Technical Specification 5.6.2

Palo Verde
Nuclear Generating Station
PO Box 52034
Phoenix, Arizona 85072-2034
Mail Station 7636

102-06875-TNW/DHK/TMJ
May 2, 2014

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report 2013

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2013.

No new commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact David Kelsey, Licensing Section Leader, at (623) 393-5730.

Sincerely,

Thomas N. Weber
Department Leader, Regulatory Affairs

TNW/DHK/TMJ/hsc

Enclosure

cc:	M. L. Dapas	NRC Region IV Regional Administrator
	J. K. Rankin	NRC NRR Project Manager (electronic & hard copy)
	A. E. George	NRC NRR Project Manager (electronic & hard copy)
	M. A. Brown	NRC Senior Resident Inspector for PVNGS
	A. V. Godwin	Arizona Radiation Regulatory Agency (ARRA)
	T. Morales	Arizona Radiation Regulatory Agency (ARRA)

IE25
NRR

ENCLOSURE

UNITS 1, 2, and 3

Annual Radiological Environmental Operating Report 2013

PALO VERDE

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2013

(Reference: RCTSAI 1643, Legacy Item No. 036843.01)

Prepared by: Lucke-McDowell, Joshua (Z08270)
Digitally signed by Lucke-McDowell, Joshua (Z08270)
DN: cn=Lucke-McDowell, Joshua (Z08270)
Reason: I am the author of this document
Date: 2014.04.17 11:03:26 -07'00'

Reviewed by: Gray, Thomas S(Z99610)
Digitally signed by Gray, Thomas S(Z99610)
DN: cn=Gray, Thomas S(Z99610)
Reason: I have reviewed this document
Date: 2014.04.17 11:42:19 -07'00'

Approved by: Moeller, Carl (Z09119)
Digitally signed by Moeller, Carl (Z09119)
DN: cn=Moeller, Carl (Z09119)
Date: 2014.04.18 08:09:15 -07'00'

Manager, Radiation Protection

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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 plant related radionuclide concentrations.

During 2013, the following categories of samples were collected by APS:

- Broad leaf vegetation
- Ground water
- 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 Reservoirs, Evaporation Ponds, and two (2) deep wells. Offsite samples analyzed by ARRA include 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.

(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.

This report contains the measurements and findings for 2013. All references are specifically identified in Section 12.

The Radiological Environmental Monitoring Program provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of members of the public resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the US Nuclear Regulatory Commission (USNRC) in their Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 (incorporated into NUREG 1301). 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).

The Land Use Census ensures that changes in the use of areas at and beyond the site boundary are identified and that modifications to the REMP are made if required by the results of this census. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50.

The Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

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 between 1979 and 1985. APS and vendors continued the program into the operational phase.

2.1. Radiological Environmental Monitoring Program

The assessment program consists of routine measurements of environmental gamma radiation and of radionuclide concentrations in media such as air, groundwater, drinking water, surface water, vegetation, 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 2.1, 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. Routine sample analyses were performed at the onsite Central Chemistry Laboratory and Operating Unit laboratories. Analyses for hard-to-detect radionuclides were performed by GEL Laboratories LLC.

Environmental gamma radiation measurements were performed by APS using TLDs at fifty (50) locations near PVNGS. The PVNGS Dosimetry Department is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) to perform ionizing radiation dosimeter analyses.

In addition to monitoring environmental media, a land use census is performed annually to identify the nearest milk animals, residents, and gardens. 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 2013

There were no changes to the Radiological Environmental Monitoring Program that impacted the Off-site Dose Calculation Manual (ODCM) Revision 26.

2.3. REMP Deviations/Abnormal Events Summary

During calendar year 2013, there were seven (7) deviations/abnormal events with regard to the monitoring program. Refer to Table 2.3 for more detail and any corrective actions taken.

The first six (1-6) deviations were exceedances of the quarterly I-131 reporting level of 20 pCi/L. This occurred at the following locations: 45 acre reservoir first and second calendar quarters, 85 acre reservoir second quarter, Evaporation Pond 1B first and third quarters, Evaporation Pond 2B second quarter. The source is radiopharmaceutical I-131 that originates in the Phoenix sewage effluent that supplies makeup to the Reservoirs and Circulating Water system. This water is wasted to the Evaporation Ponds. This is not a plant effluent.

The seventh (7) deviation was a mass air flowmeter found to be out of tolerance. This mass air flowmeter was used to calibrate air sample stations. The flowmeter failed in the conservative direction and there was no adverse impact to sample data.

The eighth (8) and final deviation for 2013 was an air sample pump failure at site #4. This resulted in not being able to collect a sample for that location. This is a supplemental site, not required per the ODCM.

In July of 2013, the REMP air samplers were moved to a lower height. This is recorded with Letter 218-03709-JLM. These sample stations were lowered for industrial safety concerns.

2.4. Ground Water Protection

PVNGS has implemented a groundwater protection initiative developed by the Nuclear Energy Institute (NEI). The implementation of this initiative, NEI 07-07 (Industry Ground Water Protection Initiative – Final Guidance Document, August 2007), provides added assurance that groundwater will not be adversely affected by PVNGS operations.

Several monitoring wells have been installed to monitor the subsurface water and shallow aquifer at Units 1, 2, and 3. These wells are sampled monthly and quarterly for chemical and radiological parameters. The State of Arizona Aquifer Protection Permit (Area-Wide) No. P-100388 (APP) provides agreed upon monitoring parameters and reporting thresholds. Sample results for the shallow aquifer wells are reported in the PVNGS Annual Radioactive Effluent Release Report (ARERR). The State of Arizona APP provides specific regulatory criteria for ground water protection.

Three subsurface samples were obtained, one each from Units 2 and 3 tritium monitoring wells, and one from the shallow aquifer outside of the Unit 1 radiological controlled area (RCA). These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) as a verification that there are no underground leaks from plant systems that may affect groundwater. All results were <MDA. Refer to Table 8.12 for sample results.

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	ESE3	Arlington School
14A	air	NNE2	371st Ave. and Buckeye-Salome Rd.
15	air	NE2	NE Site Boundary
17A	air	E3	351st Ave.
21	air	S3	S Site Boundary
29	air	W1	W Site Boundary
35	air	NNW8	Tonopah
40	air	N2	Transmission Rd
46	drinking water	NNW8	local resident
47	vegetation	N3	local resident
48	drinking water	SW1	local resident
49	drinking water	N2	local resident
51	milk	NNE3	local resident- goats
53*	milk	NE30	local resident- goats
54	milk (supplemental)	NNE4	local resident-goats
55	drinking water (supplemental)	SW3	local resident
57	ground water	ONSITE	Well 27ddc
58	ground water	ONSITE	Well 34abb
59	surface water	ONSITE	Evaporation Pond 1
60	surface water	ONSITE	85 acre Reservoir
61	surface water	ONSITE	45 acre Reservoir
62*	vegetation	ENE26	Commercial farm
63	surface water	ONSITE	Evaporation Pond 2
64	surface water	ONSITE	Evaporation Pond 3

NOTES:

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

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					
53		M/AA					
54		M/AA					
55						W	
57					Q		
58					Q		
59							Q
60							Q
61							Q
62				M/AA			
63							Q
64							Q

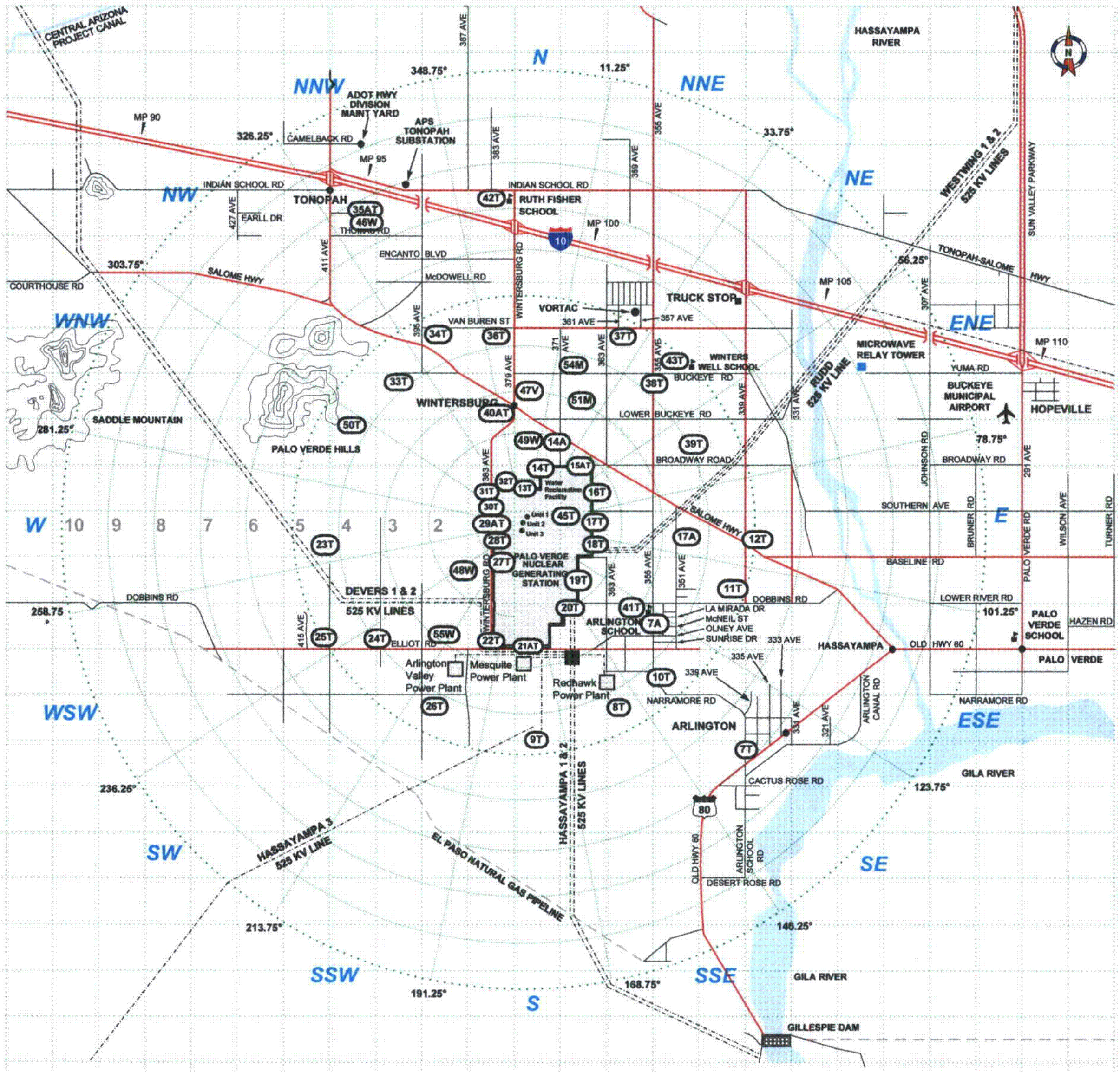
W = WEEKLY M/AA = MONTHLY AS AVAILABLE Q = QUARTERLY

TABLE 2.3 SUMMARIES OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. The 45 acre Reservoir exceeded the first quarter I-131 reporting level of 20 pCi/liter. 2. The 45 acre Reservoir exceeded the second quarter I-131 reporting level of 20 pCi/liter. 3. The 85 acre Reservoir exceeded the second quarter I-131 reporting level of 20 pCi/liter. 4. Evaporation Pond 1B exceeded the first quarter I-131 reporting level of 20 pCi/liter. 5. Evaporation Pond 1B exceeded the third quarter I-131 reporting level of 20 pCi/liter. 6. Evaporation Pond 2B exceeded the second quarter I-131 reporting level of 20 pCi/liter	1-6. Initial sample results exceeding 20 pCi/liter are validated when seen in surface water. The verification analysis results also showed levels ≥ 20 pCi/liter. The elevated I-131 concentration is due to radiopharmaceutical I-131 that is present in the reclaimed sewage water that supplies Circulating Water and is not the result of plant effluents. The source is radiopharmaceutical I-131 that originates in the Phoenix sewage effluent that supplies makeup to the Reservoirs and Circulating Water system. This water is wasted to the Evaporation Ponds via Circulating Water blowdown. Because the I-131 is not the result of plant effluents, no Special Report is required. This information is provided in this report as required by the ODCM. Refer to Corrective Action Program documents CRDR 4405324, CRDR 4343153, and 4442148 for the evaluation of exceeding the ODCM Reporting Level. No additional actions are necessary.
7. Mass air flowmeter EG7057 was found to be out of tolerance during normal calibrations.	7. The air flowmeter used for calibration of air sampling stations was found to be out of tolerance, having failed in the conservative direction. CRDR 4442150 provides evaluations for impact to REMP data. No impacts were identified. No additional actions are necessary.
8. Air sample site #4 sample pump failed between 12/10/2013 and 12/17/2013.	8. The air sample pump failed during the sample period, resulting in the inability to determine the actual sample volume. The pump was replaced and the sample for the next week was valid. No further actions required. The last pump failure occurred in 2009.

FIGURE 2.1 REMP SAMPLE SITES - MAP (0-10 miles)

FIGURE 2.1

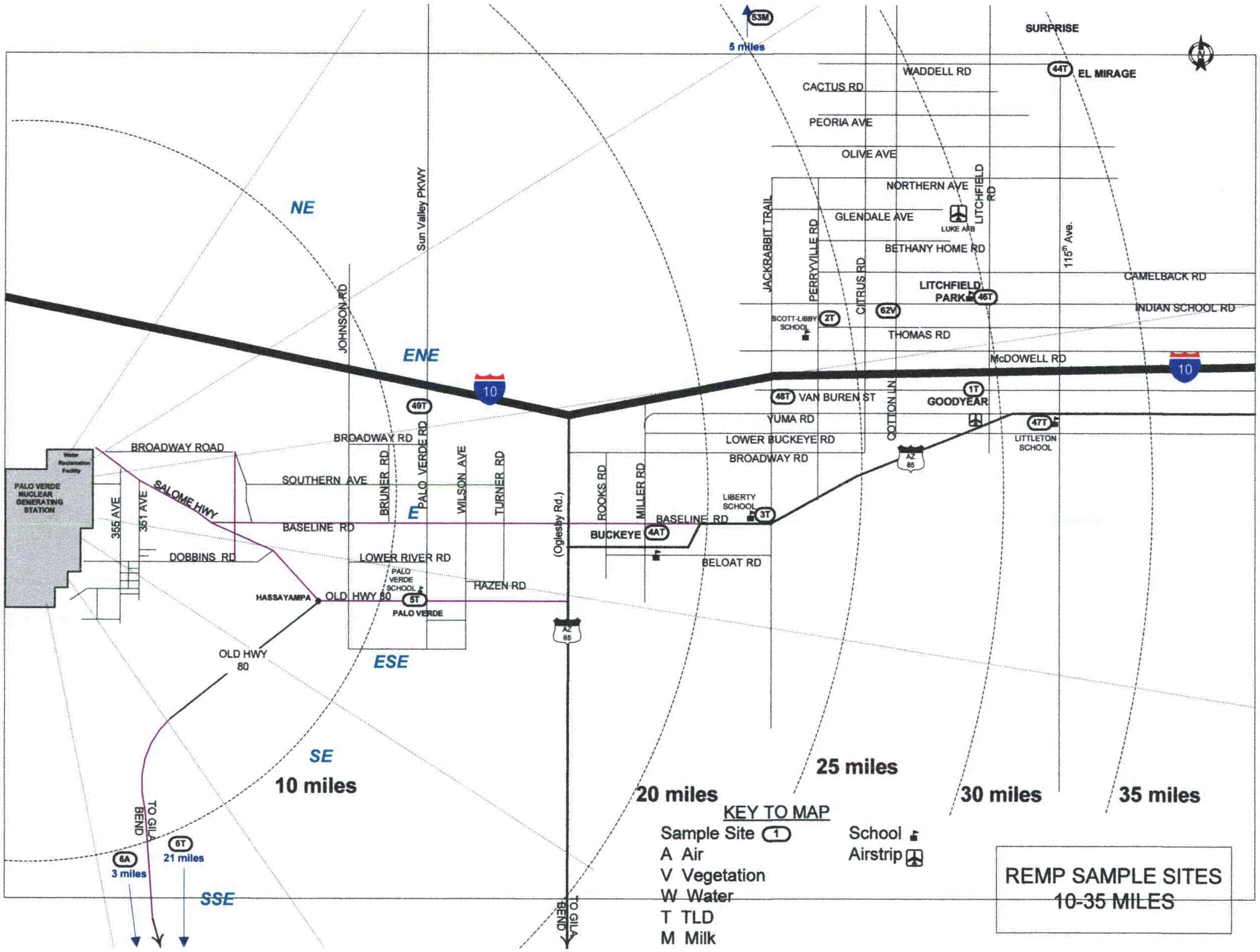


KEY TO MAP

Sample Site ①   School
A Air   Airstrip
V Vegetation
W Water
T TLD
M Milk

REMP SAMPLE SITES
0-10 MILES

FIGURE 2.2 REMP SAMPLE SITES - MAP (10-35 miles)



3. Sample Collection Program

APS personnel using PVNGS procedures collected all samples.

3.1. Water

Weekly samples were collected from four (4) residence wells for monthly and quarterly composites. Samples were collected in one-gallon containers and 500 mL glass bottles. The samples were analyzed for gross beta, gamma emitting radionuclides and tritium.

Quarterly grab samples were collected from the 45 and 85 acre Reservoirs, Evaporation Ponds 1A/B/C, 2A/B, and 3A/B, and onsite wells 34abb and 27ddc. Samples were collected in one-gallon containers and 500 mL glass bottles. Samples were analyzed for gamma emitting radionuclides 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 emitting radionuclides. A monthly composite was analyzed for tritium.

3.2. Vegetation

Vegetation samples were collected monthly, as available, and were analyzed for gamma emitting radionuclides.

3.3. Milk

Goat milk samples were collected monthly, as available, and were analyzed for gamma emitting radionuclides, including 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 emitting radionuclides.

3.5. Sludge and Sediment

Sludge samples were obtained weekly from the WRF waste centrifuge (whenever the plant was operational) and analyzed for gamma emitting radionuclides. Cooling tower sludge was analyzed for gamma emitting radionuclides prior to disposal in the WRF sludge landfill.

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 counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

4.2. Airborne Radioiodine

The charcoal cartridge is counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for I-131.

4.3. Milk

4.3.1. Gamma Spectroscopy

The sample is placed in a plastic marinelli beaker and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

4.3.2. Radiochemical I-131 Separation

Iodine in milk sample is reduced with sodium bisulfite and iodine is absorbed by the anion exchange resin. The iodine is eluted with NaOCl. Iodine is extracted from the sample with carbon tetrachloride. The iodine is back extracted from the organic with water containing sodium bisulfate and then precipitated as CuI. The precipitate is mounted in a planchet and counted for gross beta.

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 an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

4.5. Sludge/Sediment

4.5.1. Gamma Spectroscopy

The wet sample is placed in a one-liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

4.6. Water

4.6.1. Gamma Spectroscopy

The sample is placed in a one-liter plastic marinelli beaker and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

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 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 an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides.

5. Nuclear Instrumentation

5.1. Gamma Spectrometer

The Canberra Gamma Spectrometer consists of a Canberra System equipped with HPGe 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 to search, identify, and quantify the peaks of interest.

5.2. Liquid Scintillation Spectrometer

A Beckman LS-6500 Liquid Scintillation Counter is used for tritium determinations. The system background averages approximately 12-16 cpm with a counting efficiency of approximately 40% using a quenched standard.

5.3. Gas Flow Proportional Counter

The Tennelec S5E is a low background gas flow proportional counter for gross beta analysis. 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 approximately 30% for 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.

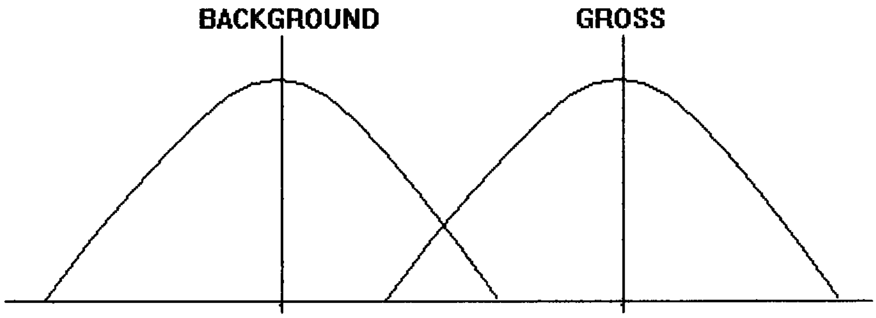
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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 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 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 are 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.

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, an absolute measurement of the disintegration rate is seldom possible, 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 surrounding materials, 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 nuclides. The disintegration constant is one of the basic characteristics of a specific radionuclide and is readily determined, if the half-life is sufficiently short. To ensure the required LLDs are achieved, appropriate decay correction values are used to account for radioactive decay during 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		
H-3	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	

* 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

NOTES:
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/m³)	MILK (pCi/liter)	VEGETATION (pCi/kg, wet)
H-3	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	

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

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

Table 6.3 TYPICAL MDA VALUES

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	MILK (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m3)	VEGETATION (pCi/kg, wet)
Gross Beta	1.8		0.003	
H-3	322			
Mn-54	11			
Fe-59	22			
Co-58	10			
Co-60	12			
Zn-65	24			
Zr-95	18			
Nb-95	11			
I-131	9[a]	1	0.05[b]	49
Cs-134	10	1	0.003[b]	52
Cs-137	11	1	0.003[b]	44
Ba-140	34	4		
La-140	12	1		

NOTES:

a - low level I-131 is not required since there is no drinking water pathway
b - Based on 433 m^3, the normal weekly sample volume

7. Interlaboratory Comparison Program

7.1. Quality Control Program

APS maintains an extensive QA/QC Program to provide assurance 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 to verify analytical precision and sample methodology. Comprehensive data reviews are performed including trending of data where appropriate.

During 2013, 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
- Gamma in Milk

7.2. Intercomparison Results

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

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample ID	Analysis Type	Nuclide	Known Value**	PVNGS Value	1 sigma Error	Resolution*	Ratio	NRC Range	Acceptable?
E10455	Gross Beta Filter	G. Beta	8.54E+01	1.00E+02	2.40E+00	42	1.17	0.75 - 1.33	YES
E10456	I-131 Cartridge	I-131	9.28E+01	9.75E+01	3.10E+00	31	1.05	0.75 - 1.33	YES
E10457	Gamma Filter	Ce-141	9.97E+01	1.03E+02	4.60E+00	22	1.03	0.75 - 1.33	YES
		Cr-51	2.51E+02	2.74E+02	1.69E+01	16	1.09	0.75 - 1.33	YES
		Cs-134	1.14E+02	1.02E+02	7.80E+00	13	0.89	0.60 - 1.66	YES
		Cs-137	1.41E+02	1.52E+02	7.80E+00	19	1.08	0.75 - 1.33	YES
		Co-58	1.11E+02	1.16E+02	6.40E+00	18	1.05	0.75 - 1.33	YES
		Mn-54	1.11E+02	1.30E+02	7.10E+00	18	1.17	0.75 - 1.33	YES
		Fe-59	1.34E+02	1.60E+02	9.20E+00	17	1.19	0.75 - 1.33	YES
		Zn-65	1.60E+02	1.97E+02	1.07E+01	18	1.23	0.75 - 1.33	YES
		Co-60	2.13E+02	2.27E+02	1.02E+01	22	1.07	0.75 - 1.33	YES
E10507	Gamma Milk	I-131	1.41E+01	1.47E+01	1.02E+00	14	1.04	0.60 - 1.66	YES
		Ce-141	2.05E+01	2.27E+01	2.17E+00	10	1.11	0.60 - 1.66	YES
		Cr-51	5.17E+01	5.64E+01	5.35E+00	11	1.09	0.60 - 1.66	YES
		Cs-134	2.34E+01	2.29E+01	1.25E+00	18	0.98	0.75 - 1.33	YES
		Cs-137	2.91E+01	3.03E+01	1.46E+00	21	1.04	0.75 - 1.33	YES
		Co-58	2.28E+01	2.12E+01	1.34E+00	16	0.93	0.75 - 1.33	YES
		Mn-54	2.28E+01	2.23E+01	2.06E+00	11	0.98	0.60 - 1.66	YES
		Fe-59	2.76E+01	2.91E+01	1.97E+00	15	1.05	0.60 - 1.66	YES
		Zn-65	3.29E+01	3.37E+01	3.11E+00	11	1.02	0.60 - 1.66	YES
		Co-60	4.38E+01	4.20E+01	2.42E+00	17	0.96	0.75 - 1.33	YES
E10680	Gross Beta Water	G. Beta	2.67E+02	2.22E+02	5.50E+00	40	0.83	0.75 - 1.33	YES
E10681	Tritium	H-3	9.96E+03	9.62E+03	6.32E+02	15	0.97	0.60 - 1.66	YES
E10682	Gamma Water	I-131	9.79E+01	9.67E+01	4.58E+00	21	0.99	0.75 - 1.33	YES
		Cr-51	2.51E+02	2.82E+02	2.26E+01	12	1.12	0.60 - 1.66	YES
		Cs-134	1.56E+02	1.38E+02	6.00E+00	23	0.88	0.75 - 1.33	YES
		Cs-137	1.18E+02	1.22E+02	5.30E+00	23	1.03	0.75 - 1.33	YES
		Co-58	9.73E+01	1.04E+02	5.00E+00	21	1.07	0.75 - 1.33	YES
		Mn-54	1.25E+02	1.32E+02	5.70E+00	23	1.06	0.75 - 1.33	YES
		Fe-59	1.18E+02	1.28E+02	7.60E+00	17	1.08	0.75 - 1.33	YES
		Zn-65	2.41E+02	2.59E+02	1.16E+01	22	1.07	0.75 - 1.33	YES
		Co-60	1.77E+02	1.86E+02	6.90E+00	27	1.05	0.75 - 1.33	YES
E10683	I-131 Cartridge	I-131	8.03E+01	8.47E+01	2.50E+00	34	1.05	0.75 - 1.33	YES
E10684	Gamma Filter	Cr-51	1.68E+02	1.76E+02	1.36E+01	13	1.05	0.60 - 1.66	YES
		Cs-134	1.05E+02	8.72E+01	4.70E+00	19	0.83	0.75 - 1.33	YES
		Cs-137	7.94E+01	8.55E+01	4.71E+00	18	1.08	0.75 - 1.33	YES

		Co-58	6.53E+01	7.02E+01	4.24E+00	17	1.08	0.75	-	1.33	YES
		Mn-54	8.42E+01	9.32E+01	5.20E+00	18	1.11	0.75	-	1.33	YES
		Fe-59	7.91E+01	1.00E+02	6.70E+00	15	1.26	0.60	-	1.66	YES
		Zn-65	1.62E+02	1.97E+02	1.03E+01	19	1.22	0.75	-	1.33	YES
		Co-60	1.19E+02	1.25E+02	6.10E+00	20	1.05	0.75	-	1.33	YES

* calculated from PVNGS value/1 sigma
error value
** Eckert & Ziegler Analytics, Inc. NIST-traceable known
value

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample Type	Analysis Type	ERA PT Study	Nuclide	PVNGS Value	Assigned Value [1]	Acceptance Limit [2]	Results
Water	Gross Beta	RAD-93	g beta	23.4	21.6	13.0 - 29.7	Acceptable
Water	Tritium	RAD-93	H-3	3,790	4,050	3450 - 4460	Acceptable
Water	Gamma	RAD-93	Ba-133 Cs-134 Cs-137 Co-60 Zn-65	84.2 40.4 43.4 68.6 196	82.1 42.8 41.7 65.9 189	69.0 - 90.3 34.2 - 47.1 37.0 - 48.8 59.3 - 75.0 170 - 222	Acceptable Acceptable Acceptable Acceptable Acceptable
Filter	Gross Beta	MRAD-19	g beta	65.8	56.3	35.6 - 82.2	Acceptable

[1] The ERA assigned values are established per the guidelines contained in the National Environmental Laboratory Accreditation Conference (NELAC) program criteria as applicable.

[2] "Acceptance Limits" have been calculated per ERA's Standard Operating Procedure for the Generation of Performance Acceptance Limits.

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, back scattering, and self-absorption. Random errors are beyond the control of the analyst.

Efforts are made to minimize both systematic and random errors in the data reported. Systematic errors are minimized 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 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 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 2013 are presented in the following sections.

8.1. Air Particulates

Weekly gross beta results, in quarterly format, are presented in Tables 8.1 and 8.2. Gross beta activity at indicator locations ranged from 0.013 to 0.077 pCi/m^3. The associated counting error ranged from 0.001 to 0.006 pCi/m^3. Mean quarterly activity is normally calculated using weekly activity over a thirteen (13) week period. Also presented in the tables are the weekly mean values of all the sites as well as the percent relative standard deviation (RSD %) for the data.

Tables 8.3 displays the results of gamma spectroscopy on the quarterly composites of the weekly samples.

8.2. Airborne Radioiodine

Tables 8.4 and 8.5 present the quarterly radioiodine results. Radioiodine was not observed in any samples.

8.3. Vegetation

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

8.4. Milk

Table 8.7 presents gamma isotopic data for the goat milk samples. No gamma emitting radionuclides were observed in any of the samples.

8.5. Drinking Water

Samples were analyzed for gross beta, tritium, and gamma emitting radionuclides. Results of these analyses are presented in Table 8.8. No tritium or gamma emitting radionuclides were detected in any samples. Gross beta activity ranged from less than detectable to a high of 10.0 pCi/liter. The gross beta activity is attributable to natural (background) radioactive materials.

8.6. Ground Water

Ground water samples were analyzed from two onsite wells (regional aquifer) for tritium and gamma emitting radionuclides. Results obtained from the analysis of the samples are presented in Table 8.9.

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

8.7. Surface Water

Surface water samples from the Reservoirs and Evaporation Ponds were analyzed for tritium and gamma emitting radionuclides. The two Reservoirs contain processed sewage water from the City of Phoenix and are approximately 45 and 85 acres in size. The three Evaporation Ponds receive mostly circulating water from main turbine condenser cooling and are about 200-250 acres each.

Sample results are presented in Table 8.10. I-131 was observed in both reservoirs and Evaporation Ponds 1B and 2B. The I-131 levels ranged from 20 pCi/L – 43 pCi/L. I-131 in these surface water locations is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent and is not attributable to plant effluents.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration was 1290 pCi/liter. Tritium was not detected in the Reservoirs. The tritium identified in the Evaporation Ponds has been attributed to permitted plant gaseous effluent releases and secondary plant liquid discharges (e.g. condensate overboard discharge, secondary side steam generator drains, secondary plant sumps, demineralizer regeneration waste). The tritium concentrations were compared to historical values and are considered typical for the Evaporation Ponds.

WRF Influent (Phoenix sewage effluent containing radiopharmaceutical I-131) samples collected by the WRF were analyzed for gamma emitting radionuclides and tritium. The results, presented in Table 8.10, demonstrate that I-131 was observed routinely. The I-131 concentration ranged from less than detectable to 62 pCi/liter. 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 water from site runoff and was dry for most of the year. Low concentrations of tritium were identified in four (4) of ten (10) samples ranging from 341 to 595 pCi/liter. The tritium was attributed to rain washout of plant gaseous effluent releases. No gamma emitting radionuclides were observed in the 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. I-131 activity in the sludge is consistent with historical values and, as previously discussed, is due to radiopharmaceuticals in the WRF Influent. The concentration of I-131 ranged from 123 to 931 pCi/kg.

In-111 was also identified in the sludge in one sample at 48 pCi/kg. It was previously established that In-111 is also used in the Phoenix area as a radiopharmaceutical.

Results for WRF centrifuge waste sludge can be found in Table 8.11.

8.8.2. Cooling Tower sludge

Sludge/sediment originating from the Unit 1 and Unit 2 Cooling Towers and Circulating Water canals was disposed of in the WRF sludge landfill during 2013. Sample results can be found in Table 8.11.

8.9. Data Trends

Figures 8.1-8.8 present data in graphical format. Historical data are displayed for comparison where practical.

8.10. Hard-to-Detect Radionuclide Results

Table 8.12 shows the results of the three subsurface samples obtained from 3 tritium monitoring points. These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) and all results were <MDA. These results indicate that no leaks from plant systems have affected groundwater.

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	1-Jan-13	8-Jan-13	0.068	0.077	0.074	0.077	0.074	0.075	0.071	0.076	0.073	0.072	0.074	6.3
2	8-Jan-13	15-Jan-13	0.041	0.046	0.038	0.041	0.039	0.037	0.040	0.041	0.036	0.039	0.040	7.0
3	15-Jan-13	22-Jan-13	0.050	0.050	0.045	0.049	0.052	0.046	0.051	0.054	0.047	0.053	0.050	5.4
4	22-Jan-13	29-Jan-13	0.038	0.047	0.044	0.038	0.041	0.043	0.040	0.045	0.042	0.043	0.042	9.2
5	29-Jan-13	5-Feb-13	0.038	0.042	0.038	0.037	0.033	0.035	0.035	0.036	0.034	0.033	0.036	7.7
6	5-Feb-13	12-Feb-13	0.041	0.043	0.043	0.044	0.035	0.039	0.038	0.039	0.038	0.043	0.040	7.4
7	12-Feb-13	19-Feb-13	0.045	0.051	0.048	0.045	0.044	0.046	0.042	0.041	0.043	0.041	0.045	7.2
8	19-Feb-13	25-Feb-13	0.025	0.021	0.030	0.023	0.022	0.023	0.021	0.022	0.022	0.027	0.024	12.2
9	25-Feb-13	5-Mar-13	0.029	0.032	0.038	0.029	0.028	0.027	0.028	0.030	0.030	0.032	0.030	11.0
10	5-Mar-13	12-Mar-13	0.032	0.039	0.046	0.034	0.031	0.031	0.034	0.045	0.034	0.038	0.037	15.0
11	12-Mar-13	19-Mar-13	0.047	0.054	0.061	0.050	0.045	0.044	0.045	0.059	0.048	0.050	0.050	12.1
12	19-Mar-13	25-Mar-13	0.042	0.041	0.048	0.040	0.038	0.037	0.041	0.045	0.040	0.035	0.041	9.1
13	25-Mar-13	2-Apr-13	0.031	0.030	0.033	0.026	0.028	0.031	0.026	0.032	0.029	0.028	0.029	8.3
Mean			0.040	0.044	0.045	0.041	0.039	0.039	0.039	0.043	0.040	0.041	0.041	5.3

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	2-Apr-13	9-Apr-13	0.025	0.023	0.024	0.025	0.023	0.023	0.022	0.023	0.024	0.019	0.023	7.3
15	9-Apr-13	15-Apr-13	0.027	0.026	0.028	0.027	0.025	0.025	0.025	0.025	0.024	0.024	0.026	5.9
16	15-Apr-13	23-Apr-13	0.029	0.030	0.031	0.031	0.023	0.030	0.023	0.027	0.029	0.024	0.028	11.4
17	23-Apr-13	30-Apr-13	0.043	0.040	0.036	0.035	0.036	0.045	0.035	0.034	0.040	0.035	0.038	9.6
18	30-Apr-13	7-May-13	0.041	0.036	0.038	0.043	0.042	0.039	0.031	0.036	0.039	0.041	0.038	8.9
19	7-May-13	13-May-13	0.028	0.031	0.030	0.031	0.030	0.034	0.029	0.031	0.029	0.031	0.030	5.4
20	13-May-13	21-May-13	0.038	0.037	0.036	0.036	0.038	0.040	0.038	0.036	0.039	0.035	0.037	4.2
21	21-May-13	28-May-13	0.041	0.043	0.040	0.044	0.041	0.041	0.042	0.039	0.041	0.041	0.041	3.4
22	28-May-13	4-Jun-13	0.029	0.031	0.028	0.027	0.029	0.032	0.026	0.028	0.029	0.023	0.028	8.5
23	4-Jun-13	11-Jun-13	0.035	0.038	0.037	0.039	0.038	0.035	0.035	0.032	0.038	0.036	0.036	5.9
24	11-Jun-13	18-Jun-13	0.043	0.047	0.046	0.045	0.045	0.044	0.040	0.042	0.046	0.045	0.044	4.7
25	18-Jun-13	25-Jun-13	0.034	0.033	0.035	0.034	0.035	0.032	0.036	0.029	0.032	0.032	0.033	6.1
26	25-Jun-13	2-Jul-13	0.029	0.030	0.028	0.030	0.027	0.030	0.029	0.029	0.028	0.029	0.029	3.6
Mean			0.034	0.034	0.034	0.034	0.033	0.034	0.032	0.032	0.034	0.032	0.033	3.4

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	2-Jul-13	9-Jul-13	0.037	0.040	0.040	0.041	0.038	0.041	0.040	0.037	0.039	0.039	0.039	3.8
28	9-Jul-13	16-Jul-13	0.030	0.029	0.030	0.032	0.031	0.030	0.028	0.027	0.031	0.028	0.030	5.5
29	16-Jul-13	23-Jul-13	0.023	0.025	0.022	0.025	0.021	0.020	0.020	0.021	0.023	0.022	0.022	8.1
30	23-Jul-13	30-Jul-13	0.026	0.033	0.032	0.032	0.032	0.030	0.032	0.031	0.035	0.031	0.031	7.2
31	30-Jul-13	6-Aug-13	0.034	0.033	0.031	0.032	0.034	0.032	0.032	0.033	0.032	0.031	0.032	3.2
32	6-Aug-13	13-Aug-13	0.027	0.028	0.032	0.030	0.027	0.033	0.028	0.032	0.030	0.029	0.030	6.9
33	13-Aug-13	20-Aug-13	0.033	0.033	0.036	0.036	0.036	0.032	0.031	0.034	0.036	0.033	0.034	5.5
34	20-Aug-13	27-Aug-13	0.024	0.023	0.024	0.028	0.030	0.023	0.027	0.028	0.023	0.027	0.026	10.2
35	27-Aug-13	3-Sep-13	0.017	0.016	0.017	0.015	0.013	0.014	0.014	0.015	0.015	0.014	0.015	9.2
36	3-Sep-13	10-Sep-13	0.027	0.030	0.028	0.030	0.027	0.029	0.030	0.031	0.033	0.030	0.029	5.9
37	10-Sep-13	17-Sep-13	0.029	0.033	0.036	0.031	0.029	0.033	0.030	0.031	0.033	0.032	0.032	6.8
38	17-Sep-13	23-Sep-13	0.030	0.029	0.032	0.030	0.032	0.031	0.028	0.031	0.030	0.028	0.030	4.6
39	23-Sep-13	1-Oct-13	0.027	0.031	0.030	0.029	0.030	0.031	0.027	0.028	0.027	0.029	0.029	5.8
Mean			0.028	0.030	0.030	0.030	0.029	0.029	0.028	0.029	0.030	0.029	0.029	2.4

4th Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
40	1-Oct-13	8-Oct-13	0.026	0.029	0.029	0.022	0.028	0.026	0.026	0.018	0.027	0.025	0.026	13.8
41	8-Oct-13	15-Oct-13	0.029	0.029	0.028	0.027	0.030	0.024	0.023	0.028	0.032	0.027	0.028	9.1
42	15-Oct-13	22-Oct-13	0.050	0.046	0.049	0.043	0.048	0.047	0.049	0.046	0.049	0.047	0.047	4.3
43	22-Oct-13	29-Oct-13	0.044	0.054	0.052	0.053	0.054	0.051	0.049	0.050	0.051	0.053	0.051	5.9
44	29-Oct-13	5-Nov-13	0.031	0.033	0.033	0.032	0.028	0.037	0.030	0.037	0.035	0.029	0.032	9.5
45	5-Nov-13	12-Nov-13	0.037	0.044	0.043	0.040	0.037	0.039	0.037	0.043	0.041	0.039	0.040	6.9
46	12-Nov-13	19-Nov-13	0.035	0.042	0.032	0.038	0.038	0.039	0.033	0.029	0.035	0.038	0.036	10.6
47	19-Nov-13	26-Nov-13	0.018	0.021	0.023	0.021	0.019	0.024	0.021	0.022	0.020	0.022	0.021	7.8
48	26-Nov-13	3-Dec-13	0.047	0.048	0.056	0.044	0.045	0.048	0.048	0.036	0.047	0.052	0.047	11.2
49	3-Dec-13	10-Dec-13	0.029	0.027	0.031	0.027	0.028	0.028	0.028	0.027	0.029	0.029	0.028	4.7
50	10-Dec-13	17-Dec-13	a	0.040	0.041	0.039	0.034	0.037	0.042	0.043	0.035	0.035	0.038	8.6
51	17-Dec-13	23-Dec-13	0.036	0.036	0.039	0.035	0.035	0.033	0.037	0.037	0.034	0.036	0.036	4.9
52	23-Dec-13	30-Dec-13	0.030	0.034	0.032	0.030	0.029	0.030	0.031	0.028	0.027	0.026	0.030	8.0
Mean			0.034	0.037	0.037	0.035	0.035	0.035	0.035	0.034	0.035	0.035	0.035	3.2
Annual Average			***0.0341***	***0.0363***	***0.0367***	***0.0351***	***0.0341***	***0.0346***	***0.0335***	***0.0345***	***0.0349***	***0.0341***	***0.035***	***2.9***

a Sample invalidated due to failure of air sample pump some time during the sample period. Unable to determine actual sample volume.

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-13	Cs-134	<0.0023	<0.0044	<0.0036	<0.0022	<0.0009	<0.0028	<0.0035	<0.0023	<0.0035	<0.0023
	Cs-137	<0.0017	<0.0050	<0.0038	<0.0025	<0.0039	<0.0030	<0.0033	<0.0030	<0.0051	<0.0023
25-Jun-13	Cs-134	<0.0022	<0.0029	<0.0034	<0.0021	<0.0032	<0.0022	<0.0039	<0.0019	<0.0029	<0.0023
	Cs-137	<0.0024	<0.0028	<0.0028	<0.0028	<0.0021	<0.0027	<0.0048	<0.0023	<0.0058	<0.0020
23-Sep-13	Cs-134	<0.0024	<0.0034	<0.0046	<0.0021	<0.0037	<0.0025	<0.0033	<0.0008	<0.0029	<0.0026
	Cs-137	<0.0022	<0.0010	<0.0028	<0.0022	<0.0028	<0.0028	<0.0041	<0.0026	<0.0048	<0.0019
30-Dec-13	Cs-134	<0.0023	<0.0037	<0.0028	<0.0012	<0.0029	<0.0020	<0.0034	<0.0020	<0.0033	<0.0018
	Cs-137	<0.0029	<0.0042	<0.0029	<0.0005	<0.0026	<0.0026	<0.0051	<0.0019	<0.0047	<0.0017

TABLE 8.4 RADIOIODINE IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	required LLD <0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
1	1-Jan-13	8-Jan-13	<0.028	<0.068	<0.062	<0.023	<0.017	<0.041	<0.046	<0.037	<0.046	<0.016
2	8-Jan-13	15-Jan-13	<0.19	<0.036	<0.046	<0.021	<0.053	<0.029	<0.053	<0.033	<0.037	<0.025
3	15-Jan-13	22-Jan-13	<0.028	<0.065	<0.070	<0.036	<0.067	<0.028	<0.068	<0.027	<0.052	<0.023
4	22-Jan-13	29-Jan-13	<0.067	<0.023	<0.067	<0.060	<0.060	<0.056	<0.065	<0.055	<0.065	<0.067
5	29-Jan-13	5-Feb-13	<0.030	<0.044	<0.043	<0.020	<0.051	<0.033	<0.066	<0.028	<0.063	<0.018
6	5-Feb-13	12-Feb-13	<0.028	<0.051	<0.062	<0.030	<0.060	<0.021	<0.058	<0.034	<0.054	<0.021
7	12-Feb-13	19-Feb-13	<0.040	<0.067	<0.056	<0.025	<0.043	<0.025	<0.058	<0.031	<0.043	<0.025
8	19-Feb-13	25-Feb-13	<0.039	<0.054	<0.067	<0.038	<0.055	<0.035	<0.069	<0.037	<0.020	<0.033
9	25-Feb-13	5-Mar-13	<0.017	<0.021	<0.017	<0.028	<0.030	<0.033	<0.035	<0.023	<0.025	<0.020
10	5-Mar-13	12-Mar-13	<0.027	<0.063	<0.040	<0.025	<0.046	<0.063	<0.032	<0.021	<0.060	<0.032
11	12-Mar-13	19-Mar-13	<0.033	<0.061	<0.044	<0.033	<0.015	<0.036	<0.067	<0.038	<0.069	<0.034
12	19-Mar-13	25-Mar-13	<0.046	<0.065	<0.060	<0.032	<0.049	<0.039	<0.066	<0.031	<0.061	<0.037
13	26-Mar-13	2-Apr-13	<0.034	<0.042	<0.043	<0.021	<0.063	<0.026	<0.044	<0.028	<0.052	<0.023

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	2-Apr-13	9-Apr-13	<0.027	<0.069	<0.060	<0.026	<0.050	<0.028	<0.045	<0.020	<0.037	<0.036
15	9-Apr-13	15-Apr-13	<0.040	<0.059	<0.058	<0.043	<0.053	<0.035	<0.060	<0.033	<0.066	<0.029
16	15-Apr-13	23-Apr-13	<0.054	<0.047	<0.033	<0.058	<0.035	<0.054	<0.039	<0.058	<0.035	<0.059
17	23-Apr-13	30-Apr-13	<0.026	<0.055	<0.055	<0.025	<0.045	<0.043	<0.064	<0.036	<0.048	<0.042
18	30-Apr-13	7-May-13	<0.037	<0.051	<0.034	<0.023	<0.050	<0.024	<0.064	<0.023	<0.060	<0.031
19	7-May-13	13-May-13	<0.039	<0.065	<0.058	<0.033	<0.053	<0.027	<0.040	<0.020	<0.052	<0.020
20	13-May-13	21-May-13	<0.021	<0.033	<0.059	<0.016	<0.049	<0.030	<0.027	<0.033	<0.025	<0.033
21	21-May-13	28-May-13	<0.030	<0.066	<0.050	<0.028	<0.051	<0.028	<0.051	<0.043	<0.045	<0.066
22	28-May-13	4-Jun-13	<0.028	<0.035	<0.050	<0.019	<0.066	<0.028	<0.044	<0.030	<0.052	<0.027
23	4-Jun-13	11-Jun-13	<0.028	<0.054	<0.034	<0.031	<0.063	<0.035	<0.013	<0.034	<0.036	<0.057
24	11-Jun-13	18-Jun-13	<0.033	<0.064	<0.055	<0.019	<0.035	<0.030	<0.053	<0.034	<0.066	<0.019
25	18-Jun-13	25-Jun-13	<0.024	<0.059	<0.049	<0.028	<0.055	<0.031	<0.063	<0.012	<0.060	<0.017
26	25-Jun-13	2-Jul-13	<0.060	<0.024	<0.067	<0.070	<0.061	<0.058	<0.055	<0.055	<0.067	<0.062

TABLE 8.5 RADIOIODINE IN AIR 3rd – 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
27	2-Jul-13	9-Jul-13	<0.027	<0.052	<0.048	<0.011	<0.037	<0.023	<0.038	<0.020	<0.044	<0.026
28	9-Jul-13	16-Jul-13	<0.023	<0.066	<0.054	<0.031	<0.063	<0.035	<0.035	<0.053	<0.036	<0.020
29	16-Jul-13	23-Jul-13	<0.017	<0.043	<0.044	<0.030	<0.057	<0.027	<0.068	<0.027	<0.064	<0.030
30	23-Jul-13	30-Jul-13	<0.033	<0.022	<0.030	<0.027	<0.066	<0.042	<0.048	<0.031	<0.061	<0.035
31	30-Jul-13	6-Aug-13	<0.033	<0.033	<0.062	<0.018	<0.028	<0.020	<0.033	<0.019	<0.041	<0.022
32	6-Aug-13	13-Aug-13	<0.038	<0.043	<0.052	<0.028	<0.065	<0.025	<0.057	<0.027	<0.051	<0.026
33	13-Aug-13	20-Aug-13	<0.025	<0.043	<0.058	<0.029	<0.054	<0.024	<0.061	<0.026	<0.065	<0.030
34	20-Aug-13	27-Aug-13	<0.024	<0.063	<0.033	<0.028	<0.047	<0.025	<0.028	<0.026	<0.041	<0.024
35	27-Aug-13	3-Sep-13	<0.022	<0.032	<0.040	<0.035	<0.040	<0.047	<0.036	<0.046	<0.040	<0.066
36	3-Sep-13	10-Sep-13	<0.034	<0.026	<0.028	<0.025	<0.031	<0.019	<0.041	<0.022	<0.054	<0.027
37	10-Sep-13	17-Sep-13	<0.023	<0.048	<0.040	<0.030	<0.066	<0.026	<0.058	<0.038	<0.058	<0.033
38	17-Sep-13	23-Sep-13	<0.070	<0.067	<0.052	<0.026	<0.064	<0.025	<0.056	<0.027	<0.060	<0.034
39	23-Sep-13	1-Oct-13	<0.028	<0.054	<0.041	<0.033	<0.060	<0.028	<0.064	<0.033	<0.064	<0.017

4th Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
40	1-Oct-13	8-Oct-13	<0.027	<0.018	<0.042	<0.032	<0.051	<0.026	<0.049	<0.033	<0.060	<0.027
41	8-Oct-13	15-Oct-13	<0.062	<0.035	<0.040	<0.030	<0.056	<0.030	<0.064	<0.022	<0.033	<0.035
42	15-Oct-13	22-Oct-13	<0.044	<0.055	<0.030	<0.060	<0.027	<0.053	<0.030	<0.060	<0.024	<0.057
43	22-Oct-13	29-Oct-13	<0.030	<0.053	<0.031	<0.050	<0.032	<0.038	<0.037	<0.012	<0.070	<0.067
44	29-Oct-13	5-Nov-13	<0.018	<0.058	<0.066	<0.029	<0.052	<0.027	<0.056	<0.007	<0.062	<0.030
45	5-Nov-13	12-Nov-13	<0.020	<0.035	<0.046	<0.029	<0.059	<0.032	<0.037	<0.028	0.065	<0.038
46	12-Nov-13	19-Nov-13	<0.018	<0.048	0.035	<0.049	<0.064	<0.027	<0.059	<0.032	<0.040	<0.029
47	19-Nov-13	26-Nov-13	<0.021	<0.012	<0.066	<0.023	<0.066	<0.070	<0.064	<0.025	<0.058	<0.030
48	26-Nov-13	3-Dec-13	<0.019	<0.056	<0.056	<0.031	<0.057	<0.039	<0.051	<0.033	<0.059	0.032
49	3-Dec-13	10-Dec-13	<0.035	<0.050	<0.064	<0.030	<0.070	<0.025	<0.045	0.020	0.055	<0.028
50	10-Dec-13	17-Dec-13	a	<0.059	<0.026	<0.065	<0.029	<0.035	<0.042	<0.041	<0.035	<0.026
51	17-Dec-13	23-Dec-13	<0.036	<0.067	<0.06376	<0.024	<0.068	<0.037	<0.068	<0.033	<0.051	<0.0692
52	23-Dec-13	30-Dec-13	<0.058	0.062	<0.051	<0.063	<0.056	0.035	<0.045	<0.067	<0.041	<0.051

a Sample invalidated due to failure of air sample pump some time during the sample period. Unable to determine actual sample volume.

TABLE 8.6 VEGETATION

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

LOCATION	TYPE	DATE COLLECTED	I-131	Cs-134	Cs-137
			<60	<60	<80
LOCAL RESIDENCE (Site #47)*	NONE AVAILABLE				
COMMERCIAL FARM (Site #62)*	Red Cabbage	10-Jan-13	<48	<57	<45
	Red Cabbage	14-Feb-13	<59	<54	<67
	Green Cabbage	15-Mar-13	<42	<42	<42
	Green Cabbage	18-Apr-13	<45	<59	<41
	Savoy Cabbage	18-Apr-13	<59	<59	<56
	Red Cabbage	18-Apr-13	<48	<47	<74
	Green Cabbage	7-Nov-13	<45	<43	<57
	Green Cabbage	12-Dec-13	<55	<60	<64
	Red Cabbage	12-Dec-13	<50	<58	<74
	Savoy Cabbage	12-Dec-13	<26	<46	<37

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
	10-Jan-13	*No milk available due to breeding				
Local Resident Goats (Site #51)*	21-Feb-13	<1	<0.85	<0.99	<3.37	<0.99
	21-Mar-13	<1	<0.83	<0.95	<3.27	<0.99
	18-Apr-13	<1	<0.84	<0.93	<3.35	<0.94
	16-May-13	<1	<0.80	<0.96	<3.41	<0.97
	28-Jun-13	<1	<0.82	<0.95	<3.30	<0.96
	26-Jul-13	<1	<0.82	<0.93	<3.32	<1.01
	30-Aug-13	<1	<0.81	<0.94	<3.30	<0.97
		*No milk available due to breeding				
		*No milk available due to small quantity				
		*No milk available due to small quantity				
		*No milk available due to small quantity				
	10-Jan-13	*No milk available due to small quantity				
	21-Feb-13	*No milk available due to small quantity				
	21-Mar-13	*No milk available due to small quantity				
Local Resident Goats (Site #53)*	26-Apr-13	<1	<0.81	<0.95	<3.31	<0.94
	23-May-13	<1	<0.86	<1.03	<3.37	<0.95
	20-Jun-13	<1	<0.83	<0.97	<3.33	<0.96
	18-Jul-13	<1	<0.83	<0.96	<3.30	<0.96
	15-Aug-13	<1	<0.82	<0.94	<3.22	<0.99
	19-Sep-13	<1	<0.82	<0.96	<3.34	<0.95
	17-Oct-13	<1	<0.84	<0.97	<3.37	<0.99
	14-Nov-13	<1	<0.83	<0.96	<3.38	<0.96
	12-Dec-13	<1	<0.79	<0.92	<3.36	<0.97
	10-Jan-13	<1	<0.82	<0.97	<3.33	<0.93
Local Resident Goats (Site #54)	07-Feb-13	<1	<0.84	<0.96	<3.45	<0.99
	07-Mar-13	<1	<0.85	<0.97	<3.42	<0.97
	11-Apr-13	<1	<0.82	<0.95	<3.32	<0.98
	16-May-13	<1	<0.80	<0.95	<3.34	<0.97
	13-Jun-13	<1	<0.82	<0.95	<3.34	<0.94
	11-Jul-13	<1	<0.86	<0.99	<3.45	<0.97
	08-Aug-13	<1	<0.83	<0.97	<3.32	<0.92
	19-Sep-23	*No milk available due to small quantity				
	10-Oct-13	<1	<0.85	<0.97	<3.41	<0.96
	07-Nov-13	<1	<0.85	<0.98	<3.41	<0.98
	12-Dec-13	<1	<0.85	<0.97	<3.29	<0.96

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
LOCAL RESIDENCE (Site #48) *	29-Jan-13	<10	<10	<18	<12	<22	<11	<17	<10	<9	<9	<34	<15		4.3 ± 2.2
	25-Feb-13	<15	<12	<26	<15	<26	<14	<19	<11	<12	<9	<38	<14		<3.4
	25-Mar-13	<11	<11	<22	<12	<24	<12	<18	<10	<10	<12	<38	<15	<308	4.1 ± 2.2
	30-Apr-13	<9	<9	<21	<10	<21	<10	<18	<9	<9	<11	<33	<15		4.9 ± 2.0
	28-May-13	<11	<11	<22	<15	<21	<10	<21	<11	<10	<11	<39	<15		<3.3
	25-Jun-13	<13	<12	<24	<14	<28	<14	<24	<12	<9	<12	<41	<15	<294	5.7 ± 2.1
	30-Jul-13	<12	<13	<24	<13	<23	<13	<22	<11	<10	<14	<37	<13		3.7 ± 2.1
	27-Aug-13	<13	<12	<27	<15	<29	<14	<23	<14	<13	<14	<50	<14		4.1 ± 2.1
	23-Sep-13	<12	<10	<24	<13	<27	<11	<17	<9	<10	<12	<40	<15	<336	3.8 ± 2.0
	29-Oct-13	<11	<10	<22	<13	<22	<11	<18	<11	<10	<11	<34	<15		4.4 ± 2.5
	26-Nov-13	<11	<12	<21	<15	<25	<13	<17	<10	<10	<12	<34	<13		<3.3
	30-Dec-13	<12	<12	<26	<13	<16	<12	<21	<9	<10	<9	<46	<15	<338	<3.7
LOCAL RESIDENCE (Site #55)	29-Jan-13	<8	<12	<21	<12	<24	<10	<21	<12	<10	<12	<40	<15		6.4 ± 1.7
	25-Feb-13	<10	<8	<21	<15	<20	<11	<21	<9	<10	<10	<38	<12		10 ± 1.8
	25-Mar-13	<12	<12	<18	<13	<23	<11	<18	<12	<10	<12	<35	<15	<309	5.8 ± 1.6
	30-Apr-13	<13	<13	<22	<12	<30	<9	<21	<12	<11	<15	<45	<13		4.6 ± 1.5
	28-May-13	<10	<11	<21	<15	<25	<12	<20	<9	<11	<11	<35	<11		3.2 ± 1.6
	25-Jun-13	<11	<11	<21	<13	<28	<12	<23	<11	<11	<11	<39	<15	<295	3.7 ± 1.3
	30-Jul-13	<13	<15	<25	<14	<27	<13	<19	<11	<11	<13	<44	<14		3.7 ± 1.4
	27-Aug-13	<9	<9	<17	<10	<20	<10	<15	<8	<7	<11	<37	<14		3.7 ± 1.5
	23-Sep-13	<10	<11	<22	<12	<27	<10	<19	<10	<10	<11	<37	<15	<335	4.7 ± 1.5
	29-Oct-13	<14	<15	<26	<14	<26	<13	<20	<12	<13	<15	<47	<13		6.1 ± 1.7
	26-Nov-13	<11	<11	<23	<12	<27	<11	<17	<10	<11	<11	<33	<14		<2.3
	30-Dec-13	<11	<10	<19	<13	<24	<9	<17	<9	<9	<10	<39	<13	<340	4.9 ± 1.4

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
LOCAL RESIDENCE (Site #46) *	29-Jan-13	<11	<12	<26	<10	<30	<10	<17	<11	<11	<11	<38	<15		3.0 ± 1.4
	25-Feb-13	<12	<12	<23	<14	<28	<14	<25	<13	<11	<13	<48	<14		3.0 ± 1.4
	25-Mar-13	<15	<13	<22	<12	<30	<12	<18	<10	<11	<13	<40	<15	<309	3.6 ± 1.4
	30-Apr-13	<9	<9	<21	<11	<17	<11	<18	<10	<8	<11	<37	<15		3.1 ± 1.4
	28-May-13	<10	<13	<30	<14	<25	<11	<21	<11	<12	<10	<38	<15		<2.2
	25-Jun-13	<10	<10	<19	<12	<26	<10	<15	<9	<9	<11	<38	<14	<294	4.1 ± 1.3
	30-Jul-13	<12	<10	<24	<12	<24	<12	<20	<10	<11	<12	<43	<15		<1.9
	27-Aug-13	<9	<10	<21	<10	<26	<13	<19	<10	<10	<11	<36	<15		3.2 ± 1.4
	23-Sep-13	<9	<12	<22	<15	<24	<11	<17	<10	<9	<12	<42	<9	<338	<2.0
	29-Oct-13	<11	<11	<21	<12	<28	<12	<20	<11	<10	<14	<36	<15		3.3 ± 1.4
	26-Nov-13	<13	<10	<25	<15	<28	<12	<20	<11	<10	<14	<38	<12		2.7 ± 1.4
	30-Dec-13	<10	<11	<20	<15	<26	<12	<14	<9	<10	<11	<37	<11	<339	<2.4
LOCAL RESIDENCE (Site #49) *	29-Jan-13	<10	<12	<22	<11	<16	<13	<18	<12	<12	<10	<42	<15		<2.1
	25-Feb-13	<11	<11	<24	<12	<26	<10	<17	<10	<10	<10	<37	<15		<2.1
	25-Mar-13	<12	<10	<18	<13	<25	<13	<21	<10	<11	<9	<37	<15	<310	<2.1
	30-Apr-13	<12	<13	<27	<13	<28	<13	<23	<13	<12	<13	<53	<15		<2.0
	28-May-13	<9	<9	<18	<11	<22	<10	<17	<9	<9	<9	<28	<15		<2.2
	25-Jun-13	<9	<10	<22	<11	<22	<10	<14	<9	<7	<9	<28	<15	<294	<1.9
	30-Jul-13	<10	<11	<20	<13	<23	<12	<15	<11	<11	<10	<40	<15		<1.9
	27-Aug-13	<9	<10	<20	<15	<27	<11	<17	<12	<11	<13	<37	<12		<2.0
	23-Sep-13	<11	<12	<26	<13	<13	<15	<26	<10	<15	<14	<53	<13	<338	<2.0
	29-Oct-13	<12	<11	<26	<13	<26	<13	<20	<10	<10	<13	<32	<15		<2.0
	26-Nov-13	<11	<11	<18	<13	<26	<10	<16	<9	<11	<12	<36	<12		<2.2
	30-Dec-13	<10	<10	<21	<10	<23	<10	<19	<9	<8	<9	<32	<15	<341	<2.4

TABLE 8.9 GROUND WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Tritium
WELL 27ddc (Site #57)*	29-Jan-13	<9	<10	<21	<10	<27	<12	<15	<11	<9	<11	<40	<15	<305
	30-Apr-13	<12	<10	<21	<14	<28	<13	<20	<13	<11	<13	<45	<15	<306
	30-Jul-13	<9	<9	<18	<13	<22	<11	<17	<11	<10	<10	<38	<14	<334
	28-Oct-13	<10	<11	<20	<10	<22	<12	<17	<10	<10	<10	<37	<15	<335
WELL 34abb (Site #58)*	30-Jan-13	<13	<12	<25	<14	<28	<13	<23	<14	<11	<15	<51	<15	<305
	30-Apr-13	<10	<8	<22	<10	<20	<12	<18	<12	<10	<11	<30	<13	<305
	30-Jul-13	<10	<9	<19	<10	<23	<12	<18	<11	<10	<10	<37	<15	<330
	28-Oct-13	<12	<12	<24	<15	<28	<13	<20	<11	<11	<11	<40	<15	<337

TABLE 8.10 SURFACE WATER

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	<3000 Tritium
45 ACRE RESERVOIR (Site #61) *	29-Jan-13	<6	<6	<11	<6	<13	<5	<10	21 ± 6	<5	<6	<22	<9	<312
	30-Apr-13	<12	<11	<23	<10	<30	<14	<21	40 ± 12	<10	<11	<46	<14	<308
	30-Jul-13	<10	<9	<27	<9	<22	<10	<23	<15	<10	<12	<41	<15	<337
	29-Oct-13	*Empty for maintenance												
85 ACRE RESERVOIR (Site #60) *	29-Jan-13	<12	<11	<25	<15	<26	<12	<15	<11	<10	<13	<39	<15	<311
	30-Apr-13	<13	<11	<25	<13	<22	<10	<23	20 ± 10	<10	<12	<41	<15	<314
	30-Jul-13	<10	<11	<20	<11	<20	<13	<20	<12	<11	<11	<44	<8	<335
	29-Oct-13	<12	<12	<27	<15	<17	<14	<29	<15	<13	<14	<38	<14	<337
EVAP POND 1 (Site #59) * CELL 1A	29-Jan-13	Relining												
	30-Apr-13													
	30-Jul-13													
	28-Oct-13	<12	<11	<30	<11	<27	<11	<20	<11	<10	<11	<42	<12	963 ± 217
CELL 1B	29-Jan-13	<10	<8	<21	<12	<22	<11	<18	43 ± 12	<9	<9	<34	<14	421 ± 188
	30-Apr-13	<9	<11	<28	<12	<24	<11	<20	<12	<12	<13	<36	<15	1001 ± 296
	30-Jul-13	<13	<11	<26	<14	<30	<12	<20	43 ± 12	<13	<13	<47	<14	888 ± 210
	28-Oct-13	<14	<15	<24	<15	<27	<13	<23	<13	<14	<12	<42	<13	1290 ± 222
CELL 1C	29-Jan-13	Under Construction												
	30-Apr-13													
	30-Jul-13	<10	<12	<24	<14	<30	<13	<18	<10	<11	<12	<40	<9	904 ± 213
	28-Oct-13	<12	<11	<30	<11	<27	<11	<20	<11	<10	<11	<42	<12	963 ± 217

TABLE 8.10 SURFACE WATER

ODCM required samples denoted by *
units are pCi/liter

EVAP POND 2	29-Jan-13	<14	<10	<25	<12	<30	<14	<23	<14	<11	<13	<38	<15	863 ± 197
(Site #63) *	30-Apr-13	<10	<9	<24	<12	<30	<11	<15	<11	<10	<10	<31	<14	1193 ± 295
CELL 2A	30-Jul-13	<11	<9	<28	<13	<29	<13	<22	<10	<10	<11	<34	<14	1056 ± 214
	28-Oct-13	<11	<11	<22	<11	<24	<12	<23	<10	<11	<13	<34	<15	1018 ± 217
CELL 2B	29-Jan-13	<9	<10	<24	<13	<23	<11	<20	<10	<10	<10	<42	<15	1052 ± 200
	30-Apr-13	<11	<10	<30	<13	<23	<12	<20	22 ± 12	<10	<13	<37	<12	1245 ± 298
	30-Jul-13	<12	<12	<20	<15	<27	<13	<19	<12	<12	<13	<43	<13	895 ± 212
	28-Oct-13	<11	<11	<26	<11	<30	<12	<20	<12	<10	<13	<42	<14	986 ± 216
EVAP POND 3	29-Jan-13	<10	<10	<24	<13	<28	<9	<17	<10	<10	<12	<42	<13	548 ± 190
(Site #64) *	30-Apr-13	<12	<11	<24	<13	<29	<10	<19	<10	<10	<13	<40	<12	1007 ± 196
CELL 3A	30-Jul-13	<12	<11	<27	<13	<30	<12	<19	<9	<9	<14	<34	<10	761 ± 207
	28-Oct-13	<12	<13	<26	<14	<30	<14	<19	<11	<10	<14	<41	<13	701 ± 212
CELL 3B	29-Jan-13	<11	<13	<28	<14	<22	<10	<21	<11	<10	<12	<42	<15	454 ± 189
	30-Apr-13	<12	<11	<25	<13	<30	<13	<20	<11	<11	<13	<39	<15	1050 ± 197
	30-Jul-13	<9	<11	<23	<13	<30	<12	<18	<11	<11	<13	<39	<11	732 ± 209
	28-Oct-13	<12	<12	<28	<13	<28	<10	<23	<10	<9	<14	<40	<15	776 ± 213

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 **
	8-Jan-13	<9	<10	<19	<15	<22	<9	<17	25 ± 9	<10	<11	<11	<12	
	15-Jan-13	<9	<10	<20	<6	<24	<9	<15	24 ± 8	<10	<11	<31	<10	
	22-Jan-13	<10	<8	<23	<13	<22	<10	<17	62 ± 12	<8	<10	<30	<9	
	29-Jan-13	<11	<10	<19	<15	<22	<11	<21	11 ± 10	<10	<14	<45	<14	<318
	5-Feb-13	<11	<11	<29	<11	<29	<12	<21	24 ± 10	<11	<12	<46	<10	
	12-Feb-13	<13	<14	<23	<14	<24	<11	<19	21 ± 8	<11	<13	<37	<15	
	19-Feb-13	<10	<11	<20	<13	<25	<12	<17	43 ± 12	<10	<10	<36	<15	
	25-Feb-13	<10	<10	<21	<13	<26	<10	<20	34 ± 11	<10	<12	<40	<15	<308
WRF INFLUENT	5-Mar-13	<14	<14	<28	<14	<27	<14	<23	46 ± 11	<12	<15	<41	<15	
	12-Mar-13	<11	<12	<23	<11	<13	<13	<16	22 ± 11	<10	<11	<40	<15	
	19-Mar-13	<11	<13	<24	<13	<25	<15	<20	34 ± 12	<10	<13	<41	<13	
	25-Mar-13	<11	<12	<22	<12	<25	<12	<19	29 ± 11	<9	<11	<38	<15	<322
	2-Apr-13	<9	<11	<21	<10	<21	<9	<18	31 ± 12	<9	<11	<39	<15	*
	9-Apr-13	WRF OUT OF SERVICE DUE OUTAGE												
	16-Apr-13	<13	<12	<23	<12	<23	<12	<18	21 ± 10	<11	<11	<34	<15	
	23-Apr-13	<11	<12	<20	<11	<30	<11	<20	15 ± 9	<13	<14	<41	<13	
	30-Apr-13	<11	<11	<22	<15	<18	<10	<19	39 ± 12	<10	<10	<33	<15	<320
	7-May-13	<14	<13	<30	<12	<22	<15	<22	20 ± 12	<13	<13	<47	<14	
	13-May-13	<10	<12	<18	<12	<26	<12	<20	37 ± 10	<10	<11	<39	<10	
	21-May-13	<10	<12	<17	<11	<23	<10	<15	22 ± 9	<9	<9	<37	<10	
	28-May-13	<9	<10	<24	<15	<22	<9	<17	22 ± 10	<9	<10	<33	<10	<311
	4-Jun-13	<15	<11	<25	<13	<27	<10	<20	16 ± 11	<9	<11	<35	<12	
	11-Jun-13	<15	<14	<23	<7	<27	<13	<21	<15	<11	<13	<45	<15	
	18-Jun-13	<11	<10	<30	<14	<28	<12	<24	17 ± 13	<9	<14	<46	<15	
	25-Jun-13	<13	<9	<18	<14	<29	<12	<18	13 ± 6	<11	<13	<33	<13	
	01-Jul-13	<10	<10	<21	<14	<22	<12	<20	26 ± 14	<9	<12	<36	<8	<303
	09-Jul-13	<15	<13	<24	<14	<25	<14	<25	15 ± 9	<13	<11	<40	<12	
	16-Jul-13	<10	<12	<22	<14	<29	<8	<20	<11	<10	<10	<34	<15	
	23-Jul-13	<11	<9	<24	<12	<27	<12	<21	15 ± 10	<11	<14	<36	<14	
	30-Jul-13	<11	<8	<18	<14	<17	<11	<18	9 ± 8	<10	<10	<35	<15	<341

*INFO ONLY, partial week samples prior to WRF S/D ** 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	6-Aug-13	<9	<12	<21	<11	<16	<10	<19	<11	<9	<11	<28	<15	
	13-Aug-13	<9	<8	<16	<11	<23	10.0	<15	28 ± 8	<8	<10	<29	<15	
	20-Aug-13	<12	<11	<20	<12	<12	<18	<9	23 ± 9	<9	<11	<38	<15	
	27-Aug-13	<11	<8	<16	<9	<14	<9	<18	32 ± 10	<9	<8	<38	<15	<348
	3-Sep-13	<10	<11	<20	<11	<24	<10	<16	15 ± 10	<10	<10	<34	<15	
	10-Sep-13	<12	<11	<22	<13	<22	<10	<17	24 ± 9	<12	<11	<37	<15	
	17-Sep-13	<12	<8	<24	<14	<28	<11	<20	26 ± 11	<12	<11	<38	<15	
	23-Sep-13	<11	<11	<18	<11	<18	<10	<14	<11	<8	<10	<30	<15	<349
	1-Oct-13	<14	<15	<24	<13	<29	<11	<22	<14	<12	<11	<52	<12	
	8-Oct-13	<12	<15	<18	<12	<23	<11	<19	27 ± 13	<10	<13	<37	<14	
	15-Oct-13	*WRF SHUT DOWN- NO DATA												
	22-Oct-13	<10	<13	<26	<15	<26	<12	<22	<13	<12	<14	<46	<11	
	29-Oct-13	<9	<10	<21	<9	<23	<10	<17	32 ± 16	<9	<10	<32	<14	<349
	5-Nov-13	<14	<10	<26	<14	<29	<11	<19	28 ± 12	<11	<14	<42	<12	
	12-Nov-13	<11	<11	<20	<14	<25	<10	<22	23 ± 11	<13	<11	<42	<10	
	19-Nov-13	<10	<11	<18	<14	<28	<14	<22	5 ± 9	<13	<12	<39	<15	
	26-Nov-13	<11	<12	<21	<7.7	<30	<13	<24	23 ± 13	<12	<15	<43	<11	<347
	3-Dec-13	<10	<13	<25	<14	<30	<10	<20	31 ± 12	<11	<13	<38	<13	
	10-Dec-13	<12	<13	<29	<14	<30	<13	<19	33 ± 11	<11	<12	<49	<10	
	17-Dec-13	<13	<11	<23	<13	<24	<10	<22	27 ± 10	<10	<11	<32	<14	
	23-Dec-13	<10	<10	<19	<11	<21	<11	<14	47 ± 11	<8	<9	<28	<12	
	30-Dec-13	<12	<13	<25	<13	<25	<15	<23	16 ± 9	<11	<13	<46	<8	<348

** 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
SEDIMENTATION BASIN #2	8-Jan-13					*No samples available, basin was empty								
	15-Jan-13					*No samples available, basin was empty								
	22-Jan-13					*No samples available, basin was empty								
	29-Jan-13	<14	<12	<25	<15	<28	<12	<25	<12	<11	<13	<41	<9	<323
	5-Feb-13					*No samples available, basin was empty								
	12-Feb-13					*No samples available, basin was empty								
	19-Feb-13					*No samples available, basin was empty								
	26-Feb-13					*No samples available, basin was empty								
	5-Mar-13					*No samples available, basin was empty								
	13-Mar-13	<10	<7	<22	<13	<21	<10	<21	<10	<10	<11	<30	<15	<324
	25-Mar-13					*No samples available, basin was empty								
	27-Aug-13	<10	<13	<24	<13	<24	<13	<20	<8	<12	<12	<40	<15	<379
	4-Sep-13	<13	<11	<29	<15	<27	<10	<22	<10	<11	<12	<38	<10	<383
	10-Sep-13	<14	<11	<21	<10	<30	<12	<18	<11	<12	<13	<39	<12	<364
	17-Sep-13	<13	<11	<18	<11	<22	<12	<18	<9	<11	<10	<34	<15	<354
	23-Sep-13					*No samples available, basin was empty								
	1-Oct-13					*No samples available, basin was empty								
	15-Oct-13					*No samples available, basin was empty								
	22-Oct-13					*No samples available, basin was empty								
	29-Oct-13					*No samples available, basin was empty								
	5-Nov-13					*No samples available, basin was empty								
	12-Nov-13					*No samples available, basin was empty								
	19-Nov-13					*No samples available, basin was empty								
	26-Nov-13	<13	<11	<26	<15	<23	<13	<21	<11	<12	<15	<41	<11	341 ± 202
	3-Dec-13					*No samples available, basin was empty								
	10-Dec-13	<14	<15	<29	<14	<29	<13	<25	<11	<11	<14	<41	<13	457 ± 218
	17-Dec-13					*No samples available, basin was empty								
	23-Dec-13	<9	<10	<20	<15	<23	<11	<17	<9	<10	<11	<30	<15	595 ± 210
	30-Dec-13	<11	<10	<19	<12	<26	<10	<17	<9	<8	<11	<32	<13	488 ± 218

TABLE 8.11 SLUDGE/SEDIMENT

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

SAMPLE LOCATION	DATE COLLECTED		I-131 (<6,000)	Cs-134 (<150)	Cs-137 (<180)	In-111
WRF CENTRIFUGE WASTE SLUDGE	8-Jan-13		766 ± 171	<145	<138	
	15-Jan-13		799 ± 181	<144	<175	
	22-Jan-13		676 ± 169	<148	<119	
	29-Jan-13		1174 ± 302	<109	<177	
	5-Feb-13		860 ± 228	<147	<150	
	12-Feb-13		664 ± 171	<67	<102	
	19-Feb-13		735 ± 184	<109	<131	
	25-Feb-13		994 ± 232	<123	<170	
	4-Mar-13		1110 ± 254	<74	<147	
	12-Mar-13		715 ± 204	<142	<119	
	19-Mar-13		529 ± 198	<137	<116	
	25-Mar-13		547 ± 165	<143	<162	
	2-Apr-13	*	477 ± 177	<142	<173	
	9-Apr-13		646 ± 202	<140	<178	
	16-Apr-13		367 ± 127	<126	<180	
	23-Apr-13		281 ± 124	<120	<174	
	30-Apr-13		226 ± 153	<143	<173	
	7-May-13		1105 ± 209	<105	<148	
	13-May-13		1291 ± 267	<115	<173	
	21-May-13		837 ± 178	<100	<102	
	27-May-13		967 ± 266	<138	<117	
	4-Jun-13		732 ± 212	<141	<176	
	10-Jun-13		706 ± 175	<142	<117	
	18-Jun-13		398 ± 169	<99	<147	
	25-Jun-13		439 ± 187	<109	<170	
	1-Jul-13		500 ± 149	<104	<172	
	9-Jul-13		469 ± 198	<138	<144	
	16-Jul-13		372 ± 123	<136	<171	
	23-Jul-13		369 ± 121	<124	<176	
	30-Jul-13		332 ± 154	<147	<173	
	6-Aug-13		280 ± 111	<124	<174	
	13-Aug-13		332 ± 184	<130	<178	
	20-Aug-13		738 ± 175	<143	<108	

***INFO ONLY, partial week sample prior WRF S/D**

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	27-Aug-13	819 ± 177	<147	<152	
	3-Sep-13	837 ± 196	<94	<180	
	10-Sep-13	562 ± 164	<147	<122	
	17-Sep-13	588 ± 172	<143	<113	
	23-Sep-13	653 ± 193	<150	<131	
	1-Oct-13	339 ± 146	<112	<179	
	8-Oct-13	296 ± 106	<139	<142	
	15-Oct-13	*WRF SHUT DOWN- NO DATA			
	22-Oct-13	123 ± 95	<98	<177	
	29-Oct-13	160 ± 77	<122	<130	
	5-Nov-13	865 ± 201	<141	<175	
	12-Nov-13	604 ± 165	<96	<81	
	19-Nov-13	780 ± 204	<99	<102	
	26-Nov-13	596 ± 161	<36	<47	
	3-Dec-13	649 ± 173	<62	<121	
	10-Dec-13	344 ± 152	<143	<152	
	17-Dec-13	458 ± 135	<74	<119	
	23-Dec-13	931 ± 184	<80	<109	48 ± 73
	30-Dec-13	669 ± 172	<73	<92	

SAMPLE LOCATION	
SEDIMENTATION BASIN #2	No samples taken in 2013

TABLE 8.11 SLUDGE/SEDIMENT

COOLING TOWER SLUDGE

UNIT CYCLE	APPROXIMATE VOLUME (yd^3)	ISOTOPE	ACTIVITY RANGE (pCi/g)	SAMPLE TYPE
U2R17	286	Cs-137	<MDA to 0.08	Towers/canal sludge
U1R17	303	All principal gamma emitters	<MDA	Towers/canal sludge

TABLE 8.12 HARD-TO-DETECT RADIONUCLIDE RESULTS

Units are pCi/liter

Sample Location	Well number	Sample Date	C-14	Fe-55	Ni-63	Sr-90
Unit 1 (outside RCA)	APP-12	10/13/2013	<56.2	<30.5	<3.58	<2.00
Unit 2 (inside RCA)	H0A	11/13/2013	<56.8	<31.8	<3.55	<1.86
Unit 3 (inside RCA)	H11	11/13/2013	<56.8	<32.6	<3.64	<1.85

FIGURE 8.1 GROSS BETA IN AIR, 1st-2nd Quarter

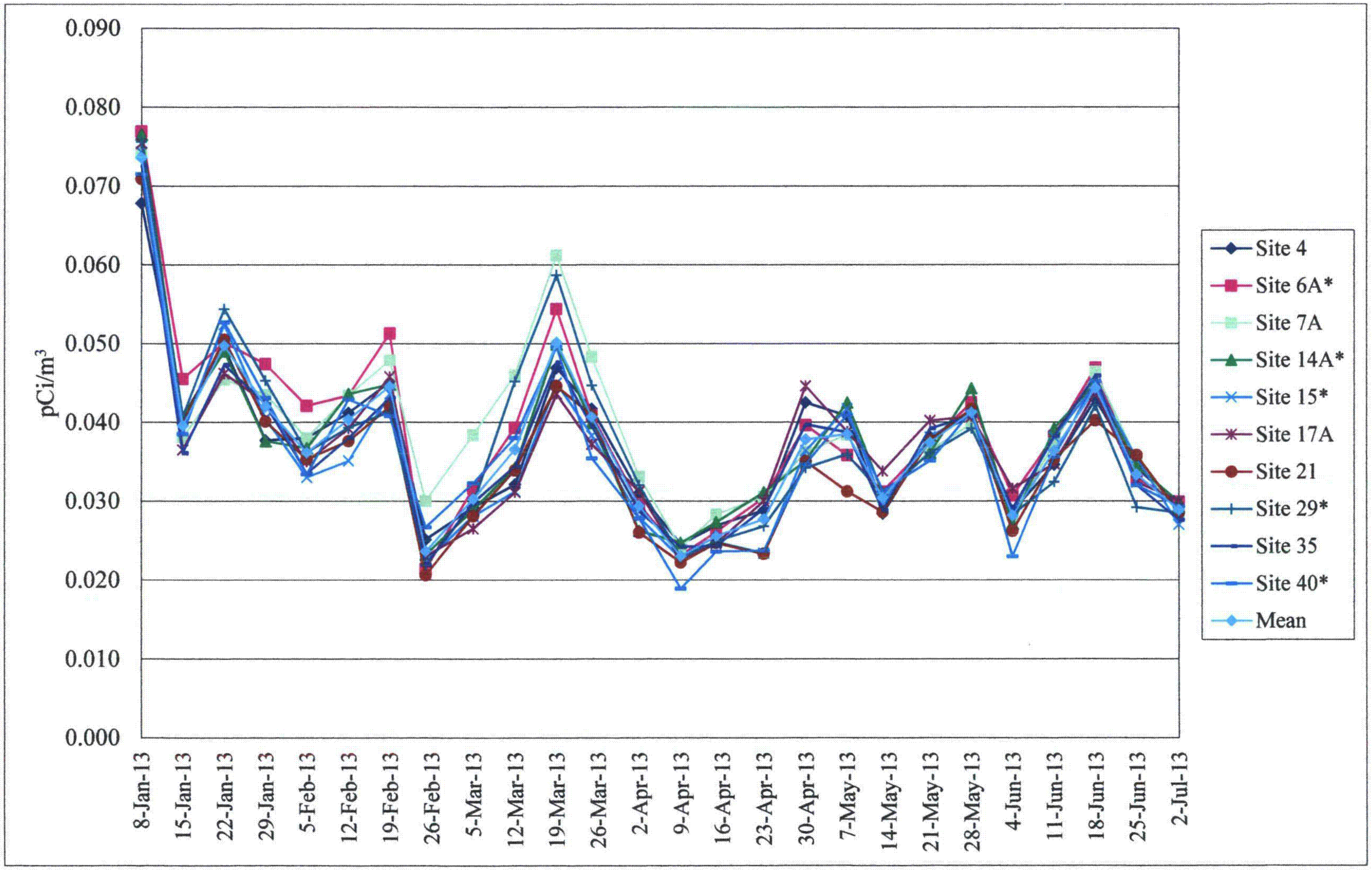


FIGURE 8.2 GROSS BETA IN AIR, 3rd-4th Quarter

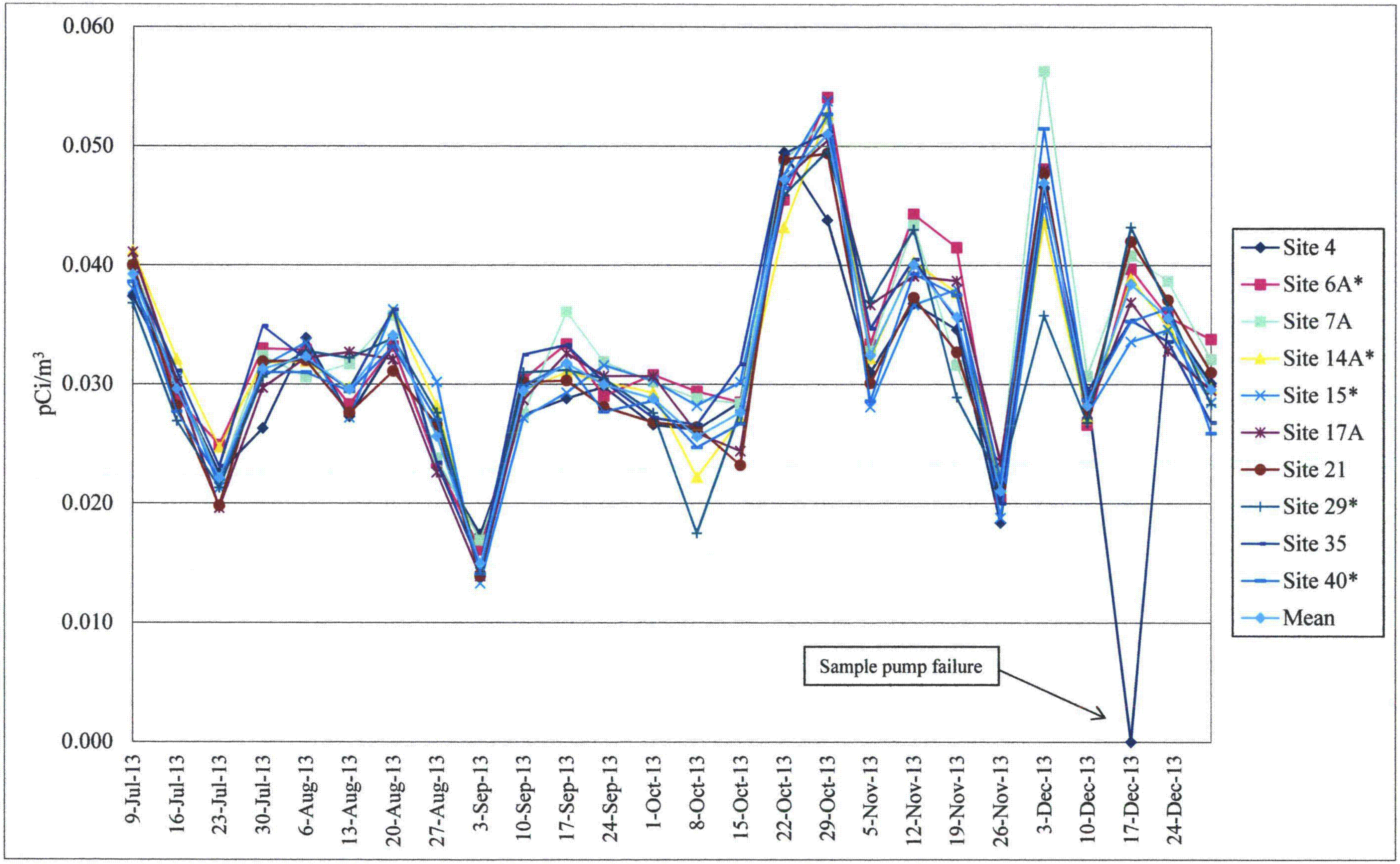


FIGURE 8.3 HISTORICAL GROSS BETA IN AIR (WEEKLY SYSTEM AVERAGES)

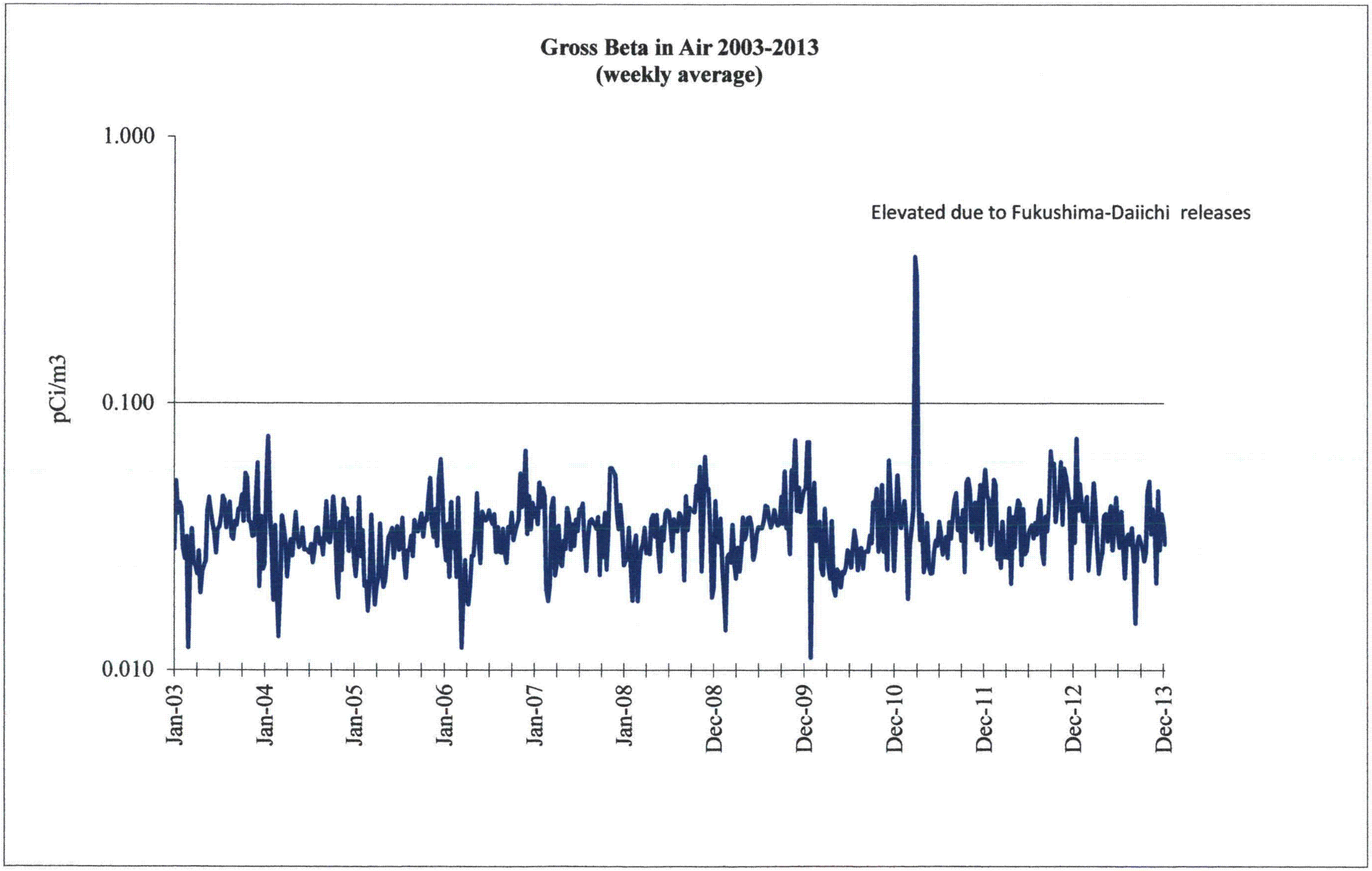
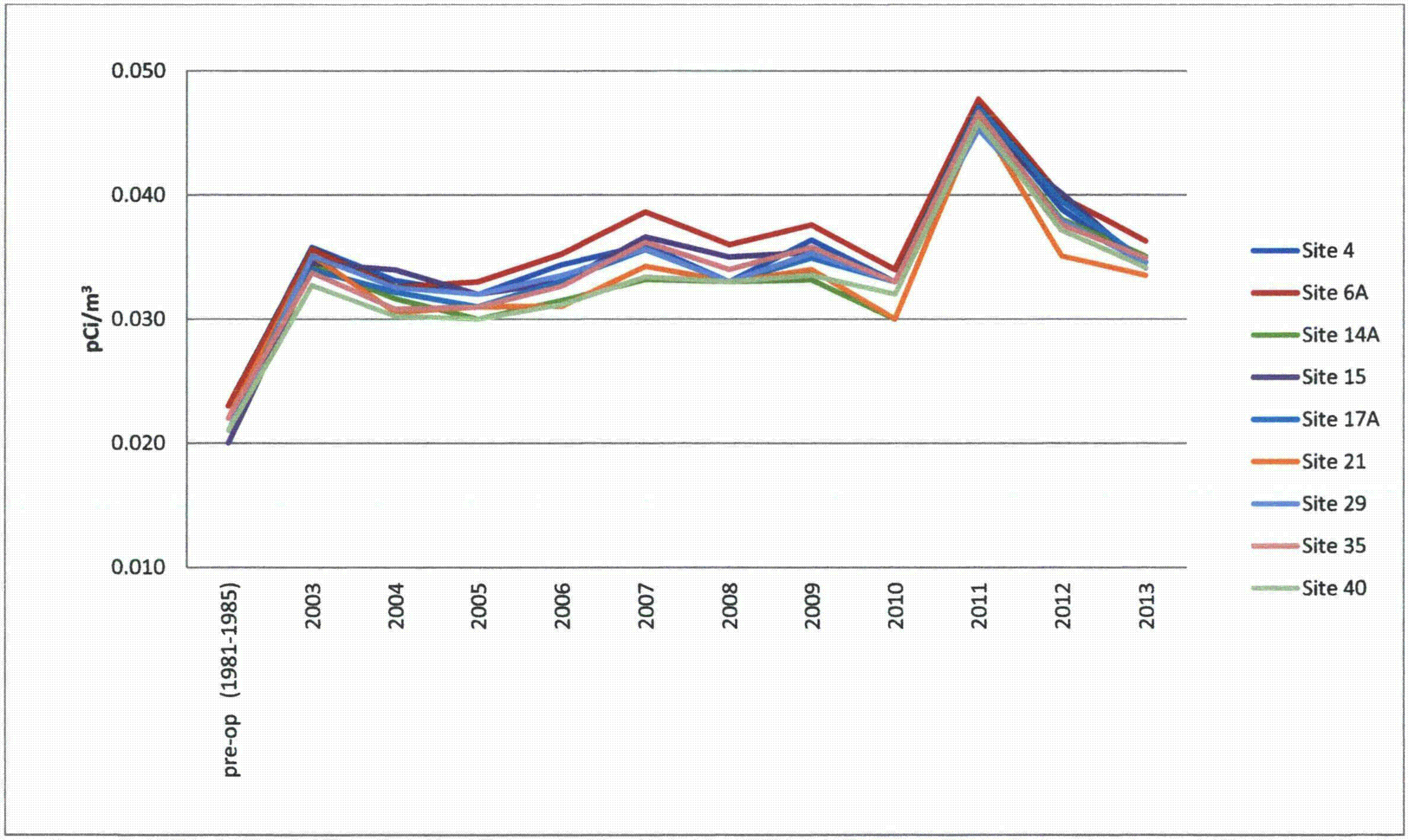
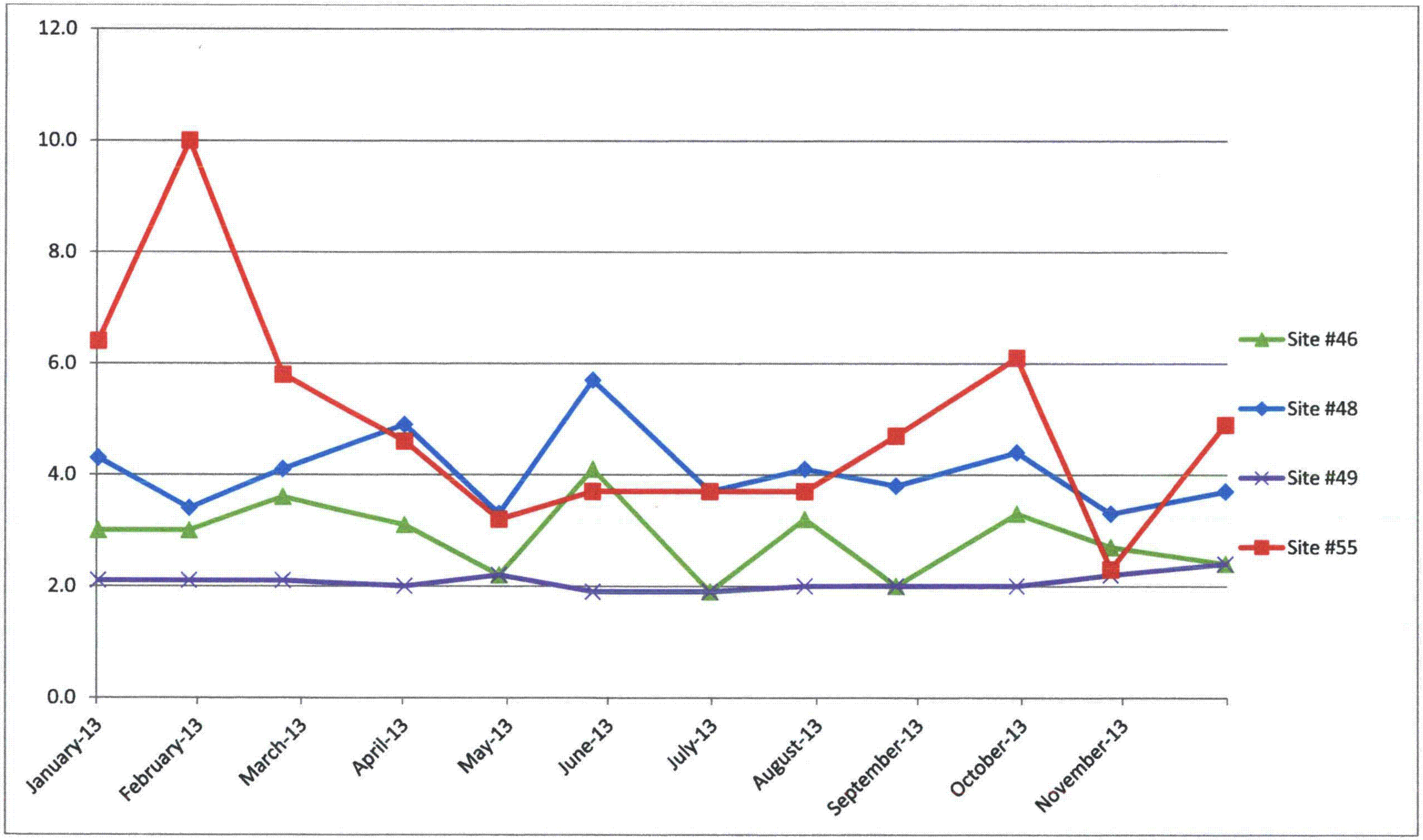


FIGURE 8.4 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP



Site 7A is not included since the location changed since the pre-operational period
A known high bias has occurred in gross beta data since the onsite laboratory began analysis in 1994. This was a stepwise increase that has carried forward since 1994.
The 2011 annual average values are higher due to the Fukushima-Daiichi releases.

FIGURE 8.5 GROSS BETA IN DRINKING WATER



NOTES: MDA values plotted as activity (e.g. <2.3 is plotted as 2.3)
The action level is 30 pCi/liter

FIGURE 8.6 EVAPORATION POND TRITIUM ACTIVITY PRE-OP - 2008

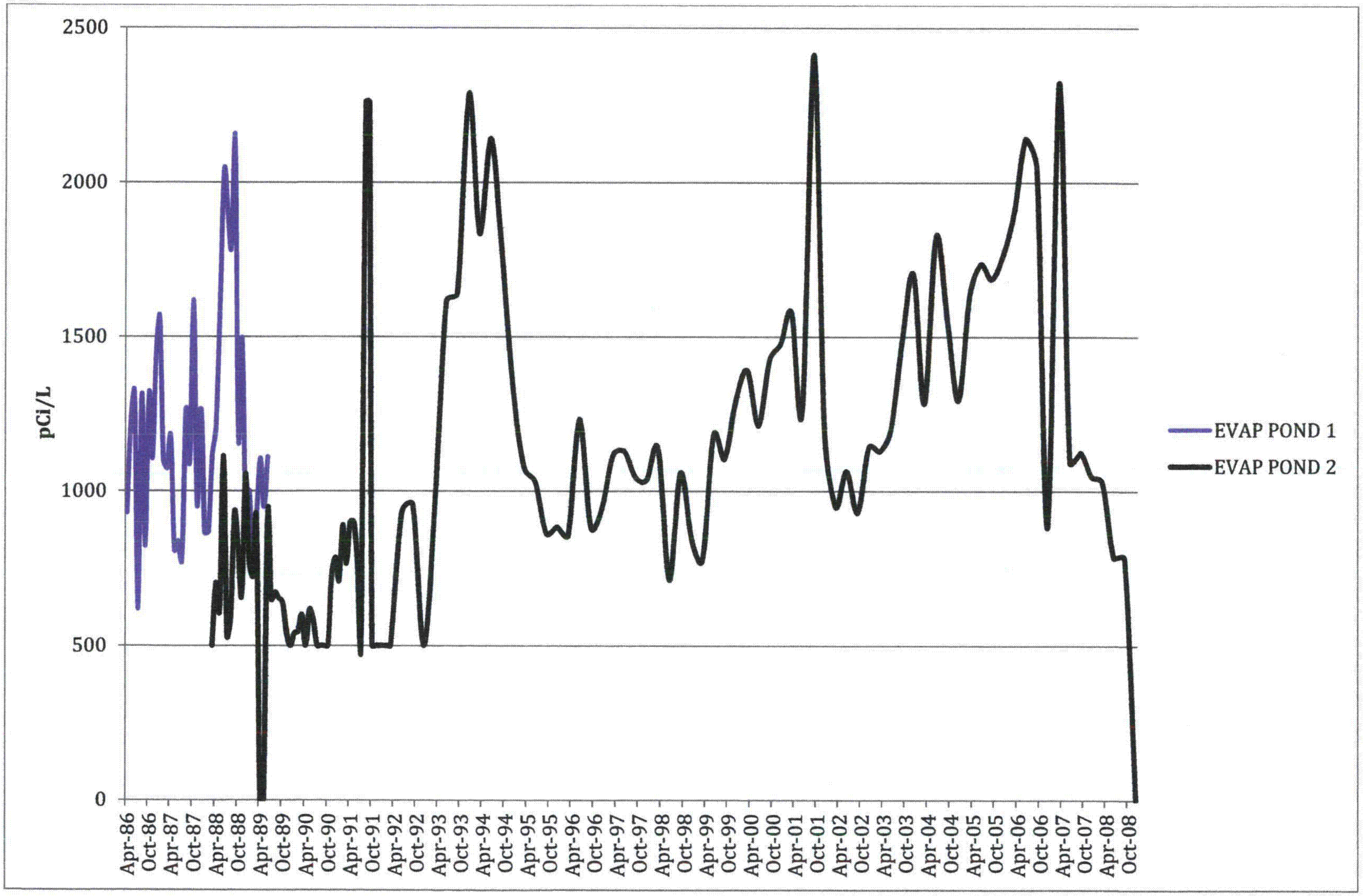


FIGURE 8.7 EVAPORATION POND TRITIUM ACTIVITY 2009-2013

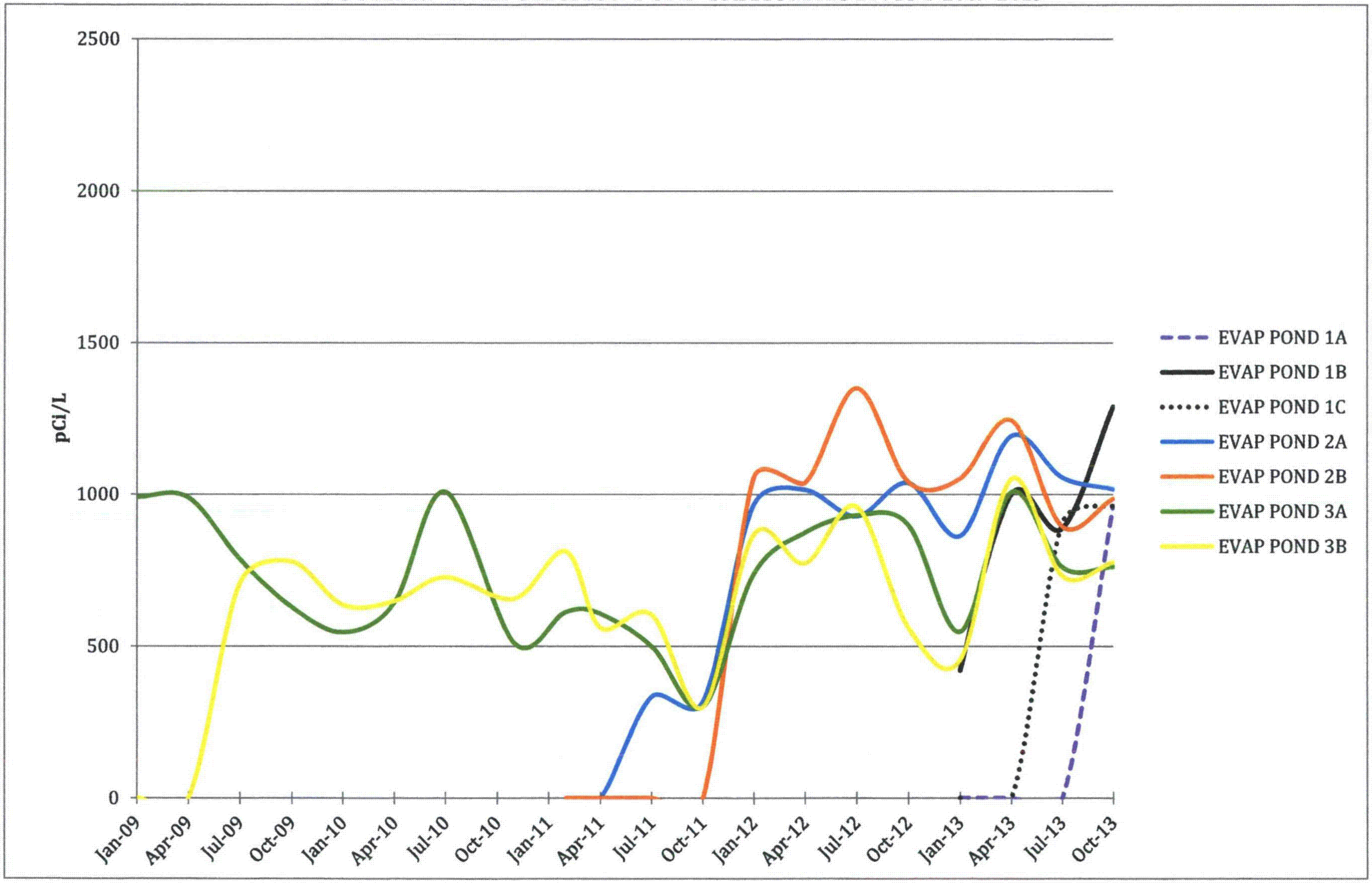
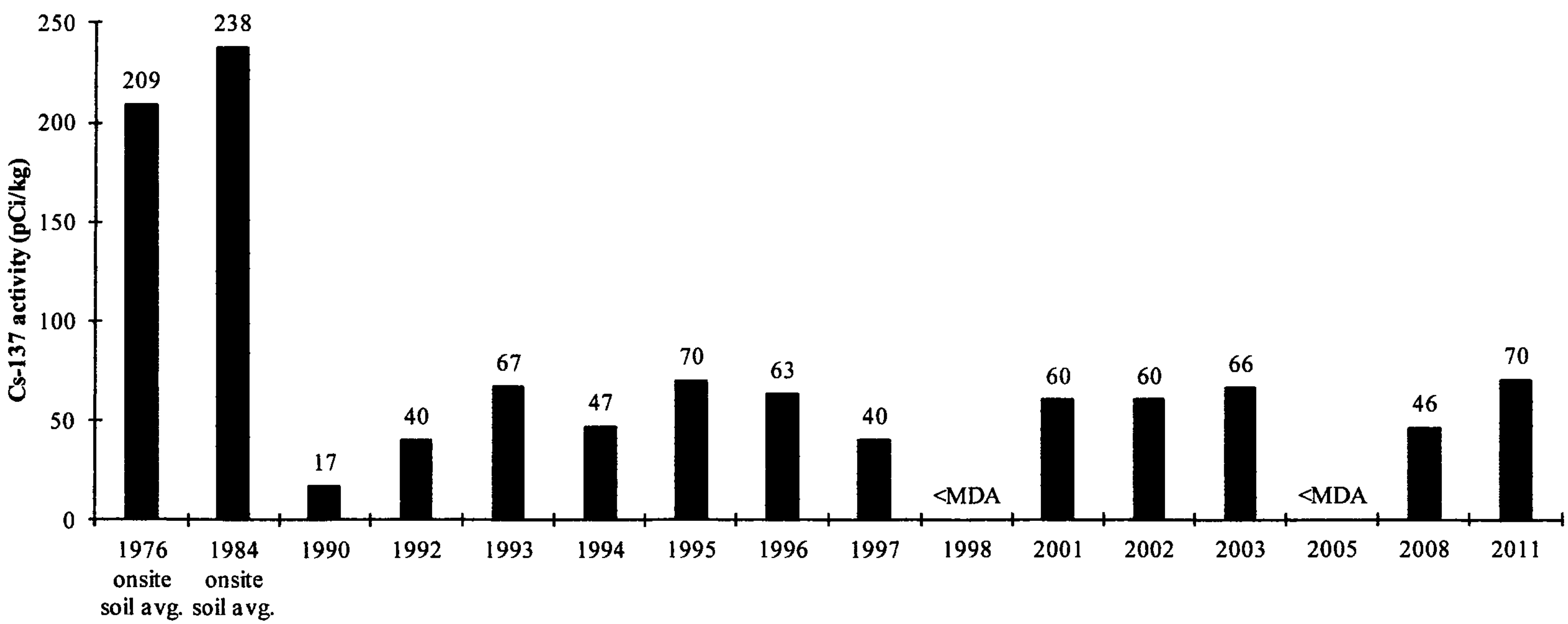


FIGURE 8.8 SEDIMENTATION BASIN 2 Cs-137



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

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.

TLDs were placed in fifty locations from one to thirty-five miles from the PVNGS. TLD locations are shown in Figures 2.1 and 2.2 and are described in Table 9.1. TLD results for 2013 are presented in Table 9.2. Historical environmental gamma radiation results for 1985 through 2013 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2013 as compared to the pre-operational TLD results (excluding sites #41 and #43, as they were deleted and later assigned to a new location, and #46-50, as they had no pre-op TLD at the location for comparison). 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	S of Elliot Rd
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	N2	Wintersburg
41	ESE3	Arlington School
42	N8	Ruth Fisher School
43	NE5	Winters Well 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.

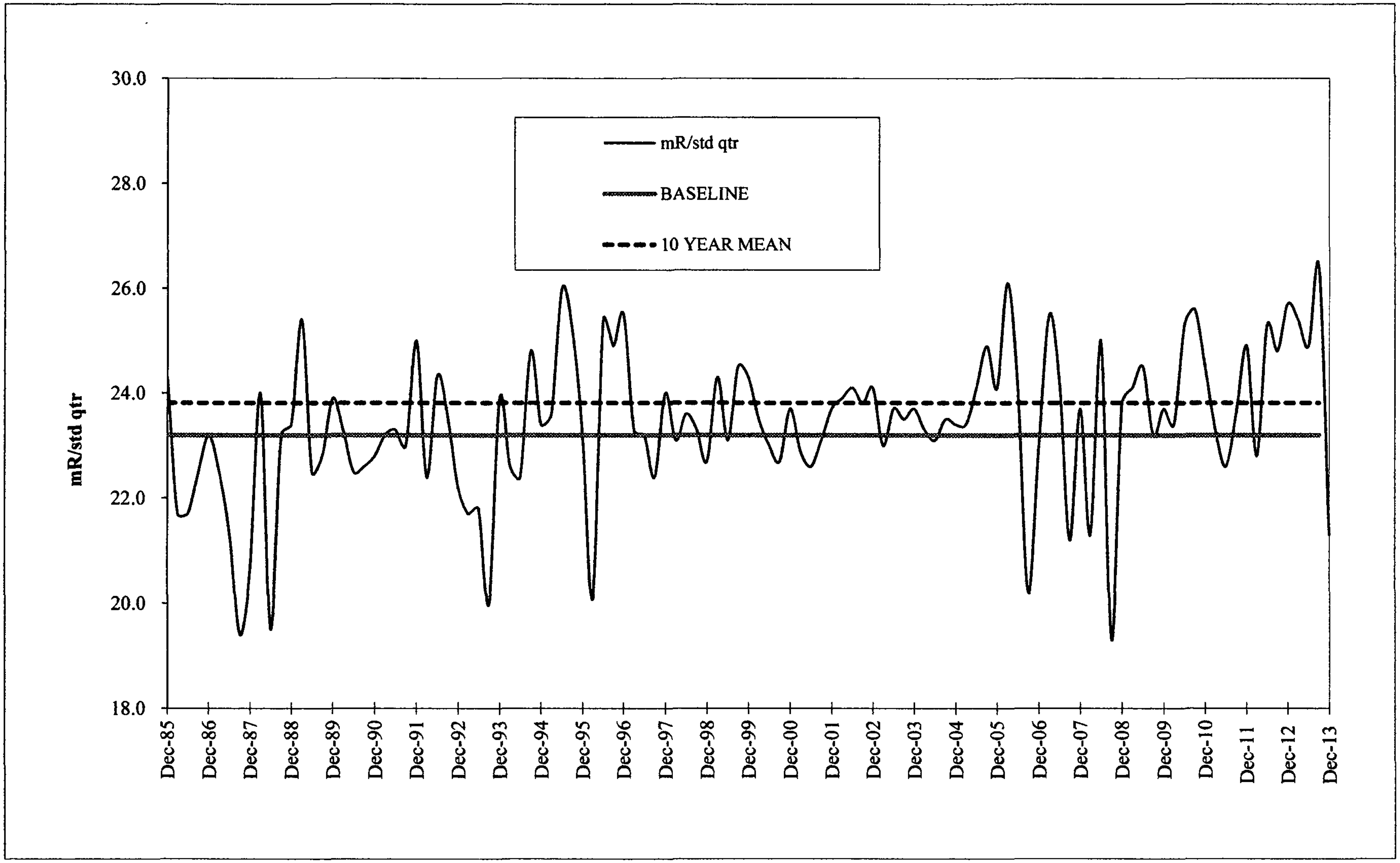
** Site #45 is the transit control TLD (stored in lead pig).

TABLE 9.2 ENVIRONMENTAL TLD RESULTS

Units are mRem/std qtr

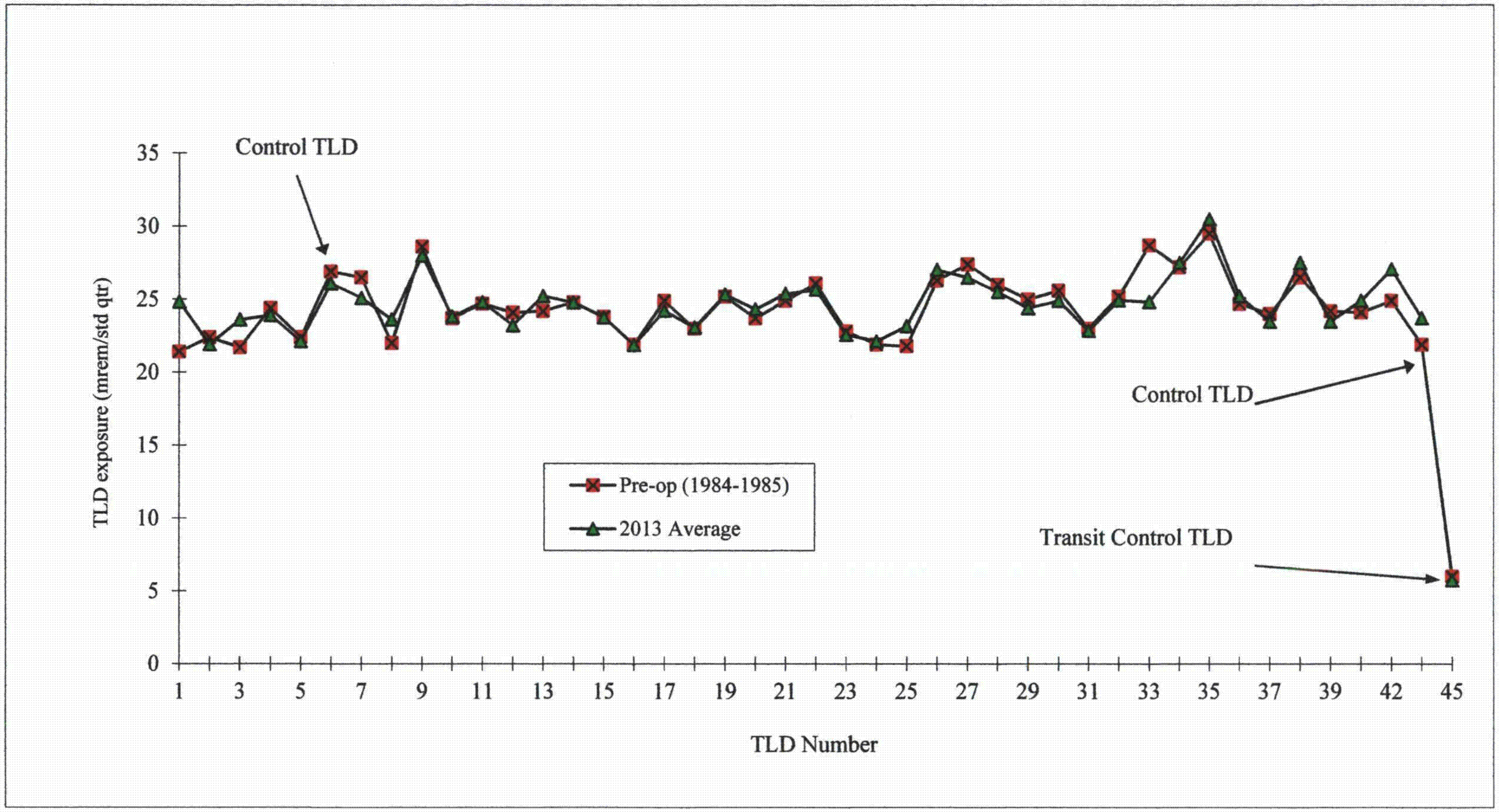
TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average
1	25.8	25.0	27.1	21.4	24.8
2	22.7	22.1	23.4	19.5	21.9
3	24.0	24.7	24.9	20.8	23.6
4	24.6	24.2	25.8	21.0	23.9
5	22.9	22.6	24.3	18.7	22.1
6 (control)	26.9	26.6	28.2	22.7	26.1
7	26.4	26.1	26.7	21.2	25.1
8	23.6	24.9	25.9	20.1	23.6
9	28.8	29.5	29.4	24.3	28.0
10	23.5	24.6	25.8	21.4	23.8
11	25.6	25.6	26.2	21.8	24.8
12	24.4	23.8	24.5	20.2	23.2
13	26.1	25.5	27.7	21.6	25.2
14	27.0	24.8	26.1	21.2	24.8
15	23.9	23.7	26.4	21.1	23.8
16	23.4	21.3	24.0	18.8	21.9
17	26.2	24.1	25.5	21.1	24.2
18	23.1	23.9	25.1	20.2	23.1
19	26.4	25.1	27.7	22.1	25.3
20	25.1	24.2	27.1	20.9	24.3
21	27.6	24.7	27.6	21.6	25.4
22	26.8	25.7	27.9	22.3	25.7
23	23.6	23.0	24.0	19.7	22.6
24	22.9	22.7	23.8	19.1	22.1
25	24.7	23.1	24.1	20.8	23.2
26	27.8	28.8	28.7	22.8	27.0
27	27.1	27.6	28.3	23.0	26.5
28	25.6	26.3	27.8	22.4	25.5
29	25.5	25.1	25.6	21.4	24.4
30	25.6	26.4	26.0	21.6	24.9
31	23.4	23.5	25.1	19.4	22.9
32	26.1	24.9	26.8	22.0	25.0
33	25.7	25.5	26.1	22.0	24.8
34	28.6	28.2	29.3	23.9	27.5
35	31.7	32.5	31.7	26.1	30.5
36	25.9	24.4	27.8	22.8	25.2
37	24.7	23.6	24.6	21.0	23.5
38	28.4	27.0	29.8	24.8	27.5
39	24.7	24.0	25.2	20.0	23.5
40	25.7	25.6	26.6	21.7	24.9
41	26.6	27.8	30.4	23.7	27.1
42	29.0	27.4	28.8	23.1	27.1
43	28.0	25.8	28.3	23.2	26.3
44 (control)	25.0	23.3	26.3	20.3	23.7
45 (transit control)	6.0	5.9	6.8	4.3	5.8
46	23.8	22.9	24.2	19.7	22.7
47	25.1	24.5	25.4	19.8	23.7
48	23.9	23.7	25.1	19.8	23.1
49	23.2	22.3	24.6	18.2	22.1
50	19.6	19.7	19.8	15.7	18.7

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES



The 10-year mean value is for the date range 2004-2013.

FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2013



The following TLDs are not included on this graph;
TLD #41 monitoring location was deleted in June, 2000 due to school closing (this TLD was placed at new school in 2004)
TLD #43 monitoring location was deleted in 1994 due to school closing (this TLD was placed at a new school in 2007)
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 in April 2013.

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

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

10.2. Census Results

Nearest Resident

There was no change in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.215 mRem.

Milk Animal

There was no change in milk animal status from the previous year. Dose calculations indicated the highest dose to be 0.456 mRem.

Vegetable Gardens

There was no change in nearest garden status. Dose calculations indicated the highest dose to be 0.855 mRem.

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

Figures 10.1 through 10.3 provide graphs depicting historical calculated doses for nearest residents, nearest milk receptor, and nearest garden receptor locations in each sector.

Differences in calculated doses are the result of many variables, including;

- Changes in receptor locations from year to year (proximity to the power plant)
- Changes in local meteorology (wind direction, wind speed, precipitation, temperature)
- Concurrent meteorology at the time of effluent releases
- Exposure pathways

TABLE 10.1 LAND USE CENSUS

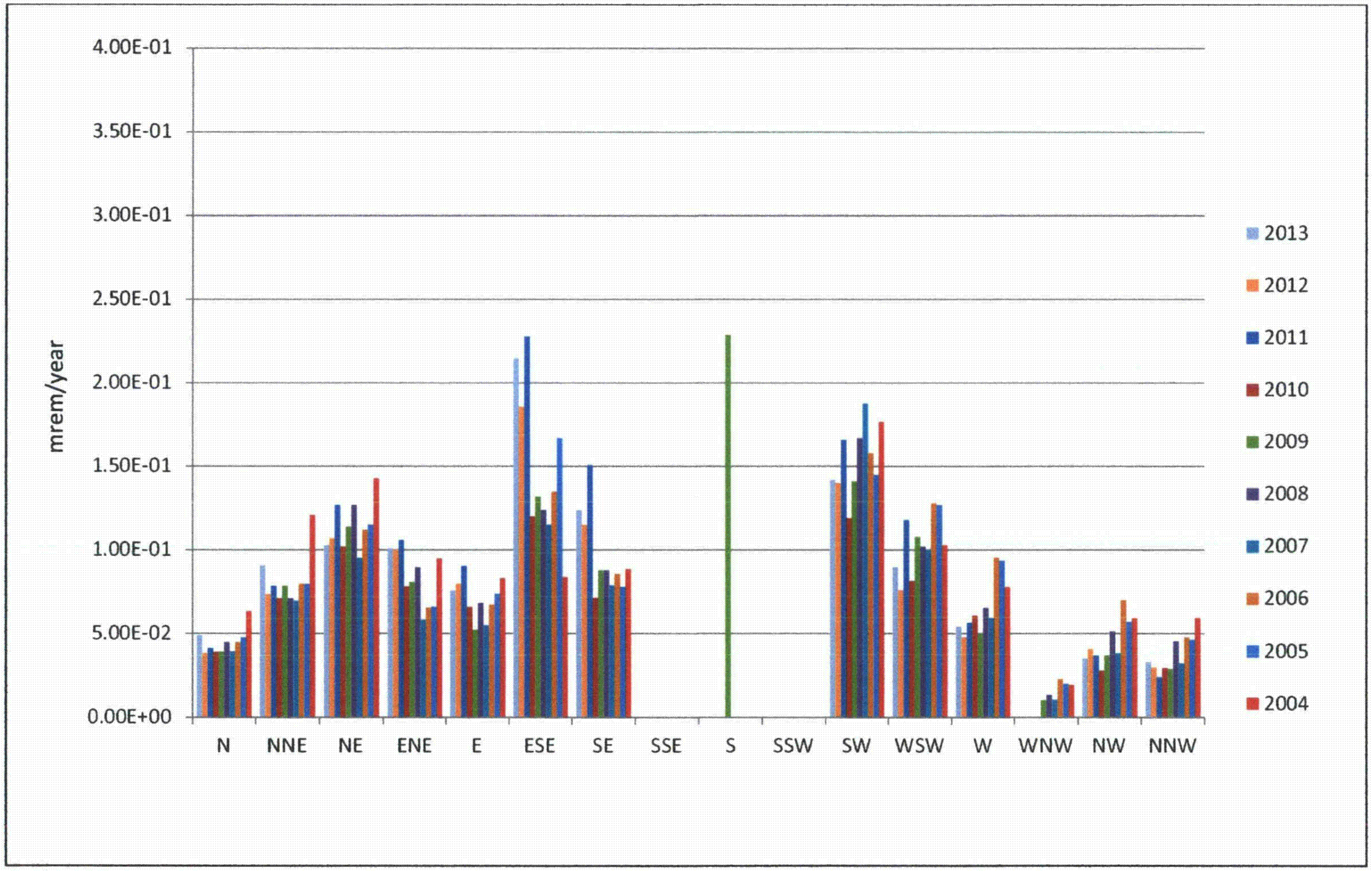
(Distances and directions are relative to Unit 2 in miles)

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST MILK ANIMAL (COW/GOAT)	CALCULATED DOSE (mRem)	CHANGE FROM 2012
N	1.55	3.10	3.66	Resident 4.92E-02 Garden 2.38E-01 Milk 1.86E-01	
NNE	1.52	3.30	3.05	Resident 9.09E-02 Garden 4.39E-01 Milk 4.56E-01	
NE	2.16	NONE	NONE	Resident 1.03E-01	
ENE	2.16	2.63	4.84	Resident 1.01E-01 Garden 8.55E-01 Milk 2.96E-01	
E	2.81	NONE	NONE	Resident 7.58E-02	
ESE	1.89	NONE	NONE	Resident 2.15E-01	
SE	3.36	NONE	NONE	Resident 1.24E-01	
SSE	NONE	NONE	NONE	NA	
S	NONE	NONE	NONE	NA	
SSW	NONE	NONE	NONE	NA	
SW	1.40	NONE	NONE	Resident 1.42E-01	
WSW	0.75	4.82	NONE	Resident 9.00E-02 Garden 1.80E-01	
W	0.70	NONE	NONE	Resident 5.44E-02	
WNW	NONE	NONE	NONE	NA	
NW	0.93	NONE	NONE	Resident 3.53E-02	
NNW	1.30	NONE	NONE	Resident 3.33E-02	

COMMENTS:

Dose calculations were performed using the GASPAR code and 2013 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual organ dose identified.

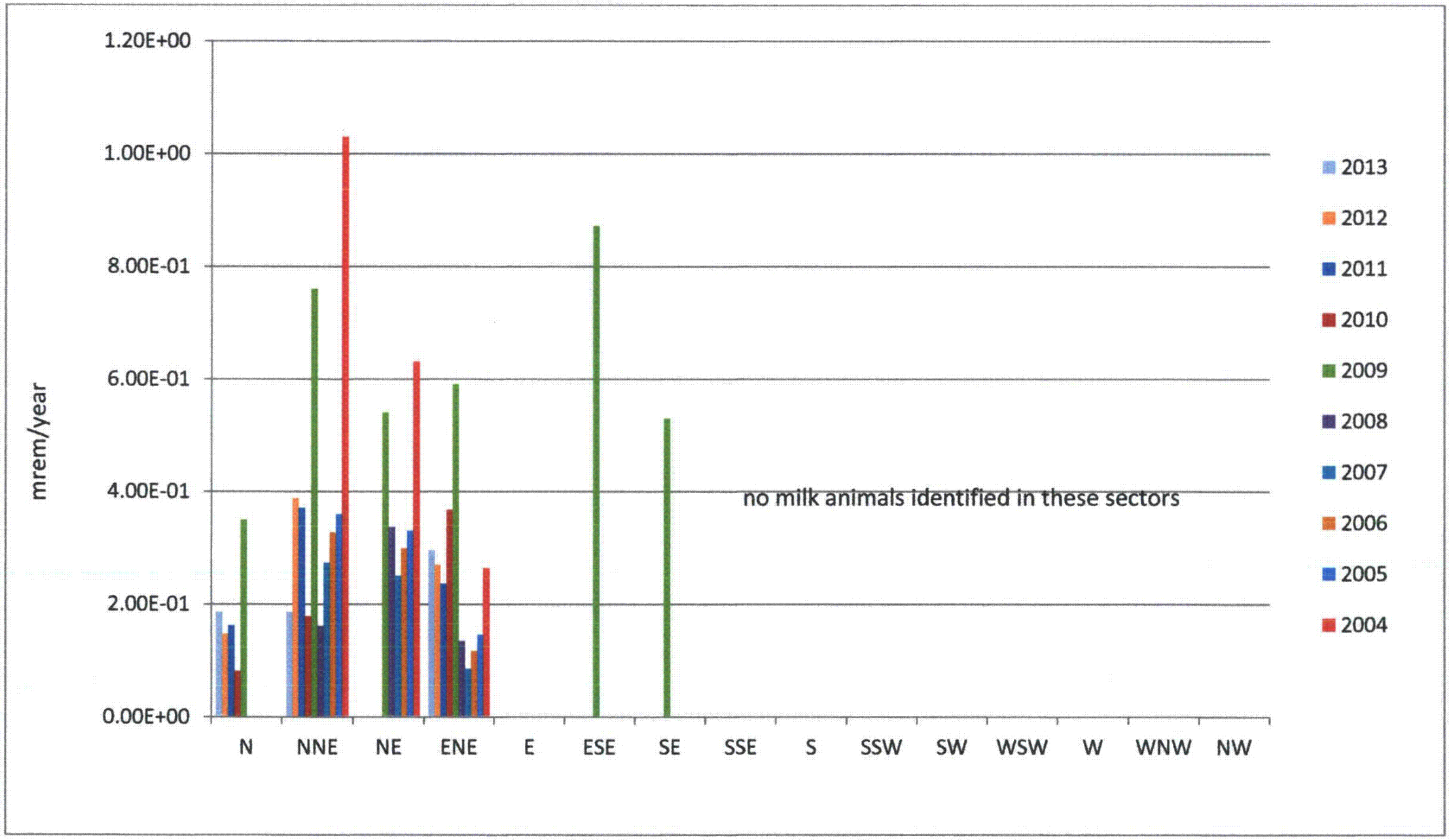
FIGURE 10.1 HISTORICAL COMPARISON OF NEAREST RESIDENT DOSE



Historical annual average most prevalent wind direction is from the SW, next highest is from the N. This is one reason for the higher doses assigned to residents in the S sector.

Historical annual average least prevalent wind direction is from the SE, next highest is from the ESE. This is one reason for the lower doses assigned to residents in the WNW, NW, and NNW sectors.

FIGURE 10.2 HISTORICAL COMPARISON OF NEAREST MILK ANIMAL DOSE

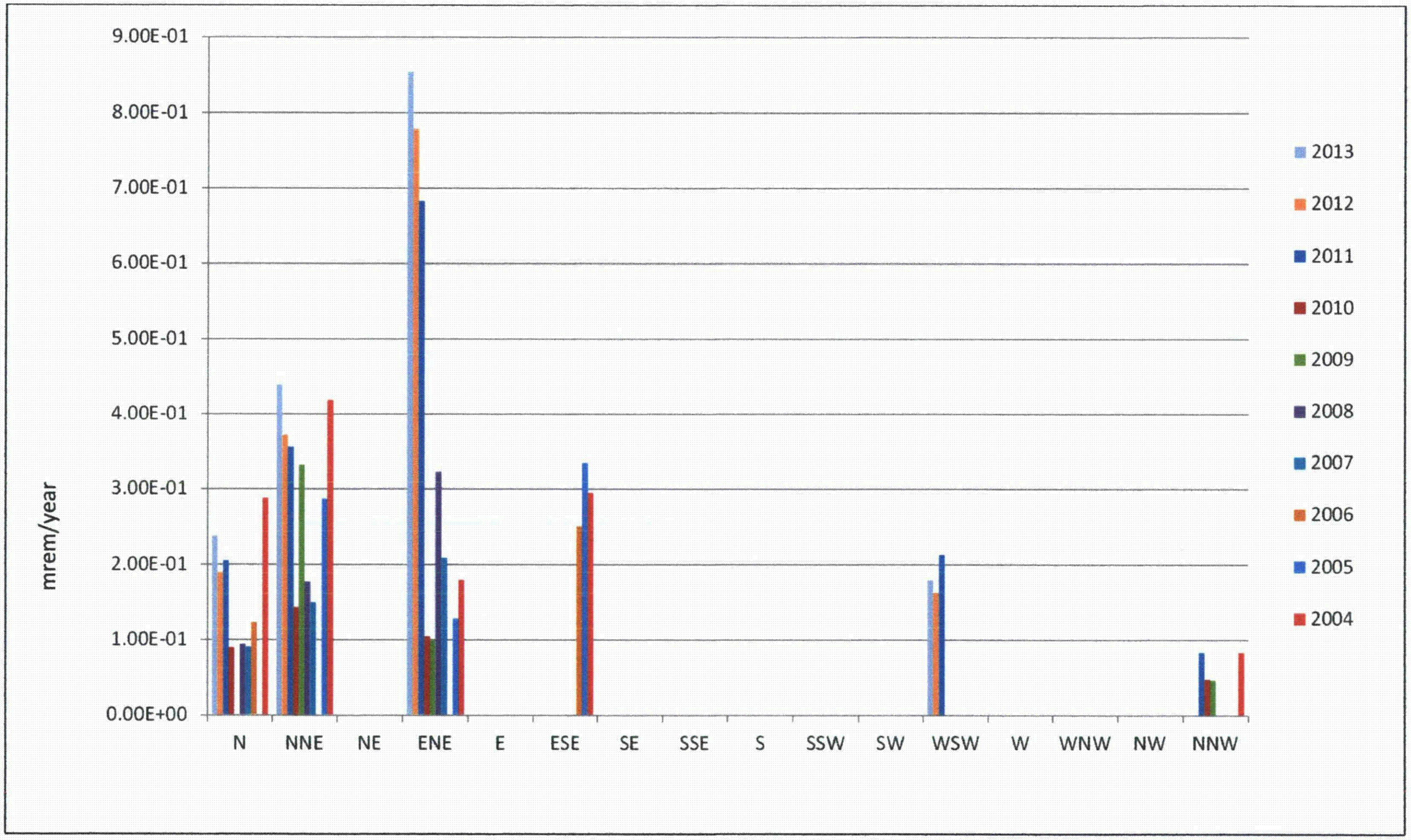


Milk animals include goats and/or cows. Several new milk animals were identified in 2009 that were closer to the power plant than in the past, resulting in generally higher calculated doses in that calendar year.

In 2002 and 2004 the combination of meteorology, milk animal proximity to the plant, and gaseous effluent releases resulted in higher calculated doses in the NNE and NE sectors.

No milk samples have indicated any plant related radionuclides. Additionally, milk animals in the desert environment are normally fed stored feed and are not on pasture. The calculated doses are conservative since they include pastured feed as part of the calculation.

FIGURE 10.3 HISTORICAL COMPARISON OF NEAREST GARDEN DOSE



Gardens were sporadically identified from year to year. Gardening is not prevalent in the desert environment. In 2001 and 2002 the combination of meteorology, garden proximity to the plant, and gaseous effluent releases resulted in higher calculated doses in the NE and ESE sectors.

11. Summary and Conclusions

The conclusions are based on a review of the radio assay results and environmental gamma radiation measurements for the 2013 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2013 are presented in Tables 8.1-8.12 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 identified in the Evaporation Ponds, WRF Influent, WRF Centrifuge sludge, and Reservoirs is the result of offsite sources and appears 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 permitted gaseous effluent releases and secondary plant releases. These concentrations are consistent with historical values.

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

There was no measurable radiological impact on the environment in 2013 resulting from the operation of PVNGS.

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station Docket Nos. STN 50-528/529/530

Maricopa County, Arizona Calendar Year 2013

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 (mrem/std. qtr.)	TLD - 200	NA	30.5 (188/188)	Site #35	30.5 (4/4)	24.9 (8/8)	0
			15.7 – 32.5	8 miles 330°	26.1 – 32.5	20.3 - 28.2	
Air Particulates (pCi/m^3)	Gross Beta - 519	0.01	0.035 (467/467)	Site #7A	0.037 (52/52)	0.036 (52/52)	0
			0.013 - 0.077	3 miles 124°	0.017 - 0.061	0.016 - 0.077	
	Gamma Spec Composite - 40						
	Cs-134 (quarterly)	0.05	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-137 (quarterly)	0.06	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	

Air Radioiodine (pCi/m^3)	Gamma Spec. - 519						
	I-131	0.07	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 10						
	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)	H-3 – 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
	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

	Gross Beta – 48	4	4.0 (27/48) 2.7 – 10.0	Site #55 3 miles 214°	5.5 (11/12) 3.2 – 10.0	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 48						
Drinking Water (pCi/liter)	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
	Gamma Spec. – 27						
Milk	I-131	1	<LLD	NA	<LLD	<LLD	0
(pCi/liter)			<LLD	NA	<LLD	<LLD	
	Cs-134	15	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-137	18	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Ba-140	60	<LLD	NA	<LLD	<LLD	0
	La-140	15	<LLD	NA	<LLD	<LLD	0

	Gamma Spec. - 30						
	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	32 (6/30)	Site #59	43 (2/4)	NA	0
			20 - 43	Onsite 180°	43 - 43		
	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
	H-3 - 20	3000	903 (23/30)	Site #63	1045 (4/4)	NA	0
			421 - 1290	Onsite 180°	895 - 1245		

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

NOTE: Miscellaneous samples that 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. 1985-2012 Annual Radiological Environmental Operating Reports, Palo Verde Nuclear Generating Station
3. Palo Verde Nuclear Generating Station Technical Specifications and Technical Reference Manual
4. Offsite Dose Calculation Manual, Revision 26, PVNGS Units 1, 2, and 3
5. Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants
6. Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants
7. NRC Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 (Incorporated into NUREG-1301)
8. NEI 07-07, Nuclear Energy Institute, Industry Ground Water Protection Initiative – Final Guidance Document, August 2007