Technical Specification 5.6.2

APS

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear
Generating Station

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May 13, 2011

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

Dear Sir:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report 2010

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2010.

No commitments are being made to the NRC in this letter. Should you need further information regarding this submittal, please contact Russell A. Stroud, Licensing Section Leader, at (623) 393-5111.

Sincerely,

Thomas N. Weber

TNW/RAS/gat

Enclosure

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IE25
NRR

ENCLOSURE

Units 1, 2, and 3

Annual Radiological Environmental Operating Report 2010

PALO VERDE[SM]

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2010

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

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Director, Radiation Protection

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 2010, the following categories of samples were collected by APS:

- Broad leaf vegetation
- Ground water
- Drinking water
- Surface water
- Airborne particulate and radioiodine
- Goat and cow 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.

Low level tritium was discovered in subsurface water onsite (not considered potable) in February 2006 at Units 2 and 3. A significant investigation was initiated to determine the source of the water, the extent of the condition, and corrective actions to protect ground water. See Section 2.4 for further discussion.

(NOTE: Reference to APS throughout this report refers to PVNGS personnel)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1. Introduction

This report presents the results of the operational radiological environmental monitoring program conducted by Arizona Public Service Company (APS). The Radiological Environmental Monitoring Program (REMP) was established for the Palo Verde Nuclear Generating Station (PVNGS) by APS in 1979. The REMP is performed in accordance with the federal requirements to provide a complete environmental monitoring program for nuclear reactors, and with concern for maintaining the quality of the local environment. The program complies with the requirements of 10 CFR 50, Appendix I, PVNGS Technical Specifications, and with the guidance 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).

This report contains the measurements and findings for 2010. All references are specifically identified in Section 12.

The objectives of the REMP are as follows: 1) to determine baseline radiation levels in the environs prior to plant operation and to compare the findings with measurements obtained during reactor operations; 2) to monitor potential radiological exposure pathways to the public; and 3) to determine radiological impacts on the environment caused by the operation of PVNGS.

Results from the REMP help to evaluate sources of elevated levels of radioactivity in the environment (e.g., atmospheric nuclear detonations or abnormal plant releases).

Results of the PVNGS pre-operational environmental monitoring program are presented in Reference 1.

The initial criticality of Unit 1 occurred May 25, 1985. Initial criticality for Units 2 and 3 were April 18, 1986, and October 25, 1987, respectively. PVNGS operational findings (historical) are presented in Reference 2.

2. Description of the Monitoring Program

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

2.1. 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. Sample analyses were performed at the onsite Central Chemistry Laboratory and Operating Unit laboratories, or at Eberline Analytical Services laboratory. Eberline provided radioanalytical services while the onsite laboratory was shut down for remodeling and upgrades between May and November.

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 2010

Beginning with this annual report, resident names/addresses will no longer be used as identifiers due to this reports availability in the public domain.

The following changes implement ODCM Revision 25 and were made as a result of the annual Land Use Census (reference Corrective Action Program CRDR #3476160);

- Replaced Site #47 garden location
- Replaced Site #51 milk sample location

Between May and November the onsite Central Chemistry Laboratory was out of service during remodeling. During this period, REMP samples were sent to the Eberline Analytical Services facility in Richmond, CA. This vendor is on the Approved Suppliers List for PVNGS.

Refer to Table 2.1 for a description of all current sample locations (except TLDs).

2.3. REMP Deviations/Abnormal Events Summary

During calendar year 2010, 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. Cow and goat milk samples from Site #51 became permanently unavailable on 5-13-10
2. A goat milk sample obtained in May was not analyzed for gamma emitting radionuclides
3. Evaporation Pond #1, the 45 acre Reservoir, and the 85 acre Reservoir exceeded the ODCM Table 6-2 reporting level for I-131
4. Air sample Site #6A was invalid due to loss of power to equipment
5. Air sample Site #21 was invalid due to loss of power to equipment
6. Air sample Site #21 was invalid due to loss of power to equipment
7. Air sample Site #14A was invalid due to loss of power to equipment

2.4. Significant Investigation Regarding Ground Water Protection

(Follow-up from past reports)

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.

On February 15, 2006 Palo Verde personnel observed water leakage into the Unit 2 Essential Pipe Density Tunnel through the 'B' Spray Pond (SP) supply line penetration seal (documented on Corrective Action Program Significant CRDR No. 2869959). Low level tritium was identified in this water. It has been determined that the water was not the result of leakage from a plant system, but more likely due to previous operating conditions combined with precipitation. The investigation revealed that Unit 3 had a similar situation. PVNGS initiated OE22651 and follow-up OE24237 to describe the incident of low level tritium at Unit 3 since the concentration exceeded a reporting threshold.

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).

PVNGS has implemented a ground water protection program initiated by the Nuclear Energy Institute (NEI). 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. 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.

Three 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). Refer to Table 8.12 for sample results and interpretation.

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 **(b)**	**local resident**
48	drinking water	SW1	local resident
49	drinking water	N2	local resident
51	milk	NNE3 **(b)**	**local resident- goats**
52	milk	ENE3	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					
52		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

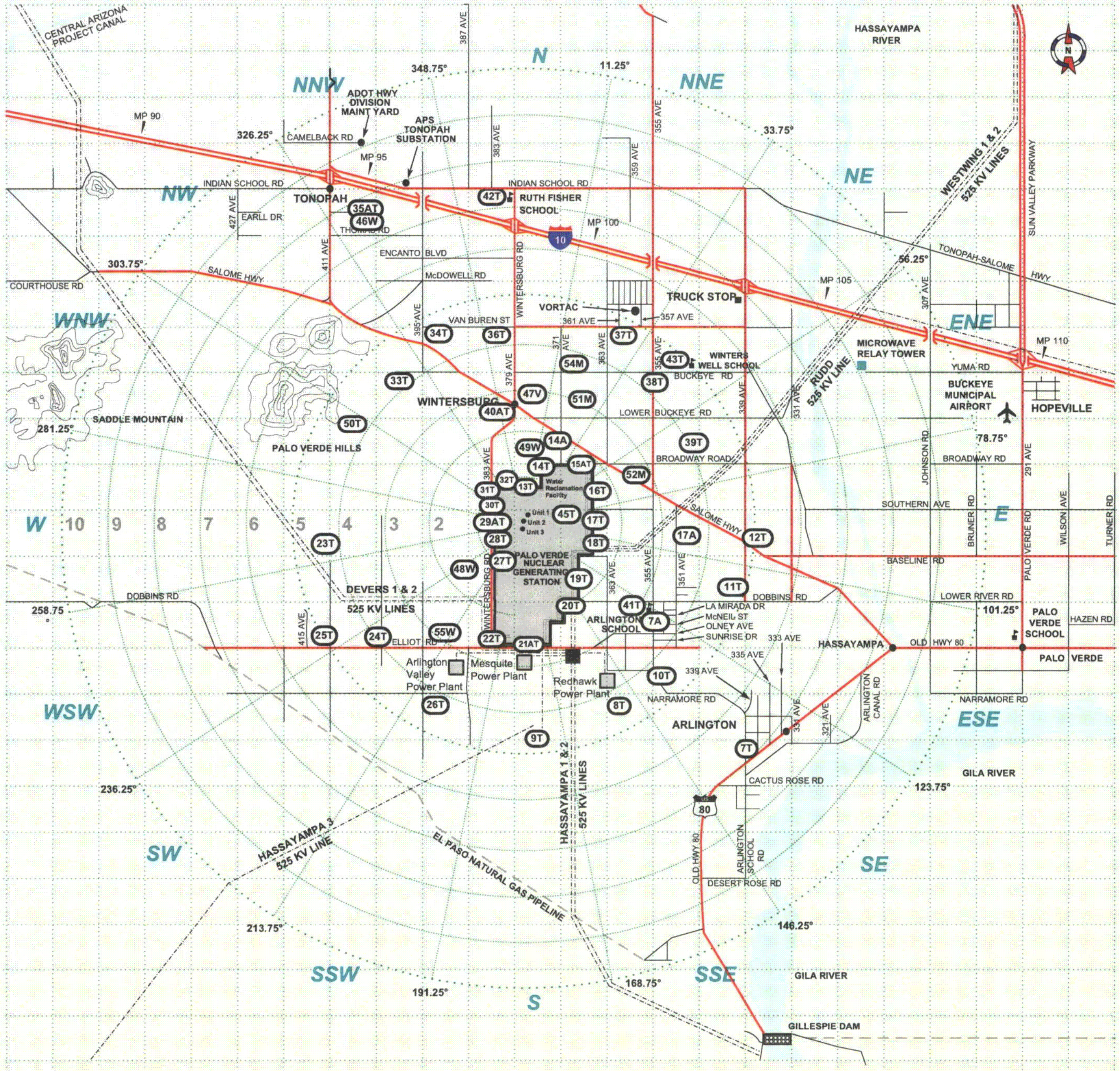
TABLE 2.3 SUMMARIES OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. Cow and goat milk samples from Site #51 became permanently unavailable on 5-13-10.	1. Corrective Action Program CRDR #3476160 was initiated to document the sample unavailability and determine a replacement location to meet ODCM requirements. The Land Use Census was performed during this time period and identified a replacement sample. No further actions are necessary.
2. A goat milk sample obtained in May was not analyzed for gamma emitting radionuclides.	2. Corrective Action Program CRDR #3488039 was initiated to document the deviation and provide needed corrective actions. This particular sample was processed by a vendor. The vendor was requested to perform a gamma isotopic analysis and a low level I-131 analysis. The I-131 analysis was performed first (a radiochemical separation method was used) and there was not enough sample left to perform the gamma analysis. The action taken by the vendor was to counsel the analyst as to the proper order of processing to prevent a recurrence. Samples analyzed since this occurrence did not have a repeat issue with order processing. No further actions are deemed necessary.
3. Evaporation Pond #1, the 45 acre Reservoir, and the 85 acre Reservoir exceeded the ODCM Table 6-2 reporting level for I-131.	3. Corrective Action Program CRDR #3435662 was initiated to document the I-131 concentration exceedance and any required corrective actions. The I-131 identified at these locations has been determined to not be 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. No further action is necessary.
4. Air sample Site #6A was invalid due to loss of power to equipment.	4. Corrective Action Program CRDR #3431187 and Corrective Maintenance Work Order # 3431905 were initiated to document and correct the loss of power to the sampling equipment between 1/19/10 and 1/26/10. The cause of the outage was storm related. Once power was restored, the equipment ran normally for the rest of the year. No further actions are needed.

TABLE 2.3 SUMMARIES OF REMP DEVIATIONS/ABNORMAL EVENTS

<u>Deviation/Abnormal Event (continued)</u>	<u>Actions taken (continued)</u>
5. Air sample Site #21 was invalid due to loss of power to equipment	5. Corrective Action Program CRDR #3431187 and Corrective Maintenance Work Order # 3431905 were initiated to document and correct the loss of power to the sampling equipment between 1/19/10 and 2/16/10. The cause of the power loss was a tripped breaker due to an Arizona Radiation Regulatory Agency air sample equipment malfunction (common power supply). PVNGS Electricians corrected the problem and power was restored. Once power was restored, the equipment ran normally. No further actions are needed.
6. Air sample Site #21 was invalid due to loss of power to equipment	6. Power was lost to equipment for several days due to construction in the area causing a local outage. Power was restored the same week. The sample volume was suspect as it was less than one-half the normal weekly volume. The sample was invalidated due to suspect volume. Subsequent samples were normal and no additional actions are necessary.
7. Air sample Site #14A was invalid due to loss of power to equipment	7. Corrective Action Program CRDR #3574902 and Corrective Maintenance Work Order # 3431905 were initiated to document and correct the loss of power to the sampling equipment between 12/28/10 and 1/13/11. The cause of the outage was storm related. The air sample equipment was returned to normal operation once the damage to the power lines was corrected. No further actions are necessary.

FIGURE 2.1



REMP SAMPLE SITES
0-10 MILES

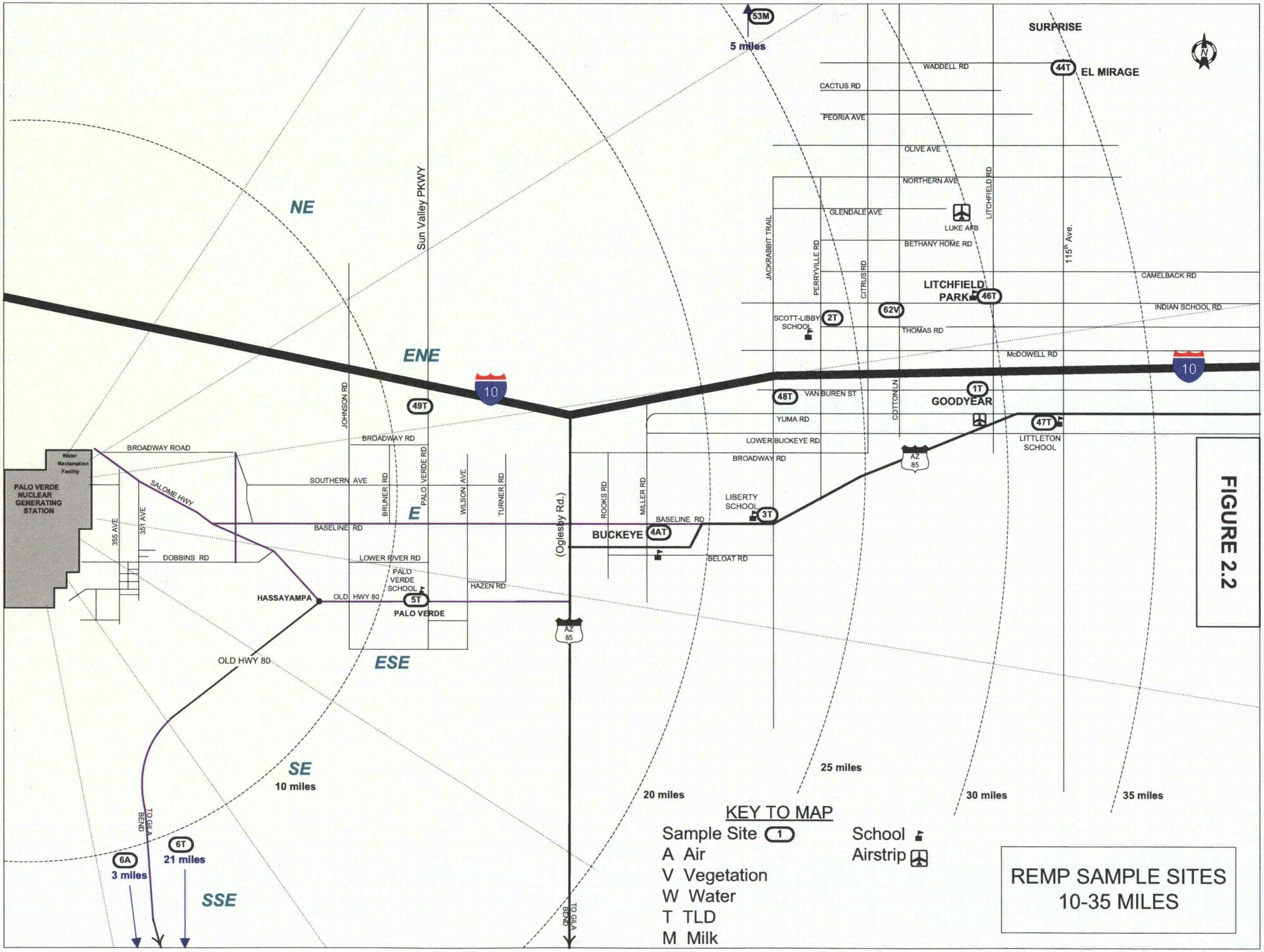


FIGURE 2.2
REMP SAMPLE SITES
10-35 MILES
KEY TO MAP
Sample Site 1
A Air
V Vegetation
W Water
T TLD
M Milk
School
Airstrip
PALO VERDE NUCLEAR GENERATING STATION
Water Reclamation Facility
NE
ENE
E
ESE
SE
SSE
10 miles
20 miles
25 miles
30 miles
35 miles
53M
5 miles
6A
3 miles
6T
21 miles
SURPRISE
EL MIRAGE
44T
WADDELL RD
CACTUS RD
PEORIA AVE
OLIVE AVE
NORTHERN AVE
GLENDALE AVE
LUKE AFB
BETHANY HOME RD
CAMELBACK RD
INDIAN SCHOOL RD
LITCHFIELD PARK
46T
62V
SCOTT-LIBBY SCHOOL
2T
THOMAS RD
McDOWELL RD
VAN BUREN ST
48T
1T
GOODYEAR
YUMA RD
LOWER BUCKEYE RD
BROADWAY RD
47T
LITTLETON SCHOOL
LIBERTY SCHOOL
3T
BASELINE RD
BUCKEYE
4AT
BELOAT RD
JACKRABBIT TRAIL
PERRYVILLE RD
CITRUS RD
COTTON LN
LITCHFIELD RD
115th Ave.
Sun Valley PKWY
49T
BROADWAY ROAD
SALOME HWY
SOUTHERN AVE
BASELINE RD
DOBBINS RD
LOWER RIVER RD
PALO VERDE SCHOOL
HAZEN RD
HASSAYAMPA
OLD HWY 80
5T
PALO VERDE
JOHNSON RD
BRUNER RD
PALO VERDE RD
WILSON AVE
TURNER RD
ROOKS RD
MILLER RD
(Oglesby Rd.)
355 AVE
351 AVE
AZ 85
TO GILA BEND
10

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 Pond #1, Evaporation Pond #3A/3B, and onsite wells 34abb and 27ddc. Evaporation Pond #2 was empty for liner replacement. 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 and cow 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 15-17 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.

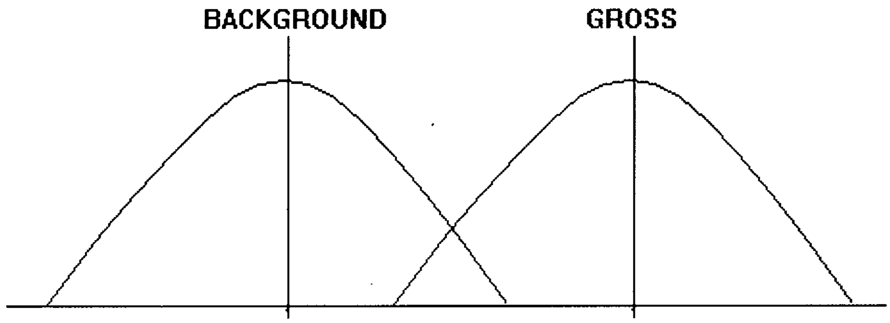
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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	

NOTES:

* If no drinking water pathway exists, a value of 3000 pCi/liter may be used.
** If no drinking water pathway exists, a value of 15 pCi/liter may be used.

This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

Table 6.2 ODCM REQUIRED REPORTING LEVELS

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	MILK (pCi/liter)	VEGETATION (pCi/kg, wet)
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	

NOTES:

* For drinking water samples. This is a 40CFR141 value. If no drinking water pathway exists, a value of 30,000 pCi/liter may be used.

** If no drinking water pathway exists, a reporting level of 20 pCi/liter may be used.

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

Table 6.3 TYPICAL MDA VALUES

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	MILK (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	VEGETATION (pCi/kg, wet)
Gross Beta	2.6		0.002	
H-3	270			
Mn-54	12			
Fe-59	20			
Co-58	11			
Co-60	12			
Zn-65	24			
Zr-95	20			
Nb-95	11			
I-131	9 [a]	0.22	0.05 [b]	38
Cs-134	10	3	0.04 [b]	57
Cs-137	11	3	0.05 [b]	48
Ba-140	36	6		
La-140	14	3		

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 2010, 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	Accept/Reject
Milk	Mixed Gamma	I-131	49.2	51.9	2.9	17.9	1.05	Accept
	E7068-111	Ce-141	47.0	50.5	2.7	18.7	1.07	Accept
		Cr-51	65.0	66.8	7.0	9.5	1.03	Accept
		Cs-134	32.0	30.7	1.9	16.2	0.96	Accept
		Cs-137	28.4	30.4	2.0	15.2	1.07	Accept
		Co-58	25.7	27.3	1.9	14.4	1.06	Accept
		Mn-54	37.3	39.7	2.4	16.5	1.06	Accept
		Fe-59	24.7	27.8	2.7	10.3	1.13	Accept
		Zn-65	45.7	47.0	3.3	14.2	1.03	Accept
		Co-60	33.0	34.0	2.0	17.0	1.03	Accept
Air	Mixed Gamma							
	E6972-111	Ce-141	139	144	5	29	1.04	Accept
		Cr-51	375	352	8	44	0.94	Accept
		Cs-134	173	167	7	24	0.97	Accept
		Cs-137	123	138	7	20	1.13	Accept
		Co-58	144	160	7	23	1.11	Accept
		Mn-54	122	139	8	17	1.14	Accept
		Fe-59	122	146	10	15	1.20	Accept
		Zn-65	236	268	8	34	1.14	Accept
		Co-60	175	182	6	30	1.04	Accept
Water	Mixed Gamma	Ce-141	204	191	7	27	0.93	Accept
	E6969-111	Cr-51	554	531	13	41	0.96	Accept
		Cs-134	255	233	7	33	0.91	Accept
		Cs-137	181	171	8	21	0.95	Accept
		Co-58	213	216	7	31	1.01	Accept
		Mn-54	179	200	8	25	1.11	Accept
		Fe-59	179	189	10	19	1.05	Accept
		Zn-65	348	332	8	42	0.95	Accept
		Co-60	258	246	7	35	0.95	Accept
		I-131	96.1	86	15	6	0.89	Accept
Water	Gross Beta		69.1	92	7	13	1.33	Accept
	E6970-111							
Air	Cartridge	I-131	93.6	96	5	19	1.03	Accept
	E6971-111							

* calculated from PVNGS value/1 sigma error 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
	Tritium	H-3	10,893	12,600	8,200-18,600	Accept
WATER	Gross Beta		109	101	59.1-148	Accept
FILTER	Gross Beta		94	70.4	43.4-103	Accept
ERA MRAD-012 PT Study Results						

[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.

Eberline Analytical Services

(units are Bq/Liter or Bq/sample)

Analyte	Result	Ref. Value	Acceptance Range	Accept/ Reject?	Analyte	Result	Ref. Value	Acceptance Range	Accept/ Reject?
MAPEP-10-GrW23: Gross alpha/beta water					**MAPEP-10-GrW22: Gross alpha/beta water**				
gross beta	4.275	4.39	2.20-6.59	Accept	gross beta	3.53	3.09	1.55-4.64	Accept
MAPEP-10-RdF23: Radiological air filter					**MAPEP-10-RdF22: Radiological air filter**				
Cs-134	3.25	2.98	2.09-3.87	Accept	Cs-134	2.7	2.13	1.49-2.77	Accept
Co-57	4.45	4.08	2.86-5.30	Accept	Cs-137	1.81	1.53	1.07-1.99	Accept
Co-60	3.19	2.92	2.04-3.80	Accept	Co-60	2.74	2.473	1.731-3.215	Accept
Mn-54	3.82	3.18	2.23-4.13	Accept	Mn-54	3.18	3.02	2.11-3.93	Accept
MAPEP-10-GrF23: Gross alpha/beta air filter					**MAPEP-10-GrF22: Gross alpha/beta air filter**				
gross beta	0.522	0.5	0.25-0.75	Accept	gross beta	1.278	1.29	0.65-1.94	Accept
MAPEP-10-RdV23: Radiological Vegetation					**MAPEP-10-RdV22: Radiological vegetation**				
Cs-134	5.32	4.79	3.35-6.23	Accept	Cs-134	5	4.39	3.07-5.71	Accept
Cs-137	6.15	5.88	4.12-7.64	Accept	Cs-137	3.32	3.06	2.14-3.98	Accept
Co-57	8.82	8.27	5.79-10.75	Accept	Co-60	3.48	3.27	2.29-4.25	Accept
Mn-54	6.85	6.287	4.401-8.173	Accept	Zn-65	8.05	7.1	4.97-9.23	Accept
Zn-65	6.44	5.39	3.77-7.01	Accept					
MAPEP-10-MaW22: Radiological water standard									
Cs-137	63.4	60.6	42.4-78.8	Accept					
Co-57	29.4	28.3	19.8-36.8	Accept					
H-3	92	90.8	63.6-118.0	Accept					
Mn-54	28.6	26.9	18.8-35.0	Accept					
Zn-65	44.4	40.7	28.5-52.9	Accept					

8. Data Interpretations and Conclusions

Associated with the analytical process are potential random and systematic errors. Systematic errors can be caused by instrument malfunctions, incomplete precipitation, 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 2010 are presented in the following sections. Assessment of pre-operational and operational data revealed no changes to environmental radiation levels. ***The only measurable impact on the environment in 2010 was the low level tritium discovered in subsurface water onsite in the RCA in 2006. See Section 2.4 for specific information.***

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 0.009 to 0.082 pCi/m^3. This range is typical and due to normal seasonal variations. 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. The gross beta activity is attributable to natural (background) radioactive materials. The findings are consistent with pre-operational baseline and previous operational results. The results are summarized in Table 11.1.

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

8.2. Airborne Radioiodine

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

8.3. Vegetation

Table 8.6 presents gamma isotopic data for the vegetation samples. No gamma emitting 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 4.3 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. Evaporation Pond #3 was constructed in 2008 to allow for re-lining of the older ponds. Evaporation Pond #2 was pumped into Evaporation Pond #3 (sections 3A and 3B) and is in process of refurbishment.

Sample results are presented in Table 8.10. I-131 was observed in the Evaporation Ponds in three (3) samples (12 to 35 pCi/liter) and two (2) of the Reservoir samples (20 to 54 pCi/liter). I-131 in these surface water locations is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent and are not attributable to plant effluents.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration in Evaporation Pond #1 was 1321 pCi/liter and the highest concentration in Evaporation Pond #3 (cell 3A) was 1008 pCi/liter. Evaporation Pond #2 was empty the entire year due to liner replacement. 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).

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 highest I-131 concentration was 85 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 three (3) samples ranging from 339 to 631 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. I-131 was present in all forty-six (46) samples ranging from 367 to 2743 pCi/kg.

In-111 was also identified in the sludge in 24 of the 46 samples. The highest concentration was 188 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/or Circulating Water canals was disposed of in the WRF sludge landfill during 2010. 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/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	28-Dec-09	5-Jan-10	0.050	0.049	0.048	0.044	0.048	0.049	0.047	0.051	0.047	0.045	0.048	4.5
2	5-Jan-10	12-Jan-10	0.079	0.077	0.071	0.055	0.068	0.082	0.064	0.075	0.072	0.071	0.071	11.0
3	12-Jan-10	19-Jan-10	0.070	0.078	0.070	0.070	0.071	0.073	0.068	0.071	0.076	0.068	0.072	4.6
4	19-Jan-10	26-Jan-10	0.012	invalid [a]	0.011	0.009	0.011	0.011	invalid [a]	0.011	0.013	0.011	0.011	10.1
5	26-Jan-10	2-Feb-10	0.037	0.044	0.042	0.039	0.044	0.044	invalid [a]	0.043	0.044	0.040	0.042	6.3
6	2-Feb-10	9-Feb-10	0.050	0.050	0.050	0.048	0.052	0.049	invalid [a]	0.053	0.048	0.052	0.050	3.6
7	9-Feb-10	16-Feb-10	0.029	0.032	0.031	0.028	0.033	0.030	invalid [a]	0.030	0.031	0.030	0.030	5.0
8	16-Feb-10	23-Feb-10	0.035	0.034	0.034	0.031	0.034	0.035	0.030	0.033	0.036	0.034	0.034	5.5
9	23-Feb-10	2-Mar-10	0.039	0.034	0.037	0.033	0.035	0.039	0.035	0.035	0.036	0.036	0.036	5.5
10	2-Mar-10	9-Mar-10	0.026	0.024	0.023	0.023	0.023	0.025	0.023	0.023	0.022	0.027	0.024	6.7
11	9-Mar-10	16-Mar-10	0.023	0.022	0.022	0.020	0.023	0.026	0.021	0.024	0.022	0.024	0.023	7.5
12	16-Mar-10	23-Mar-10	0.041	0.039	0.038	0.039	0.041	0.040	0.043	0.041	0.041	0.039	0.040	3.7
13	23-Mar-10	30-Mar-10	0.028	0.034	0.031	0.029	0.030	0.030	0.027	0.025	0.027	0.027	0.029	8.9
	Mean		0.040	0.043	0.039	0.036	0.039	0.041	0.040	0.040	0.040	0.039	0.040	4.5

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	30-Mar-10	6-Apr-10	0.026	0.023	0.027	0.022	0.024	0.025	0.024	0.027	0.024	0.027	0.025	7.2
15	6-Apr-10	13-Apr-10	0.023	0.021	0.023	0.020	0.022	0.023	0.019	0.023	0.023	0.023	0.022	6.8
16	13-Apr-10	20-Apr-10	0.036	0.035	0.037	0.035	0.039	0.037	0.033	0.037	0.036	0.036	0.036	4.4
17	20-Apr-10	27-Apr-10	0.018	0.022	0.020	0.019	0.020	0.020	0.020	0.021	0.022	0.021	0.020	6.2
18	27-Apr-10	4-May-10	0.020	0.021	0.018	0.018	0.018	0.021	0.018	0.019	0.020	0.017	0.019	7.4
19	4-May-10	11-May-10 [b]	0.023	0.024	0.024	0.023	0.024	0.025	0.024	0.024	0.024	0.023	0.024	2.7
20	11-May-10	18-May-10	0.025	0.023	0.025	0.021	0.025	0.025	0.022	0.022	0.023	0.021	0.023	7.3
21	18-May-10	25-May-10	0.019	0.021	0.021	0.019	0.021	0.022	0.020	0.019	0.021	0.021	0.020	5.3
22	25-May-10	1-Jun-10	0.025	0.023	0.023	0.023	0.024	0.025	0.022	0.025	0.022	0.021	0.023	6.1
23	1-Jun-10	8-Jun-10	0.023	0.025	0.024	0.023	0.024	0.024	0.018	0.023	0.022	0.024	0.023	8.5
24	8-Jun-10	15-Jun-10	0.024	0.029	0.025	0.024	0.026	0.023	0.022	0.023	0.024	0.023	0.024	8.2
25	15-Jun-10	22-Jun-10	0.028	0.028	0.027	0.028	0.027	0.030	0.024	0.029	0.029	0.031	0.028	6.8
26	22-Jun-10	29-Jun-10	0.027	0.028	0.028	0.026	0.027	0.028	0.024	0.030	0.030	0.026	0.027	6.7
	Mean		0.024	0.025	0.025	0.023	0.025	0.025	0.022	0.025	0.025	0.024	0.024	3.7

a Power outage at this location due to storm. Unable to accurately determine sample volume. Corrective Action Program CRDR # 3431187 and CM WO #3431905 initiated.

b Vendor lab begins analyzing samples due to onsite lab shutdown for remodeling.

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	29-Jun-10	6-Jul-10	0.024	0.023	0.028	0.022	0.023	0.027	0.021	0.025	0.029	0.020	0.024	12.4
28	6-Jul-10	13-Jul-10	0.031	0.030	0.030	0.027	0.028	0.031	0.025	0.027	0.031	0.030	0.029	7.3
29	13-Jul-10	20-Jul-10	0.033	0.035	0.034	0.033	0.034	0.034	0.031	0.030	0.036	0.034	0.033	5.3
30	20-Jul-10	27-Jul-10	0.030	0.030	0.035	0.027	0.030	0.031	0.029	0.030	0.032	0.030	0.030	6.8
31	27-Jul-10	3-Aug-10	0.023	0.026	0.025	0.025	0.026	0.017	0.022	0.024	0.025	0.024	0.024	11.3
32	3-Aug-10	10-Aug-10	0.031	0.029	0.028	0.032	0.027	0.030	0.025	0.025	0.027	0.028	0.028	8.3
33	10-Aug-10	17-Aug-10	0.029	0.029	0.029	0.027	0.027	0.030	0.028	0.028	0.031	0.029	0.029	4.4
34	17-Aug-10	24-Aug-10	0.025	0.024	0.024	0.023	0.024	0.025	0.021	0.024	0.025	0.025	0.024	5.2
35	24-Aug-10	31-Aug-10	0.028	0.029	0.028	0.027	0.028	0.028	0.025	0.028	0.029	0.026	0.028	4.6
36	31-Aug-10	7-Sep-10	0.027	0.027	0.028	0.027	0.029	0.030	0.026	0.028	0.028	0.029	0.028	4.3
37	7-Sep-10	14-Sep-10	0.026	0.028	0.031	0.027	0.026	0.031	0.023	0.029	0.029	0.028	0.028	8.8
38	14-Sep-10	21-Sep-10	0.032	0.036	0.032	0.029	0.033	0.034	0.027	0.033	0.030	0.033	0.032	8.2
39	21-Sep-10	27-Sep-10	0.030	0.030	0.033	0.026	0.029	0.032	0.028	0.027	0.033	0.031	0.030	8.1
	Mean		0.028	0.029	0.030	0.027	0.028	0.029	0.025	0.028	0.030	0.028	0.028	4.6

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	27-Sep-10	5-Oct-10	0.047	0.042	0.044	0.040	0.042	0.044	0.039	0.042	0.045	0.041	0.043	5.7
41	5-Oct-10	12-Oct-10	0.045	0.044	0.043	0.032	0.040	0.042	0.040	0.037	0.040	0.041	0.040	9.3
42	12-Oct-10	19-Oct-10	0.049	0.048	0.051	0.045	0.049	0.046	0.043	0.050	0.049	0.048	0.048	5.1
43	19-Oct-10	26-Oct-10	0.028	0.030	0.026	0.025	0.027	0.031	0.026	0.029	0.030	0.026	0.028	7.5
44	26-Oct-10	2-Nov-10	0.033	0.033	0.031	0.030	0.033	0.030	0.029	0.032	0.032	0.028	0.031	5.8
45	2-Nov-10	8-Nov-10	0.051	0.050	0.047	0.044	0.051	0.052	0.048	0.050	0.048	0.053	0.049	5.4
46	8-Nov-10	16-Nov-10	0.029	0.030	0.029	0.026	0.026	0.030	0.027	0.028	0.027	0.026	0.028	5.8
47	16-Nov-10	22-Nov-10	0.038	0.038	0.037	0.033	0.036	0.036	0.036	0.038	0.037	0.036	0.037	4.1
48	22-Nov-10	30-Nov-10	0.025	0.024	0.023	0.025	0.026	0.023	0.021	0.023	0.024	0.024	0.024	5.9
49	30-Nov-10	8-Dec-10	0.061	0.074	0.064	0.056	0.056	0.059	0.057	0.061	0.064	0.059	0.061	8.8
50	8-Dec-10	14-Dec-10	0.047	0.050	0.044	0.038	0.048	0.043	invalid [a]	0.049	0.043	0.044	0.045	8.3
51	14-Dec-10	20-Dec-10	0.035	0.036	0.036	0.037	0.036	0.034	0.029	0.039	0.037	0.036	0.036	7.4
52	20-Dec-10	28-Dec-10	0.027	0.025	0.022	invalid [b]	0.023	0.022	0.024	0.024	0.022	0.023	0.024	7.1
	Mean		0.040	0.040	0.038	0.036	0.038	0.038	0.035	0.039	0.038	0.037	0.038	4.2
	Annual Average		***0.033***	***0.034***	***0.033***	***0.030***	***0.033***	***0.033***	***0.030***	***0.033***	***0.033***	***0.032***	***0.032***	***4.1***

a Sample invalidated due to power outage sometime during the sample period causing suspect sample volume.

b Power was lost to equipment. Corrective Action Program CRDR #3574902 and CMWO #3431905 initiated.

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*
30-Mar-10	Cs-134	<0.0038	<0.0025	<0.0033	<0.0023	<0.0037	<0.0037	<0.0047	<0.0033	<0.0042	<0.0038
	Cs-137	<0.0042	<0.0030	<0.0047	<0.0041	<0.0053	<0.0035	<0.0061	<0.0050	<0.0036	<0.0044
29-Jun-10	Cs-134	<0.0004	<0.0003	<0.0007	<0.0005	<0.0009	<0.0005	<0.0004	<0.0003	<0.0006	<0.0008
	Cs-137	<0.0006	<0.0002	<0.0005	<0.0004	<0.0007	<0.0004	<0.0003	<0.0002	<0.0005	<0.0007
27-Sep-10	Cs-134	<0.0006	<0.0004	<0.0006	<0.0005	<0.0004	<0.0006	<0.0005	<0.0006	<0.0005	<0.0004
	Cs-137	<0.0005	<0.0003	<0.0005	<0.0006	<0.0003	<0.0006	<0.0004	<0.0005	<0.0005	<0.0003
28-Dec-10	Cs-134	<0.0036	<0.0034	<0.0047	<0.0037	<0.0031	<0.0042	<0.0046	<0.0029	<0.0024	<0.0030
	Cs-137	<0.0042	<0.0046	<0.0041	<0.0047	<0.0050	<0.0036	<0.0043	<0.0035	<0.0037	<0.0042

TABLE 8.4 RADIOIODINE IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

(control) required LLD <0.070

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
1	28-Dec-09	5-Jan-10	<0.042	<0.033	<0.035	<0.035	<0.028	<0.035	<0.031	<0.034	<0.041	<0.034
2	5-Jan-10	12-Jan-10	<0.044	<0.070	<0.049	<0.049	<0.068	<0.035	<0.068	<0.053	<0.066	<0.053
3	12-Jan-10	19-Jan-10	<0.036	<0.068	<0.054	<0.032	<0.070	<0.046	<0.060	<0.040	<0.049	<0.044
4	19-Jan-10	26-Jan-10	<0.042	invalid [a]	<0.053	<0.067	<0.036	<0.061	invalid [a]	<0.060	<0.056	<0.048
5	26-Jan-10	2-Feb-10	<0.039	<0.064	<0.045	<0.035	<0.053	<0.031	invalid [a]	<0.036	<0.046	<0.053
6	2-Feb-10	9-Feb-10	<0.045	<0.013	<0.052	<0.036	<0.036	<0.037	invalid [a]	<0.058	<0.030	<0.032
7	9-Feb-10	16-Feb-10	<0.042	<0.046	<0.058	<0.038	<0.050	<0.044	invalid [a]	<0.050	<0.032	<0.067
8	16-Feb-10	23-Feb-10	<0.041	<0.031	<0.063	<0.031	<0.033	<0.032	<0.042	<0.039	<0.034	<0.036
9	23-Feb-10	2-Mar-10	<0.035	<0.057	<0.053	<0.035	<0.065	<0.041	<0.013	<0.056	<0.054	<0.043
10	2-Mar-10	9-Mar-10	<0.035	<0.064	<0.052	<0.056	<0.045	<0.037	<0.054	<0.046	<0.045	<0.035
11	9-Mar-10	16-Mar-10	<0.059	<0.052	<0.058	<0.069	<0.052	<0.064	<0.067	<0.063	<0.054	<0.058
12	16-Mar-10	23-Mar-10	<0.055	<0.035	<0.069	<0.050	<0.069	<0.069	<0.036	<0.059	<0.069	<0.067
13	23-Mar-10	30-Mar-10	<0.067	<0.050	<0.065	<0.044	<0.056	<0.036	<0.055	<0.025	<0.065	<0.036

2nd Quarter

(control) required LLD <0.070

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
14	30-Mar-10	6-Apr-10	<0.041	<0.040	<0.032	<0.020	<0.067	<0.032	<0.046	<0.026	<0.049	<0.035
15	6-Apr-10	13-Apr-10	<0.034	<0.063	<0.042	<0.055	<0.049	<0.043	<0.034	<0.068	<0.037	<0.034
16	13-Apr-10	20-Apr-10	<0.026	<0.054	<0.068	<0.037	<0.054	<0.041	<0.037	<0.042	<0.056	<0.036
17	20-Apr-10	27-Apr-10	<0.046	<0.041	<0.039	<0.031	<0.067	<0.046	<0.058	<0.038	<0.062	<0.051
18	27-Apr-10	4-May-10	<0.036	<0.057	<0.068	<0.039	<0.061	<0.040	<0.057	<0.036	<0.058	<0.042
19	4-May-10	11-May-10 [b]	<0.004	<0.004	<0.004	<0.002	<0.007	<0.006	<0.006	<0.007	<0.006	<0.004
20	11-May-10	18-May-10	<0.005	<0.005	<0.008	<0.006	<0.006	<0.006	<0.006	<0.007	<0.006	<0.004
21	18-May-10	25-May-10	<0.005	<0.004	<0.005	<0.005	<0.004	<0.005	<0.009	<0.005	<0.004	<0.004
22	25-May-10	1-Jun-10	<0.004	<0.004	<0.003	<0.004	<0.007	<0.005	<0.007	<0.007	<0.004	<0.006
23	1-Jun-10	8-Jun-10	<0.005	<0.006	<0.004	<0.005	<0.005	<0.005	<0.003	<0.004	<0.008	<0.004
24	8-Jun-10	15-Jun-10	<0.005	<0.004	<0.002	<0.003	<0.007	<0.009	<0.007	<0.007	<0.007	<0.004
25	15-Jun-10	22-Jun-10	<0.002	<0.008	<0.003	<0.004	<0.005	<0.004	<0.003	<0.002	<0.004	<0.008
26	22-Jun-10	29-Jun-10	<0.005	<0.005	<0.005	<0.003	<0.004	<0.009	<0.006	<0.008	<0.008	<0.007

a Power outage at this location due to storm. Unable to accurately determine sample volume. Corrective Action Program CRDR # 3431187 and CM WO #3431187 initiated.

b Vendor lab begins analyzing samples due to onsite lab shutdown for remodeling.

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	29-Jun-10	6-Jul-10	<0.006	<0.006	<0.006	<0.004	<0.005	<0.011	<0.004	<0.005	<0.005	<0.003
28	6-Jul-10	13-Jul-10	<0.004	<0.004	<0.004	<0.002	<0.004	<0.008	<0.006	<0.006	<0.008	<0.007
29	13-Jul-10	20-Jul-10	<0.004	<0.003	<0.003	<0.007	<0.005	<0.008	<0.006	<0.004	<0.007	<0.011
30	20-Jul-10	27-Jul-10	<0.005	<0.003	<0.003	<0.007	<0.004	<0.008	<0.007	<0.006	<0.005	<0.005
31	27-Jul-10	3-Aug-10	<0.004	<0.003	<0.002	<0.003	<0.006	<0.006	<0.005	<0.005	<0.004	<0.004
32	3-Aug-10	10-Aug-10	<0.005	<0.004	<0.003	<0.004	<0.008	<0.007	<0.007	<0.006	<0.004	<0.006
33	10-Aug-10	17-Aug-10	<0.004	<0.004	<0.002	<0.007	<0.007	<0.008	<0.006	<0.004	<0.011	<0.011
34	17-Aug-10	24-Aug-10	<0.008	<0.003	<0.004	<0.004	<0.006	<0.004	<0.005	<0.004	<0.005	<0.004
35	24-Aug-10	31-Aug-10	<0.004	<0.004	<0.004	<0.003	<0.008	<0.007	<0.007	<0.006	<0.005	<0.012
36	31-Aug-10	7-Sep-10	<0.005	<0.005	<0.005	<0.003	<0.010	<0.006	<0.007	<0.008	<0.007	<0.005
37	7-Sep-10	14-Sep-10	<0.008	<0.008	<0.007	<0.004	<0.011	<0.003	<0.003	<0.003	<0.003	<0.002
38	14-Sep-10	21-Sep-10	<0.006	<0.006	<0.005	<0.003	<0.009	<0.012	<0.007	<0.008	<0.007	<0.004
39	21-Sep-10	27-Sep-10	<0.008	<0.007	<0.006	<0.003	<0.012	<0.010	<0.007	<0.006	<0.005	<0.004

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	27-Sep-10	5-Oct-10	<0.007	<0.004	<0.005	<0.006	<0.005	<0.006	<0.005	<0.004	<0.010	<0.008
41	5-Oct-10	12-Oct-10	<0.005	<0.006	<0.005	<0.003	<0.009	<0.006	<0.007	<0.007	<0.005	<0.012
42	12-Oct-10	19-Oct-10	<0.005	<0.005	<0.005	<0.003	<0.005	<0.007	<0.007	<0.006	<0.004	<0.005
43	19-Oct-10	26-Oct-10	<0.008	<0.007	<0.008	<0.005	<0.009	<0.005	<0.010	<0.009	<0.009	<0.005
44	26-Oct-10	2-Nov-10	<0.038	<0.069	<0.064	<0.069	<0.037	<0.046	<0.058	<0.015	<0.053	<0.062
45	2-Nov-10	8-Nov-10	<0.063	<0.063	<0.069	<0.069	<0.066	<0.059	<0.066	<0.057	<0.064	<0.064
46	8-Nov-10	16-Nov-10	<0.034	<0.053	<0.046	<0.041	<0.051	<0.048	<0.039	<0.062	<0.043	<0.062
47	16-Nov-10	22-Nov-10	<0.068	<0.058	<0.067	<0.062	<0.068	<0.053	<0.069	<0.043	<0.068	<0.062
48	22-Nov-10	30-Nov-10	<0.033	<0.040	<0.039	<0.032	<0.040	<0.048	<0.060	<0.057	<0.052	<0.031
49	30-Nov-10	8-Dec-10	<0.048	<0.054	<0.052	<0.046	<0.045	<0.055	<0.013	<0.057	<0.057	<0.055
50	8-Dec-10	14-Dec-10	<0.064	<0.065	<0.050	<0.064	<0.055	<0.015	invalid [a]	<0.068	<0.067	<0.069
51	14-Dec-10	20-Dec-10	<0.039	<0.063	<0.070	<0.069	<0.065	<0.057	<0.070	<0.064	<0.064	<0.060
52	20-Dec-10	28-Dec-10	<0.060	<0.060	<0.059	invalid [b]	<0.039	<0.055	<0.051	<0.050	<0.047	<0.055

a Sample invalidated due to power outage sometime during the sample period causing suspect sample volume.

b Power was lost to equipment. Corrective Action Program CRDR #3574902 and CM WO #3431905 initiated.

TABLE 8.6 VEGETATION

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

			<60	<60	<80
LOCATION	**TYPE**	**DATE COLLECTED**	**I-131**	**Cs-134**	**Cs-137**
LOCAL RESIDENCE (Site #47)*	NONE AVAILABLE				
COMMERCIAL FARM (Site #62)*	savoy cabbage	12-Feb-10	<51	<48	<69
	red cabbage	12-Feb-10	<48	<44	<47
	green cabbage	12-Feb-10	<50	<43	<48
	green cabbage	11-Mar-10	<42	<60	<36
	red cabbage	11-Mar-10	<44	<41	<32
	savoy cabbage	11-Mar-10	<51	<56	<64
	green cabbage	9-Apr-10	<30	<53	<56
	red cabbage	9-Apr-10	<48	<59	<59
	savoy cabbage	9-Apr-10	<44	<60	<13
	red cabbage	18-Nov-10	<44	<55	<43
	green cabbage	18-Nov-10	<32	<58	<52
	red cabbage	27-Dec-10	<28	<40	<75
	green cabbage	27-Dec-10	<38	<34	<52

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 COWS	10-Feb-10	<1	<1	<1	<3	<1
	16-Mar-10	<1	<1	<1	<3	<1
GOATS (Site #51)*	no samples available					
LOCAL RESIDENT GOATS (Site #52)*	no samples available					
LOCAL RESIDENT GOATS (Site #53)*	26-Mar-10	<1	<1	<1	<3	<1
	23-Apr-10	<1	<1	<1	<3	<1
	20-May-10	<0.15	[a]	[a]	[a]	[a]
	23-Jun-10	<0.19	<7	<5	<13	<7
	21-Jul-10	<0.36	<12	<13	<32	<14
	19-Aug-10	<0.32	<6	<5	<16	<7
	23-Sep-10	<0.33	<12	<10	<25	<12
	20-Oct-10	<0.26	<8	<6	<17	<8
	18-Nov-10	<0.29	<6	<4	<14	<7
	17-Dec-10	<0.28	<10	<10	<25	<13
LOCAL RESIDENT GOATS (Site #54)	15-Jan-10	<1	<1	<1	<3	<1
	12-Feb-10	<1	<1	<1	<3	<1
	23-Sep-10	<0.30	<6	<4	<14	<8
	20-Oct-10	<0.34	<10	<9	<28	<14
	18-Nov-10	<0.28	<8	<6	<16	<9
	17-Dec-10	<0.21	<6	<5	<13	<6

Notes:
a Vendor lab begins analyzing samples in May due to onsite lab shutdown for remodeling. Gamma emitting radionuclide analysis not performed in error. Corrective Action Program CRDR #3488039 initiated.

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
	26-Jan-10	<12	<11	<22	<14	<30	<13	<20	<12	<12	<13	<41	<13		<3.6
	23-Feb-10	<10	<12	<25	<12	<30	<12	<19	<11	<11	<12	<40	<12		<3.1
	30-Mar-10	<10	<11	<23	<12	<27	<12	<20	<11	<10	<9	<38	<15	<269	<3.4
	27-Apr-10	<11	<13	<28	<14	<28	<12	<19	<10	<10	<11	<38	<15		<3.9
LOCAL	25-May-10 [a]	<4	<4	<11	<5	<9	<5	<8	<5	<6	<5	<12	<6		2.4 ± 2.4
RESIDENCE	29-Jun-10	<7	<7	<23	<8	<17	<9	<12	<9	<10	<8	<23	<11	<265	2.0 ± 3.1
(Site #48) *	27-Jul-10	<4	<4	<12	<4	<11	<5	<7	<5	<6	<4	<12	<6		3.3 ± 2.4
	31-Aug-10	<5	<5	<13	<5	<10	<5	<8	<8	<6	<5	<16	<7		3.0 ± 2.1
	27-Sep-10	<9	<9	<25	<8	<19	<9	<15	<15	<9	<9	<34	<15	<256	2.4 ± 1.9
	26-Oct-10	<5	<5	<15	<5	<10	<10	<9	<8	<6	<5	<16	<9		2.6 ± 2.1
	30-Nov-10	<2	<3	<7	<3	<5	<3	<5	<7	<3	<3	<11	<4		2.1 ± 1.4
	28-Dec-10	<11	<10	<25	<13	<23	<11	<17	<8	<11	<8	<36	<15	<271	<3.9
	26-Jan-10	<15	<12	<24	<14	<28	<15	<24	<15	<12	<14	<54	<14		3.4 ± 1.6
	23-Feb-10	<13	<12	<27	<12	<24	<12	<21	<14	<11	<12	<49	<15		4.2 ± 1.5
	30-Mar-10	<14	<12	<27	<15	<26	<14	<24	<13	<13	<14	<52	<15	<270	3.8 ± 1.6
	27-Apr-10	<12	<13	<30	<14	<25	<13	<22	<13	<12	<13	<46	<14		<2.7
LOCAL	25-May-10 [a]	<5	<5	<13	<6	<11	<5	<9	<5	<7	<5	<12	<8		3.9 ± 1.4
RESIDENCE	29-Jun-10	<4	<4	<9	<3	<8	<4	<7	<6	<5	<4	<12	<5	<265	3.6 ± 1.3
(Site #55)	27-Jul-10	<8	<8	<21	<9	<21	<8	<15	<9	<11	<10	<22	<10		2.1 ± 1.3
	31-Aug-10	<4	<4	<10	<4	<8	<4	<7	<8	<5	<5	<16	<7		4.3 ± 1.1
	27-Sep-10	<7	<8	<21	<8	<16	<8	<14	<14	<9	<8	<27	<14	<257	3.9 ± 1.2
	26-Oct-10	<4	<5	<13	<6	<9	<6	<9	<12	<6	<5	<20	<10		3.7 ± 1.8
	30-Nov-10	<4	<4	<12	<5	<9	<5	<8	<11	<5	<5	<19	<9		3.9 ± 1.0
	28-Dec-10	<10	<12	<21	<14	<28	<11	<20	<10	<10	<10	<35	<15	<270	3.8 ± 1.8

a Vendor lab begins analyzing samples due to onsite lab shutdown for remodeling

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
	26-Jan-10	<13	<11	<30	<12	<28	<13	<23	<15	<12	<13	<47	<11		<2.4
	23-Feb-10	<10	<9	<20	<10	<22	<11	<15	<9	<9	<11	<34	<15		3.2 ± 1.4
	30-Mar-10	<14	<12	<26	<13	<20	<11	<20	<11	<10	<13	<41	<11	<272	<2.2
	27-Apr-10	<11	<11	<19	<10	<29	<12	<20	<11	<11	<13	<40	<15		<2.6
	25-May-10 [a]	<5	<5	<14	<7	<11	<5	<9	<5	<7	<5	<14	<7		4.2 ± 1.7
LOCAL	29-Jun-10	<4	<4	<10	<5	<8	<4	<6	<4	<5	<4	<11	<6	<267	3.4 ± 1.3 [b]
RESIDENCE	27-Jul-10	<5	<5	<14	<6	<11	<5	<9	<6	<7	<5	<15	<7		2.4 ± 1.3
(Site #46) *	31-Aug-10	<4	<4	<12	<4	<9	<4	<7	<6	<5	<4	<15	<8		2.5 ± 0.8
	27-Sep-10	<4	<4	<13	<4	<9	<4	<9	<6	<6	<4	<15	<7	<258	1.3 ± 1.1
	26-Oct-10	<4	<4	<11	<4	<8	<5	<7	<8	<6	<4	<18	<8		2.1 ± 1.5
	30-Nov-10	<2	<2	<6	<2	<5	<2	<4	<5	<3	<2	<9	<4		1.6 ± 1.2
	28-Dec-10	<14	<11	<23	<13	<22	<11	<19	<10	<10	<13	<40	<12	<270	<2.5
	26-Jan-10	<12	<9	<24	<12	<25	<9	<17	<10	<9	<11	<39	<13		<2.3
	23-Feb-10	<13	<12	<27	<14	<28	<12	<20	<12	<11	<13	<44	<15		<1.9
	30-Mar-10	<11	<14	<23	<14	<29	<13	<22	<14	<12	<13	<46	<15	<275	<2.2
	27-Apr-10	<11	<12	<24	<13	<26	<11	<20	<11	<12	<12	<40	<15		<2.6
	25-May-10 [a]	<4	<4	<11	<5	<8	<4	<7	<5	<6	<4	<11	<6		0.9 ± 1.1
LOCAL	29-Jun-10	<7	<7	<20	<8	<16	<8	<13	<9	<10	<8	<23	<10	<264	0.9 ± 1.8
RESIDENCE	27-Jul-10	<8	<9	<25	<9	<19	<8	<15	<10	<10	<10	<25	<11		0.7 ± 1.5
(Site #49) *	31-Aug-10	<7	<8	<19	<9	<16	<8	<13	<14	<9	<8	<26	<14		1.0 ± 0.8
	27-Sep-10	<3	<3	<8	<4	<7	<4	<6	<6	<5	<4	<12	<9	<254	0.7 ± 0.8
	26-Oct-10	<5	<5	<12	<5	<9	<5	<8	<10	<7	<5	<19	<9		1.8 ± 1.5
	30-Nov-10	<3	<3	<8	<3	<6	<3	<5	<6	<4	<3	<11	<5		1.3 ± 0.7
	28-Dec-10	<11	<10	<21	<10	<28	<11	<19	<11	<11	<13	<42	<15	<272	<2.5

a Vendor lab begins analyzing samples due to onsite lab shutdown for remodeling

b The initial gross beta result was reported as 51.47 ± 3.1 pCi/liter. Laboratory was requested to re-analyze sample for verification and the result was within historical normal values.

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)*	26-Jan-10	<12	<11	<21	<12	<22	<11	<17	<11	<10	<12	<43	<13	<283
	27-Apr-10	<11	<12	<24	<10	<25	<12	<19	<12	<11	<11	<41	<15	<292
	12-Jul-10	<5	<5	<15	<5	<10	<5	<10	<11	<6	<4	<37	<13	<260
	8-Nov-10	<9	<10	<19	<12	<27	<11	<18	<10	<9	<10	<35	<15	<272
WELL 34abb (Site #58)*	26-Jan-10	<11	<10	<22	<13	<23	<13	<17	<12	<10	<11	<40	<15	<283
	27-Apr-10	<11	<10	<24	<12	<22	<13	<21	<10	<10	<11	<34	<15	<289
	12-Jul-10	<8	<8	<21	<10	<16	<9	<14	<11	<9	<8	<25	<13	<259
	8-Nov-10	<14	<14	<29	<13	<30	<13	<25	<13	<12	<11	<47	<15	<270

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) *	26-Jan-10	<13	<11	<25	<12	<27	<12	<22	54 ± 16[b]	<11	<11	<42	<15	<286
	27-Apr-10	<12	<15	<25	<9	<25	<12	<24	<13	<9	<14	<40	<14	<290
	12-Jul-10	<8	<8	<24	<9	<18	<8	<15	<14	<6	<9	<30	<13	<269
	2-Nov-10	<14	<13	<22	<14	<27	<14	<22	<12	<12	<13	<48	<14	<272
85 ACRE RESERVOIR (Site #60) *	empty for re-lining													
	27-Apr-10	<13	<12	<25	<11	<29	<12	<21	<13	<11	<14	<42	<15	<292
	12-Jul-10	<4	<4	<12	<5	<10	<5	<8	<13	<6	<5	<16	<8	<257
	2-Nov-10	<12	<14	<24	<11	<26	<14	<23	20 ± 9[c]	<10	<13	<38	<15	<272
EVAP POND 1 (Site #59) *	26-Jan-10	<12	<11	<21	<12	<26	<12	<19	35 ± 15[a]	<10	<13	<41	<15	1154 ± 187
	27-Apr-10	<11	<11	<26	<12	<28	<12	<21	12 ± 10	<11	<13	<47	<13	1321 ± 190
	12-Jul-10	<5	<5	<14	<7	<12	<5	<10	<8	<7	<5	<16	<8	1189 ± 175
	9-Nov-10	<9	<10	<24	<12	<28	<11	<18	13 ± 7	<9	<12	<35	<15	877 ± 177
EVAP POND 2 (Site #63) *	empty for re-lining													
EVAP POND 3 (Site #64) * CELL 3A	26-Jan-10	<12	<12	<29	<11	<30	<11	<19	<10	<10	<14	<39	<15	546 ± 175
	27-Apr-10	<12	<11	<25	<13	<30	<11	<18	<9	<10	<12	<34	<12	642 ± 178
	12-Jul-10	<9	<8	<25	<10	<20	<8	<15	<15	<10	<9	<27	<14	1008 ± 172
	9-Nov-10	<10	<10	<24	<14	<30	<11	<15	<9	<9	<11	<32	<11	510 ± 171
CELL 3B	26-Jan-10	<11	<11	<25	<12	<30	<11	<19	<13	<10	<11	<42	<12	636 ± 176
	27-Apr-10	<13	<14	<23	<14	<28	<13	<23	<12	<13	<16	<47	<14	648 ± 178
	12-Jul-10	<6	<7	<21	<7	<16	<6	<11	<8	<8	<7	<19	<10	727 ± 168
	9-Nov-10	<13	<12	<28	<12	<30	<10	<17	<9	<10	<12	<32	<12	656 ± 172

a Sample re-analyzed with an I-131 result of 38 ± 12 pCi/liter. Refer to Corrective Action Program CRDR #3435662. b Sample re-analyzed with an I-131 result of 34 ± 10 pCi/liter. Refer to Corrective Action Program CRDR #3435662. c Re-sampled on 11/30/10 to validate, results were 16 ± 7 pCi/liter. Refer to Corrective Action Program CRDR #3435662.

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	5-Jan-10	<13	<13	<24	<10	<30	<13	<23	35 ± 16	<12	<14	<41	<15	
	12-Jan-10	<14	<13	<26	<15	<30	<13	<21	52 ± 15	<11	<13	<48	<11	
	19-Jan-10	<12	<10	<28	<14	<25	<13	<24	60 ± 20	<11	<13	<47	<15	
	26-Jan-10	<12	<11	<21	<11	<30	<11	<16	48 ± 12	<9	<13	<43	<13	<291
	2-Feb-10	<10	<11	<23	<13	<28	<14	<20	80 ± 21	<11	<13	<40	<15	
	9-Feb-10	<12	<11	<23	<12	<24	<12	<22	71 ± 21	<10	<14	<42	<15	
	16-Feb-10	<13	<11	<23	<14	<30	<12	<20	35 ± 13	<11	<12	<48	<14	
	23-Feb-10	<12	<10	<26	<13	<30	<11	<19	55 ± 12	<9	<12	<30	<14	<282
	2-Mar-10	<11	<12	<26	<12	<24	<11	<20	42 ± 12	<8	<12	<30	<14	
	9-Mar-10	<14	<11	<25	<15	<30	<15	<23	85 ± 24	<13	<13	<46	<13	
	16-Mar-10	<8	<9	<22	<15	<18	<11	<20	82 ± 14	<10	<10	<32	<13	
	23-Mar-10	<8	<9	<16	<11	<24	<10	<17	43 ± 11	<10	<12	<37	<11	
	30-Mar-10	<11	<13	<23	<15	<30	<13	<21	44 ± 12	<11	<11	<34	<11	<277
	6-Apr-10	<11	<8	<20	<12	<22	<9	<19	52 ± 14	<9	<11	<33	<15	
	13-Apr-10	<12	<15	<27	<15	<29	<15	<21	37 ± 15	<11	<14	<42	<13	
	20-Apr-10	<13	<12	<27	<15	<25	<13	<24	34 ± 14	<11	<13	<49	<15	<299
	4-May-10	<9	<10	<21	<11	<26	<10	<17	28 ± 12	<9	<9	<37	<12	
	11-May-10	<11	<10	<21	<12	<21	<10	<19	23 ± 10	<10	<11	<33	<15	
	18-May-10	<11	<11	<23	<14	<25	<14	<21	43 ± 16	<12	<12	<45	<15	
	25-May-10	<12	<8	<18	<12	<26	<10	<18	24 ± 8	<10	<10	<34	<12	<268
	1-Jun-10	<13	<13	<23	<14	<27	<15	<23	29 ± 13	<11	<11	<37	<15	
	8-Jun-10	<13	<12	<23	<15	<30	<12	<22	28 ± 14	<12	<14	<43	<14	
	15-Jun-10	<14	<12	<30	<17	<30	<13	<22	11 ± 11	<16	<15	<38	<19	
	22-Jun-10	<13	<12	<31	<14	<29	<13	<20	38 ± 14	<12	<12	<47	<14	
	29-Jun-10	<12	<14	<31	<13	<35	<14	<19	13 ± 8	<12	<13	<47	<13	<272
	6-Jul-10	<12	<13	<21	<13	<25	<13	<22	<14	<14	<13	<48	<18	
	13-Jul-10	<14	<13	<24	<17	<31	<11	<21	<15	<13	<15	<44	<18	
	19-Jul-10	<17	<14	<38	<16	<41	<15	<34	43 ± 19	<18	<18	<51	<26	
	27-Jul-10	<12	<13	<29	<19	<37	<15	<21	29 ± 10	<16	<12	<37	<18	<258

** 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 **
	3-Aug-10	<13	<12	<27	<18	<28	<12	<23	<15	<14	<15	<45	<22	
	9-Aug-10	<10	<15	<39	<19	<35	<12	<29	19 ± 14	<21	<20	<62	<30	
	17-Aug-10	<8	<9	<16	<11	<19	<8	<16	38 ± 11	<9	<10	<30	<11	
	23-Aug-10	<11	<9	<23	<15	<24	<10	<15	14 ± 9	<11	<11	<33	<13	
	31-Aug-10	<9	<9	<17	<12	<19	<9	<16	46 ± 11	<16	<10	<29	<8	<261
	7-Sep-10	<6	<6	<13	<8	<13	<6	<10	26 ± 8	<8	<8	<24	<7	
	14-Sep-10	<7	<7	<15	<7	<17	<7	<13	22 ± 8	<8	<7	<24	<9	
	21-Sep-10	<8	<8	<18	<10	<20	<9	<16	19 ± 9	<11	<10	<29	<11	
	27-Sep-10	<11	<10	<18	<13	<23	<12	<19	9 ± 9	<14	<11	<37	<13	<266
	5-Oct-10	<7	<8	<18	<11	<19	<8	<18	30 ± 8	<10	<10	<27	<11	
	12-Oct-10			WRF shutdown										<274
WRF	2-Nov-10	<13	<11	<26	<13	<23	<13	<19	18 ± 10	<11	<13	<41	<13	
INFLUENT	8-Nov-10	<9	<11	<24	<11	<21	<10	<15	47 ± 12	<10	<11	<33	<12	
	16-Nov-10	<14	<10	<25	<14	<22	<13	<20	19 ± 12	<11	<12	<37	<14	
	22-Nov-10	<9	<11	<26	<13	<24	<11	<22	34 ± 10	<10	<13	<36	<10	
	30-Nov-10	<10	<10	<19	<10	<25	<11	<17	<13	<10	<13	<33	<15	<273
	7-Dec-10	<8	<8	<19	<10	<21	<10	<17	33 ± 10	<7	<10	<31	<13	
	14-Dec-10	<13	<10	<29	<13	<30	<10	<26	34 ± 14	<13	<17	<50	<14	
	20-Dec-10	<13	<12	<30	<14	<25	<14	<20	45 ± 15	<11	<14	<39	<14	
	27-Dec-10	<9	<9	<22	<11	<18	<9	<18	42 ± 11	<9	<9	<36	<15	<279

** 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
	26-Jan-10	<14	<11	<23	<14	<28	<11	<20	<13	<12	<11	<30	<9	<302
SEDIMENT.	9-Feb-10	<11	<12	<25	<15	<24	<12	<16	<9	<10	<11	<33	<12	<287
BASIN #2	16-Feb-10	<11	<9	<21	<14	<22	<11	<18	<9	<11	<11	<38	<12	<291
	23-Feb-10	<13	<12	<25	<14	<30	<12	<19	<12	<10	<13	<40	<12	<282
	2-Mar-10	<13	<11	<28	<15	<30	<12	<22	<10	<12	<14	<46	<11	<290
	9-Mar-10	<10	<11	<19	<12	<21	<12	<16	<9	<8	<10	<30	<10	<277
	16-Mar-10	<11	<12	<25	<15	<26	<11	<19	<11	<12	<11	<37	<14	339 ± 171
	23-Mar-10	<12	<11	<23	<9	<30	<11	<19	<10	<9	<13	<35	<11	631 ± 174
	30-Mar-10	<14	<12	<28	<15	<25	<14	<22	<14	<12	<13	<48	<15	520 ± 172
	24-Aug-10	<8	<9	<17	<10	<22	<9	<16	<8	<9	<10	<29	<10	<285
	31-Aug-10	<11	<9	<24	<12	<27	<11	<16	<9	<14	<12	<31	<12	<279

A review of plant operational data indicate that approximately 50 curies of tritium was released from the Unit 1 Boric Acid Concentrator to the plant vent the week of 3/1/10 to 3/7/10. On 3/7/10 the rainfall total was 0.73 inches. Also, the Unit 1 circulating water system had a tritium concentration of 1.18E-05 uCi/ml, which has been attributed to re-entrainment of plant vent released tritium in the cooling towers. The tritium in the sedimentation basin can be attributed to the rain washout effect.

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	5-Jan-10	1080 ± 269	<128	<176	
	12-Jan-10	1174 ± 238	<107	<110	
	19-Jan-10	1175 ± 238	<113	<171	
	26-Jan-10	1465 ± 271	<124	<167	
	2-Feb-10	2051 ± 367	<113	<160	
	9-Feb-10	2743 ± 446	<146	<178	
	16-Feb-10	2133 ± 307	<147	<171	
	23-Feb-10	1398 ± 247	<111	<179	
	2-Mar-10	1031 ± 252	<141	<166	
	9-Mar-10	757 ± 181	<132	<165	
	16-Mar-10	837 ± 212	<142	<119	
	23-Mar-10	927 ± 210	<140	<139	
	30-Mar-10	717 ± 171	<146	<147	
	6-Apr-10	658 ± 188	<139	<116	
	13-Apr-10	641 ± 194	<147	<41	
	20-Apr-10	758 ± 193	<145	<168	
	11-May-10	367 ± 73	<39	<30	70 ± 35
	18-May-10	1153 ± 153	<23	<33	105 ± 50
	1-Jun-10	1749 ± 361	<28	<21	52 ± 27
	8-Jun-10	1589 ± 192	<17	<33	61 ± 37
	15-Jun-10	1786 ± 212	<25	<22	177 ± 38
	22-Jun-10	1668 ± 203	<27	<25	171 ± 41
	29-Jun-10	1491 ± 205	<19	<18	68 ± 32
	6-Jul-10	1033 ± 132	<25	<23	
	13-Jul-10	767 ± 103	<27	<32	40 ± 19
	19-Jul-10	1111 ± 150	<13	<13	35 ± 15
	27-Jul-10	1652 ± 205	<32	<33	
	3-Aug-10	1716 ± 269	<24	<79	188 ± 93
	9-Aug-10	1098 ± 191	<14	<33	78 ± 53
	17-Aug-10	1624 ± 247	<22	<64	88 ± 44
	23-Aug-10	1110 ± 188	<40	<57	
	31-Aug-10	1555 ± 238	<22	<76	69 ± 45

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	7-Sep-10	2405 ± 340	<70	<58	82 ± 66
	14-Sep-10	1813 ± 271	<23	<44	
	21-Sep-10	1496 ± 231	<99	<64	78 ± 47
	27-Sep-10	1933 ± 299	<73	<83	76 ± 48
	5-Oct-10	1839 ± 284	<70	<22	89 ± 61
	2-Nov-10	526 ± 86	<24	<29	51 ± 25
	8-Nov-10	1620 ± 195	<23	<32	119 ± 40
	16-Nov-10	1807 ± 224	<27	<23	129 ± 44
	22-Nov-10	1343 ± 170	<31	<31	48 ± 39
	30-Nov-10	1123 ± 142	<19	<30	
	7-Dec-10	938 ± 117	<15	<19	45 ± 48
	14-Dec-10	1118 ± 144	<20	<29	114 ± 46
	20-Dec-10	961 ± 129	<11	<27	51 ± 23
	27-Dec-10	1195 ± 158	<24	<30	

TABLE 8.11 SLUDGE/SEDIMENT

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

COOLING TOWER SLUDGE

UNIT CYCLE	APPROXIMATE VOLUME (yd^3)	ISOTOPE	ACTIVITY RANGE (uCi/ml)	SAMPLE TYPE	FRACTION OF SAMPLES ABOVE MDA
U2R15	319	NA	<MDA	Tower/canal sludge	NA
U1R15	422	NA	<MDA	Tower/canal sludge	NA

All sample results were <MDA (minimum detectable activity), therefore no isotopes are listed.

TABLE 8.12 HARD-TO-DETECT RADIONUCLIDE RESULTS

Sample Location	Well number	Sample Date	C-14 (pCi/liter)	Fe-55 pCi/liter)	Ni-63 (pCi/liter)	Sr-90 (pCi/liter)	Comments
Unit 1 (outside RCA)	APP-12	10/14/2010	<41.14	<15.44	<3.58	0.73	Sr-90 MDA for this sample was 0.48 with 53% 2-sigma error
Unit 2 (inside RCA)	H0B	10/8/2010	<41.26	<12.99	<3.10	<0.29	
Unit 3 (inside RCA)	H11	10/26/2010	<39.87	<7.90	<3.07	<0.34	

Notes:

1. A review of the pre-operational radiological environmental monitoring program (1979-1985) indicated several instances of local drinking water containing Sr-90 up to a concentration of 4.2 ± 2.0 pCi/liter and dairy milk samples containing Sr-90 up to a concentration of 3.2 ± 2.1 pCi/liter.
2. The 1976 and 1984 pre-operational soil studies included Sr-90 analysis. All eleven onsite soil samples indicated Sr-90 at concentrations between 10 and 240 pCi/kg.
3. Dairy feed samples indicated Sr-90 in concentrations from <50 pCi/kg to 460 pCi/kg.
4. The half-life of Sr-90 is 28 years.

Based on the pre-operational data and that well APP-12 does not contain other plant related radionuclides, the Sr-90 can be attributed to previous weapons testing fallout.

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

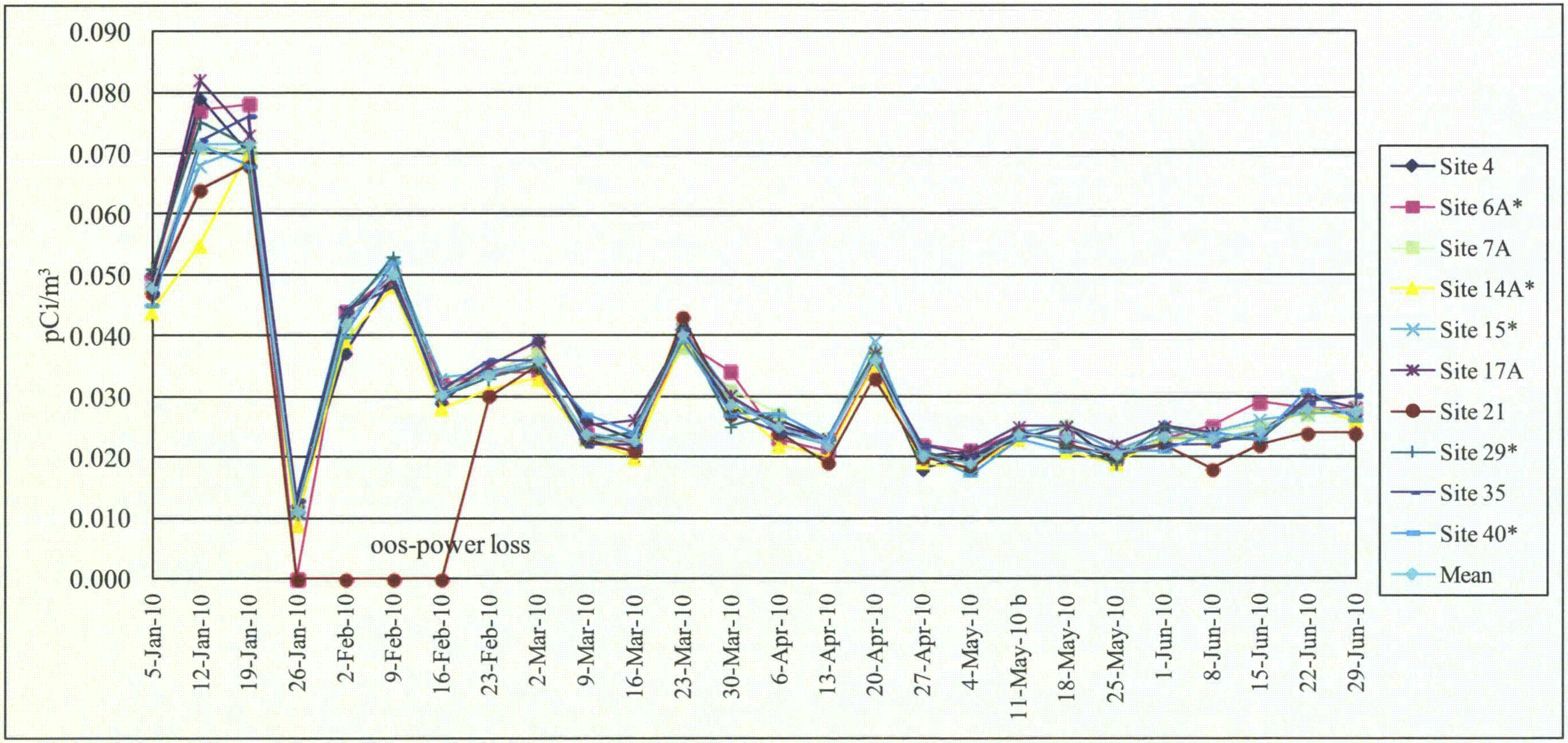


FIGURE 8.2 GROSS BETA IN AIR, 3rd-4th Quarter

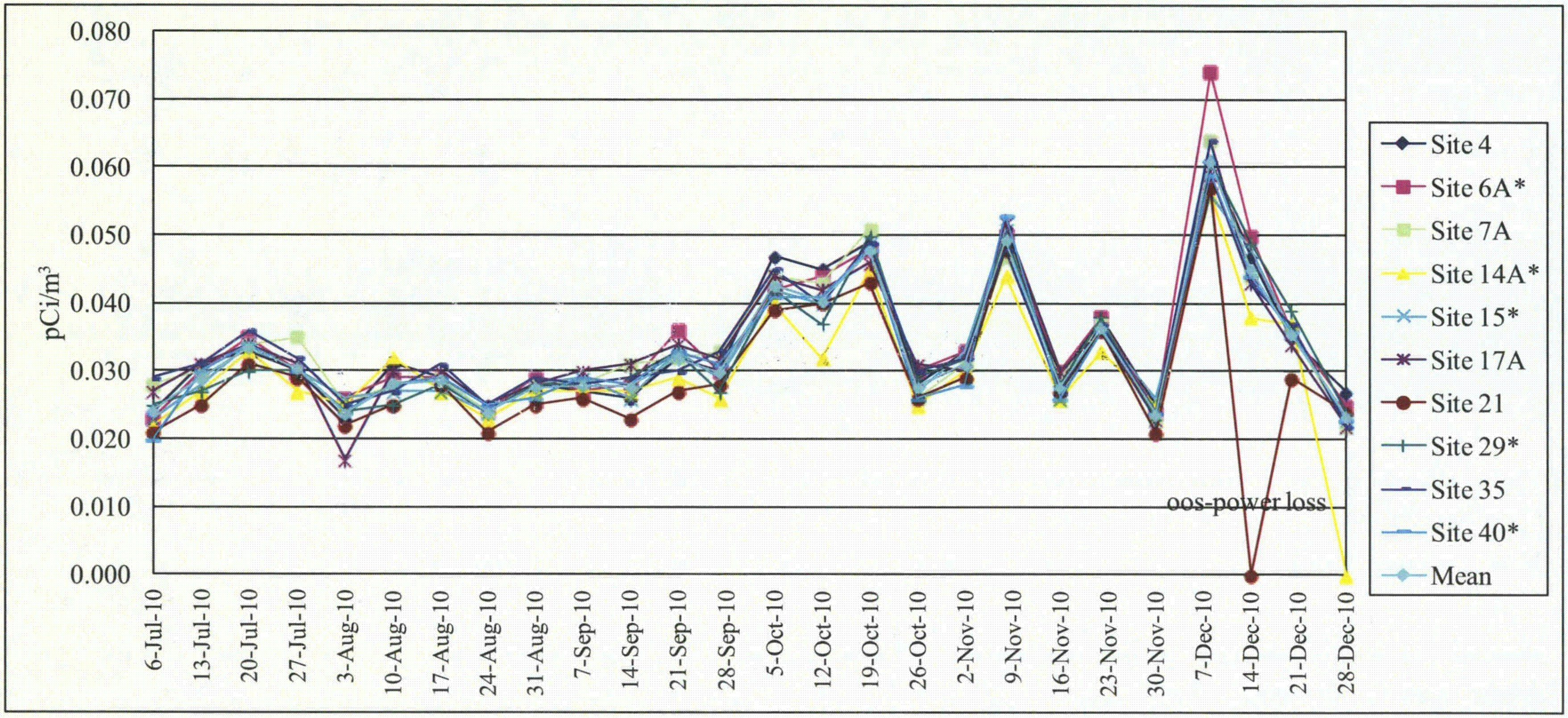


FIGURE 8.3 HISTORICAL GROSS BETA IN AIR (WEEKLY SYSTEM AVERAGES)

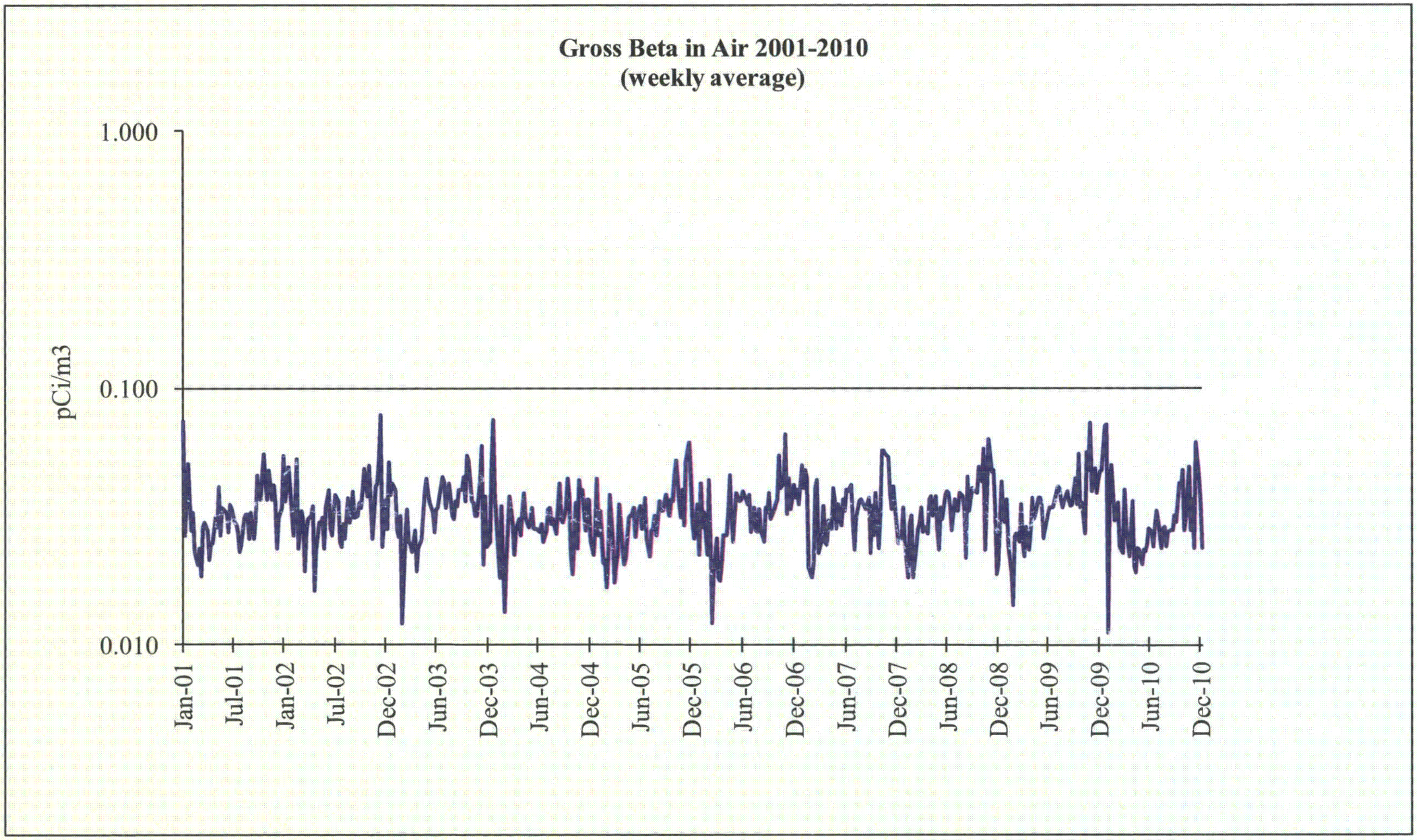
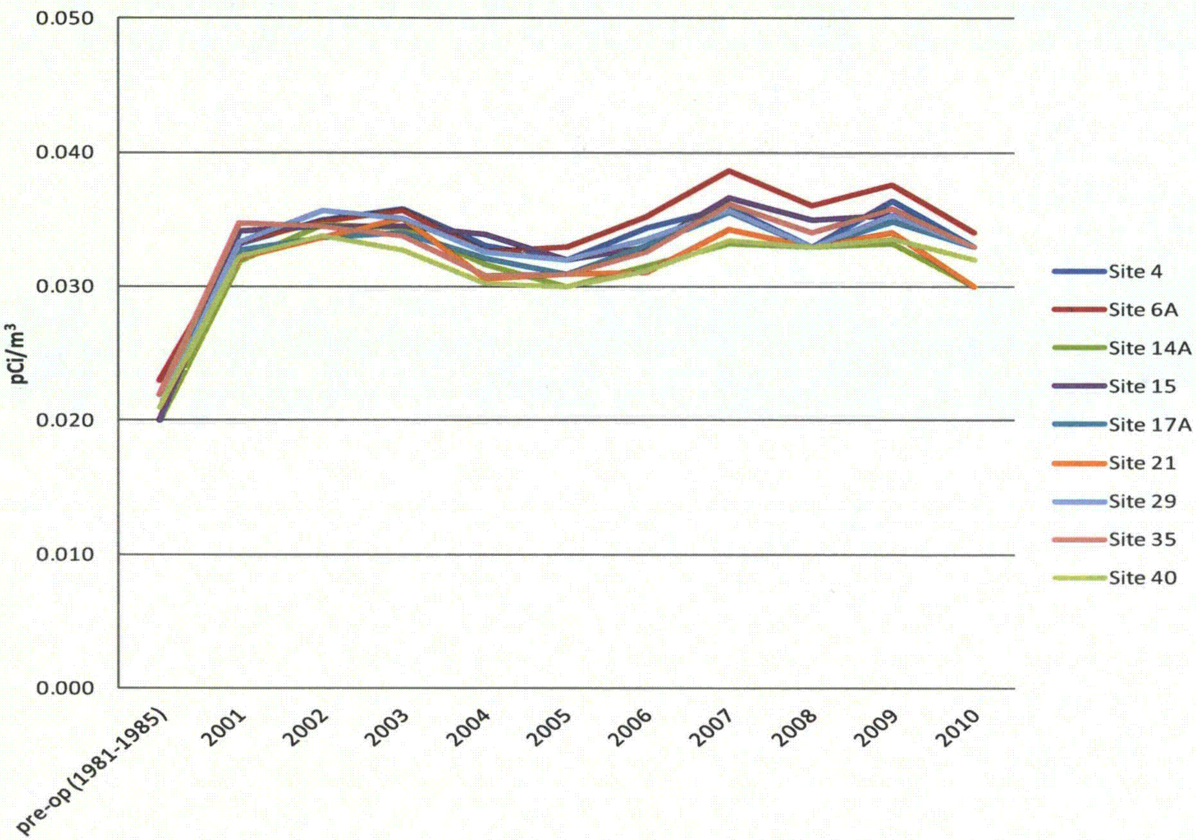
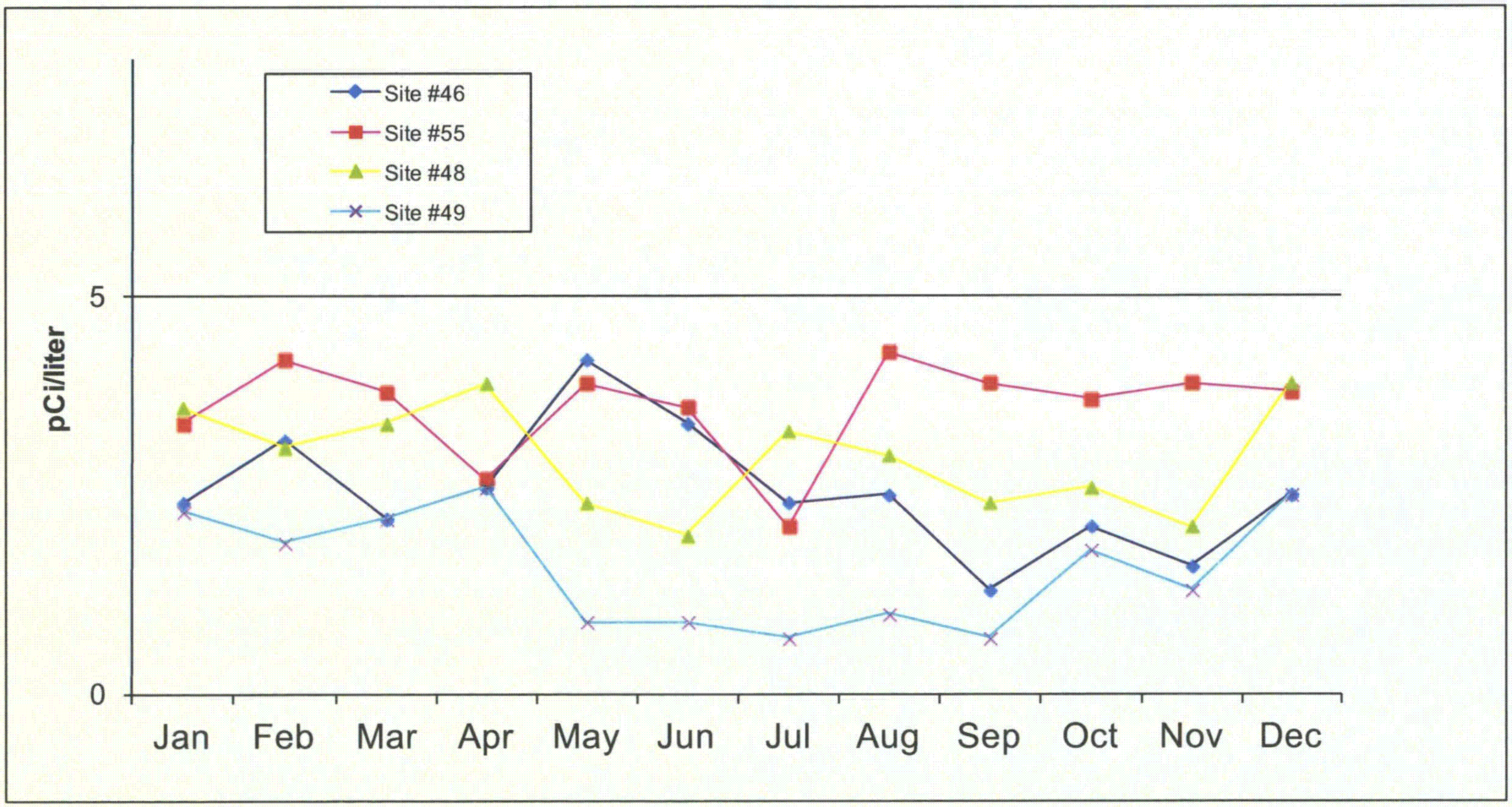


FIGURE 8.4 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP



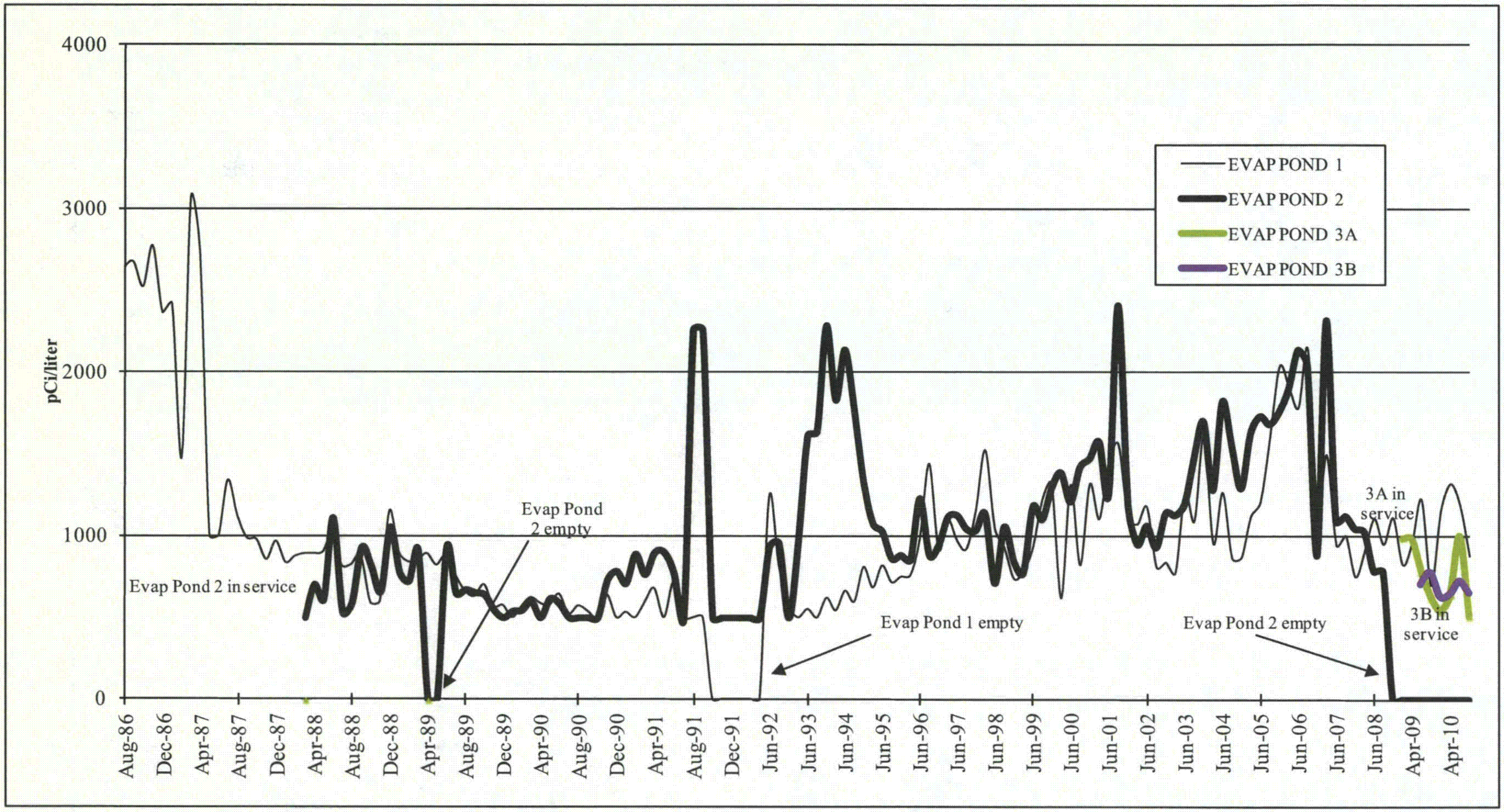
Site 7A is not included since the location changed since the pre-operational period
A known high bias has occurred in gross beta data since the onsite laboratory began analysis in 1994. This was a stepwise increase that has carried forward since 1994.

FIGURE 8.5 GROSS BETA IN DRINKING WATER



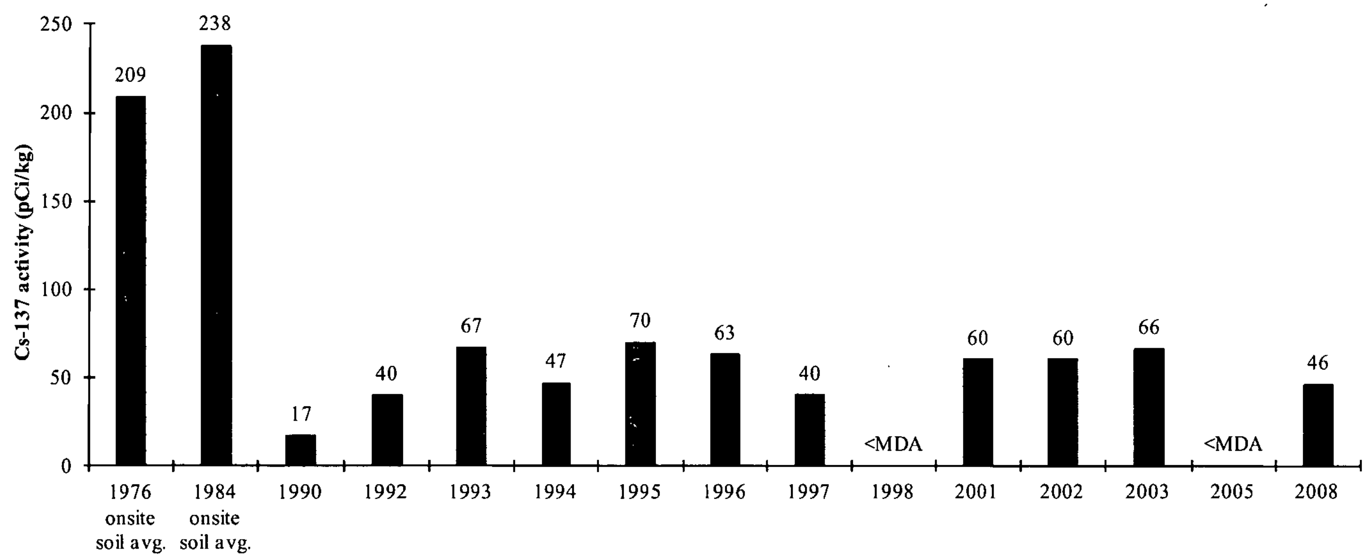
NOTES: MDA values plotted as activity (e.g. <2.3 is plotted as 2.3)
The action level is 30 pCi/liter

FIGURE 8.6 EVAPORATION POND TRITIUM ACTIVITY



Evaporation Pond #3 was constructed with two sections designated as 3A and 3B. Evaporation Pond #2 was pumped into sections 3A and 3B and is in process of liner replacement.

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 forty-nine 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 2010 are presented in Table 9.2. Historical environmental gamma radiation results for 1985 through 2010 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2010 as compared to the pre-operational TLD results (excluding sites #41, #43, and #46-50 as they were deleted (and later assigned to a new location) or 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	23.2	25.1	24.8	25.0	24.5
2	22.0	22.3	23.9	21.8	22.5
3	21.2	24.5	24.3	23.3	23.3
4	21.4	23.4	22.8	22.5	22.5
5	22.3	22.7	22.8	21.8	22.4
6 (control)	24.6	27.0	28.6	25.9	26.5
7	23.5	26.2	26.7	24.5	25.2
8	21.7	23.1	24.9	24.5	23.6
9	25.7	27.5	28.9	28.2	27.6
10	22.2	23.4	24.6	23.8	23.5
11	22.3	25.9	26.2	23.6	24.5
12	21.6	23.2	23.6	22.6	22.8
13	23.8	24.6	26.1	24.3	24.7
14	22.8	25.1	26.2	26.0	25.0
15	21.8	24.3	24.8	24.1	23.8
16	20.4	22.5	23.6	22.1	22.2
17	22.9	25.1	25.3	24.8	24.5
18	23.2	24.0	24.4	23.9	23.9
19	23.9	25.5	27.1	25.2	25.4
20	22.5	24.8	26.9	24.2	24.6
21	24.8	26.3	26.3	25.5	25.7
22	26.1	26.7	28.4	26.7	27.0
23	22.4	23.6	23.9	23.2	23.3
24	20.4	21.5	22.7	23.3	22.0
25	22.1	23.5	23.7	23.9	23.3
26	26.1	28.1	28.2	27.3	27.4
27	25.7	27.6	27.9	26.8	27.0
28	24.4	26.1	26.6	25.8	25.7
29	22.9	25.0	25.7	25.2	24.7
30	24.3	26.4	26.4	25.0	25.5
31	22.8	23.7	23.9	22.9	23.3
32	23.9	26.4	25.7	24.7	25.2
33	24.3	26.8	26.8	24.7	25.7
34	25.9	28.1	27.9	26.6	27.1
35	28.3	32.8	30.2	30.0	30.3
36	24.4	25.9	25.6	24.5	25.1
37	22.3	24.3	23.3	22.4	23.1
38	25.4	28.5	27.3	26.3	26.9
39	23.0	24.5	23.8	23.3	23.7
40	24.0	25.6	25.6	24.4	24.9
41	25.7	27.2	27.0	26.9	26.7
42	28.2	30.7	29.8	29.4	29.5
43	27.4	27.9	28.7	26.5	27.6
44 (control)	19.1	21.2	19.9	18.9	19.8
45 (transit control)	5.4	6.3	6.0	4.8	5.6
46	25.2	27.4	27.4	25.4	26.4
47	22.9	25.9	24.0	24.1	24.2
48	22.6	23.7	25.5	23.7	23.9
49	21.6	22.7	23.8	21.4	22.4
50	17.8	19.1	19.9	19.1	19.0

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES

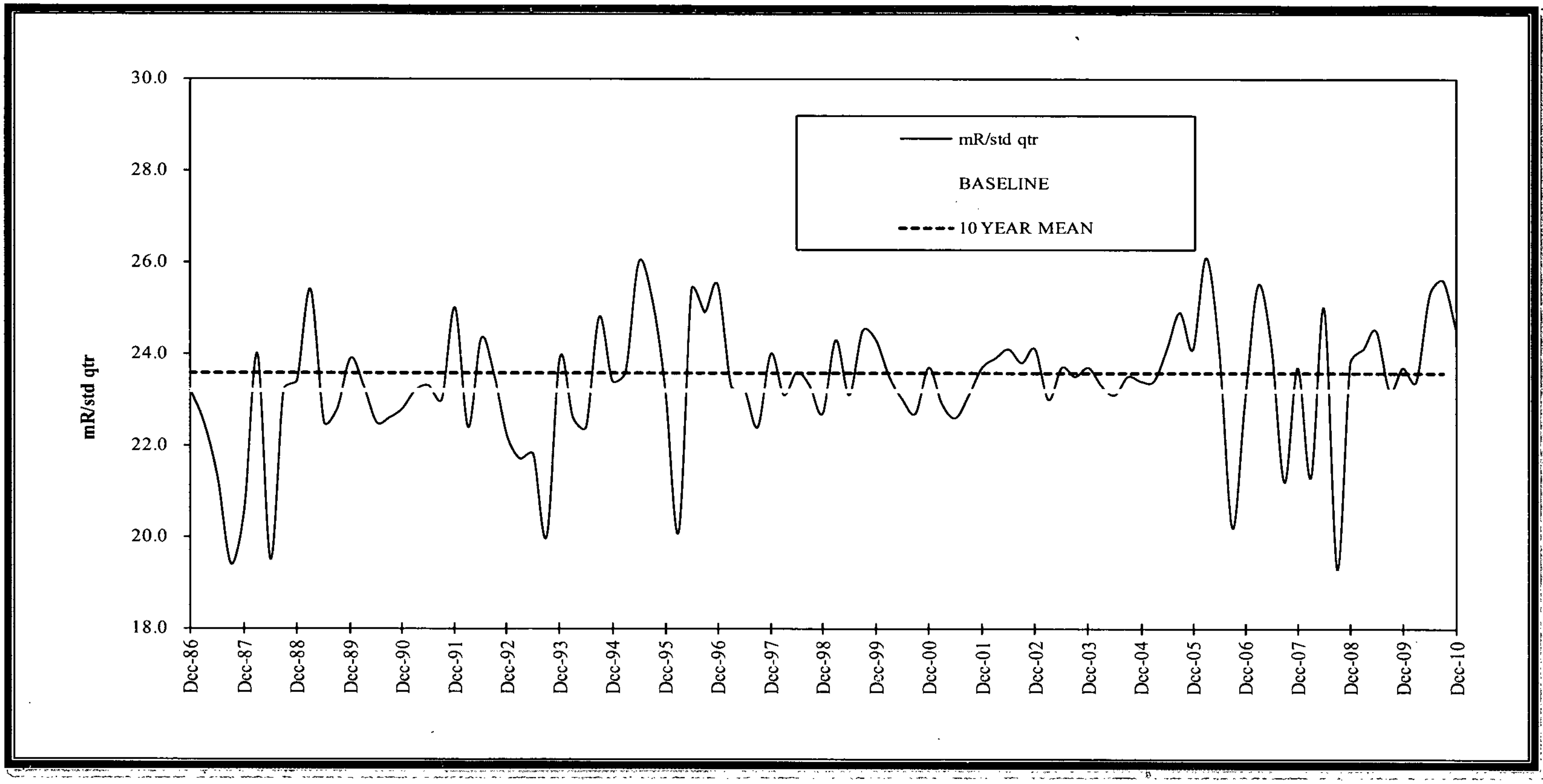
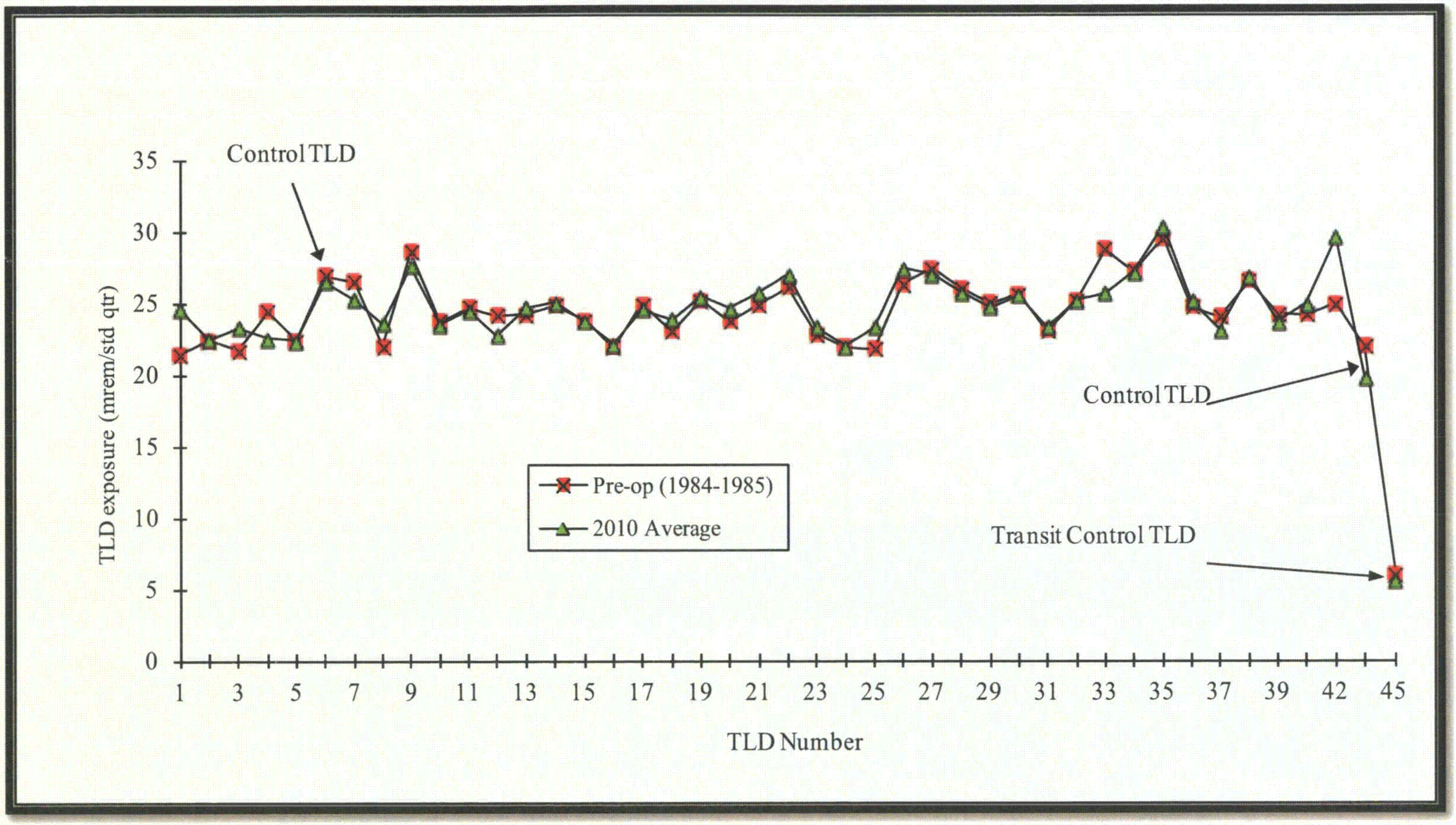


FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2010



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 2010.

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 four (4) changes in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.120 mrem.

Milk Animal

There were five (5) changes in milk animal status from the previous year. Dose calculations indicated the highest dose to be 0.367 mrem.

Vegetable Gardens

There were two (2) changes in nearest garden status. Dose calculations indicated the highest dose to be 0.143 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

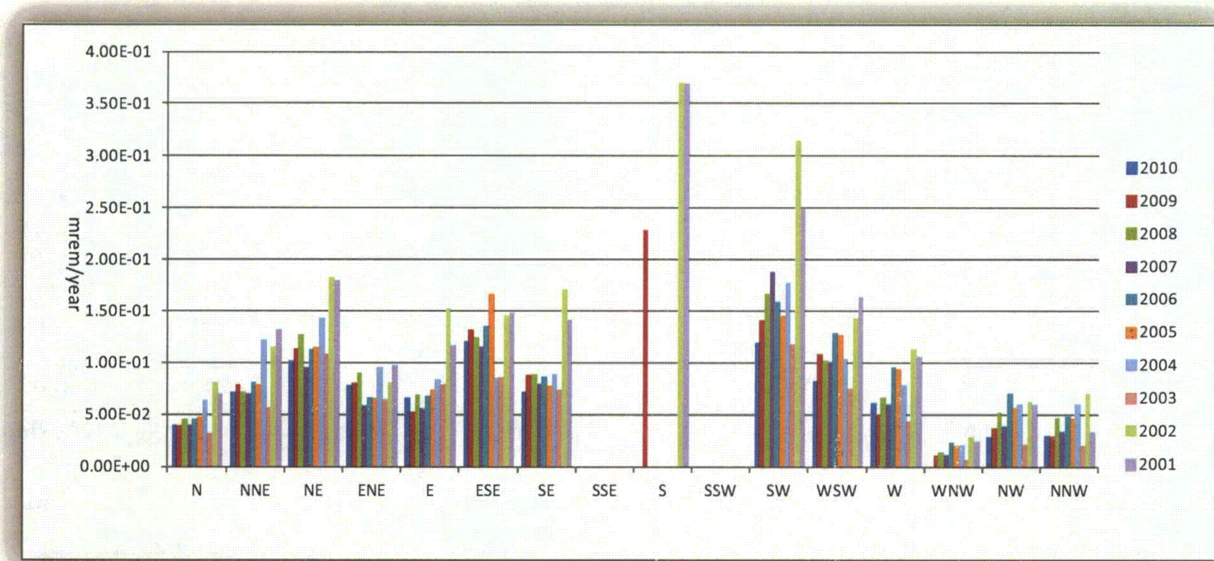
(Distances and directions are relative to Unit 2 in miles)

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST MILK ANIMAL (COW/GOAT)	CALCULATED DOSE (mrem)	CHANGE FROM 2009
N	1.55	**2.87**	**3.66**	Resident 3.91E-02 Garden 8.98E-02 Milk 8.07E-02	**Garden** **Milk**
NNE	1.52	**3.30**	**3.05**	Resident 7.13E-02 Garden 1.43E-01 Milk 1.78E-01	**Garden** **Milk**
NE	2.16	NONE	**NONE**	Resident 1.02E-01	**Milk**
ENE	**2.16**	4.72	2.52	Resident 7.83E-02 Garden 1.05E-01 Milk 3.67E-01	**Resident**
E	2.81	NONE	NONE	Resident 6.60E-02	
ESE	**1.95**	NONE	**NONE**	Resident 1.20E-01	**Resident** **Milk**
SE	3.36	NONE	**NONE**	Resident 7.15E-02	**Milk**
SSE	NONE	NONE	NONE	NA	
S	**NONE**	NONE	NONE	NA	**Resident**
SSW	NONE	NONE	NONE	NA	
SW	1.39	NONE	NONE	Resident 1.19E-01	
WSW	0.75	NONE	NONE	Resident 8.16E-02	
W	0.70	NONE	NONE	Resident 6.09E-02	
WNW	**NONE**	NONE	NONE	NA	**Resident**
NW	0.93	NONE	NONE	Resident 2.79E-02	
NNW	1.30	4.34	NONE	Resident 2.97E-02 Garden 4.83E-02	

COMMENTS:

Dose calculations were performed using the GASPAR code and 2009 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual dose identified (organ, bone, total body, or skin).

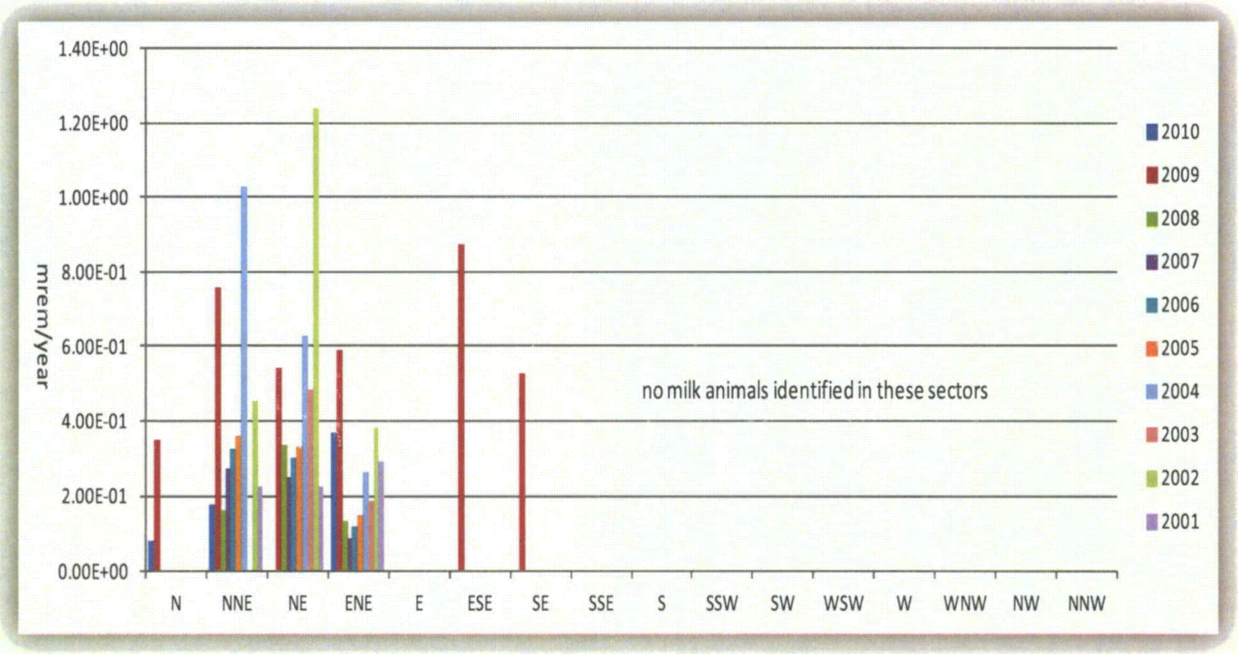
FIGURE 10.1 HISTORICAL COMPARISON OF NEAREST RESIDENT DOSE



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

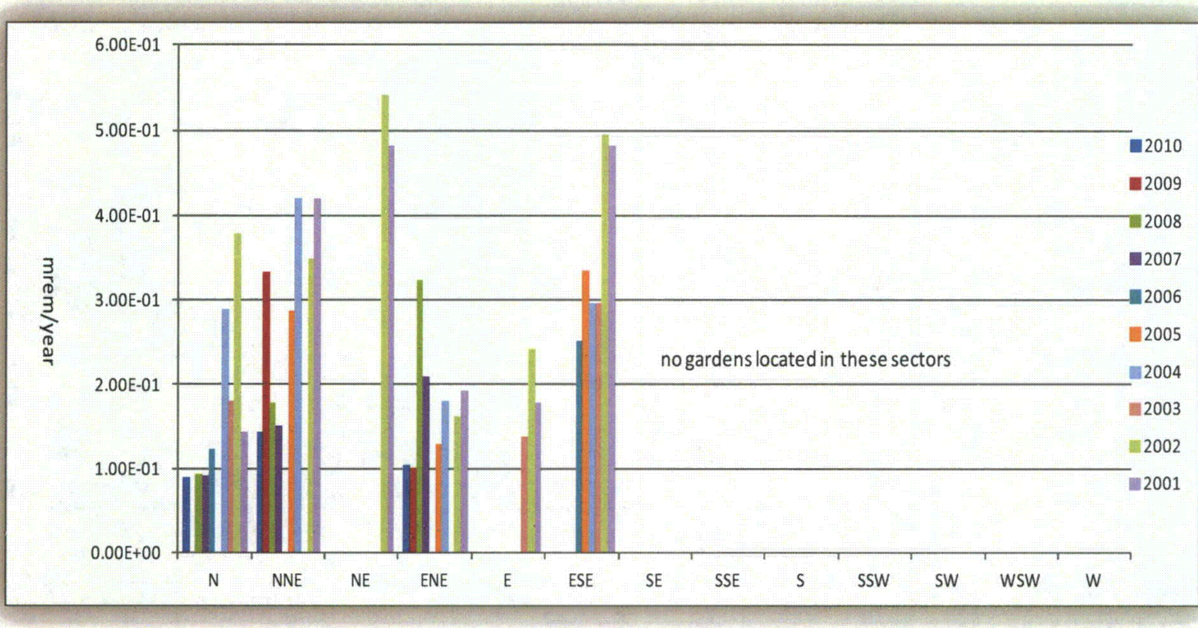


Milk animals include goats and/or cows. Several new milk animals were identified in 2009 that were closer to the power plant than in the past, resulting in generally higher calculated doses in that calendar year.

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 2010 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2010 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 concentrations identified on occasion 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.

The only measurable impact on the environment in 2010 was the low level tritium discovered in subsurface water onsite in the Radiological Controlled Area in 2006. See Section 2.4 for specific information.

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 2010

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	24.7 (188/188) 17.8 – 32.8	Site #35 8 miles 330°	30.3 (4/4) 28.3 – 32.8	23.2 (8/8) 18.9 - 26.7	0
Air Particulates (pCi/m^3)	Gross Beta – 513	0.010	0.032 (462/462) 0.009 - 0.082	Site #17A 3 miles 90°	0.033 (52/52) 0.011 - 0.082	0.034 (51/51) 0.021 - 0.078	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. - 513						
	I-131	0.07	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 13						
	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

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Ground Water (pCi/liter) -continued-	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
Drinking Water (pCi/liter)	Gross Beta – 48	4.0	2.6 (33/48) 0.7 – 4.3	Site #55 3 miles 215°	3.7 (11/12) 2.1 – 4.3	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 48						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
Milk (pCi/liter)	Gamma Spec. – 18						
	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
	La-140	15	<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 2010

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean: Name Distance and Direction	Location with Highest Annual Mean: Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	Gamma Spec. - 19						
	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	27 (5/19) 12 - 54	Site #61 Onsite 67°	54 (1/4) 54 - 54	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 - 19	3000	826 (12/19) 546 - 1321	Site #59 Onsite 180°	1135 (4/4) 877 - 1321	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. 1985-2009 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, 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