aps

Technical Specification 5.6.2

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

102-06695-TNW/RKR/KAR
April 26, 2013

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 2012

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2012.

No new commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Robert Roehler, Licensing Section Leader, at (623) 393-5241.

Sincerely,

Thomas N. Weber
Department Leader, Regulatory Affairs

TNW/RKR/KAR/hsc

Enclosure

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IE25
NRR

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2012

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

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ABSTRACT

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

During 2012, 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 2012. 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, ground water, 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 Eberline Analytical Services.

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 2012

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 2012, 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.

1. The 45 acre Reservoir exceeded the 1st quarter I-131 reporting level of 20 pCi/liter.

2. The 45 acre Reservoir exceeded the 2nd quarter I-131 reporting level of 20 pCi/liter.

3. The 85 acre Reservoir exceeded the 2nd quarter I-131 reporting level of 20 pCi/liter.

4. Air sample site #21 data was invalid

5. Resident well water Site #55 was out of service for a week in April.

6. Milk sample from Site #51 not available for December 2012.

7. Missing TLDs at location 22 for 4th quarter.

2.4. Ground Water Protection

NOTE:

Although not part of the REMP, this information is being provided due to the identification of low level tritium in the onsite environs (within the Radiological Controlled Area) and heightened sensitivity to communicate the potential to affect ground water.

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. PVNGS is working with the Arizona Department of Environmental Quality (ADEQ) to prevent this tritiated water from affecting the local aquifer.

PVNGS has implemented a ground water 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 ground water will not be adversely affected by PVNGS operations.

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 ground water. 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

(b) Denotes a change in location or a new sample location

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

Table 2.2 SAMPLE COLLECTION SCHEDULE

SAMPLE SITE #	*AIR PARTICULATE*	*MILK*	*AIRBORNE RADIOIODINE*	*VEGETATION*	*GROUND WATER*	*DRINKING WATER*	*SURFACE WATER*
4	W		W				
6A	W		W				
7A	W		W				
14A	W		W				
15	W		W				
17A	W		W				
21	W		W				
29	W		W				
35	W		W				
40	W		W				
46						W	
47				M/AA			
48						W	
49						W	
51		M/AA					
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

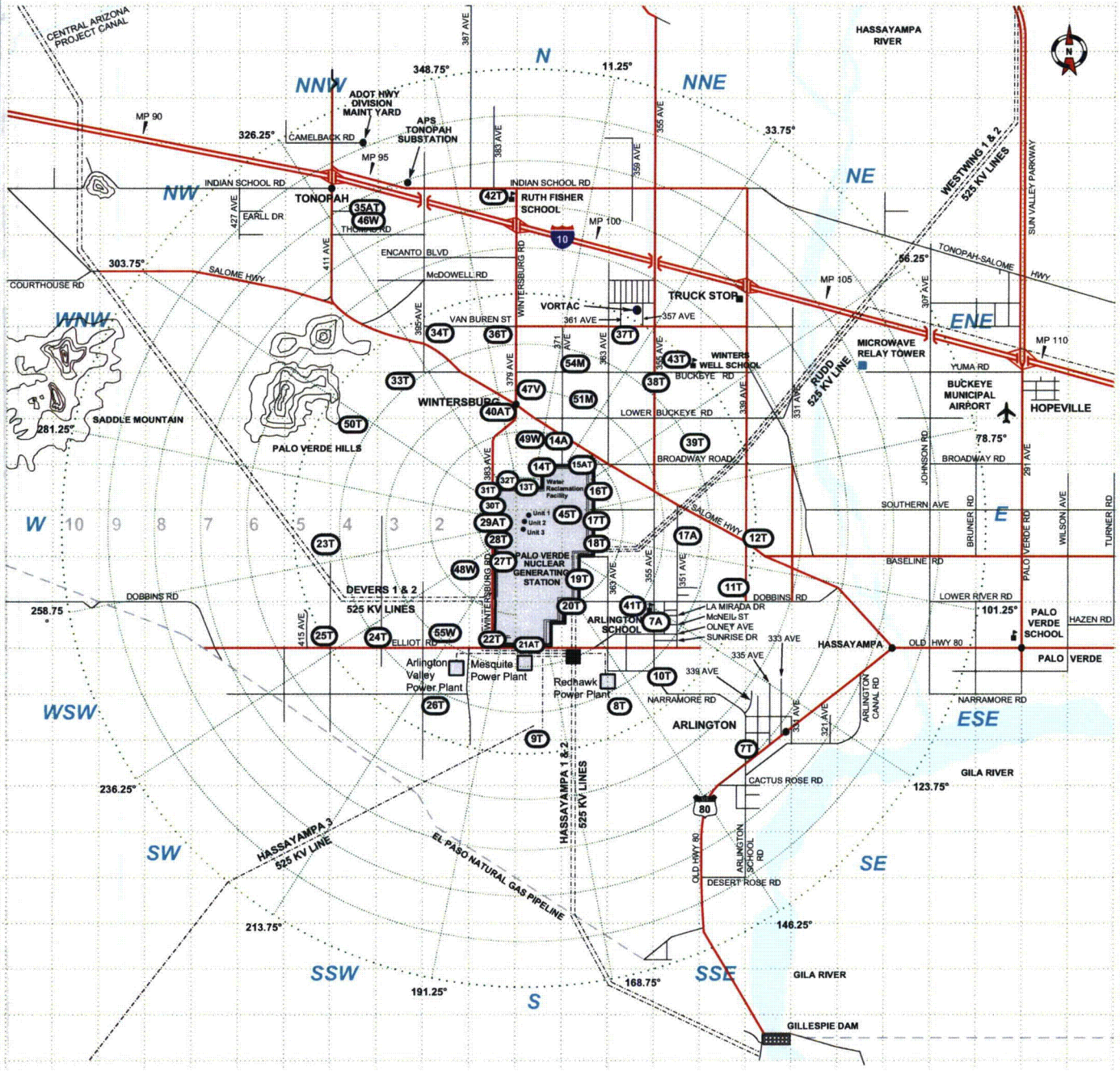
W = WEEKLY M/AA = MONTHLY AS AVAILABLE Q = QUARTERLY

TABLE 2.3 SUMMARIES OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. The 45 acre Reservoir exceeded the 1st quarter I-131 reporting level of 20 pCi/liter.	1. The initial sample result was 20 ± 10 pCi/liter. The verification analysis result was 21 ± 11 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. Refer to Corrective Action Program document CRDR 4051062 for the evaluation of exceeding the ODCM Reporting Level.
2. The 45 acre reservoir exceeded the 2nd quarter I-131 reporting level of 20pCi/liter.	2. The initial sample result was 50 ± 14 pCi/liter. The verification analysis result was 38 ± 12 pCi/liter. The elevated I-131 concentration is due to the radiopharmaceutical I-131 that is present in the reclaimed sewage water that supplies the Circulating Water and is not the result of the plant effluents. Refer to Corrective Action Program document CRDR 4051062 for the evaluation of exceeding the ODCM Reporting Level
3. The 85 acre Reservoir exceeded the 2nd quarter I-131 reporting level of 20pCi/liter.	3. The initial sample result was 32 ± 15 pCi/liter. The verification analysis result was 34 ± 10 pCi/liter. The elevated I-131 concentration is due to the radiopharmaceutical I-131 that is present in the reclaimed sewage water that supplies the Circulating Water and is not the result of the plant effluents. Refer to Corrective Action Program document CRDR 4051062 for the evaluation of exceeding the ODCM Reporting Level
4. Air sample site #21 data was invalid.	4. The results for the weekly air filter gross beta Radiological Environmental Monitoring Program (REMP) air sample taken at Site 21 on 5-15-12 was much lower than expected. The gross beta counts per minute (cpm) are 9.4 for Site 21 in comparison to a range of 13.3 to 14.8 cpm for the other 9 samples. The calculated Relative Standard Deviation (RSD) for the sample set with Site 21 included is 15.6; with Site 21 excluded the RSD is 8.5. Corrective Action Program CRDR 4172123 initiated for evaluation but cause was indeterminate. Meteorology data indicated that there were winds in excess of 45 mph on 5/9/12.
5. Resident well water Site #55 was out of service.	5. The resident well at Site #55 was out of service from 4/3/12 to 4/10/12. The monthly composite sample only includes weeks 4/17/12 and 4/24/12.

6. Milk sample from Site #51 not available	6. The resident at Site #51 was not available to provide a monthly goat milk sample on 12/14/2012.
7. Missing TLDs at location 22 for 4th quarter	7. The TLDs used for monitoring location 22 (SSW site boundary - corner of Wintersburg and Elliott) were missing at the time of exchange. This was most likely due to road grading in this area. All TLD results appear normal. This is reflected in Table 9.2 ENVINRONMENTAL TLD RESULTS.

FIGURE 2.1

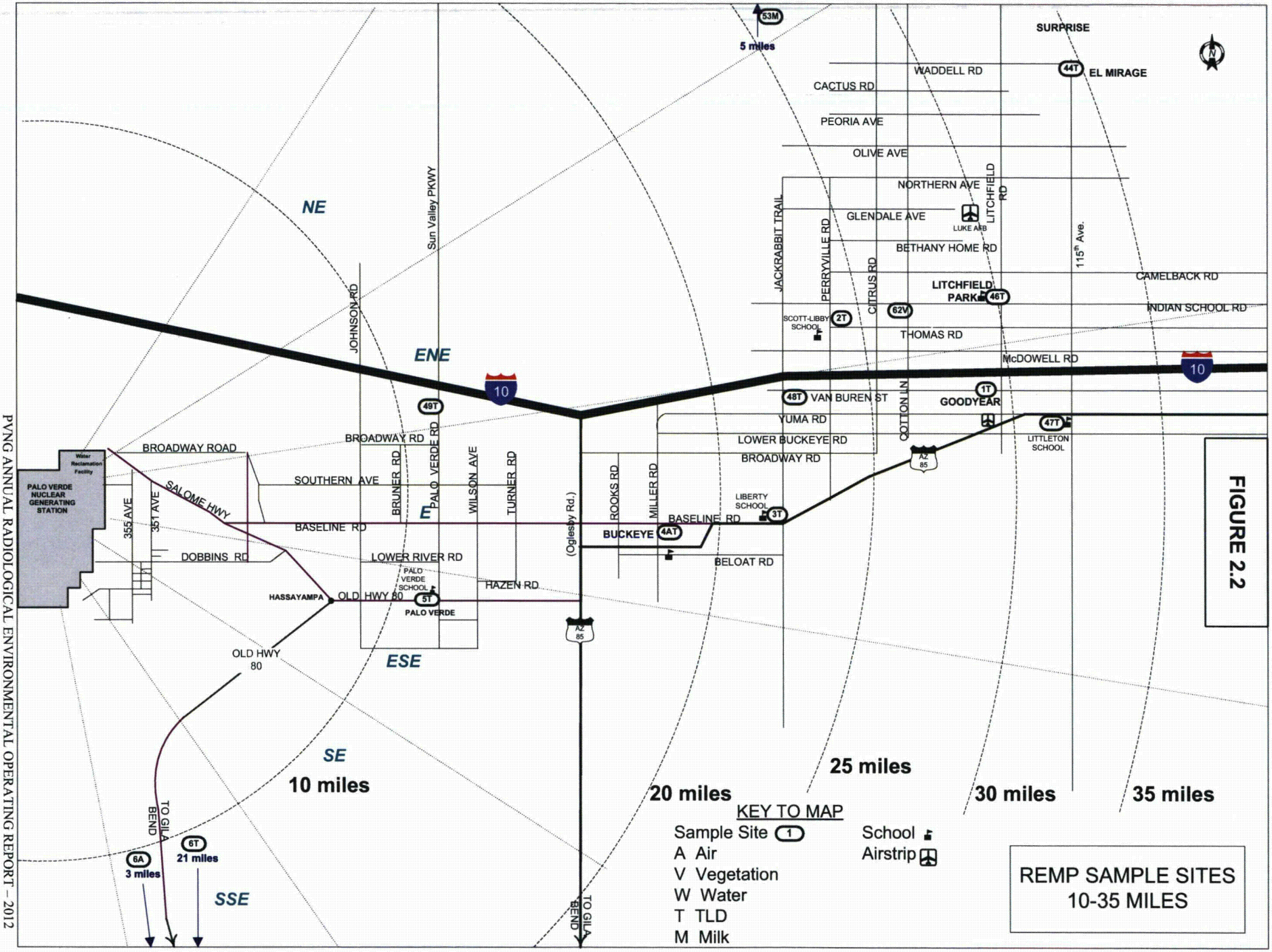


KEY TO MAP

Sample Site (1)
A Air
V Vegetation
W Water
T TLD
M Milk

School
Airstrip

REMP SAMPLE SITES
0-10 MILES


NE
ENE
E
ESE
SE
SSE
5 miles
10 miles
20 miles
25 miles
30 miles
35 miles
PALO VERDE NUCLEAR GENERATING STATION
Water Reclamation Facility
SALOME HWY
BROADWAY ROAD
SOUTHERN AVE
BASELINE RD
DOBBINS RD
LOWER RIVER RD
OLD HWY 80
HASSAYAMPA
PALO VERDE
PALO VERDE SCHOOL
OLD HWY 80
TO GILA BEND
3 miles
21 miles
355 AVE
351 AVE
JOHNSON RD
Sun Valley PKWY
BRUNER RD
PALO VERDE RD
WILSON AVE
TURNER RD
HAZEN RD
(Oglesby Rd.)
ROOKS RD
MILLER RD
BROADWAY RD
BASELINE RD
BUCKEYE
BELOAT RD
LIBERTY SCHOOL
LOWER BUCKEYE RD
YUMA RD
VAN BUREN ST
GOODYEAR
LITTLETON SCHOOL
COTTON LN
JACKRABBIT TRAIL
PERRYVILLE RD
CITRUS RD
LITCHFIELD RD
115th Ave.
LUKE AFB
GLENDALE AVE
NORTHERN AVE
OLIVE AVE
PEORIA AVE
CACTUS RD
WADDELL RD
SURPRISE
EL MIRAGE
BETHANY HOME RD
LITCHFIELD PARK
SCOTT-LIBBY SCHOOL
THOMAS RD
McDOWELL RD
CAMELBACK RD
INDIAN SCHOOL RD
AZ 85
10
KEY TO MAP
Sample Site (1)
A Air
V Vegetation
W Water
T TLD
M Milk
School
Airstrip
REMP SAMPLE SITES
10-35 MILES
FIGURE 2.2

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 1/2A/2B/3A/3B, 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.

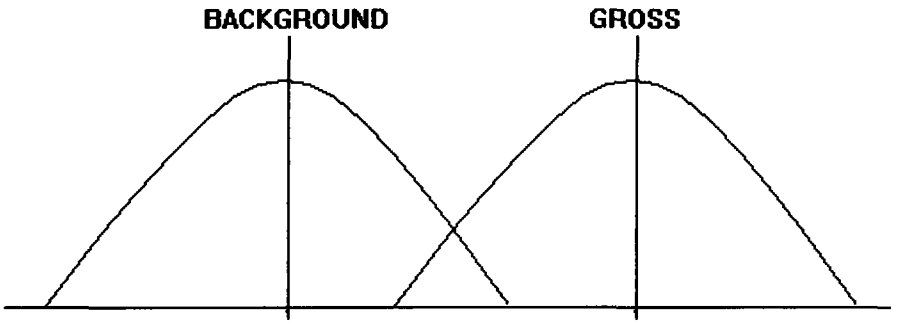
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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/m^3)	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	1.9		*0.003*	
H-3	289			
Mn-54	11			
Fe-59	18			
Co-58	10			
Co-60	11			
Zn-65	25			
Zr-95	18			
Nb-95	10			
I-131	9	1	0.05	43
Cs-134	10	1	0.02	56
Cs-137	11	1	0.02	49
Ba-140	34	4		
La-140	13	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 2012, 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 Type	Analysis Type	Nuclide	Known Value**	PVNGS Value	1 sigma Error	Resolution*	Ratio	Acceptable?
Milk	Mixed Gamma E10008	I-131	1.72E+01	1.74E+01	1.02E+00	17	1.01	YES
		Ce-141	4.65E+01	4.84E+01	2.17E+00	22	1.04	YES
		Cr-51	7.80E+01	8.22E+01	5.35E+00	15	1.05	YES
		Cs-134	2.67E+01	2.57E+01	1.25E+00	21	0.96	YES
		Cs-137	2.84E+01	3.08E+01	1.46E+00	21	1.08	YES
		Co-58	2.36E+01	2.42E+01	1.34E+00	18	1.03	YES
		Mn-54	3.49E+01	3.85E+01	2.06E+00	19	1.10	YES
		Fe-59	3.00E+01	3.28E+01	1.97E+00	17	1.09	YES
		Zn-65	5.95E+01	6.39E+01	3.11E+00	21	1.07	YES
		Co-60	4.98E+01	5.46E+01	2.42E+00	23	1.10	YES
Air	Mixed Gamma E10007	Ce-141	1.83E+02	1.85E+02	8.00E+00	23	1.01	YES
		Cr-51	3.06E+02	3.38E+02	2.22E+01	15	1.10	YES
		Cs-134	1.05E+02	9.43E+01	4.97E+00	19	0.90	YES
		Cs-137	1.12E+02	1.19E+02	6.10E+00	20	1.06	YES
		Co-58	9.27E+01	9.95E+01	5.37E+00	19	1.07	YES
		Mn-54	1.37E+02	1.56E+02	7.70E+00	20	1.14	YES
		Fe-59	1.18E+02	1.36E+02	9.00E+00	15	1.15	YES
		Zn-65	2.34E+02	2.58E+02	1.28E+01	20	1.10	YES
		Co-60	1.96E+02	2.10E+02	9.30E+00	23	1.07	YES
Water	Mixed Gamma E10005	I-131	9.38E+01	9.58E+01	5.38E+00	18	1.02	YES
		Ce-141	1.84E+02	1.95E+02	7.70E+00	25	1.06	YES
		Cr-51	3.09E+02	2.78E+02	2.73E+01	10	0.90	YES
		Cs-134	1.06E+02	9.69E+01	4.60E+00	21	0.91	YES
		Cs-137	1.13E+02	1.19E+02	5.20E+00	23	1.05	YES
		Co-58	9.34E+01	9.67E+01	4.68E+00	21	1.04	YES
		Mn-54	1.38E+02	1.47E+02	6.40E+00	23	1.07	YES
		Fe-59	1.19E+02	1.45E+02	9.50E+00	15	1.22	YES
		Zn-65	2.35E+02	2.52E+02	1.15E+01	22	1.07	YES
		Co-60	1.97E+02	2.08E+02	8.00E+00	26	1.06	YES
Water	Mixed Gamma E10226	I-131	9.99E+01	9.70E+01	8.26E+00	12	0.97	YES
		Ce-141	2.51E+02	2.32E+02	1.15E+01	20	0.92	YES
		Cr-51	3.80E+02	3.82E+02	3.60E+01	11	1.01	YES
		Cs-134	1.66E+02	1.60E+02	9.50E+00	17	0.96	YES
		Cs-137	2.67E+02	2.61E+02	1.46E+01	18	0.98	YES
		Co-58	1.54E+02	1.53E+02	9.40E+00	16	0.99	YES
		Mn-54	3.00E+02	3.12E+02	1.61E+01	19	1.04	YES
		Fe-59	2.33E+02	2.50E+02	1.64E+01	15	1.07	YES
		Zn-65	2.95E+02	2.73E+02	1.81E+01	15	0.93	YES
		Co-60	2.33E+02	2.46E+02	1.26E+01	20	1.06	YES

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample Type	Analysis Type	Nuclide	Known Value**	PVNGS Value	1 sigma Error	Resolution*	Ratio	Acceptable?
Air	Gamma Filter E10229	Ce-141	1.33E+02	1.40E+02	6.00E+00	23	1.05	YES
		Cr-51	2.02E+02	2.12E+02	1.69E+01	13	1.05	YES
		Cs-134	8.81E+01	7.87E+01	4.45E+00	18	0.89	YES
		Cs-137	1.42E+02	1.49E+02	7.70E+00	19	1.05	YES
		Co-58	8.18E+01	8.88E+01	5.14E+00	17	1.09	YES
		Mn-54	1.59E+02	1.78E+02	9.30E+00	19	1.12	YES
		Fe-59	1.24E+02	1.56E+02	9.40E+00	17	1.26	YES
		Zn-65	1.57E+02	1.82E+02	1.00E+01	18	1.16	YES
		Co-60	1.24E+02	1.33E+02	6.40E+00	21	1.07	YES
Air	Cartridge E10006	I-131	9.26E+01	9.95E+01	3.34E+00	30	1.07	YES
Water	Gross Beta E10224	G. Beta	2.51E+02	3.04E+02	6.35E+00	48	1.21	YES
Water	Tritium E10225	H-3	1.30E+04	1.24E+04	3.45E+02	36	0.95	YES
Air	Gross Beta E10227	G. Beta	8.87E+01	1.08E+02	2.47E+00	44	1.22	YES
Air	Cartridge E10228	I-131	9.68E+01	9.74E+01	3.91E+00	25	1.01	YES

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

NRC Acceptance Criteria [1]

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

[1] From NRC Inspection Manual, procedure #84750, "Radioactive Waste Systems; Water Chemistry; Confirmatory Measurements"

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample Type	Analysis Type	Nuclide	PVNGS Value	Assigned Value [1]	Acceptance Limit [2]	Results
Water	Tritium	H-3	16,500[3]	19,200	16,800 - 21,100	Acceptable
RAD-88 ERA STUDY						
Water	Gross Beta	g beta	35.1	36.8	24.2 - 44.4	Acceptable
RAD-90 ERA STUDY						
Filter	Gross Beta	g beta	67.3	52.5	33.2 - 76.5	Acceptable
MRAD-16 ERA STUDY						

[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.

[3] PVNGS failed the RAD-88 ERA STUDY (outside of range). This was documented in PVAR 4111670 and the subsequent corrective actions were taken to recalibrate the liquid scintillation counter.

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 2012 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 0.019 to 0.069 pCi/m^3. The associated counting error ranged from 0.001 to 0.004 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 display the results of gamma spectroscopy on the quarterly composite samples.

8.2. Airborne Radioiodine

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

8.3. Vegetation

Table 8.6 presents gamma isotopic data for the vegetation samples. No Gamma emitting 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 7.6 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 8.11. I-131 was observed in Evaporation Pond 2B in one (1) sample (34 pCi/liter). The 45 acre Reservoir observed two (2) I-131 samples (21 pCi/liter and 50 pCi/liter). The 85 acre reservoir observed one (1) I-131 sample (32 pCi/liter). 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 1350 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 10 to 50 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.

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 162 to 2013 pCi/kg.

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 3 Cooling Towers and Circulating Water canals was disposed of in the WRF sludge landfill during 2012. Sample results can be found in Table 8.11.

8.9. Data Trends

Figures 8.1-8.7 present data in graphical format. Historical data are displayed for comparison where practical.

TABLE 8.1 PARTICULATE GROSS BETA IN 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*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
1	27-Dec-11	3-Jan-12	0.059	0.063	0.058	0.054	0.059	0.054	0.054	0.057	0.051	0.055	0.056	6.3
2	3-Jan-12	10-Jan-12	0.047	0.053	0.047	0.043	0.045	0.046	0.042	0.043	0.043	0.043	0.045	7.0
3	10-Jan-12	17-Jan-12	0.044	0.046	0.047	0.044	0.045	0.042	0.039	0.044	0.042	0.042	0.043	5.4
4	17-Jan-12	24-Jan-12	0.028	0.034	0.032	0.028	0.032	0.026	0.026	0.030	0.030	0.029	0.029	9.2
5	24-Jan-12	31-Jan-12	0.035	0.039	0.035	0.035	0.036	0.031	0.031	0.033	0.032	0.031	0.034	7.9
6	31-Jan-12	7-Feb-12	0.048	0.054	0.050	0.051	0.056	0.054	0.048	0.053	0.052	0.051	0.052	5.1
7	7-Feb-12	13-Feb-12	0.050	0.052	0.047	0.051	0.049	0.050	0.047	0.049	0.048	0.049	0.049	3.3
8	13-Feb-12	21-Feb-12	0.025	0.026	0.025	0.027	0.028	0.026	0.025	0.026	0.025	0.028	0.026	4.6
9	21-Feb-12	28-Feb-12	0.031	0.033	0.035	0.034	0.032	0.035	0.032	0.033	0.031	0.031	0.033	4.8
10	28-Feb-12	6-Mar-12	0.024	0.026	0.025	0.024	0.025	0.024	0.023	0.023	0.025	0.023	0.024	4.3
11	6-Mar-12	13-Mar-12	0.035	0.034	0.037	0.037	0.040	0.038	0.034	0.034	0.037	0.034	0.036	5.9
12	13-Mar-12	20-Mar-12	0.027	0.026	0.029	0.027	0.028	0.028	0.024	0.027	0.025	0.025	0.027	5.9
13	20-Mar-12	27-Mar-12	0.028	0.028	0.027	0.028	0.029	0.026	0.026	0.026	0.024	0.024	0.027	6.4
Mean			0.037	0.040	0.038	0.037	0.039	0.037	0.035	0.037	0.036	0.036	0.037	3.9

2nd Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
14	27-Mar-12	3-Apr-12	0.027	0.029	0.027	0.027	0.026	0.029	0.026	0.025	0.023	0.025	0.026	7.0
15	3-Apr-12	10-Apr-12	0.043	0.042	0.045	0.039	0.042	0.040	0.037	0.038	0.039	0.040	0.041	6.1
16	10-Apr-12	17-Apr-12	0.023	0.021	0.020	0.022	0.021	0.022	0.021	0.019	0.019	0.023	0.021	6.9
17	17-Apr-12	24-Apr-12	0.040	0.040	0.034	0.035	0.041	0.039	0.036	0.037	0.035	0.037	0.037	6.6
18	24-Apr-12	1-May-12	0.030	0.030	0.029	0.029	0.030	0.030	0.026	0.028	0.029	0.028	0.029	4.5
19	1-May-12	8-May-12	0.038	0.042	0.039	0.036	0.040	0.040	0.036	0.037	0.040	0.036	0.038	5.5
20	8-May-12	15-May-12	0.045	0.051	0.043	0.039	0.045	0.043	invalid [a]	0.041	0.044	0.039	0.043	8.5
21	15-May-12	22-May-12	0.043	0.044	0.042	0.042	0.045	0.043	0.039	0.041	0.041	0.039	0.042	4.7
22	22-May-12	29-May-12	0.026	0.023	0.026	0.025	0.025	0.026	0.024	0.025	0.023	0.025	0.025	4.6
23	29-May-12	5-Jun-12	0.040	0.038	0.043	0.040	0.044	0.045	0.038	0.039	0.038	0.036	0.040	7.4
24	5-Jun-12	12-Jun-12	0.025	0.027	0.031	0.027	0.031	0.027	0.026	0.025	0.026	0.027	0.027	7.9
25	12-Jun-12	19-Jun-12	0.028	0.029	0.027	0.029	0.031	0.031	0.023	0.027	0.029	0.026	0.028	8.6
26	19-Jun-12	26-Jun-12	0.034	0.036	0.033	0.031	0.033	0.034	0.028	0.031	0.033	0.030	0.032	7.2
Mean			0.034	0.035	0.034	0.032	0.035	0.035	0.030	0.032	0.032	0.032	0.033	5.0

(a) Site 21 results were invalidated due to anomalous result (0.026 pCi/m³).
Corrective Action Program CRDR 4171246 initiated for evaluation but cause was indeterminate.

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	26-Jun-12	2-Jul-12	0.033	0.033	0.037	0.033	0.036	0.035	0.033	0.033	0.033	0.032	0.034	4.8
28	2-Jul-12	10-Jul-12	0.038	0.034	0.035	0.036	0.036	0.039	0.029	0.035	0.034	0.033	0.035	7.9
29	10-Jul-12	17-Jul-12	0.029	0.033	0.031	0.030	0.031	0.034	0.027	0.031	0.035	0.031	0.031	7.5
30	17-Jul-12	24-Jul-12	0.038	0.036	0.034	0.036	0.037	0.039	0.033	0.034	0.034	0.035	0.036	5.5
31	24-Jul-12	30-Jul-12	0.033	0.029	0.034	0.031	0.034	0.032	0.031	0.033	0.034	0.032	0.032	5.1
32	30-Jul-12	7-Aug-12	0.041	0.033	0.041	0.042	0.045	0.045	0.037	0.036	0.043	0.040	0.040	9.7
33	7-Aug-12	14-Aug-12	0.044	0.046	0.045	0.044	0.045	0.044	0.037	0.044	0.042	0.042	0.043	5.9
34	14-Aug-12	21-Aug-12	0.027	0.025	0.027	0.028	0.030	0.028	0.026	0.027	0.029	0.028	0.028	5.2
35	21-Aug-12	28-Aug-12	0.025	0.026	0.027	0.025	0.025	0.025	0.024	0.023	0.025	0.025	0.025	4.2
36	28-Aug-12	4-Sep-12	0.037	0.036	0.038	0.038	0.038	0.038	0.033	0.039	0.040	0.039	0.038	5.2
37	4-Sep-12	11-Sep-12	0.031	0.035	0.034	0.033	0.034	0.036	0.029	0.034	0.033	0.032	0.033	6.1
38	11-Sep-12	18-Sep-12	0.042	0.045	0.040	0.043	0.044	0.043	0.035	0.041	0.040	0.043	0.042	6.8
39	18-Sep-12	25-Sep-12	0.066	0.069	0.067	0.062	0.069	0.067	0.064	0.067	0.064	0.067	0.066	3.4
Mean			0.037	0.037	0.038	0.037	0.039	0.039	0.034	0.037	0.037	0.037	0.037	3.8

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	25-Sep-12	2-Oct-12	0.057	0.059	0.051	0.058	0.064	0.052	0.052	0.064	0.060	0.060	0.058	7.8
41	2-Oct-12	9-Oct-12	0.064	0.053	0.064	0.051	0.067	0.067	0.056	0.059	0.057	0.058	0.060	9.8
42	9-Oct-12	16-Oct-12	0.030	0.034	0.039	0.038	0.039	0.037	0.035	0.034	0.038	0.035	0.036	7.9
43	16-Oct-12	25-Oct-12	0.042	0.041	0.040	0.043	0.045	0.046	0.038	0.046	0.041	0.043	0.043	6.2
44	25-Oct-12	30-Oct-12	0.045	0.045	0.048	0.045	0.044	0.044	0.042	0.047	0.043	0.041	0.044	4.9
45	30-Oct-12	6-Nov-12	0.066	0.067	0.062	0.062	0.064	0.061	0.052	0.059	0.064	0.045	0.060	11.3
46	6-Nov-12	13-Nov-12	0.034	0.037	0.036	0.034	0.034	0.040	0.032	0.036	0.033	0.034	0.035	6.2
47	13-Nov-12	19-Nov-12	0.061	0.063	0.061	0.055	0.058	0.055	0.045	0.058	0.054	0.059	0.057	9.0
48	19-Nov-12	27-Nov-12	0.050	0.061	0.056	0.051	0.051	0.054	0.047	0.055	0.049	0.054	0.053	7.7
49	27-Nov-12	4-Dec-12	0.050	0.047	0.048	0.050	0.050	0.511	0.045	0.045	0.046	0.045	0.094	156.5
50	4-Dec-12	11-Dec-12	0.047	0.051	0.044	0.041	0.042	0.043	0.037	0.038	0.040	0.040	0.042	10.4
51	11-Dec-12	18-Dec-12	0.023	0.021	0.023	0.022	0.022	0.024	0.020	0.023	0.021	0.022	0.022	4.9
52	18-Dec-12	25-Dec-12	0.045	0.047	0.046	0.042	0.044	0.045	0.038	0.042	0.040	0.039	0.043	7.0
	Mean		0.047	0.048	0.048	0.046	0.048	0.083	0.041	0.047	0.045	0.044	0.050	23.9
	Annual Average		***0.0389***	***0.0398***	***0.0393***	***0.0380***	***0.0401***	***0.0483***	***0.0351***	***0.0379***	***0.0376***	***0.0371***	***0.039***	***9.0***

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*
27-Mar-12	Cs-134	<0.0013	<0.0030	<0.0039	<0.0013	<0.0034	<0.0023	<0.0037	<0.0019	<0.0024	<0.0018
	Cs-137	<0.0027	<0.0037	<0.0046	<0.0023	<0.0011	<0.0033	<0.0059	<0.0016	<0.0053	<0.0026
26-Jun-12	Cs-134	<0.0025	<0.0025	<0.0042	<0.0017	<0.0040	<0.0021	<0.0038	<0.0025	<0.0036	<0.0016
	Cs-137	<0.0030	<0.0011	<0.0036	<0.0020	<0.0050	<0.0008	<0.0051	<0.0020	<0.0022	<0.0009
25-Sep-12	Cs-134	<0.0090	<0.0030	<0.0018	<0.0016	<0.0037	<0.0017	<0.0008	<0.0018	<0.0042	<0.0019
	Cs-137	<0.0030	<0.0020	<0.0036	<0.0023	<0.0011	<0.0016	<0.0028	<0.0026	<0.0037	<0.0029
31-Dec-12	Cs-134	<0.0026	<0.0034	<0.0035	<0.0020	<0.0021	<0.0021	<0.0027	<0.0020	<0.0028	<0.0016
	Cs-137	<0.0024	<0.0045	<0.0023	<0.0020	<0.0035	<0.0019	<0.0045	<0.0015	<0.0030	<0.0022

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	Site 6A* (control)	Site 7A	Site 14A*	Site 15* required LLD <0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
1	27-Dec-11	3-Jan-12	<0.027	<0.024	<0.026	<0.038	<0.027	<0.026	<0.029	<0.031	<0.021	<0.029
2	3-Jan-12	10-Jan-12	<0.032	<0.045	<0.063	<0.030	<0.060	<0.037	<0.028	<0.057	<0.045	<0.029
3	10-Jan-12	17-Jan-12	<0.047	<0.036	<0.032	<0.053	<0.034	<0.035	<0.024	<0.059	<0.025	<0.052
4	17-Jan-12	24-Jan-12	<0.025	<0.064	<0.048	<0.029	<0.067	<0.020	<0.046	<0.024	<0.062	<0.032
5	24-Jan-12	31-Jan-12	<0.040	<0.055	<0.060	<0.021	<0.048	<0.033	<0.037	<0.033	<0.048	<0.035
6	31-Jan-12	7-Feb-12	<0.057	<0.026	<0.055	<0.031	<0.051	<0.027	<0.043	<0.034	<0.013	<0.032
7	7-Feb-12	13-Feb-12	<0.050	<0.040	<0.063	<0.051	<0.039	<0.064	<0.064	<0.059	<0.065	<0.063
8	13-Feb-12	21-Feb-12	<0.064	<0.020	<0.056	<0.058	<0.053	<0.034	<0.043	<0.026	<0.048	<0.028
9	21-Feb-12	28-Feb-12	<0.042	<0.023	<0.065	<0.035	<0.049	<0.034	<0.042	<0.034	<0.049	<0.045
10	28-Feb-12	6-Mar-12	<0.031	<0.051	<0.048	<0.031	<0.046	<0.029	<0.061	<0.026	<0.070	<0.027
11	6-Mar-12	13-Mar-12	<0.029	<0.060	<0.066	<0.020	<0.048	<0.047	<0.038	<0.038	<0.056	<0.020
12	13-Mar-12	20-Mar-12	<0.053	<0.052	<0.024	<0.052	<0.033	<0.047	<0.019	<0.060	<0.032	<0.039
13	20-Mar-12	27-Mar-12	<0.025	<0.054	<0.063	<0.035	<0.047	<0.020	<0.062	<0.035	<0.046	<0.029

2nd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15* required LLD <0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
14	27-Mar-12	3-Apr-12	<0.046	<0.033	<0.065	<0.031	<0.053	<0.029	<0.041	<0.026	<0.049	<0.026
15	3-Apr-12	10-Apr-12	<0.036	<0.048	<0.066	<0.032	<0.049	<0.033	<0.037	<0.029	<0.062	<0.033
16	10-Apr-12	17-Apr-12	<0.062	<0.025	<0.053	<0.031	<0.061	<0.029	<0.045	<0.028	<0.059	<0.033
17	17-Apr-12	24-Apr-12	<0.061	<0.063	<0.040	<0.041	<0.043	<0.050	<0.043	<0.052	<0.008	<0.031
18	24-Apr-12	1-May-12	<0.029	<0.035	<0.027	<0.042	<0.025	<0.034	<0.069	<0.031	<0.047	<0.032
19	1-May-12	8-May-12	<0.031	<0.048	<0.041	<0.025	<0.058	<0.034	<0.052	<0.022	<0.043	<0.025
20	8-May-12	15-May-12	<0.048	<0.059	<0.047	<0.062	<0.044	<0.060	<0.034	<0.040	<0.029	<0.066
21	15-May-12	22-May-12	<0.062	<0.028	<0.032	<0.062	<0.030	<0.039	<0.030	<0.044	<0.036	<0.057
22	22-May-12	29-May-12	<0.042	<0.043	<0.062	<0.034	<0.068	<0.028	<0.042	<0.023	<0.065	<0.027
23	29-May-12	5-Jun-12	<0.028	<0.052	<0.058	<0.029	<0.044	<0.026	<0.035	<0.020	<0.064	<0.007
24	5-Jun-12	12-Jun-12	<0.025	<0.018	<0.066	<0.035	<0.036	<0.030	<0.049	<0.032	<0.056	<0.031
25	12-Jun-12	19-Jun-12	<0.030	<0.057	<0.058	<0.035	<0.059	<0.024	<0.055	<0.032	<0.047	<0.019
26	19-Jun-12	26-Jun-12	<0.032	<0.045	<0.052	<0.028	<0.054	<0.033	<0.043	<0.034	<0.052	<0.033

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	Site 6A* (control)	Site 7A	Site 14A*	Site 15* required LLD <0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
27	26-Jun-12	2-Jul-12	<0.029	<0.059	<0.057	<0.031	<0.052	<0.031	<0.064	<0.038	<0.068	<0.023
28	2-Jul-12	10-Jul-12	<0.034	<0.039	<0.044	<0.023	<0.048	<0.028	<0.032	<0.027	<0.051	<0.022
29	10-Jul-12	17-Jul-12	<0.049	<0.055	<0.050	<0.056	<0.051	<0.033	<0.055	<0.047	<0.031	<0.066
30	17-Jul-12	24-Jul-12	<0.019	<0.051	<0.064	<0.036	<0.061	<0.028	<0.055	<0.025	<0.064	<0.032
31	24-Jul-12	30-Jul-12	<0.034	<0.049	<0.041	<0.034	<0.050	<0.021	<0.057	<0.031	<0.039	<0.026
32	30-Jul-12	7-Aug-12	<0.052	<0.049	<0.038	<0.044	<0.052	<0.037	<0.037	<0.023	<0.056	<0.035
33	7-Aug-12	14-Aug-12	<0.039	<0.066	<0.046	<0.029	<0.057	<0.029	<0.057	<0.035	<0.070	<0.027
34	14-Aug-12	21-Aug-12	<0.064	<0.024	<0.065	<0.027	<0.056	<0.033	<0.070	<0.024	<0.064	<0.049
35	21-Aug-12	28-Aug-12	<0.055	<0.030	<0.036	<0.032	<0.049	<0.026	<0.045	<0.024	<0.070	<0.021
36	28-Aug-12	4-Sep-12	<0.045	<0.056	<0.055	<0.018	<0.058	<0.044	<0.032	<0.043	<0.021	<0.043
37	4-Sep-12	11-Sep-12	<0.037	<0.033	<0.048	<0.020	<0.069	<0.026	<0.060	<0.029	<0.069	<0.041
38	11-Sep-12	18-Sep-12	<0.046	<0.069	<0.057	<0.036	<0.051	<0.062	<0.056	<0.052	<0.021	<0.046
39	18-Sep-12	25-Sep-12	<0.042	<0.038	<0.069	<0.023	<0.070	<0.030	<0.057	<0.021	<0.050	<0.033

4th Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15* required LLD <0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
40	25-Sep-12	2-Oct-12	<0.026	<0.054	<0.053	<0.027	<0.022	<0.032	<0.047	<0.025	<0.064	<0.026
41	2-Oct-12	9-Oct-12	<0.037	<0.053	<0.066	<0.020	<0.068	<0.008	<0.062	<0.043	<0.055	<0.030
42	9-Oct-12	16-Oct-12	<0.030	<0.054	<0.045	<0.040	<0.062	<0.027	<0.068	<0.030	<0.061	<0.033
43	16-Oct-12	25-Oct-12	<0.022	<0.061	<0.030	<0.037	<0.021	<0.067	<0.034	<0.058	<0.029	<0.067
44	25-Oct-12	30-Oct-12	<0.032	<0.036	<0.052	<0.040	<0.036	<0.040	<0.044	<0.037	<0.046	<0.030
45	30-Oct-12	6-Nov-12	<0.031	<0.048	<0.066	<0.019	<0.061	<0.027	<0.043	<0.031	<0.055	<0.024
46	6-Nov-12	13-Nov-12	<0.014	<0.046	<0.025	<0.061	<0.025	<0.025	<0.019	<0.069	<0.028	<0.054
47	13-Nov-12	19-Nov-12	<0.038	<0.036	<0.037	<0.029	<0.036	<0.028	<0.037	<0.038	<0.036	<0.039
48	19-Nov-12	27-Nov-12	<0.031	<0.046	<0.047	<0.065	<0.059	<0.012	<0.052	<0.064	<0.049	<0.026
49	27-Nov-12	4-Dec-12	<0.037	<0.052	<0.070	<0.020	<0.061	<0.040	<0.036	<0.025	<0.060	<0.026
50	4-Dec-12	11-Dec-12	<0.034	<0.058	<0.052	<0.025	<0.033	<0.065	<0.056	<0.026	<0.064	<0.028
51	11-Dec-12	18-Dec-12	<0.034	<0.047	<0.020	<0.025	<0.062	<0.037	<0.066	<0.036	<0.069	<0.037
52	18-Dec-12	25-Dec-12	<0.043	<0.068	<0.058	<0.067	<0.042	<0.063	<0.045	<0.060	<0.058	<0.009

TABLE 8.6 VEGETATION

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

LOCATION	TYPE	DATE COLLECTED	<60 I-131	<60 Cs-134	<80 Cs-137
LOCAL RESIDENCE (Site #47)*	NONE AVAILABLE				
COMMERCIAL FARM (Site #62)*	red cabbage	20-Jan-12	<46	<41	<45
	green cabbage	20-Jan-12	<60	<53	<65
	green cabbage	10-Feb-12	<51	<48	<75
	red cabbage	10-Feb-12	<60	<55	<39
	green cabbage	15-Mar-12	<47	<45	<41
	green cabbage	13-Apr-12	<42	<58	<49
	green cabbage	14-Nov-12	<46	<35	<57
	green cabbage	20-Dec-12	<43	<45	<17
	savoy cabbage	20-Dec-12	<49	<51	<72

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
Local Resident Goats (Site #51)*	29-Mar-12	<1	<1	<1	<3	<1
	26-Apr-12	<1	<1	<1	<3	<1
	24-May-12	<1	<1	<1	<3	<1
	22-Jun-12	<1	<1	<1	<3	<1
	26-Jul-12	<1	<1	<1	<3	<1
	24-Aug-12	<1	<1	<1	<3	<1
	20-Sep-12	<1	<1	<1	<3	<1
	25-Oct-12	<1	<1	<1	<3	<1
	15-Nov-12	<1	<1	<1	<3	<1
	14-Dec-12	*				
Local Resident Goats (Site #53)*	15-Mar-12	<1	<1	<1	<3	<1
	20-Apr-12	<1	<1	<1	<3	<1
	17-May-12	<1	<1	<1	<3	<1
	14-Jun-12	<1	<1	<1	<3	<1
	19-Jul-12	<1	<1	<1	<3	<1
	16-Aug-12	<1	<1	<1	<3	<1
	13-Sep-12	<1	<1	<1	<3	<1
	19-Oct-12	<1	<1	<1	<3	<1
	14-Nov-12	<1	<1	<1	<3	<1
	14-Dec-12	<1	<1	<1	<3	<1
Local Resident Goats (Site #54)	13-Jan-12	<1	<1	<1	<3	<1
	10-Feb-12	<1	<1	<1	<3	<1
	23-Mar-12	<1	<1	<1	<3	<1
	13-Apr-12	<1	<1	<1	<3	<1
	11-May-12	<1	<1	<1	<3	<1
	07-Jun-12	<1	<1	<1	<3	<1
	12-Jul-12	<1	<1	<1	<3	<1
	06-Sep-12	<1	<1	<1	<3	<1
	11-Oct-12	<1	<1	<1	<3	<1
	09-Nov-12	<1	<1	<1	<3	<1
	07-Dec-12	<1	<1	<1	<3	<1

* Site #51 did not have an available sample on 12-14-2012 due to not being able to contact the land owner

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) *	31-Jan-12	<13	<15	<26	<14	<23	<13	<19	<12	<9	<13	<43	<15		<3.0
	28-Feb-12	<13	<9	<20	<12	<29	<10	<19	<10	<10	<12	<30	<15		<3.7
	27-Mar-12	<12	<9	<19	<10	<21	<11	<18	<9	<9	<11	<33	<13	<259	<3.8
	24-Apr-12	<10	<11	<26	<12	<23	<12	<19	<9	<10	<10	<36	<15		<3.0
	29-May-12	<11	<13	<26	<14	<25	<13	<26	<10	<12	<13	<33	<13		<3.2
	26-Jun-12	<13	<12	<19	<13	<26	<12	<19	<10	<10	<11	<35	<13	<258	<3.2
	30-Jul-12	<11	<9	<26	<14	<26	<13	<21	<11	<9	<14	<33	<15		<3.3
	28-Aug-12	<10	<10	<23	<15	<26	<11	<18	<9	<11	<12	<35	<10		3.6 ± 2.2
	25-Sep-12	<11	<10	<25	<9	<21	<10	<19	<11	<10	<11	<35	<15	<305	4.4 ± 2.1
	30-Oct-12	<13	<11	<21	<15	<25	<13	<23	<12	<12	<10	<44	<15		5.1 ± 2.1
	27-Nov-12	<12	<10	<22	<14	<30	<13	<20	<8	<11	<11	<26	<12		5.9 ± 2.1
	31-Dec-12	<8	<11	<21	<11	<30	<11	<22	<10	<10	<11	<37	<13	<300	4.2 ± 2.0
LOCAL RESIDENCE (Site #55)	31-Jan-12	<15	<10	<22	<11	<24	<11	<18	<10	<11	<12	<36	<12		5.0 ± 1.5
	28-Feb-12	<10	<10	<23	<8	<30	<11	<18	<9	<9	<11	<34	<9		<2.5
	27-Mar-12	<7	<7	<16	<8	<15	<9	<13	<7	<8	<8	<24	<11	<259	<3.2
	24-Apr-12 [a]	<11	<11	<24	<14	<23	<12	<19	<12	<11	<12	<41	<12		2.3 ± 1.3
	29-May-12	<12	<10	<27	<13	<28	<12	<15	<12	<10	<11	<40	<11		5.2 ± 1.5
	26-Jun-12	<11	<10	<19	<10	<30	<9	<16	<10	<9	<13	<34	<11	<259	3.0 ± 1.4
	30-Jul-12	<13	<9	<24	<15	<25	<12	<22	<11	<12	<15	<43	<15		2.8 ± 1.4
	28-Aug-12	<12	<10	<19	<12	<23	<10	<17	<11	<10	<13	<37	<15		3.0 ± 1.4
	25-Sep-12	<15	<14	<30	<11	<30	<13	<23	<12	<13	<14	<50	<15	<304	5.1 ± 1.6
	30-Oct-12	<10	<10	<21	<10	<22	<12	<20	<11	<11	<12	<36	<15		5.2 ± 1.4
	27-Nov-12	<11	<12	<22	<13	<24	<12	<20	<11	<10	<11	<39	<15		7.6 ± 1.6
	31-Dec-12	<14	<11	<25	<13	<26	<12	<24	<12	<12	<12	<49	<15	<298	6.5 ± 1.6

TABLE 8.8 DRINKING WATER

ODCM required samples denoted by *

units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Qtrly Tritium	<4.0 Gross Beta
LOCAL RESIDENCE (Site #46) *	31-Jan-12	<15	<12	<22	<15	<28	<13	<23	<13	<10	<15	<42	<11		3.1 ± 1.4
	28-Feb-12	<14	<11	<21	<15	<30	<14	<15	<11	<10	<12	<41	<14		<2.4
	27-Mar-12	<14	<13	<26	<14	<30	<13	<21	<13	<9	<12	<38	<15	<258	<3.0
	24-Apr-12	<13	<12	<24	<13	<25	<9	<16	<10	<11	<12	<37	<15		3.0 ± 1.4
	29-May-12	<9	<11	<22	<15	<27	<11	<18	<12	<12	<12	<42	<15		<2.0
	26-Jun-12	<10	<10	<28	<15	<27	<12	<17	<12	<11	<11	<43	<15	<257	3.8 ± 1.4
	30-Jul-12	<12	<10	<22	<11	<22	<12	<18	<9	<9	<11	<34	<15		2.2 ± 1.3
	28-Aug-12	<15	<13	<21	<13	<26	<12	<18	<11	<11	<12	<48	<13		<2.0
	25-Sep-12	<11	<12	<23	<15	<24	<11	<20	<10	<10	<11	<38	<10	<307	2.34 ± 1.3
	30-Oct-12	<13	<11	<26	<12	<30	<12	<21	<11	<9	<14	<42	<14		3.3 ± 1.3
	27-Nov-12	<14	<13	<29	<13	<26	<14	<22	<10	<11	<13	<39	<14		4.5 ± 1.3
	31-Dec-12	<7	<10	<19	<8	<23	<8	<17	<10	<9	<8	<35	<15	<299	3.3 ± 1.3
LOCAL RESIDENCE (Site #49) *	31-Jan-12	<10	<13	<18	<14	<30	<12	<19	<13	<11	<11	<46	<15		<2.1
	28-Feb-12	<13	<13	<30	<15	<28	<14	<19	<11	<11	<11	<45	<13		<2.4
	27-Mar-12	<12	<11	<25	<15	<25	<13	<24	<11	<12	<12	<41	<15	<257	<3.0
	24-Apr-12	<12	<13	<21	<14	<29	<14	<22	<11	<11	<13	<47	<15		<1.9
	29-May-12	<10	<9	<15	<10	<19	<10	<18	<10	<9	<10	<33	<14		<2.0
	26-Jun-12	<11	<12	<29	<10	<26	<11	<21	<11	<10	<13	<34	<15	<257	2.6 ± 1.4
	30-Jul-12	<13	<9	<27	<13	<29	<13	<23	<11	<13	<14	<46	<10		<2.0
	28-Aug-12	<11	<11	<24	<15	<30	<10	<18	<10	<11	<11	<38	<13		<2.0
	25-Sep-12	<11	<11	<24	<12	<18	<10	<21	<12	<10	<12	<33	<15	<304	2.1 ± 1.3
	30-Oct-12	<13	<13	<21	<9	<29	<14	<23	<12	<11	<15	<43	<11		2.41 ± 1.3
	27-Nov-12	<10	<10	<20	<15	<23	<12	<18	<10	<10	<10	<44	<13		3.0 ± 1.2
	31-Dec-12	<11	<11	<22	<15	<25	<10	<17	<11	<10	<11	<36	<13	<299	2.3 ± 1.3

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)*	31-Jan-12	<10	<11	<26	<13	<24	<13	<19	<11	<11	<13	<35	<15	<256
	24-Apr-12	<9	<9	<20	<11	<21	<12	<17	<10	<9	<10	<36	<15	<255
	31-Jul-12	<12	<13	<23	<15	<24	<12	<21	<12	<11	<11	<37	<14	<302
	30-Oct-12	<12	<12	<23	<11	<28	<13	<19	<11	<11	<12	<43	<15	<297
WELL 34abb (Site #58)*	31-Jan-12	<13	<8	<27	<14	<30	<15	<21	<13	<11	<13	<44	<15	<258
	24-Apr-12	<10	<11	<24	<11	<25	<12	<18	<10	<10	<11	<32	<15	<256
	31-Jul-12	<11	<11	<24	<12	<22	<12	<17	<11	<10	<11	<35	<15	<303
	30-Oct-12	<9	<9	<17	<9	<22	<11	<16	<9	<9	<9	<31	<15	<297

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) *	31-Jan-12	<11	<10	<23	<14	<30	<14	<21	21 ± 11[a]	<12	<14	<45	<13	<258
	24-Apr-12	<15	<10	<24	<13	<29	<13	<19	50 ± 14[a]	<11	<12	<46	<15	<257
	31-Jul-12	<15	<11	<23	<14	<25	<12	<19	12 ± 10	<12	<12	<38	<13	<306
	30-Oct-12	<13	<11	<18	<10	<27	<13	<19	<13	<11	<15	<37	<13	<301
85 ACRE RESERVOIR (Site #60) *	31-Jan-12	<10	<9	<18	<15	<24	<9	<18	<10	<10	<10	<30	<12	<258
	24-Apr-12	<15	<11	<19	<14	<29	<14	<20	32 ± 15[a]	<13	<15	<46	<13	<258
	31-Jul-12	<12	<12	<18	<14	<29	<11	<18	10 ± 10	<10	<12	<46	<15	<305
	30-Oct-12	<11	<12	<23	<13	<21	<10	<14	<13	<9	<10	<35	<10	<300
EVAP POND 1 (Site #59) *	Empty for Refurbishment													
EVAP POND 2 (Site #63) *	31-Jan-12	<12	<10	<18	<8	<30	<12	<17	<12	<10	<12	<42	<15	966 ± 172
	24-Apr-12	<11	<9	<21	<12	<24	<10	<19	<13	<10	<12	<34	<15	1015 ± 172
CELL 2A	31-Jul-12	<13	<13	<23	<14	<27	<15	<25	<13	<10	<14	<41	<8	928 ± 190
	30-Oct-12	<14	<12	<26	<10	<30	<13	<21	<12	<10	<12	<37	<12	1038 ± 201
CELL 2B	31-Jan-12	<12	<10	<25	<10	<25	<11	<19	34 ± 11[a]	<10	<12	<39	<10	1055 ± 173
	24-Apr-12	<13	<12	<25	<13	<30	<12	<21	<12	<10	<12	<40	<14	1038 ± 171
	31-Jul-12	<10	<10	<27	<11	<30	<13	<15	16 ± 11	<10	<11	<38	<13	1350 ± 198
	30-Oct-12	<10	<12	<28	<13	<23	<12	<22	<14	<11	<14	<32	<15	1041 ± 199
EVAP POND 3 (Site #64) *	31-Jan-12	<9	<10	<25	<12	<29	<10	<18	<10	<9	<14	<33	<15	738 ± 168
	24-Apr-12	<11	<9	<27	<12	<25	<11	<18	<9	<9	<12	<37	<11	874 ± 169
CELL 3A	31-Jul-12	<12	<11	<30	<14	<28	<11	<21	<10	<10	<13	<35	<13	931 ± 191
	30-Oct-12	<13	<12	<22	<13	<23	<13	<16	<10	<9	<11	<41	<14	900 ± 199
CELL 3B	31-Jan-12	<11	<11	<29	<15	<30	<12	<20	<10	<11	<14	<41	<13	867 ± 170
	24-Apr-12	<13	<11	<27	<14	<27	<13	<22	<12	<12	<14	<44	<12	773 ± 168
	31-Jul-12	<12	<11	<25	<15	<29	<13	<20	<10	<9	<14	<42	<11	959 ± 191
	30-Oct-12	<12	<11	<28	<14	<30	<12	<18	<12	<10	<12	<41	<12	562 ± 192

(a) The sample was recounted and indicated >20 pCi/liter. The I-131 reporting level was exceeded but is not a result of plant effluents. Refer to Corrective Action Program CRDR 4051062 for the evaluation.

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 **
	3-Jan-12	<13	<12	<20	<11	<29	<13	<24	14 ± 9	<11	<11	<46	<15	
	10-Jan-12	<12	<11	<20	<12	<24	<11	<18	<11	<10	<9	<36	<15	
	17-Jan-12	<12	<12	<24	<12	<30	<12	<23	44 ± 14	<11	<13	<41	<14	
	24-Jan-12	<13	<9	<27	<11	<30	<11	<19	8 ± 7	<10	<12	<35	<14	
	31-Jan-12	<11	<13	<28	<15	<25	<13	<20	22 ± 11	<11	<14	<40	<12	<264
	7-Feb-12	<14	<11	<27	<14	<30	<12	<19	19 ± 11	<11	<13	<41	<10	
	13-Feb-12	<14	<13	<27	<15	<28	<13	<25	41 ± 17	<14	<15	<43	<14	
	21-Feb-12	<11	<12	<26	<15	<24	<11	<19	32 ± 10	<10	<13	<40	<12	
WRF	28-Feb-12	<15	<12	<23	<12	<18	<13	<20	36 ± 13	<11	<10	<49	<15	<266
INFLUENT	6-Mar-12	<12	<11	<22	<8	<20	<11	<17	49 ± 11	<10	<12	<29	<15	
	13-Mar-12	<10	<12	<22	<13	<22	<10	<17	53 ± 13	<9	<13	<38	<14	
	19-Mar-12	<12	<8	<20	<12	<29	<10	<19	93 ± 17	<10	<10	<41	<15	<284
	26-Mar-12	WRF OOS												
	2-Apr-12	WRF OOS												
	10-Apr-12	<14	<13	<21	<15	<22	<11	<22	18 ± 10	<11	<11	<37	<14	
grab sample	17-Apr-12	<14	<11	<29	<15	<23	<12	<18	40 ± 13	<11	<11	<44	<14	
	24-Apr-12	<12	<14	<29	<15	<26	<13	<22	21 ± 15	<13	<15	<43	<13	<264
	1-May-12	<12	<11	<24	<15	<26	<15	<20	54 ± 14	<12	<14	<41	<15	
	8-May-12	<10	<12	<28	<13	<28	<10	<23	27 ± 12	<13	<12	<46	<13	
	15-May-12	<13	<13	<25	<14	<27	<10	<24	11 ± 10	<12	<12	<46	<13	
	22-May-12	<9	<10	<21	<13	<20	<9	<17	13 ± 9	<10	<11	<35	<15	
	29-May-12	<15	<13	<21	<14	<27	<11	<19	9 ± 10	<11	<15	<35	<15	<273
	5-Jun-12	<9	<10	<19	<15	<20	<11	<19	<11	<9	<12	<32	<12	
	12-Jun-12	<15	<15	<26	<11	<21	<12	<19	22 ± 12	<14	<12	<41	<13	
	19-Jun-12	<11	<11	<25	<14	<30	<14	<20	13 ± 10	<12	<13	<37	<13	
	26-Jun-12	<10	<10	<18	<12	<26	<11	<17	<11	<10	<10	<28	<14	<264
	02-Jul-12	<12	<12	<19	<15	<29	<12	<20	<13	<11	<14	<40	<8	
	10-Jul-12	<11	<9	<20	<11	<28	<11	<20	<11	<9	<9	<36	<9	
	17-Jul-12	<11	<10	<20	<15	<26	<11	<21	14 ± 12	<10	<11	<39	<12	

** 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 **
	24-Jul-12	<12	<8	<26	<9	<25	<10	<18	14 ± 9	<10	<11	<32	<12	
	31-Jul-12	<10	<11	<23	<12	<25	<10	<17	11 ± 10	<9	<10	<32	<15	<306
	7-Aug-12	<10	<10	<20	<9	<29	<10	<20	22 ± 12	<12	<14	<35	<15	
	14-Aug-12	<10	<13	<22	<12	<24	<12	<21	21 ± 10	<10	<13	<32	<15	
	21-Aug-12	<9	<11	<23	<14	<20	<11	<15	32 ± 10	<9	<9	<33	<15	
	28-Aug-12	<11	<10	<25	<13	<25	<11	<17	27 ± 8	<10	<9	<40	<10	<329
	4-Sep-12	<10	<12	<28	<14	<23	<15	<17	<14	<9	<14	<41	<11	
	11-Sep-12	<11	<10	<20	<10	<28	<11	<20	23 ± 9	<10	<13	<32	<15	
	18-Sep-12	<8	<10	<20	<9	<21	<10	<14	39 ± 9	<8	<11	<28	<15	
	25-Sep-12	<9	<10	<28	<13	<29	<12	<18	17 ± 10	<9	<12	<38	<13	<314
	2-Oct-12	<11	<13	<21	<12	<27	<13	<17	11 ± 10	<12	<11	<37	<15	
WRF	9-Oct-12	<11	<11	<21	<12	<26	<12	<18	17 ± 12	<11	<9	<43	<15	
INFLUENT	16-Oct-12	WRF OOS												
	23-Oct-12	<10	<11	<24	<15	<22	<11	<17	18 ± 9	<10	<13	<33	<13	
	30-Oct-12	<8	<9	<21	<11	<24	<11	<15	21 ± 10	<10	<11	<28	<13	<307
	6-Nov-12	<12	<12	<27	<12	<30	<12	<22	23 ± 14	<13	<11	<41	<38	
	13-Nov-12	<12	<13	<23	<13	<26	<14	<19	15 ± 10	<10	<13	<37	<13	
	19-Nov-12	<14	<11	<20	<13	<25	<14	<24	21 ± 10	<13	<15	<55	<15	
	27-Nov-12	<12	<11	<26	<15	<28	<12	<17	20 ± 9	<11	<16	<37	<13	<308
	4-Dec-12	<10	<12	<22	<15	<28	<11	<17	16 ± 10	<9	<13	<39	<14	
	11-Dec-12	<14	<12	<30	<14	<30	<12	<24	24 ± 10	<12	<13	<31	<12	
	18-Dec-12	<14	<10	<29	<12	<30	<11	<21	29 ± 12	<13	<14	<51	<13	
	24-Dec-12	<11	<9	<17	<9	<26	<11	<18	46 ± 11	<9	<10	<32	<13	<312
	31-Dec-12	<11	<13	<28	<11	<25	<10	<20	44 ± 13	<13	<10	<40	<15	

** 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	20-Mar-12	<10	<10	<22	<14	<23	<11	<15	<9	<11	<11	<38	<15	<275
	17-Jul-12	<10	<10	<21	<14	<19	<8	<19	<8	<12	<14	<37	<13	<348
	31-Jul-12	<11	<10	<26	<15	<27	<10	<22	<10	<10	<12	<41	<12	<311
	28-Aug-12	<13	<11	<24	<15	<29	<12	<21	<11	<10	<14	<42	<15	<347
	11-Sep-12	<13	<11	<22	<15	<25	<12	<20	<11	<11	<13	<43	<14	<325
	18-Sep-12	<11	<10	<20	<12	<18	<10	<19	<11	<11	<11	<40	<15	<327
	25-Sep-12	<10	<10	<26	<15	<20	<11	<18	<11	<12	<16	<41	<14	<321

TABLE 8.11 SLUDGE/SEDIMENT

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

SAMPLE LOCATION	DATE COLLECTED	I-131	<150 Cs-134	<180 Cs-137	In-111
WRF CENTRIFUGE WASTE SLUDGE	3-Jan-12	601 ± 201	<111	<174	
	10-Jan-12	524 ± 182	<109	<170	
	17-Jan-12	408 ± 49	<139	<174	
	24-Jan-12	547 ± 147	<81	<39	
	31-Jan-12	438 ± 162	<149	<143	
	6-Feb-12	926 ± 203	<69	<150	
	13-Feb-12	673 ± 192	<142	<140	
	20-Feb-12	1116 ± 237	<123	<171	
	27-Feb-12	629 ± 230	<142	<133	
	5-Mar-12	543 ± 142	<114	<86	
	12-Mar-12	768 ± 216	<138	<114	
	19-Mar-12	1741 ± 341	<149	<168	
	26-Mar-12	OOS			
	2-Apr-12	OOS			
	10-Apr-12	311 ± 105	<85	<160	
	17-Apr-12	400 ± 148	<124	<180	
	23-Apr-12	1673 ± 366	<149	<142	
	1-May-12	1686 ± 278	<47	<81	
	7-May-12	2013 ± 364	<139	<96	
	15-May-12	1191 ± 263	<145	<180	
	21-May-12	870 ± 236	<141	<170	
	29-May-12	587 ± 247	<147	<124	
	5-Jun-12	593 ± 184	<145	<164	
	12-Jun-12	461 ± 172	<130	<164	
	19-Jun-12	762 ± 159	<122	<126	
	26-Jun-12	808 ± 200	<82	<176	
	2-Jul-12	791 ± 175	<118	<174	
	10-Jul-12	476 ± 170	<138	<171	
	17-Jul-12	479 ± 175	<119	<48	
	24-Jul-12	321 ± 175	<139	<167	
	31-Jul-12	290 ± 135	<146	<161	
	7-Aug-12	455 ± 142	<116	<166	

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	14-Aug-12	322 ± 182	<143	<153	
	21-Aug-12	568 ± 172	<108	<168	
	28-Aug-12	893 ± 208	<148	<165	
	4-Sep-12	832 ± 192	<121	<171	
	11-Sep-12	920 ± 229	<147	<107	
	18-Sep-12	725 ± 191	<141	<167	
	25-Sep-12	655 ± 164	<129	<99	
	2-Oct-12	810 ± 236	<113	<176	
	9-Oct-12	593 ± 151	<131	<170	
	16-Oct-12	OOS			
	23-Oct-12	162 ± 147	<40	<18	
	30-Oct-12	246 ± 148	<148	<130	
	6-Nov-12	536 ± 197	<149	<30	
	13-Nov-12	450 ± 190	<123	<162	
	19-Nov-12	630 ± 162	<119	<80	
	27-Nov-12	531 ± 200	<140	<178	
	4-Dec-12	6521 ± 171	<138	<130	
	24-Dec-12	1244 ± 241	<117	<86	
	31-Dec-12	1079 ± 232	<101	<47	
SEDIMENTATION BASIN 2	**No samples taken in 2012**				

*3 day composite due to the outage

TABLE 8.11 SLUDGE/SEDIMENT

COOLING TOWER SLUDGE

UNIT CYCLE	APPROXIMATE VOLUME (yd^3)	ISOTOPE	ACTIVITY RANGE (pCi/g)	SAMPLE TYPE
U1R16	314	Cs-134 Cs-137	<MDA	Towers/canal sludge
U3R16	316	Cs-134 Cs-137	<MDA	Towers/canal sludge

TABLE 8.12 HARD-TO-DETECT RADIONUCLIDES 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	10/23/2012	< 51	< 12	< 3.9	< 0.4
Unit 2 (inside RCA)	H0B	10/23/2012	< 51	< 13	< 4.0	< 0.4
Unit 3 (inside RCA)	H11	10/23/2012	< 49	< 16	< 3.5	< 0.4

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

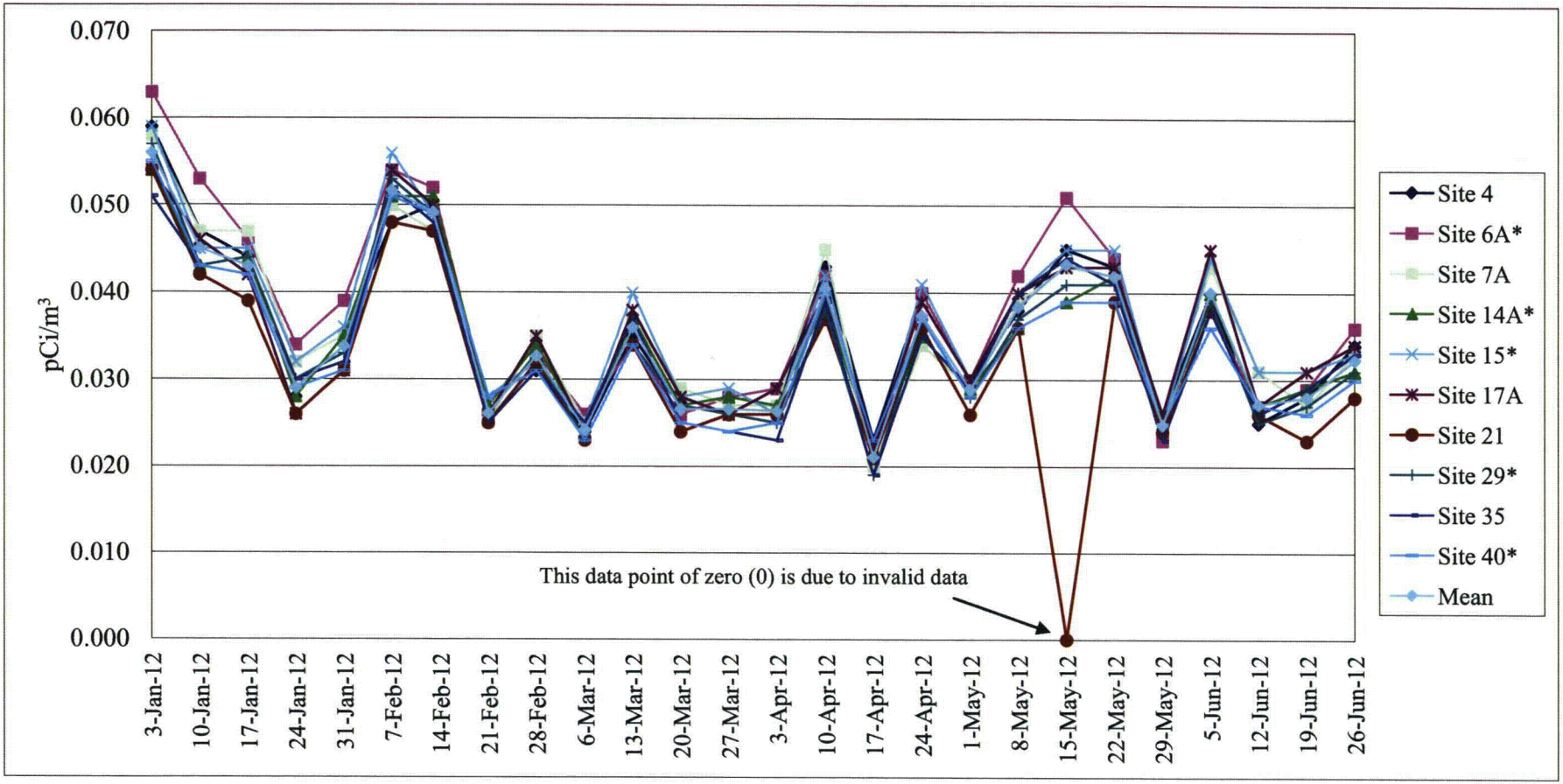


FIGURE 8.2 GROSS BETA IN AIR, 3rd-4th Quarter

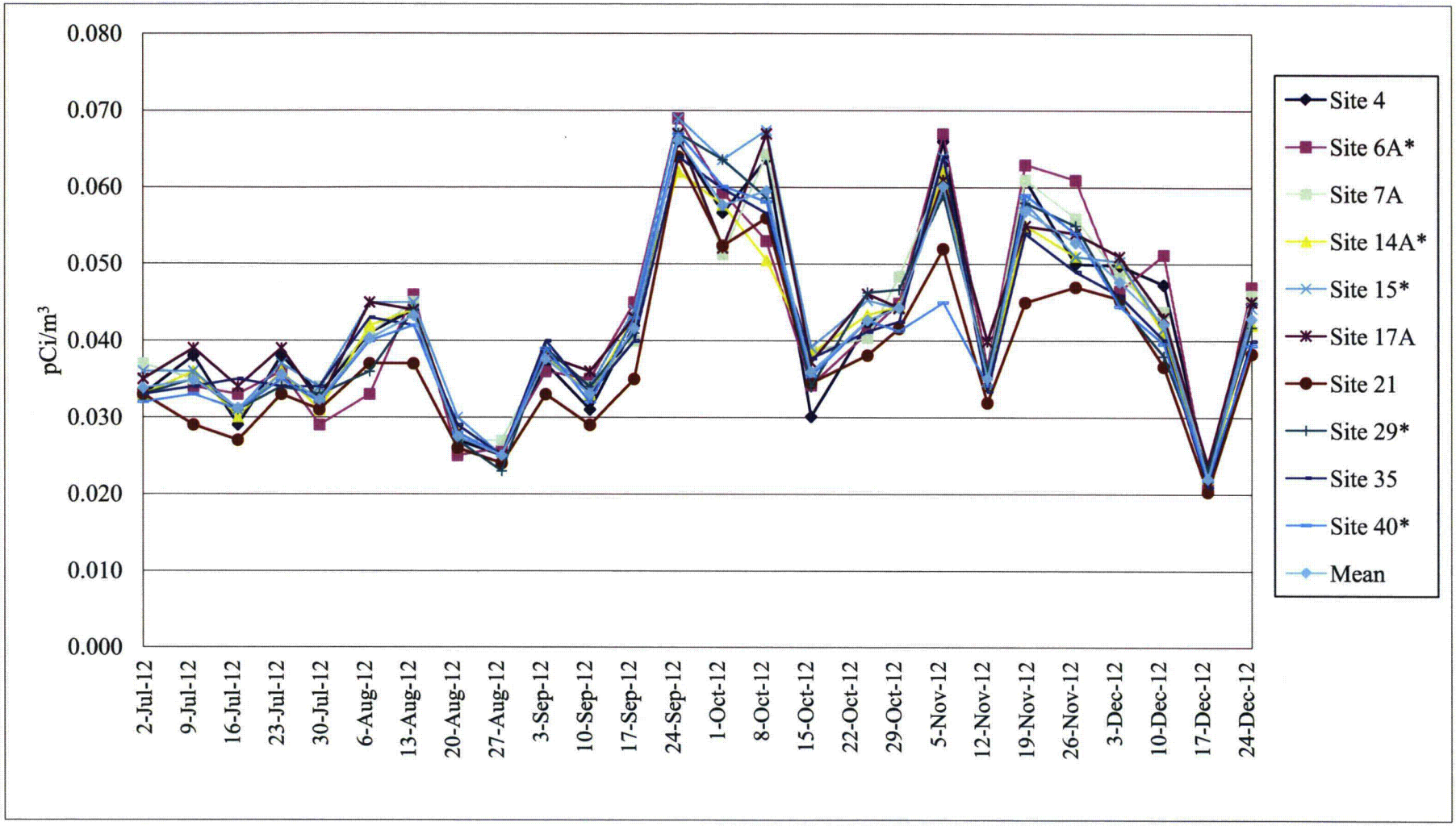


FIGURE 8.3 HISTORICAL GROSS BETA IN AIR (WEEKLY SYSTEM AVERAGES)

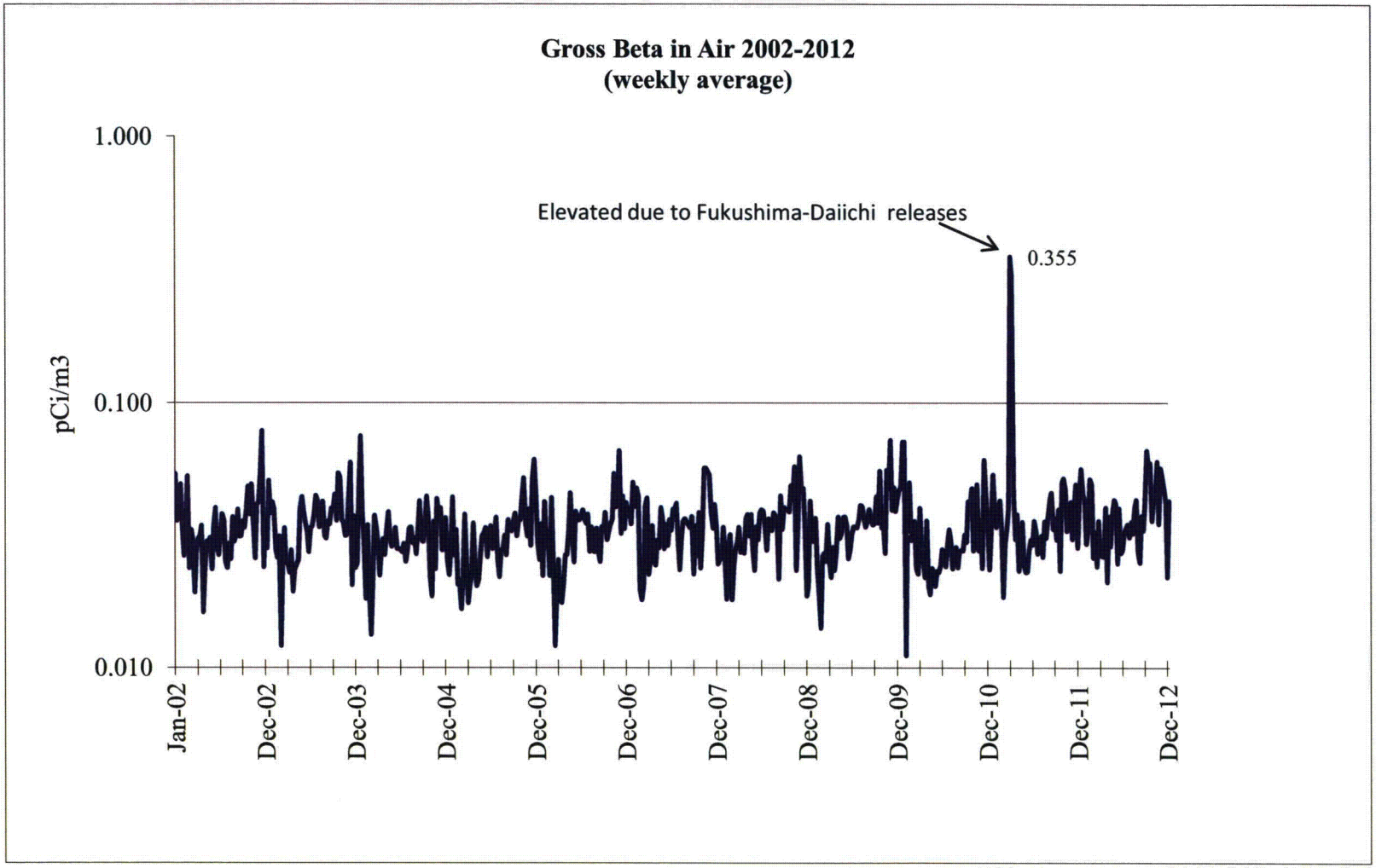
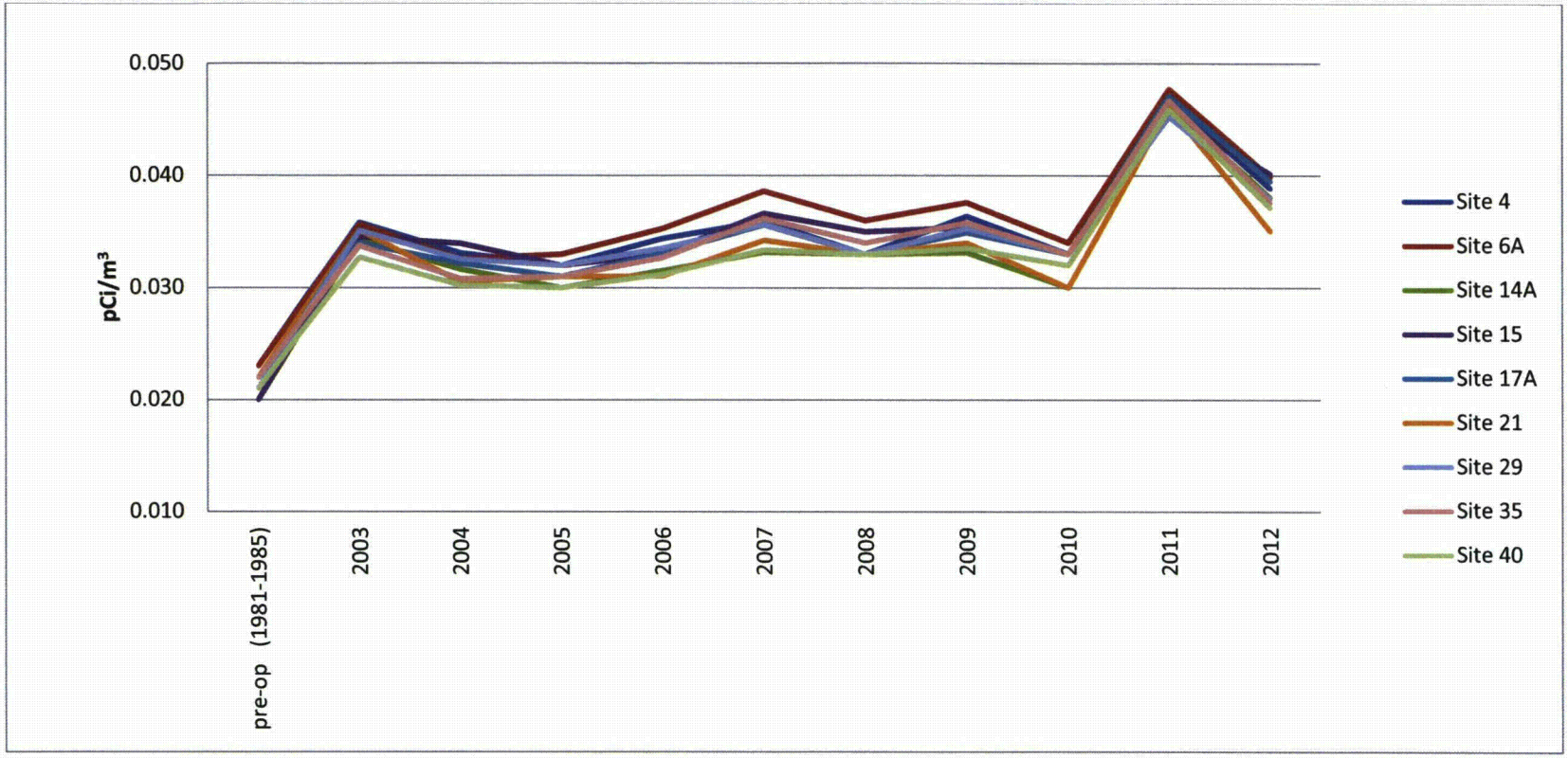
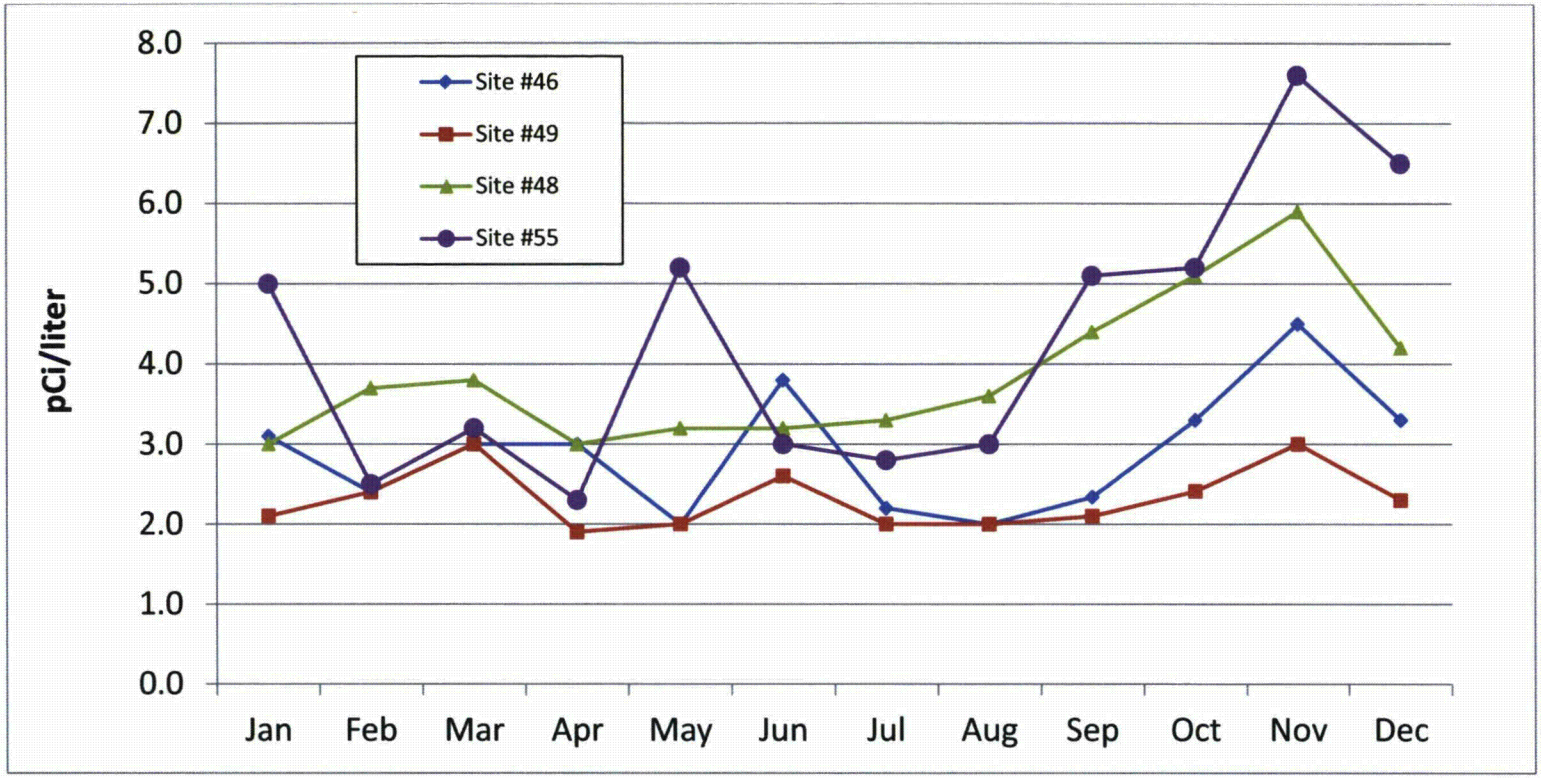


FIGURE 8.4 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP



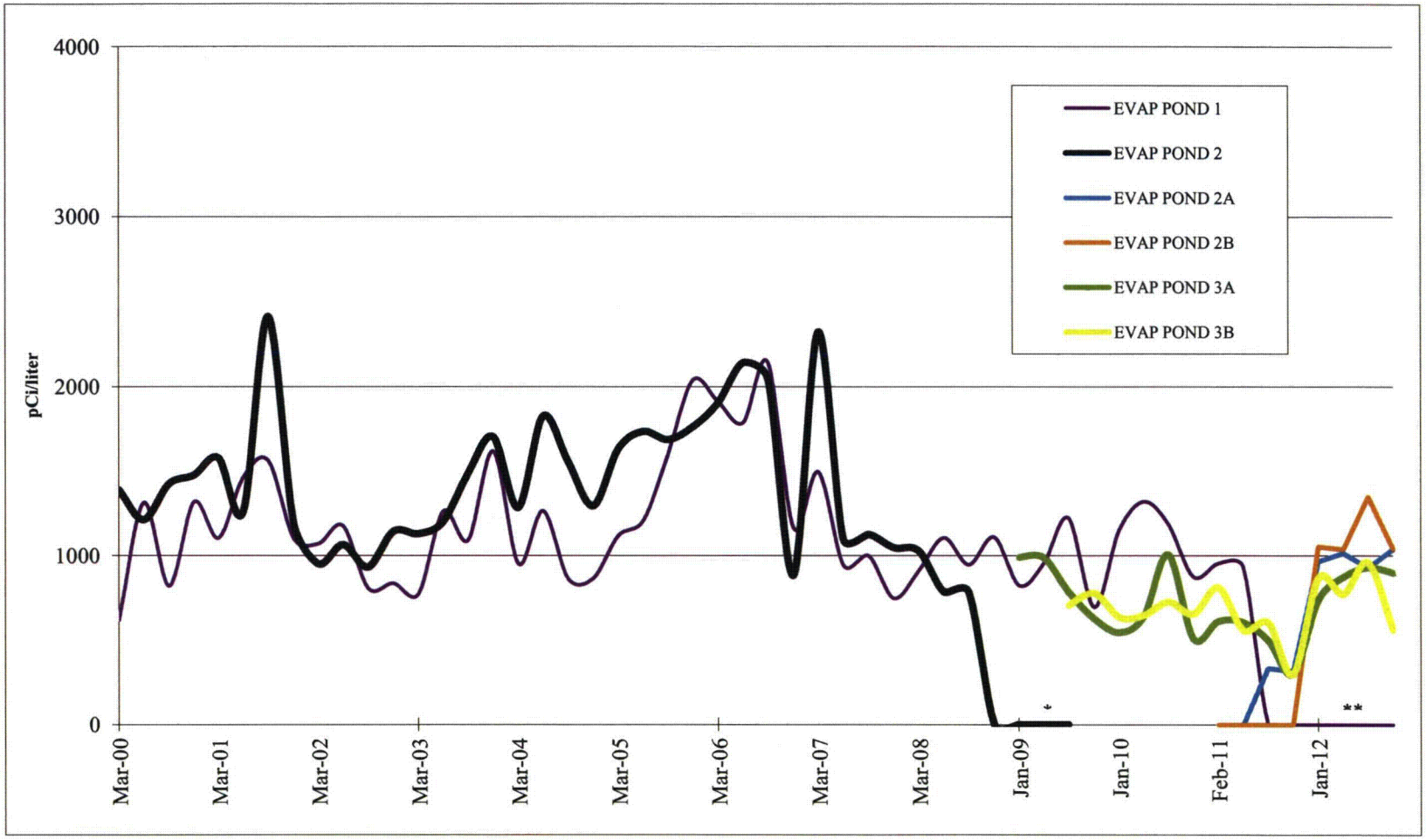
Site 7A is not included since the location changed since the pre-operational period
A known high bias has occurred in gross beta data since the onsite laboratory began analysis in 1994. This was a stepwise increase that has carried forward since 1994.
The 2011 annual average values are higher due to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

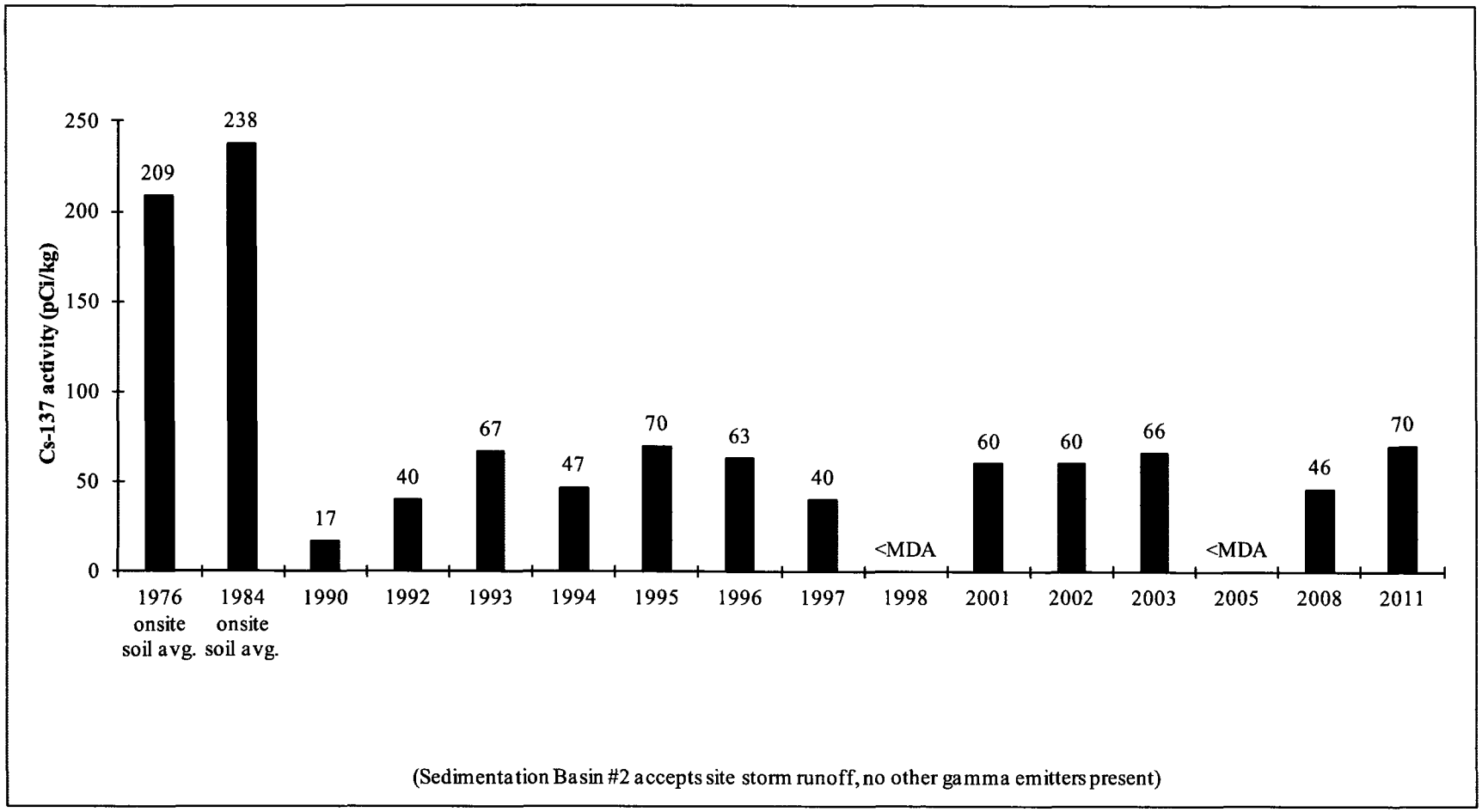
FIGURE 8.6 EVAPORATION POND TRITIUM ACTIVITY



*Evaporation Pond #2 underwent refurbishment starting in December 2008 and was subsequently split into Ponds 2A and 2B. This accounts for the gap in sampling.

** Evaporation Pond #1 underwent refurbishment in 2012

FIGURE 8.7 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 2012 are presented in Table 9.2. Historical environmental gamma radiation results for 1985 through 2012 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2012 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.

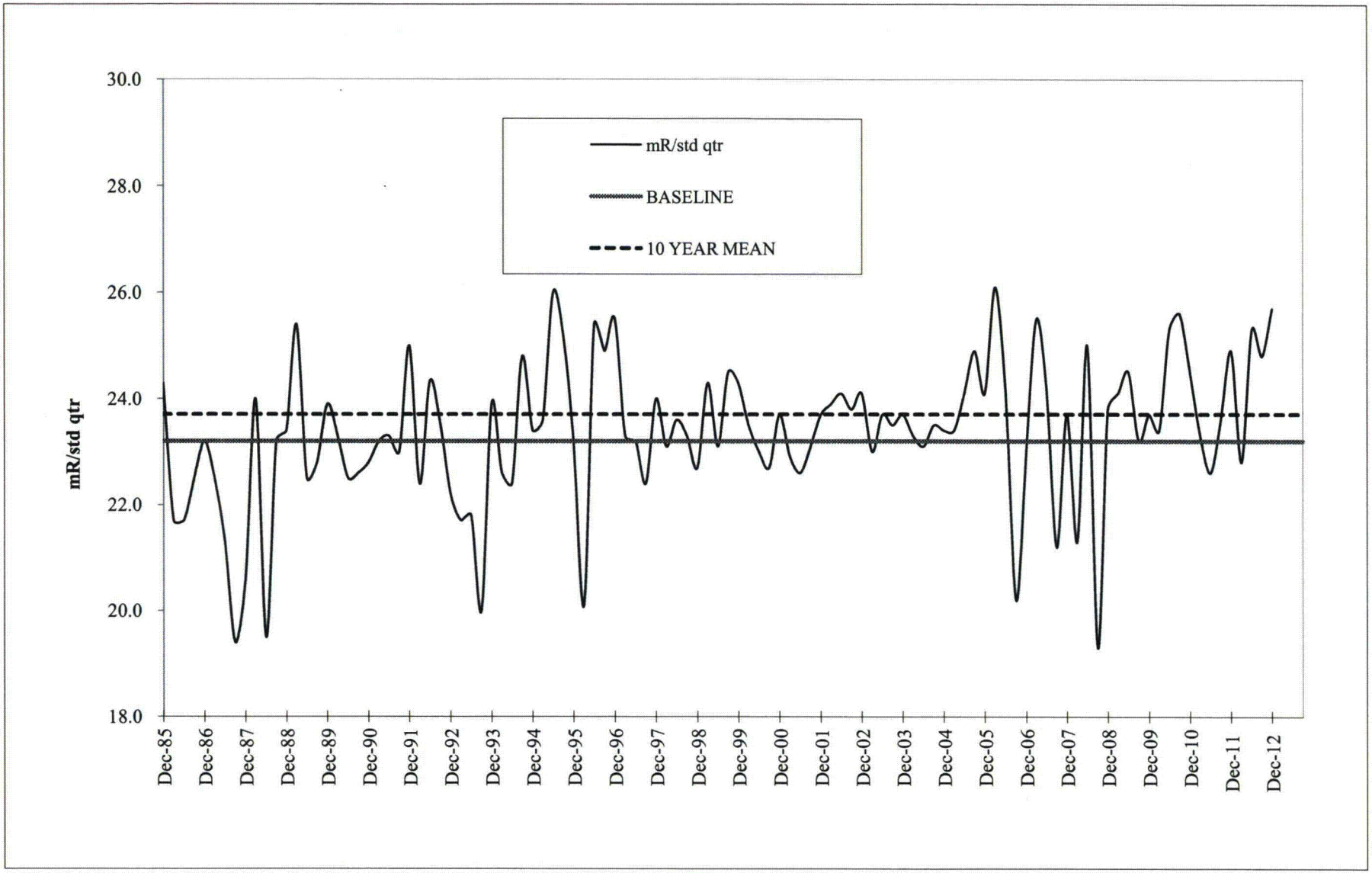
** Site #45 is the transit control TLD (stored in lead pig).

TABLE 9.2 ENVIRONMENTAL TLD RESULTS

Units are mrem/std qtr

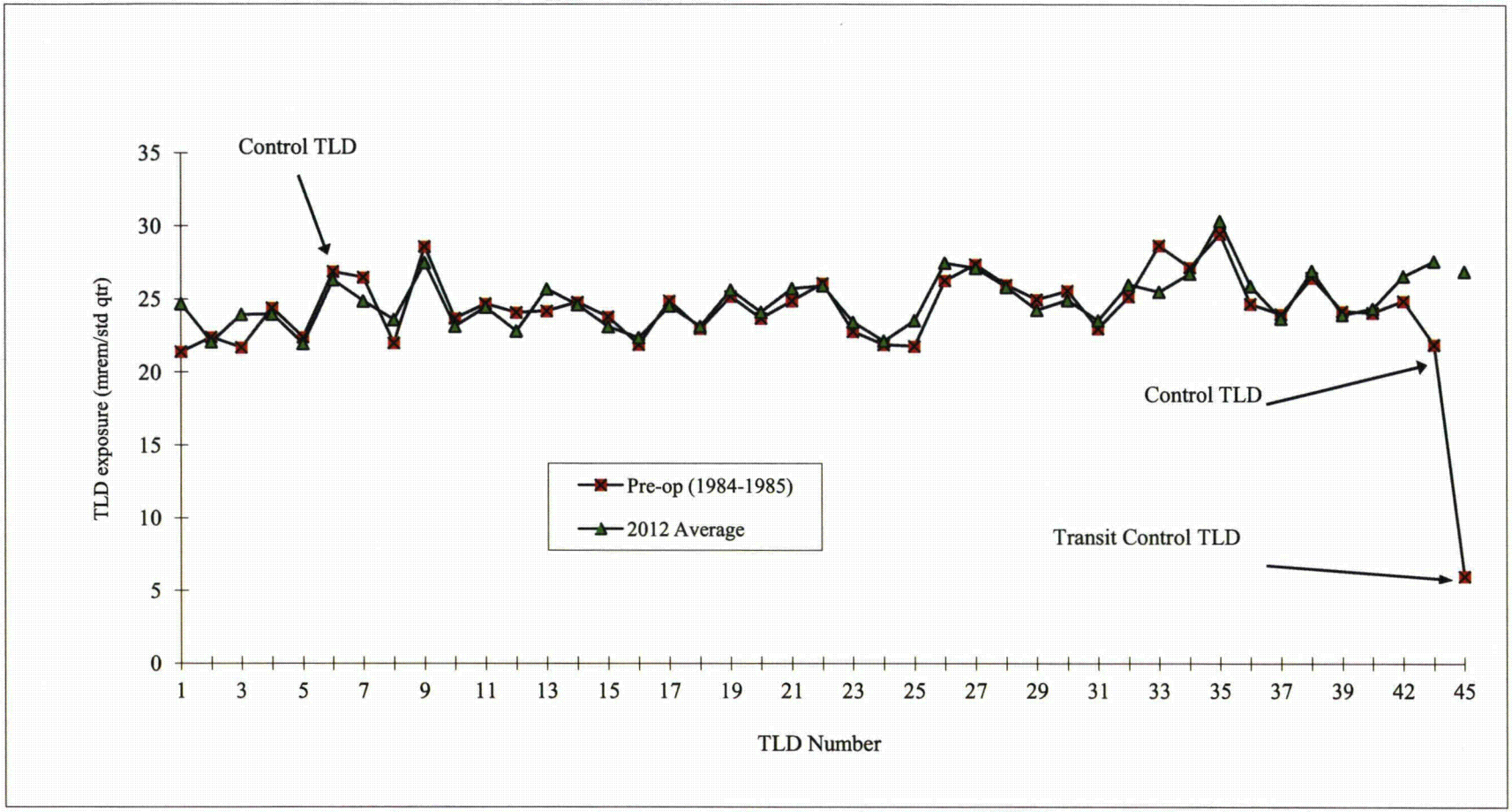
TLD NO	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average
1	22.2	25.3	24.8	26.4	24.7
2	19.4	23.1	22.7	23.1	22.1
3	23.1	24.6	23.4	24.7	24.0
4	22.0	25.1	24.7	24.1	24.0
5	20.2	23.0	22.5	22.1	22.0
6 (control)	24.0	27.7	26.6	27.0	26.3
7	22.9	24.4	25.0	27.2	24.9
8	21.9	23.9	23.3	25.3	23.6
9	26.1	27.4	27.6	28.9	27.5
10	21.3	23.4	23.8	24.1	23.2
11	22.5	24.9	23.8	26.6	24.5
12	21.4	22.9	22.6	24.4	22.8
13	23.9	25.3	26.0	27.6	25.7
14	23.2	24.1	24.7	26.5	24.6
15	20.8	24.0	22.8	24.9	23.1
16	20.2	23.7	23.5	22.1	22.4
17	22.4	24.3	25.0	26.5	24.6
18	21.5	23.1	23.9	24.1	23.2
19	22.8	26.1	26.3	27.4	25.7
20	22.5	24.5	24.3	25.2	24.1
21	23.2	27.9	25.7	26.2	25.8
22	25.1	26.6	26.1	*	25.9
23	21.4	23.2	23.4	25.8	23.5
24	20.3	21.7	23.2	23.4	22.2
25	22.4	23.4	23.1	25.3	23.6
26	26.3	30.2	25.7	27.8	27.5
27	23.4	28.6	27.0	29.6	27.2
28	24.0	26.6	25.3	27.5	25.9
29	23.8	24.6	24.0	24.7	24.3
30	22.3	24.7	26.1	26.7	25.0
31	21.5	25.1	23.7	23.9	23.6
32	23.2	27.4	27.0	26.5	26.0
33	24.3	27.0	26.0	24.8	25.5
34	26.4	28.1	25.9	26.7	26.8
35	27.9	30.4	30.3	32.9	30.4
36	24.5	27.1	26.1	26.0	25.9
37	22.6	23.8	24.0	24.4	23.7
38	25.9	26.2	27.2	28.6	27.0
39	23.5	23.6	24.6	24.1	24.0
40	22.7	24.8	24.7	25.3	24.4
41	24.4	28.3	27.0	26.7	26.6
42	26.6	27.4	28.8	27.7	27.6
43	25.7	27.8	26.7	27.5	26.9
44 (control)	17.7	19.9	20.7	25.9	21.1
45 (transit control)	4.8	5.5	5.9	6.3	5.6
46	25.1	28.2	23.9	24.7	25.5
47	22.6	25.8	24.7	23.9	24.3
48	21.3	24.9	25.4	24.8	24.1
49	20.4	23.3	22.9	23.7	22.6
50	16.7	20.4	18.6	21.2	19.2

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES



*The 10-year mean value is for the date range 2003-2012.

FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2012



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 2012.

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

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

10.2. Census Results

Nearest Resident

There were zero (0) changes in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.186 mrem.

Milk Animal

There was one (1) change in milk animal status from the previous year. Dose calculations indicated the highest dose to be 0.388 mrem.

Vegetable Gardens

There was one (1) change in nearest garden status from the previous year. Dose calculations indicated the highest dose to be 0.779 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

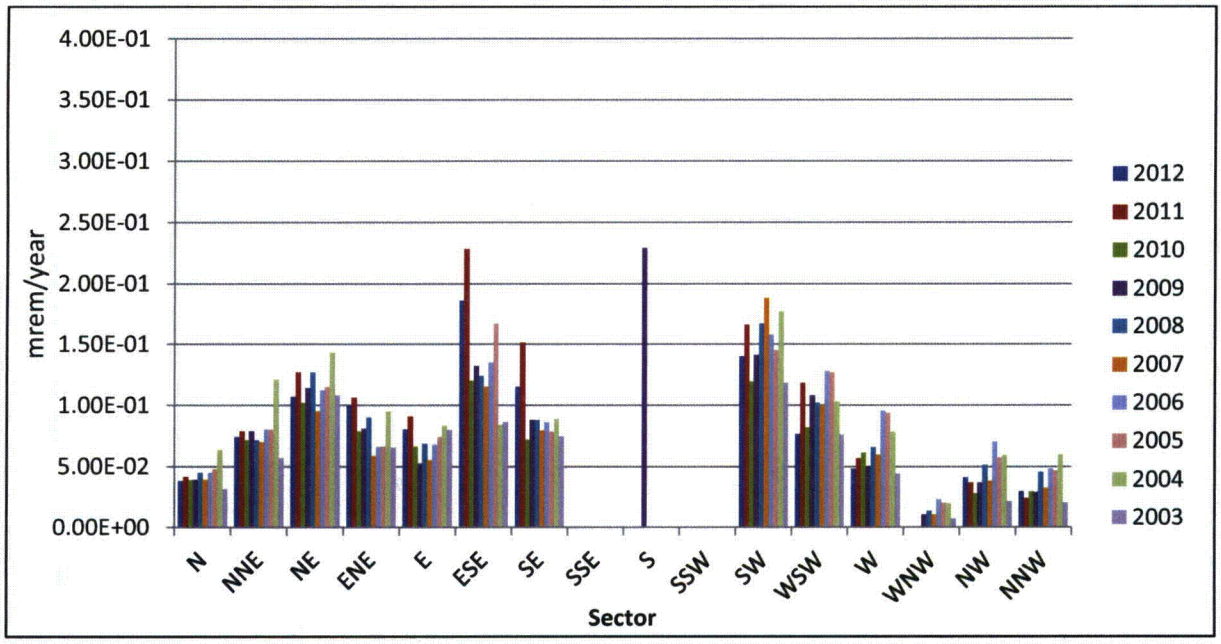
(Distances and directions are relative to Unit 2 in miles)

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST MILK ANIMAL (COW/GOAT)	CALCULATED DOSE (mrem)		CHANGE FROM 2011
N	1.55	**3.10**	3.66	Resident Garden Milk	3.84E-02 1.89E-01 1.47E-01	**Garden**
NNE	1.52	3.30	3.05	Resident Garden Milk	7.37E-02 3.72E-01 3.88E-01	
NE	2.16	NONE	NONE	Resident	1.07E-01	
ENE	2.16	2.63	4.84	Resident Garden Milk	1.00E-01 7.79E-01 2.70E-01	
E	2.81	NONE	NONE	Resident	8.00E-02	
ESE	1.89	NONE	NONE	Resident	1.86E-01	
SE	3.36	NONE	NONE	Resident	1.15E-01	
SSE	NONE	NONE	NONE	NA		
S	NONE	NONE	NONE	NA		
SSW	NONE	NONE	NONE	NA		
SW	1.39	NONE	NONE	Resident	1.40E-01	
WSW	0.75	**4.82**	NONE	Resident Garden	7.62E-02 1.63E-01	**Garden**
W	0.70	NONE	NONE	Resident	4.80E-02	
WNW	NONE	NONE	NONE	NA		
NW	0.93	NONE	NONE	Resident	4.10E-02	
NNW	1.30	NONE	NONE	Resident	3.01E-02	

COMMENTS:

Dose calculations were performed using the GASPAR code and 2012 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.

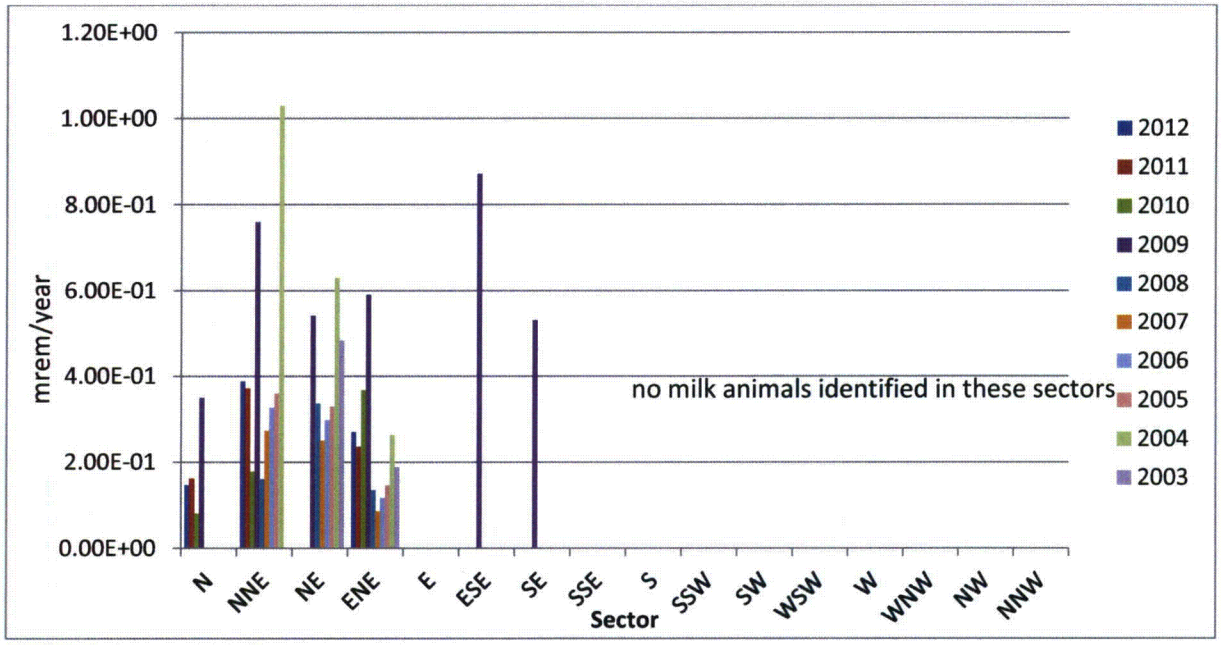
FIGURE 10.1 HISTORICAL COMPARISON OF NEAREST RESIDENT DOSE



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

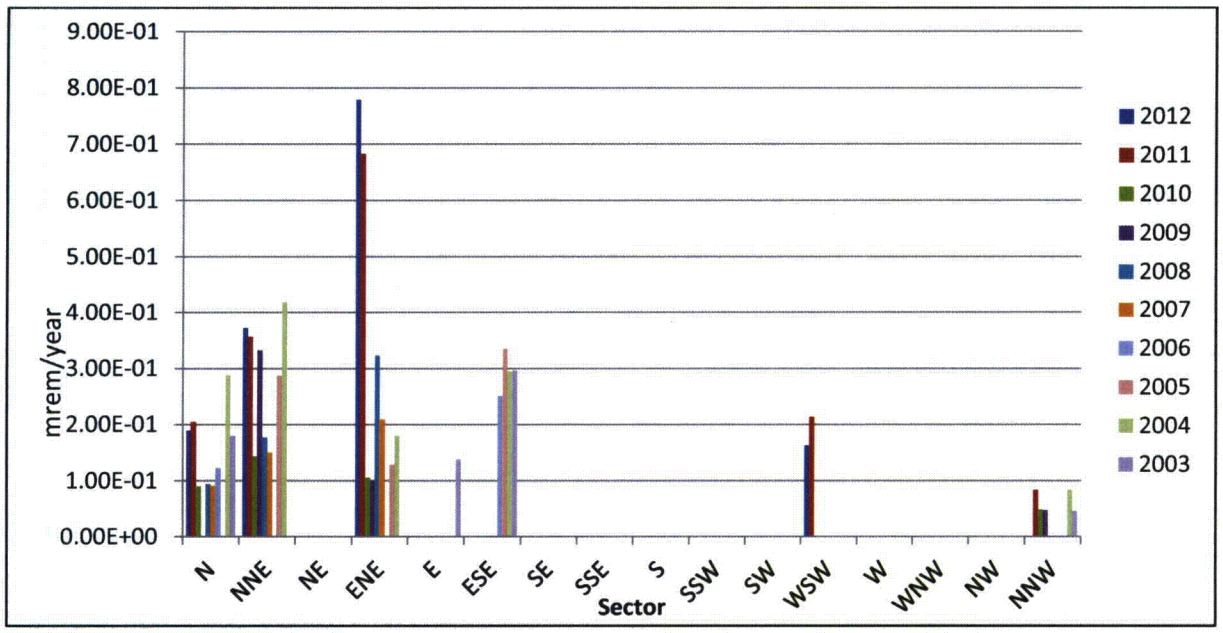


Milk animals include goats and/or cows. Several new milk animals were identified in 2009 that were closer to the power plant than in the past, resulting in generally higher calculated doses in that calendar year.

In 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 are sporadically identified from year to year. Gardening is not prevalent in the desert environment.

11. Summary and Conclusions

The conclusions are based on a review of the radio assay results and environmental gamma radiation measurements for the 2012 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2012 are presented in Tables 8.1-8.13 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 2012 resulting from the operation of PVNGS.

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2012

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	 Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mrem/std. qtr.)	TLD - 199	NA	24.7 (188/188) 16.7 – 32.9	Site #35 8 miles 330°	30.4 (4/4) 27.9 – 32.9	23.7 (8/8) 17.7 – 27.7	0
Air Particulates (pCi/m^3)	Gross Beta - 529	0.010	0.040 (476/476) 0.019 - 0.069	Site #6A 13 miles 158°	0.039 (53/53) 0.021 - 0.069	0.039 (53/53) 0.021 - 0.069	0
	Gamma Spec Composite – 40						
	Cs-134	0.05	<LLD	NA	<LLD	<LLD	0
	Cs-137	0.06	<LLD	NA	<LLD	<LLD	0
Air Radioiodine (pCi/m^3)	Gamma Spec. - 530 I-131	0.07	<LLD	NA	<LLD	NA	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 9						
	I-131	60	<LLD	NA	<LLD	<LLD	0
	Cs-134	60	<LLD	NA	<LLD	<LLD	0
	Cs-137	80	<LLD	NA	<LLD	<LLD	0
Ground Water (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

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2012

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	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	4.0	3.8 (28/48) 2.1 – 7.6	Site #48 1 mile 236°	4.7 (5/12) 3.6 – 5.9	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 46						
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. – 22						
Milk (pCi/liter)	I-131	1.0	<LLD	NA	<LLD	<LLD	0
	Cs-134	15	<LLD	NA	<LLD	<LLD	0
	Cs-137	18	<LLD	NA	<LLD	<LLD	0
	Ba-140	60	<LLD	NA	<LLD	<LLD	0

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station
Maricopa County, Arizona

Docket Nos. STN 50-528/529/530
Calendar Year 2012

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	La-140	15	<LLD	NA	<LLD	<LLD	0
	Gamma Spec. - 20						
	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	31 (5/24) 16 - 50	Site #61 Onsite 67°	35 (2/4) 21 - 50	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
	H-3 - 20	3000	940 (16/24) 562 - 1350	Site #63 Onsite 180°	1054 (8/8) 966 - 1350	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 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. 1985-2011 Annual Radiological Environmental Operating Reports, Palo Verde Nuclear Generating Station
3. Palo Verde Nuclear Generating Station Technical Specifications and Technical Reference Manual
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