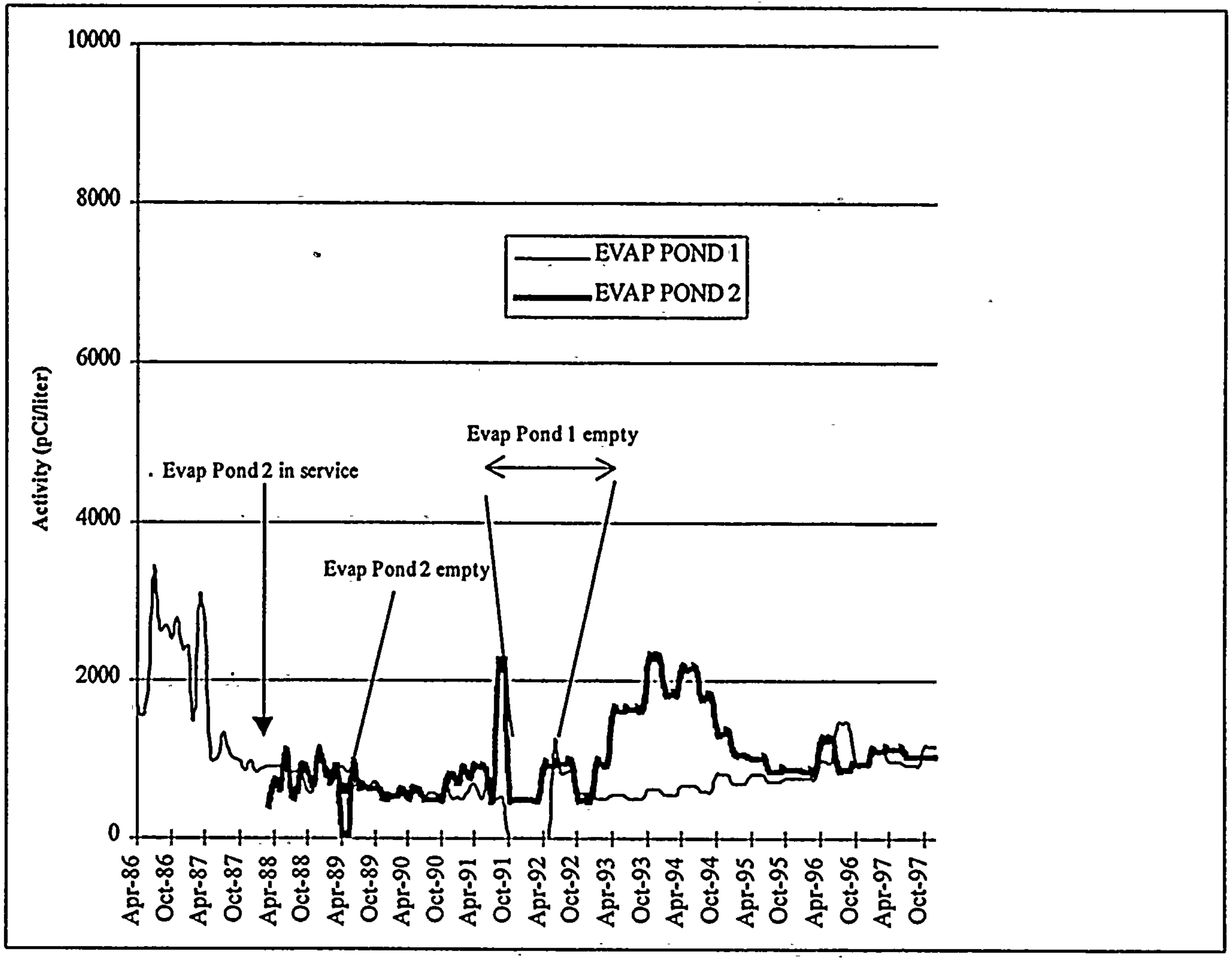
NOTES: MDA values plotted as activity (e.g. <2.3 is plotted as 2.3)
October Sheppard composite not available
Sheppard well routinely contains visible suspended solids

FIGURE 8.4 SOIL Cs-137 COMPAR[illegible]O ONSITE SEDIMENT BASIN #2



(Sedimentation Basin #2 accepts site storm runoff, no other gamma emitters present)

FIGURE 8.5 EVAPORATION POND TRITIUM ACTIVITY



9. Thermoluminescent Dosimetry (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. TLD locations are shown in Figures 2.1 and 2.2. TLD locations are described in Table 9.1. TLD results for 1997 are presented in Table 9.2. TLD results for 1985 through 1997 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 1997 as compared to the pre-operational TLD results (excluding indicator location #43 which 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	APS Western Division Office, Goodyear
2	ENE24	Scott-Libby School, Perryville and Thomas Roads
3	E21	Liberty School, 19800 W. Hwy. 85
4	E16	APS Buckeye Office, 615 N. 4th St., Buckeye
5	ESE11	Palo Verde School, Palo Verde Rd. (291st Ave.) and Old US 80
6	SSE31	APS Gila Bend substation, frontage road west of town
7	SE7	Old US 80 and Arlington School Rd.
8	SSE5	Southern Pacific Pipeline Rd., 1.4 miles SW of 355th Ave.
9	S5	Southern Pacific Pipeline Rd., 2.5 miles SW of 355th Ave.
10	SE5	SE corner of 355th Ave. and Elliot Rd.
11	ESE5	NW corner of 339th Ave. and Dobbins Rd.
12	E5	NE corner of 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	2 miles north of Elliot Rd., 3 miles west of Wintersburg Rd.
24	SW4	Elliot Rd., 2 miles west of Wintersburg Rd.
25	WSW5	Elliot Rd., 3 miles west of Wintersburg Rd. at cattleguard
26	SSW5	Sheppard farm, 13202 S. 383rd Ave., 0.5 miles west of house
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	Buckeye Rd., 0.5 miles west of 395th Ave.
34	NNW5	SE corner of 395th Ave. and Van Buren St.
35	NNW8	Fire Station, 40901 W. Osborn Rd., Tonopah
36	N5	SW corner of Wintersburg Rd. and Van Buren St.
37	NNE5	SE corner of 363rd Ave. and Van Buren St.
38	NE5	SW corner of 355th Ave. and Buckeye Rd.
39	ENE5	343rd Ave., 0.5 miles south of Lower Buckeye Rd.
40	N3	Wintersburg, Transmission Rd. south of trailer park

TABLE 9.1 TLD SITE LOCATIONS

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

TLD SITE	LOCATION	LOCATION DESCRIPTION
41	WNW20	Harquahala Valley School, Van Buren St., 1 mile west of Steve Martori Dr.
42	N8	Ruth Fisher School, Indian School Rd. and Wintersburg Rd.
43	DELETED	DELETED
44*	ENE35	APS El Mirage Office, 12313 W. Grand Ave.
45**	Onsite	Central Laboratory (lead pig)
46	ENE30	Litchfield Park School, 13825 W. Indian School Rd.
47	E35	Littleton School, 115th Ave. and Hwy. 85, Cashion
48	E24	Jackrabbit Trail south of I-10, north of Filmore St.
49	ENE11	Palo Verde Rd., 0.25 miles south of I-10
50	WNW5	3.5 miles west of Wintersburg Rd., 2 miles south 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 1997 ENVIRONMENTAL TLD RESULTS

units are mR/std qtr

TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Annual Average
1	19.4	20.1	22.2	24.2	21.5
2	21	21.2	19.7	21.4	20.8
3	22.5	21.8	21.4	22.7	22.1
4	21.4	21.8	21.2	22.5	21.7
5	21.2	21.8	20.5	22.0	21.4
6 (control)	25.3	24.6	24.4	25.7	25.0
7	24.8	23.8	22.9	25.1	24.1
8	22.5	21.6	21.8	24.4	22.6
9	28.5	28.1	27.0	29.4	28.3
10	22.7	22.0	21.6	23.5	22.5
11	23.5	23.3	23.1	24.6	23.6
12	21.6	22.2	21.4	22.7	22.0
13	23.8	24.2	22.7	24.2	23.7
14	23.8	23.5	22.9	24.4	23.6
15	22.7	22.9	21.6	23.1	22.6
16	21.2	20.7	19.4	22.2	20.9
17	24.2	23.3	22.0	24.0	23.4
18	22.2	22.0	21.8	22.5	22.1
19	24.0	23.8	23.1	24.6	23.9
20	22.5	22.9	21.6	23.3	22.6
21	24.4	24.2	23.3	25.3	24.3
22	24.6	25.1	24.0	25.5	24.8
23	21.6	22.2	21.2	22.5	21.9
24	21.2	20.7	19.9	21.0	20.7
25	22	22.2	21.6	22.7	22.1
26	26.4	25.5	24.0	24.6	25.1
27	26.1	25.9	25.3	26.1	25.8
28	25.3	24.0	24.0	24.6	24.5
29	24.0	23.8	22.7	24.2	23.7
30	25.3	25.3	23.1	25.5	24.8
31	21.8	21.8	21.2	22.7	21.9
32	23.8	24.2	21.8	24.6	23.6
33	missing	24.4	24.4	24.8	24.5
34	27.0	26.6	25.7	27.2	26.6
35	29.6	29.2	28.5	29.4	29.2
36	24.6	24.4	22.7	23.8	23.9
37	22.9	22.5	21.0	23.8	22.5
38	26.8	26.8	25.1	26.8	26.4
39	22.9	22.2	22.5	22.9	22.6
40	23.1	23.5	22.2	24.4	23.3
41	27.6	25.1	24.4	25.9	25.8
42	23.3	23.5	22.7	24.0	23.4
43	DELETED				
44 (control)	19	19.9	17.9	19.4	19.1
45 (transit control)	3.9	4.5	3.9	4.5	4.2
46	25.1	24.8	24.2	26.4	25.1
47	21.2	21.2	21.2	23.1	21.7
48	20.1	21.4	20.3	22.5	21.1
49	19.9	20.5	19.0	22.0	20.4
50	18.1	17.7	16.8	18.8	17.9

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES

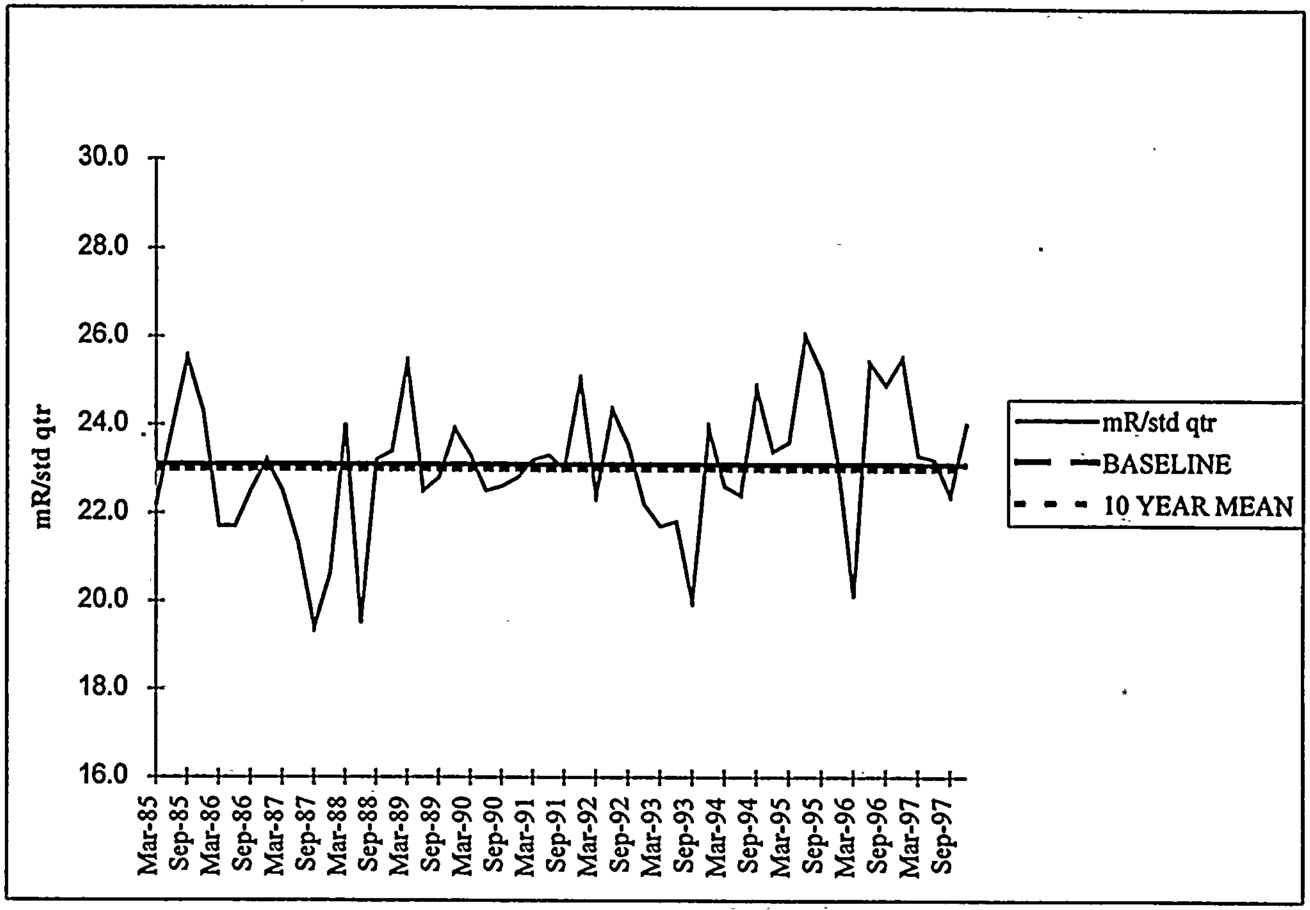
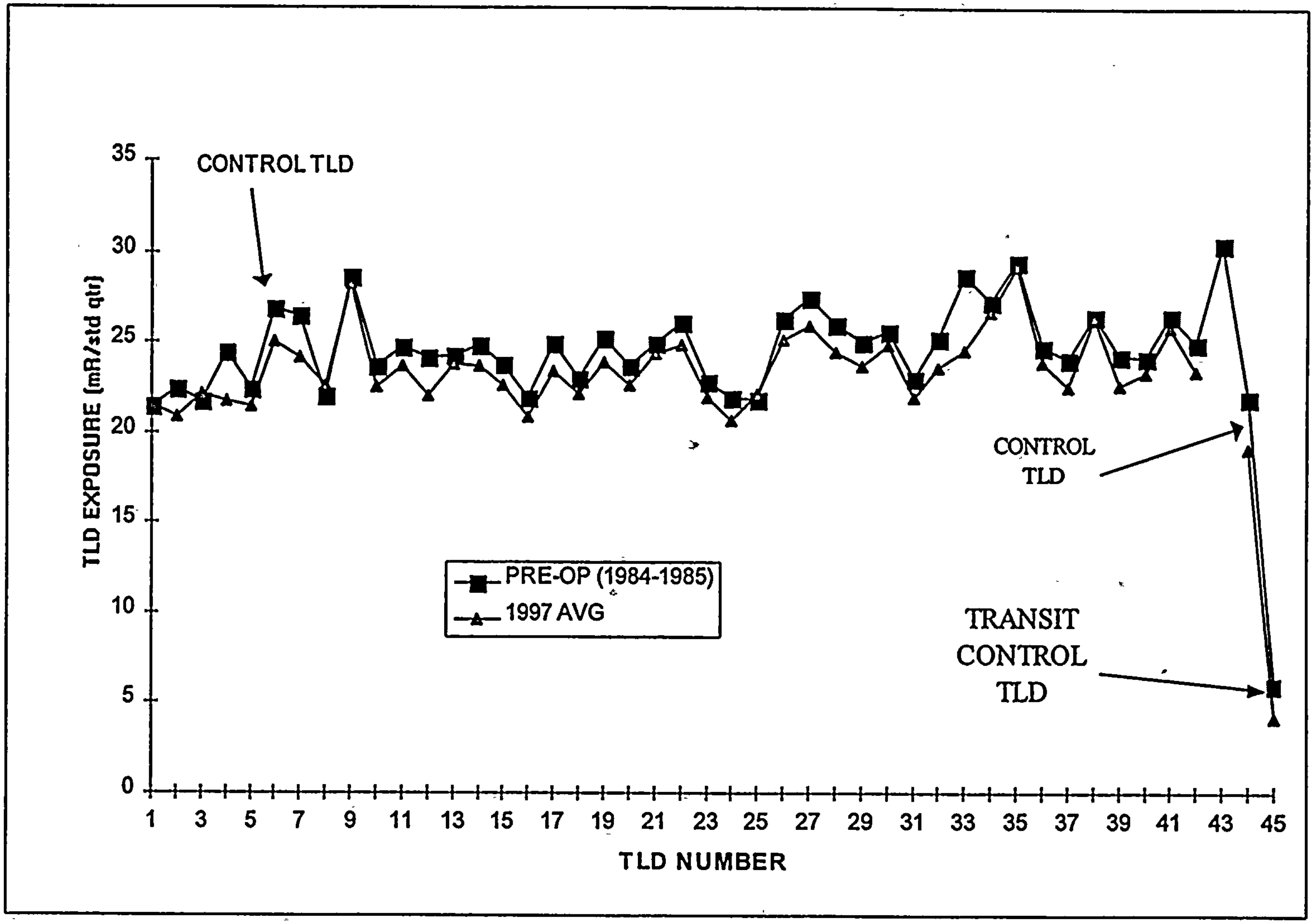


FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 1997



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, 1997.

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 six (6) changes in nearest resident status. Locations changed in the S, SW, WSW, W, WNW, and NW sectors. Most of the changes were due to new residents in sectors which were previously unoccupied.

Milking Animal

There were no milking animals located in the five mile radius in the census.

Vegetable Gardens

There was one (1) change in nearest garden status. A new garden was located in the NNE sector which is closer than the previous garden in this sector.

Conclusion

See Table 10.1 for a summary of the specific results.

TABLE 10.1 1997 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 1996
N	1.79	NONE	NONE	3.93E-02	NONE
NNE	1.66	2.10	NONE	7.73E-02 (resident) 2.12E-01 (garden)	garden
NE	2.16	NONE	NONE	9.48E-02	NONE
ENE	2.77	2.87	NONE	6.55E-02 (resident) 2.98E-01 (garden)	NONE
E	2.86	NONE	NONE	6.29E-02	NONE
ESE	3.44	NONE	NONE	6.87E-02	NONE
SE	4.18	NONE	NONE	7.94E-02	NONE
SSE	4.21	NONE	NONE	1.54E-01	NONE
S	4.67	NONE	NONE	2.20E-01	resident
SSW	4.17	NONE	NONE	1.33E-01	NONE
SW	1.39	NONE	NONE	1.15E-01	resident
WSW	1.44	NONE	NONE	7.76E-02	resident
W	2.74	NONE	NONE	1.25E-02	resident
WNW	2.40	NONE	NONE	1.12E-02	resident
NW	3.27	NONE	NONE	7.26E-03	resident
NNW	2.63	NONE	NONE	1.33E-02	NONE

COMMENTS:

Dose calculations were performed using the GASPAR code and 1996 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 1997 calendar year. The radioassay results and conclusions are based on observations of fission product and/or activation radionuclides and do not include observations of naturally occurring radionuclides, with the exception of gross beta in air and drinking water.

A summary of all sample results for 1997 is presented in Table 11.1. With the exception of onsite surface water and associated sludge, all sample assays presented in the report reveal no detectable man-made radioactivity which can be attributed to PVNGS. 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.

Natural background radiation is consistent with measurements reported in previous pre-operational and Operational Radiological Environmental annual reports, Reference 2.

TA[illegible]1.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 1997

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
Direct Radiation (mR/std. qtr.)	TLD - 195	NA	23.3 (183/183) 16.8 - 29.6	Site #35 8 miles 330°	29.2 (4/4) 28.5 - 29.6	22.1 (8/8) 17.9 - 25.7	0
Air Particulates (pCi/m^3)	Gross Beta - 518	0.010	0.035 (466/466) 0.016 - 0.074	Site #6A 13 miles 160°	0.036 (52/52) 0.023 - 0.075	0.036 (52/52) 0.023 - 0.075	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	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 35						
	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/l)	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

TAB[illegible]1.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

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Groundwater (pCi/l) -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/l)	Gross Beta - 47	4.0	4.4 (33/48) 2.2 - 10.8	Site #48 5 miles 190°	6.3 (11/11) 3.4 - 10.8	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

TA[illegible]1.1

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 1997

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/l)	I-131	15	12 (3/36) 11-13	Site #60 Onsite 67°	12 (3/12) 11-13	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	12 (2/36) 11-13	Site #63 Onsite 180°	12 (2/12) 11-13	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Tritium - 12	3000	977 (9/12) 311 - 1157	Site #63 Onsite 180°	1082 (4/4) 1037 - 1129	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.