Technical Specification 5.6.2

A subsidiary of Pinnacle West Capital Corporation

Palo Verde Nuclear Generating Station

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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 2011

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2011.

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/hsc

Enclosure

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IE25
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ENCLOSURE

Units 1, 2, and 3

Annual Radiological Environmental Operating Report 2011

NUCLEAR GENERATING STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2011

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

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ABSTRACT

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

During 2011, the following categories of samples were collected by APS:

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

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

The Arizona Radiation Regulatory Agency (ARRA) performs radiochemistry analyses on various duplicate samples provided to them by APS. Samples analyzed by ARRA include onsite samples from the Reservoirs, Evaporation Ponds, and two (2) deep wells. Offsite samples analyzed by ARRA include two (2) local resident wells. ARRA also performs air sampling at seven (7) offsite locations identical to APS and maintains approximately fifty (50) environmental TLD monitoring locations, eighteen (18) of which are duplicates of APS locations.

A comparison of pre-operational and operational data indicates no changes to environmental radiation levels.

The Fukushima-Daiichi nuclear plant in Japan suffered major damage due to a natural disaster. REMP samples obtained from air, vegetation, and milk samples in March and April indicated elevated radionuclides that were attributed to reactor releases. It was determined, and is well established across the nuclear industry, that these radionuclides were the result of radiological releases from the Fukushima-Daiichi plant, and were not due to the operation of the PVNGS. These conclusions are based on the following facts:

(1) The quantities of radioactive airborne effluents from PVNGS during 2011 did not increase significantly compared to previous years.

(2) Prior and subsequent REMP sample results have not detected the presence of these radionuclides in PVNGS samples.

(3) The radionuclides detected in the indicator samples were also identified in control samples.

(4) Discussion with other US nuclear plants identified similar sample results.

(5) A review of USEPA RADNET data during the same time period identified similar sample results.

REMP samples containing radiological materials attributable to Fukushima-Daiichi releases are identified as such on data tables.

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

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

1. Introduction

This report presents the results of the operational radiological environmental monitoring program conducted by Arizona Public Service Company (APS). The Radiological Environmental Monitoring Program (REMP) was established for the Palo Verde Nuclear Generating Station (PVNGS) by APS in 1979.

This report contains the measurements and findings for 2011. All references are specifically identified in Section 12.

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

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

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

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

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

2. Description of the Monitoring Program

APS and vendor organizations performed the pre-operational radiological environmental monitoring program between 1979 and 1985. APS and vendors continued the program into the operational phase.

2.1. Radiological Environmental Monitoring Program

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

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

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

In addition to monitoring environmental media, a land use census is performed annually to identify the nearest milk animals, residents, and gardens. This information is used to evaluate the potential dose to members of the public for those exposure pathways that are indicated.

2.2. Radiological Environmental Monitoring Program Changes for 2011

The following changes implement ODCM Revision 26 and were made as a result of the annual Land Use Census (reference Corrective Action Program document CRDR 3824797);

- Replaced Site #47 vegetation location
- Replaced Site #51 goat milk location
- Deleted Site #52 goat milk location
- Changed designation of goat milk location at Site #54 from supplemental to required

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 2011, there were five (5) deviations/abnormal events with regard to the monitoring program. Refer to Table 2.3 for more detail and any corrective actions taken.

1. The 45 acre Reservoir exceeded the quarterly I-131 reporting level of 20 pCi/liter.
2. Air sample site #14A equipment was out of service due to a power outage.
3. Air, vegetation, and milk samples indicated radionuclide activity due to the Fukushima-Daiichi plant releases.
4. Resident well water Site #49 no longer available.
5. One Interlaboratory comparison sample analysis failed the acceptance criteria (Cs-134 in water).

2.4. 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). The State of Arizona APP provides specific regulatory criteria for ground water protection. PVNGS is working with the Arizona Department of Environmental Quality (ADEQ) to prevent this tritiated water from affecting the local aquifer.

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

Three subsurface samples were obtained, one each from Units 2 and 3 tritium monitoring wells, and one from the shallow aquifer outside of the Unit 1 radiological controlled area (RCA). These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) as a verification that there are no underground leaks from plant systems that may affect ground water. All results were <MDA. Refer to Table 8.13 for sample results.

Table 2.1 SAMPLE COLLECTION LOCATIONS

SAMPLE SITE #	*SAMPLE TYPE*	*LOCATION (a)*	*LOCATION DESCRIPTION*
4	air	E16	APS Office
6A*	air	SSE13	Old US 80
7A	air	ESE3	Arlington School
14A	air	NNE2	371st Ave. and Buckeye-Salome Rd.
15	air	NE2	NE Site Boundary
17A	air	E3	351st Ave.
21	air	S3	S Site Boundary
29	air	W1	W Site Boundary
35	air	NNW8	Tonopah
40	air	N2	Transmission Rd
46	drinking water	NNW8	local resident
47	vegetation	N3 **(b)**	**local resident (new location as of September)**
48	drinking water	SW1	local resident
49	drinking water	N2 **(b)**	**Local resident (new location as of December)**
51	milk	NNE3 **(b)**	**local resident- goats (new location as of September)**
53*	milk	NE30	local resident- goats
54	milk (supplemental)	NNE4	local resident-goats
55	drinking water (supplemental)	SW3	local resident
57	ground water	ONSITE	Well 27ddc
58	ground water	ONSITE	Well 34abb
59	surface water	ONSITE	Evaporation Pond 1
60	surface water	ONSITE	85 acre Reservoir
61	surface water	ONSITE	45 acre Reservoir
62*	vegetation	ENE26	Commercial farm
63	surface water	ONSITE	Evaporation Pond 2
64	surface water	ONSITE	Evaporation Pond 3

NOTES:

* Designates a control site

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

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

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

Table 2.2 SAMPLE COLLECTION SCHEDULE

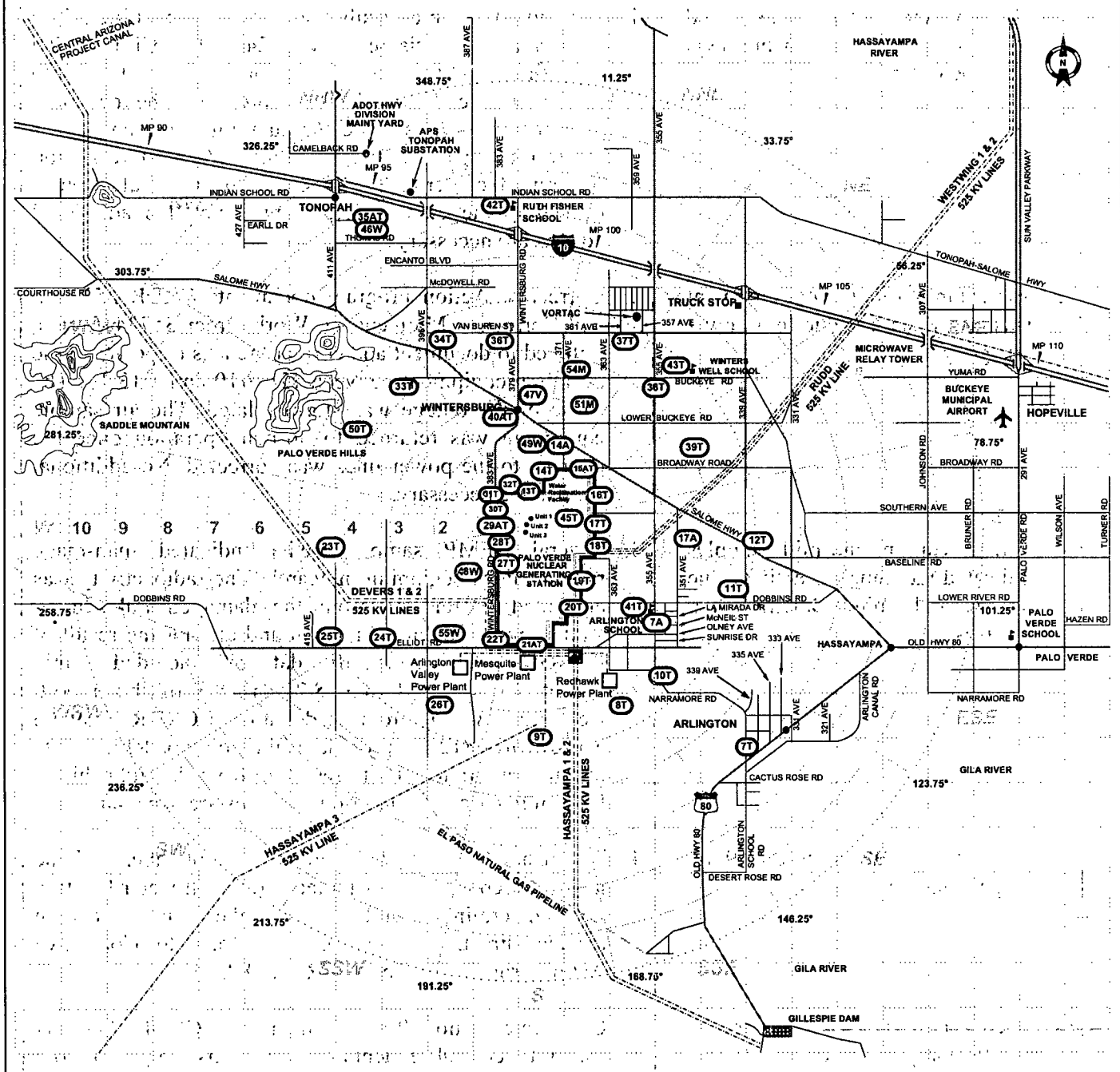
SAMPLE SITE #	*AIR PARTICULATE*	*MILK*	*AIRBORNE RADIOIODINE*	*VEGETATION*	*GROUND WATER*	*DRINKING WATER*	*SURFACE WATER*
4	W		W				
6A	W		W				
7A	W		W				
14A	W		W				
15	W		W				
17A	W		W				
21	W		W				
29	W		W				
35	W		W				
40	W		W				
46						W	
47				M/AA			
48						W	
49						W	
51		M/AA					
53		M/AA					
54		M/AA					
55						W	
57					Q		
58					Q		
59							Q
60							Q
61							Q
62				M/AA			
63							Q
64							Q

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

TABLE 2.3 SUMMARIES OF REMP DEVIATIONS/ABNORMAL EVENTS

Deviation/Abnormal Event	Actions taken
1. The 45 acre Reservoir exceeded the quarterly I-131 reporting level of 20 pCi/liter.	1. The initial sample result was 27 ± 10 pCi/liter. The verification analysis result was 24 ± 10 pCi/liter. The elevated I-131 concentration is due to radiopharmaceutical I-131 that is present in the reclaimed sewage water that supplies Circulating Water and is not the result of plant effluents. Refer to Corrective Action Program document CRDR 3739206 for the evaluation of exceeding the ODCM Reporting Level. No additional actions are necessary.
2. Air sample site #14A equipment was out of service due to a power outage.	2. Corrective Action Program documents CRDR 3574902 and Corrective Maintenance Work Order 3573475 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 additional actions are necessary.
3. Air, vegetation, and milk samples indicated radionuclide activity due to the Fukushima-Daiichi plant releases.	3. Several REMP sample media indicated man-made radionuclides beginning in March. The radioactivity was attributed to releases from the damaged Fukushima-Daiichi nuclear plants in Japan and are not the result of PVNGS effluents. Specific data are included within Tables 8.1, 8.3, 8.4, 8.5, 8.7, and 8.8 of this report. Corrective Action Program documents CRDR 3739206 and CRDR 3812184 provide evaluations for REMP data that indicate radioactivity resulting from the Fukushima-Daiichi releases. No additional actions are necessary.
4. Resident well water Site #49 no longer available.	4. The resident at Site #49 moved in September and the land was repossessed. A replacement well water location was determined and is in the same relative distance/direction from the site. Refer to Corrective Action Program document CRDR 3882110.
5. One Interlaboratory comparison sample analysis failed the acceptance criteria (Cs-134 in water).	5. Corrective Action Program document CRDR 3980064 was initiated. Subsequent analysis of this sample (3 more times) passed the acceptance criteria. Another interlaboratory comparison sample (E8164-111) was ordered and passed the acceptance criteria. The low result for Cs-134 was attributed to coincidence summing that sometimes occurs with low activity samples analyzed using a high efficiency detector. No additional actions are necessary.

FIGURE 2.1

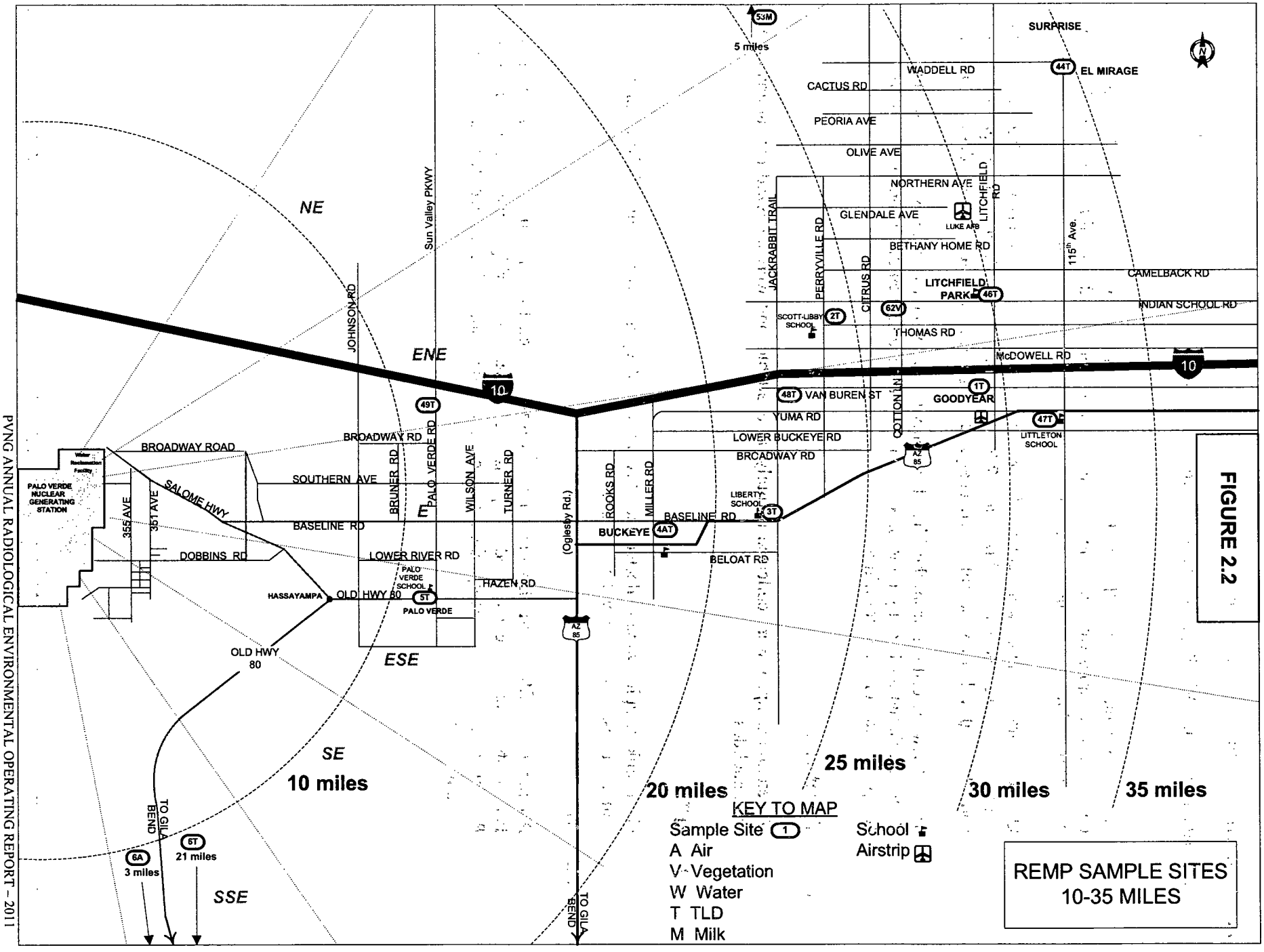


KEY TO MAP

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

School
Airstrip

REMP SAMPLE SITES 0-10 MILES


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

3. Sample Collection Program

APS personnel using PVNGS procedures collected all samples.

3.1. Water

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

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

Treated sewage effluent from the City of Phoenix was sampled as a weekly composite at the onsite Water Reclamation Facility (WRF), and analyzed for gamma emitting radionuclides. A monthly composite was analyzed for tritium.

3.2. Vegetation

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

3.3. Milk

Goat milk samples were collected monthly, as available, and were analyzed for gamma emitting radionuclides, including low level I-131.

3.4. Air

Air particulate filters and charcoal cartridges were collected at ten (10) sites on a weekly basis. Particulate filters were analyzed for gross beta. Charcoal cartridges were analyzed for I-131. Particulate filters were composited quarterly, by location, and analyzed for gamma emitting radionuclides.

3.5. Sludge and Sediment

Sludge samples were obtained weekly from the WRF waste centrifuge (whenever the plant was operational) and analyzed for gamma emitting radionuclides.

Cooling tower sludge was analyzed for gamma emitting radionuclides prior to disposal in the WRF sludge landfill.

4. Analytical Procedures

The procedures described in this report are those used by APS to routinely analyze samples.

4.1. Air Particulate

4.1.1. Gross Beta

A glass fiber filter sample is placed in a stainless steel planchet and counted for gross beta activity utilizing a low background gas flow proportional counter.

4.1.2. Gamma Spectroscopy

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

4.2. Airborne Radioiodine

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

4.3. Milk

4.3.1. Gamma Spectroscopy

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

4.4. Vegetation

4.4.1. Gamma Spectroscopy

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

4.5. Sludge/Sediment

4.5.1. Gamma Spectroscopy

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

4.6. Water

4.6.1. Gamma Spectroscopy

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

4.6.2. Tritium

The sample is evaluated to determine the appropriate method of preparation prior to counting. If the sample contains suspended solids or is turbid, it may be filtered, distilled, and/or de-ionized, as appropriate. Eight (8) milliliters of sample are mixed with fifteen (15) milliliters of liquid scintillation cocktail. The mixture is dark adapted and counted for tritium activity using a liquid scintillation counting system.

4.6.3. Gross Beta

A 200-250 milliliter sample is placed in a beaker. Five (5) milliliters of concentrated nitric (HNO_3) acid is added and the sample is evaporated down to about twenty (20) milliliters. The remaining sample is transferred to a stainless steel planchet. The sample is heated to dryness and counted for gross beta in a gas flow proportional counter.

4.7. Soil

4.7.1. Gamma Spectroscopy

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

5. Nuclear Instrumentation

5.1. Gamma Spectrometer

The Canberra Gamma Spectrometer consists of a Canberra System equipped with HPGe detectors having resolutions of 1.73 keV and 1.88 keV (as determined by full width half max with an energy of 0.5 keV per channel) and respective efficiencies of 21.5% and 38.4% (as determined by the manufacturer with Co-60). The Canberra System is used for all gamma counting. The system uses Canberra developed software to search, identify, and quantify the peaks of interest.

5.2. Liquid Scintillation Spectrometer

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

5.3. Gas Flow Proportional Counter

The Tennelec S5E is a low background gas flow proportional counter for gross beta analysis. The system contains an automatic sample changer capable of counting 50 samples in succession. Average beta background count rate is about 1-2 cpm with a beta efficiency of approximately 30% for Cs-137.

6. Isotopic Detection Limits and Reporting Criteria

6.1. Lower Limits of Detection

The lower limits of detection (LLD) and the method for calculation are specified in the PVNGS ODCM, Reference 4. The ODCM required *a priori* LLDs are presented in Table 6.1. For reference, *a priori* LLDs are indicated at the top of data tables for samples having required LLD values.

6.2. Data Reporting Criteria

All results that are greater than the Minimum Detectable Activity (MDA) (a posteriori LLD) are reported as positive activity with its associated 2σ counting error. All results that are less than the MDA are reported as less than values at the associated MDA. For example, if the MDA is 12 pCi/liter, the value is reported as <12.

Typical MDA values are presented in Table 6.3.

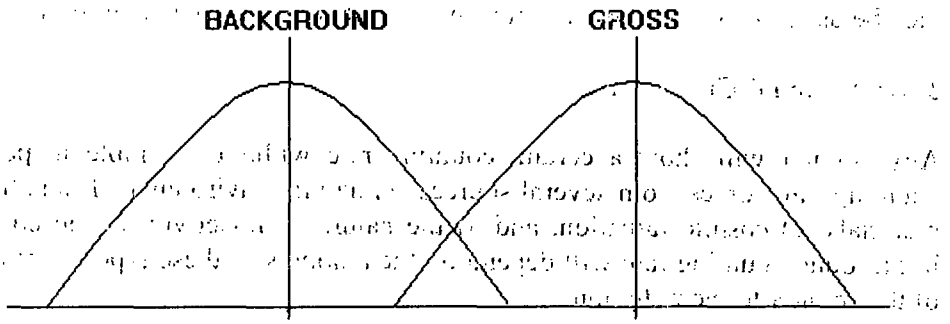
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

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

In these instances, the contributing factors will be noted in the table where the data are presented. A summary of deviations/abnormal events is presented in Table 2.3 and includes a description of any sample results that did not meet *a priori* LLD requirements.

6.3. LLD and Reporting Criteria Overview

Making a reasonable estimate of the limits of detection for a counting procedure or a radiochemical method is usually complicated by the presence of significant background. It must be considered that the background or blank is not a fixed value but that a series of replicates would be normally distributed. The desired net activity is the difference between the gross and background activity distributions. The interpretation of this difference becomes a problem if the two distributions intersect as indicated in the diagram.



If a sufficient number of replicate analyses are run, it is expected that the results would fall in a normal Gaussian distribution. Standard statistics allow an estimate of the probability of any particular deviation from the mean value. It is common practice to report the mean ± one or two standard deviations as the result. In routine analysis, such replication is not carried out, and it is not possible to report a Gaussian standard deviation. With counting procedures, however, it is possible to estimate a Poisson standard deviation directly from the count. Data are commonly reported as the measured value ± one or two Poisson standard deviations. The reported values are then considered to give some indication of the range in which the true value might be expected to occur.

A LLD is the smallest amount of sample activity that will yield a net count for which there is confidence at a predetermined level that activity is present. LLDs are calculated values for individual radionuclides based on a number of different factors including sample size, counting efficiency and background count rate of the instrument, the background and sample counting time, the decay time, and the chemical recovery of the analytical procedures. A minimum detectable activity value (MDA) is the smallest amount of activity that can be detected in an actual sample and uses the values obtained from the instrument and outcome of the analytical process. Therefore, the MDA values may differ from the calculated LLD values if the sample size and chemical recovery, decay values, or the instrument efficiency, background, or count time differed from those used in the LLD calculation.

The factors governing the calculation of the LLD and MDA values are discussed below:

1. Sample Size

2. Counting Efficiency

The fundamental quantity in the measurement of a radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, an absolute measurement of the disintegration rate is seldom possible, rather it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency that may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

3. Background Count Rate

Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surrounding materials, 2) cosmic radiation, and 3) the natural radioactivity in the counter material itself. The background counting rate will depend on the amounts of these types of radiation and the sensitivity of the counter to the radiation.

4. Background and Sample Counting Time

The amount of time devoted to the counting of the background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

5. Time Interval between Sample Collection and Counting

Decay measurements are useful in identifying certain short-lived nuclides. The disintegration constant is one of the basic characteristics of a specific radionuclide and is readily determined, if the half-life is sufficiently short. To ensure the required LLDs are achieved, appropriate decay correction values are used to account for radioactive decay during transit time and sample processing.

Table 6.1 ODCM REQUIRED LOWER LIMITS OF DETECTION (*a priori*)

ANALYSIS/ NUCLIDE	WATER (pCi/liter)	AIRBORNE PARTICULATE or GAS (pCi/m^3)	MILK (pCi/liter)	VEGETATION (pCi/kg, wet)
Gross Beta	4	0.01		
H-3	2000*			
Mn-54	15			
Fe-59	30			
Co-58, 60	15			
Zn-65	30			
Zr-95	30			
Nb-95	15			
I-131	1**	0.07	1	60
Cs-134	15	0.05	15	60
Cs-137	18	0.06	18	80
Ba-140	60		60	
La-140	15		15	

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	1.8		0.002	
H-3	271			
Mn-54	11			
Fe-59	19			
Co-58	11			
Co-60	13			
Zn-65	26			
Zr-95	19			
Nb-95	11			
I-131	10 [a]	1	0.04 [b]	43
Cs-134	10	1	0.02 [b]	38
Cs-137	11	1	0.03 [b]	52
Ba-140	37	3		
La-140	12	1		

NOTES:

a - low level I-131 is not required since there is no drinking water pathway

b - Based on 433 m^3, the normal weekly sample volume

7. Interlaboratory Comparison Program

7.1. Quality Control Program

APS maintains an extensive QA/QC Program to provide assurance that samples are collected, handled, tracked, and analyzed to specified requirements. This program includes appropriate elements of USNRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Rev. 1. Included in the program are procedures for sample collection, preparation and tracking, sample analysis, equipment calibration and checks, and ongoing participation in an interlaboratory comparison program. Duplicate/replicate samples are analyzed to verify analytical precision and sample methodology. Comprehensive data reviews are performed including trending of data where appropriate.

During 2011, 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 E8030-111	I-131	1.89E+01	1.88E+01	1.76E+00	11	0.99	Accept
		Ce-141	2.17E+01	2.71E+01	2.01E+00	13	1.25	Accept
		Cr-51	7.38E+01	6.63E+01	8.62E+00	8	0.90	Accept
		Cs-134	4.18E+01	3.77E+01	2.39E+00	16	0.90	Accept
		Cs-137	3.71E+01	3.75E+01	2.45E+00	15	1.01	Accept
		Co-58	3.18E+01	3.23E+01	2.24E+00	14	1.02	Accept
		Mn-54	4.92E+01	5.48E+01	3.41E+00	16	1.11	Accept
		Fe-59	1.79E+01	2.07E+01	2.59E+00	8	1.16	Accept
		Zn-65	5.88E+01	7.50E+01	5.05E+00	15	1.28	Accept
		Co-60	5.12E+01	5.15E+01	2.89E+00	18	1.01	Accept
Air	Mixed Gamma E8027-111	Ce-141	7.19E+01	7.16E+01	3.48E+00	21	1.00	Accept
		Cr-51	2.44E+02	2.58E+02	1.73E+01	15	1.06	Accept
		Cs-134	1.38E+02	1.22E+02	6.10E+00	20	0.88	Accept
		Cs-137	1.23E+02	1.31E+02	6.70E+00	20	1.07	Accept
		Co-58	1.05E+02	1.11E+02	5.80E+00	19	1.06	Accept
		Mn-54	1.63E+02	1.67E+02	8.10E+00	21	1.02	Accept
		Fe-59	5.91E+01	7.08E+01	5.81E+00	12	1.20	Accept
		Zn-65	1.95E+02	2.14E+02	1.13E+01	19	1.10	Accept
		Co-60	1.69E+02	1.68E+02	7.60E+00	22	0.99	Accept
Water	Mixed Gamma E8026-111	Ce-141	9.15E+01	9.88E+01	9.59E+00	10	1.08	Accept
		Cr-51	3.10E+02	2.77E+02	5.36E+01	5	0.89	Accept
		Cs-134	1.76E+02	1.48E+02	1.16E+01	13	0.84	Accept
		Cs-137	1.56E+02	1.61E+02	1.17E+01	14	1.03	Accept
		Co-58	1.34E+02	1.26E+02	1.04E+01	12	0.94	Accept
		Mn-54	2.07E+02	1.95E+02	1.43E+01	14	0.94	Accept
		Fe-59	7.52E+01	6.94E+01	1.32E+01	5	0.92	Accept
		Zn-65	2.47E+02	2.47E+02	2.49E+01	10	1.00	Accept
		Co-60	2.15E+02	2.20E+02	1.31E+01	17	1.02	Accept
		I-131	8.01E+01	7.20E+01	9.41E+00	8	0.90	Accept
Air	Cartridge E8028-111	I-131	8.05E+01	8.25E+01	5.58E+00	15	1.02	Accept
Air	Gross Beta E8029-111		7.18E+01	8.73E+01	2.20E+00	40	1.02	Accept
Water	Tritium E8119-111		9.01E+03	7.67E+03	2.64E+02	29	0.85	Accept
Water	Gross Beta E8118-111		2.49E+02	3.17E+02	6.49E+00	49	1.27	Accept

TABLE 7.1 INTERLABORATORY COMPARISON RESULTS

Sample Type	Analysis Type	Nuclide	Known Value	PVNGS Value	1 Sigma Error	Resolution*	Ratio	Accept/Reject
Air	Mixed Gamma E8166-111	Cr-51	3.07E+02	3.01E+02	2.80E+01	11	0.98	Accept
		Cs-134	9.30E+01	8.62E+01	5.16E+00	17	0.93	Accept
		Cs-137	1.14E+02	1.09E+02	6.50E+00	17	0.96	Accept
		Co-58	1.20E+02	1.21E+02	6.80E+00	18	1.01	Accept
		Mn-54	1.31E+02	1.30E+02	7.50E+00	17	0.99	Accept
		Fe-59	9.95E+01	9.84E+01	8.75E+00	11	0.99	Accept
		Zn-65	1.58E+02	1.61E+02	1.10E+01	15	1.02	Accept
		Co-60	1.47E+02	1.46E+02	8.10E+00	18	0.99	Accept
Water	Mixed Gamma E8164-111	Cr-51	5.66E+02	6.37E+02	3.84E+01	17	1.12	Accept
		Cs-134	1.71E+02	1.66E+02	6.80E+00	24	0.97	Accept
		Cs-137	2.10E+02	2.21E+02	8.20E+00	27	1.05	Accept
		Co-58	2.21E+02	2.20E+02	8.60E+00	26	1.00	Accept
		Mn-54	2.41E+02	2.59E+02	9.80E+00	26	1.07	Accept
		Fe-59	1.83E+02	1.96E+02	1.10E+01	18	1.07	Accept
		Zn-65	2.91E+02	3.15E+02	1.37E+01	23	1.08	Accept
		Co-60	2.70E+02	2.84E+02	1.01E+01	28	1.05	Accept
		I-131	8.87E+01	1.00E+02	6.00E+00	17	1.13	Accept
Air	Cartridge E8165-111	I-131	8.97E+01	1.00E+02	4.10E+00	24	1.12	Accept

* 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
Water	Tritium	H-3	6860	7620	6600 - 8370	Accept
RAD 86 ERA PT Study						
Water	Gamma	Ba-133	50.5	51.6	42.5 - 57.2	Accept
		Cs-134	**68.3**	**84.1**	**68.9 - 92.5**	**Not Accept [3]**
		Cs-137	101	109	98.1 - 122	Accept
		Co-60	104	109	98.1 - 122	Accept
		Zn-65	50.4	52.8	46.3 - 64.8	Accept
RAD 800 ERA PT Study						
Water	Tritium	H-3	13100	15200	9900 - 22500	Accept
	Gross Beta		109	99.8	58.4 - 146	Accept
Filter	Gross Beta		91.2	69.5	42.8 - 102	Accept
MRAD-014 ERA PT Study						

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

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

[3] Corrective Action Program document CRDR 3980064 was initiated. Subsequent analysis of this sample (3 more times) passed the acceptance criteria. Another interlaboratory comparison sample (E8164-111) was ordered and passed acceptance criteria. The low result for Cs-134 was attributed to coincidence summing that sometimes occurs with low activity samples analyzed using a high efficiency detector.

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 2011 are presented in the following sections.

8.1. Air Particulates

Weekly gross beta results, in quarterly format, are presented in Tables 8.1 and 8.2. Gross beta activity at indicator locations ranged from 0.016 to 0.372 pCi/m^3. This range is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously. Samples from the control location identified similar results. The associated counting error ranged from 0.001 to 0.004 pCi/m^3. Mean quarterly activity is normally calculated using weekly activity over a thirteen (13) week period. Also presented in the tables are the weekly mean values of all the sites as well as the percent relative standard deviation (RSD %) for the data.

Tables 8.3 and 8.4 display the results of gamma spectroscopy on the weekly and quarterly composite samples. Cs-134, Cs-137, I-131, I-132, and Te-132 were identified on particulate samples. The presence of man-made radionuclides on particulate filters is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously.

8.2. Airborne Radioiodine

Tables 8.5 and 8.6 present the quarterly radioiodine results. Radioiodine was identified during a three-week period between March 15 and April 5. The radioiodine concentration ranged from 0.037 to 1.258 pCi/m^3 at indicator and control locations. The identification of radioiodine is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously.

8.3. Vegetation

Table 8.7 presents gamma isotopic data for the vegetation samples. One sample from the control location indicated I-131 at a concentration of 53 pCi/kg on March 24th. This was the same time period that airborne samples also contained I-131, Cs-134, Cs-137, Te-132, and I-132. There were no indicator samples available in 2011. The identification of I-131 is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously.

8.4. Milk

Table 8.8 presents gamma isotopic data for the goat milk samples. Two samples from the control location and two samples from an indicator location had I-131 during the same time period as the airborne samples (airborne samples also contained Cs-134, Cs-137, Te-132, and I-132). The concentration of I-131 ranged from 1.3 to 6 pCi/liter. One indicator sample indicated Cs-134 and Cs-137 in the range of 1.5 to 2.0 pCi/liter. All goats that provide milk for the REMP are fed stored feed (hay) and are not pastured. Hay from this location was sampled and indicated Cs-137 at a concentration of 13 pCi/kg. The identification of I-131, Cs-134, and Cs-137 in milk is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously.

8.5. Drinking Water

Samples were analyzed for gross beta, tritium, and gamma emitting radionuclides. Results of these analyses are presented in Table 8.9. No tritium or gamma emitting radionuclides were detected in any samples. Gross beta activity ranged from less than detectable to a high of 8.4 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 8.10.

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

8.7. Surface Water

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

Sample results are presented in Table 8.11. I-131 was observed in Evaporation Pond 2A in one (1) sample (18 pCi/liter) and in one (1) of the Reservoir samples (27 pCi/liter). I-131 in these surface water locations is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent and is not attributable to plant effluents.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration was 956 pCi/liter. Tritium was not detected in the Reservoirs. The tritium identified in the Evaporation Ponds has been attributed to permitted plant gaseous effluent releases and secondary plant liquid

discharges (e.g. condensate overboard discharge, secondary side steam generator drains, secondary plant sumps, demineralizer regeneration waste). The tritium concentrations were compared to historical values and are considered typical for the Evaporation Ponds.

WRF Influent (Phoenix sewage effluent containing radiopharmaceutical I-131) samples collected by the WRF were analyzed for gamma emitting radionuclides and tritium. The results, presented in Table 8.11, demonstrate that I-131 was observed routinely. The I-131 concentration ranged from 9 to 51 pCi/liter. None of the samples analyzed indicated the presence of tritium.

Table 8.11 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) of five (5) samples ranging from 291 to 425 pCi/liter. The tritium was attributed to rain washout of plant gaseous effluent releases. No gamma emitting radionuclides were observed in the samples.

8.8. Sludge and Sediment

8.8.1. WRF Centrifuge waste sludge

Sludge samples were obtained from the WRF centrifuge and analyzed by gamma spectroscopy. I-131 activity in the sludge is consistent with historical values and, as previously discussed, is due to radiopharmaceuticals in the WRF Influent. The I-131 concentration ranged from 178 to 1734 pCi/kg.

In-111 was also identified in the sludge in one sample at 35 pCi/kg. It was previously established that In-111 is also used in the Phoenix area as a radiopharmaceutical. Sample results can be found in Table 8.12.

8.8.2. Cooling Tower sludge

Sludge/sediment originating from the Unit 2 and Unit 3 Cooling Towers and Circulating Water canals was disposed of in the WRF sludge landfill during 2011. Low levels of Co-60, Cs-134, and Cs-137 were identified in the sludge. The Co-60 and Cs-137 activity can be attributed to the 1993 Unit 2 steam generator tube rupture event. The Cs-134 is atypical and due to airborne releases from the Fukushima-Daiichi plants in Japan as discussed previously. Sample results can be found in Table 8.12.

8.8.3. Sedimentation Basin 2 sediment

Sediment samples were collected from Sedimentation Basin 2. This basin collects storm water runoff from the site drainage ditches. Low level Cs-137 was identified in these samples. The results are consistent with historical values and are attributed to previous atmospheric bomb testing. Sample results can be found in Table 8.12. Refer to Figure 8.7 for a historical trend graph.

8.9. Data Trends

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

TABLE 8.1 PARTICULATE GROSS BETA IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *
units are pCi/m³
1st Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
1	28-Dec-10	4-Jan-11	0.036	0.034	0.033	OOS [a]	0.034	0.034	0.029	0.032	0.033	0.031	0.033	6.2
2	4-Jan-11	11-Jan-11	0.051	0.054	0.053	OOS [a]	0.053	0.054	0.054	0.056	0.053	0.055	0.054	2.6
3	11-Jan-11	18-Jan-11	0.043	0.042	0.041	OOS [a]	0.038	0.039	0.038	0.041	0.039	0.039	0.040	4.5
4	18-Jan-11	25-Jan-11	0.040	0.039	0.035	0.031	0.032	0.033	0.031	0.033	0.031	0.036	0.034	9.7
5	25-Jan-11	1-Feb-11	0.042	0.041	0.040	0.038	0.040	0.039	0.039	0.041	0.039	0.040	0.040	3.0
6	1-Feb-11	8-Feb-11	0.050	0.047	0.040	0.041	0.042	0.045	0.043	0.040	0.043	0.039	0.043	8.1
7	8-Feb-11	15-Feb-11	0.037	0.033	0.032	0.034	0.030	0.031	0.033	0.036	0.033	0.031	0.033	6.7
8	15-Feb-11	22-Feb-11	0.021	0.018	0.019	0.018	0.017	0.016	0.018	0.018	0.018	0.022	0.019	9.6
9	22-Feb-11	1-Mar-11	0.031	0.032	0.031	0.029	0.029	0.028	0.028	0.028	0.030	0.029	0.030	4.9
10	1-Mar-11	8-Mar-11	0.032	0.038	0.035	0.032	0.035	0.031	0.030	0.036	0.035	0.034	0.034	7.4
11	8-Mar-11	15-Mar-11	0.040	0.043	0.042	0.038	0.046	0.036	0.041	0.040	0.036	0.039	0.040	7.7
12	15-Mar-11	22-Mar-11	**0.346**	**0.388**	**0.369**	**0.358**	**0.360**	**0.355**	**0.372**	**0.353**	**0.325**	**0.320**	0.355	5.8
13	22-Mar-11	29-Mar-11	**0.305**	**0.279**	**0.263**	**0.273**	**0.313**	**0.329**	**0.299**	**0.326**	**0.305**	**0.317**	0.301	7.5
Mean			0.083	0.084	0.079	0.089	0.082	0.082	0.081	0.083	0.078	0.079	0.082	3.7

2nd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)
14	29-Mar-11	5-Apr-11	0.043	0.047	0.048	0.045	0.045	0.047	0.044	0.046	0.041	0.043	0.045	4.9
15	5-Apr-11	12-Apr-11	0.029	0.032	0.030	0.031	0.034	0.030	0.032	0.029	0.028	0.032	0.031	6.0
16	12-Apr-11	19-Apr-11	0.037	0.037	0.038	0.039	0.041	0.035	0.036	0.041	0.038	0.040	0.038	5.4
17	19-Apr-11	26-Apr-11	0.024	0.024	0.026	0.021	0.021	0.026	0.022	0.022	0.027	0.020	0.023	10.5
18	26-Apr-11	3-May-11	0.024	0.030	0.028	0.024	0.024	0.026	0.023	0.028	0.026	0.026	0.026	8.6
19	3-May-11	10-May-11	0.036	0.035	0.036	0.036	0.035	0.035	0.032	0.035	0.036	0.040	0.036	5.5
20	10-May-11	17-May-11	0.025	0.027	0.025	0.025	0.024	0.023	0.024	0.026	0.024	0.022	0.025	5.9
21	17-May-11	24-May-11	0.023	0.021	0.025	0.021	0.025	0.024	0.021	0.024	0.024	0.022	0.023	7.1
22	24-May-11	31-May-11	0.028	0.022	0.022	0.023	0.022	0.022	0.021	0.023	0.023	0.025	0.023	8.8
23	31-May-11	7-Jun-11	0.028	0.028	0.030	0.022	0.028	0.028	0.029	0.029	0.028	0.027	0.028	7.8
24	7-Jun-11	14-Jun-11	0.032	0.030	0.029	0.031	0.031	0.026	0.029	0.032	0.032	0.034	0.031	7.3
25	14-Jun-11	21-Jun-11	0.028	0.033	0.030	0.026	0.031	0.032	0.030	0.025	0.028	0.030	0.029	8.7
26	21-Jun-11	28-Jun-11	0.034	0.038	0.038	0.037	0.038	0.034	0.035	0.030	0.036	0.040	0.036	8.0
Mean			0.030	0.031	0.031	0.029	0.031	0.030	0.029	0.030	0.030	0.031	0.030	2.4

a Power was lost to equipment. Corrective Action Program CRDR 3574902 and CMWO 3573475 initiated.

All elevated sample results in weeks 12 and 13 have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program document CRDR 3739206.

TABLE 8.2 PARTICULATE GROSS BETA IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *
units are pCi/m³

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	28-Jun-11	5-Jul-11	0.033	0.035	0.033	0.036	0.034	0.036	0.025	0.031	0.039	0.026	0.033	13.5
28	5-Jul-11	12-Jul-11	0.031	0.030	0.024	0.029	0.029	0.021	0.021	0.027	0.031	0.028	0.027	14.1
29	12-Jul-11	19-Jul-11	0.032	0.024	0.024	0.035	0.035	0.028	0.022	0.026	0.030	0.028	0.028	16.1
30	19-Jul-11	26-Jul-11	0.032	0.029	0.031	0.031	0.033	0.031	0.032	0.031	0.033	0.033	0.032	4.0
31	26-Jul-11	1-Aug-11	0.027	0.023	0.024	0.025	0.027	0.028	0.029	0.024	0.029	0.027	0.026	8.2
32	1-Aug-11	9-Aug-11	0.038	0.040	0.035	0.031	0.035	0.033	0.035	0.035	0.038	0.038	0.036	7.5
33	9-Aug-11	16-Aug-11	0.033	0.032	0.030	0.029	0.032	0.034	0.030	0.027	0.030	0.034	0.031	7.3
34	16-Aug-11	23-Aug-11	0.042	0.040	0.035	0.036	0.034	0.031	0.038	0.037	0.036	0.044	0.037	10.3
35	23-Aug-11	30-Aug-11	0.040	0.043	0.044	0.043	0.044	0.044	0.042	0.043	0.042	0.046	0.043	3.7
36	30-Aug-11	6-Sep-11	0.046	0.049	0.042	0.044	0.049	0.045	0.044	0.049	0.045	0.048	0.046	5.5
37	6-Sep-11	13-Sep-11	0.028	0.032	0.037	0.029	0.037	0.035	0.034	0.033	0.036	0.034	0.034	9.3
38	13-Sep-11	20-Sep-11	0.038	0.037	0.039	0.038	0.034	0.037	0.036	0.037	0.039	0.035	0.037	4.4
39	20-Sep-11	27-Sep-11	0.032	0.032	0.029	0.026	0.038	0.030	0.031	0.025	0.026	0.037	0.031	14.5
Mean			0.035	0.034	0.033	0.033	0.035	0.033	0.032	0.033	0.035	0.035	0.034	3.5

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-11	4-Oct-11	0.042	0.038	0.041	0.041	0.032	0.038	0.038	0.042	0.045	0.041	0.040	8.8
41	4-Oct-11	11-Oct-11	0.024	0.022	0.026	0.022	0.022	0.024	0.024	0.025	0.022	0.022	0.023	6.4
42	11-Oct-11	18-Oct-11	0.049	0.055	0.052	0.050	0.049	0.050	0.049	0.049	0.050	0.051	0.050	3.8
43	18-Oct-11	25-Oct-11	0.051	0.057	0.051	0.052	0.052	0.052	0.048	0.053	0.052	0.053	0.052	4.3
44	25-Oct-11	1-Nov-11	0.047	0.051	0.048	0.048	0.046	0.043	0.044	0.047	0.049	0.048	0.047	4.9
45	1-Nov-11	7-Nov-11	0.031	0.032	0.035	0.033	0.036	0.032	0.032	0.034	0.032	0.033	0.033	4.7
46	7-Nov-11	15-Nov-11	0.035	0.040	0.037	0.036	0.037	0.036	0.036	0.039	0.039	0.036	0.037	4.5
47	15-Nov-11	21-Nov-11	0.041	0.042	0.041	0.042	0.045	0.043	0.043	0.043	0.041	0.043	0.042	3.0
48	21-Nov-11	29-Nov-11	0.031	0.032	0.033	0.030	0.029	0.030	0.030	0.032	0.029	0.031	0.031	4.4
49	29-Nov-11	6-Dec-11	0.042	0.046	0.041	0.039	0.042	0.040	0.039	0.042	0.038	0.036	0.041	6.8
50	6-Dec-11	13-Dec-11	0.050	invalid[a]	0.052	0.050	0.050	0.042	0.050	0.052	0.052	0.047	0.049	6.5
51	13-Dec-11	20-Dec-11	0.030	0.030	0.031	0.028	0.030	0.030	0.025	0.026	0.027	0.028	0.029	7.1
52	20-Dec-11	27-Dec-11	0.045	0.050	0.045	0.047	0.049	0.045	0.044	0.048	0.044	0.044	0.046	4.8

a Sample invalidated due to sample pump malfunction.

Mean	0.040	0.041	0.041	0.040	0.040	0.039	0.039	0.041	0.040	0.039	0.040	2.2
Annual Average	***0.0468***	***0.0477***	***0.0461***	***0.0454***	***0.0471***	***0.0461***	***0.0453***	***0.0467***	***0.0459***	***0.0462***	***0.046***	***1.6***

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*
29-Mar-11	Cs-134	**0.007 ± 0.004**	**0.008 ± 0.004**	**0.010 ± 0.004**	<0.010	**0.008 ± 0.003**	**0.008 ± 0.003**	**0.007 ± 0.003**	<0.007	**0.010 ± 0.004**	**0.010 ± 0.004**
	Cs-137	**0.009 ± 0.005**	**0.006 ± 0.004**	**0.010 ± 0.004**	<0.013	<0.007	**0.008 ± 0.005**	<0.010	**0.007 ± 0.004**	<0.009	**0.011 ± 0.005**
	I-131	**0.016 ± 0.012**	**0.032 ± 0.010**	**0.017 ± 0.007**	**0.022 ± 0.011**	**0.029 ± 0.009**	**0.024 ± 0.014**	**0.025 ± 0.011**	**0.020 ± 0.014**	**0.016 ± 0.012**	**0.020 ± 0.011**
28-Jun-11	Cs-134	<0.0039	<0.0035	<0.0030	<0.0025	<0.0034	<0.0035	<0.0035	<0.0044	<0.0027	<0.0034
	Cs-137	<0.0043	<0.0036	<0.0028	<0.0064	<0.0040	<0.0047	<0.0046	<0.0042	<0.0044	<0.0036
27-Sep-11	Cs-134	<0.0036	<0.0031	<0.0024	<0.0042	<0.0023	<0.0030	<0.0029	<0.0037	<0.0039	<0.0034
	Cs-137	<0.0048	<0.0011	<0.0047	<0.0029	<0.0036	<0.0029	<0.0048	<0.0043	<0.0037	<0.0031
27-Dec-11	Cs-134	<0.0014	<0.0026	<0.0026	<0.0046	<0.0013	<0.0014	<0.0028	<0.0019	<0.0030	<0.0010
	Cs-137	<0.0030	<0.0027	<0.0016	<0.0046	<0.0030	<0.0035	<0.0035	<0.0023	<0.0057	<0.0016

All positive sample results in the 1st quarter have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program document CRDR 3739206.

TABLE 8.4 AIR PARTICULATE GAMMA DUE TO FUKUSHIMA RELEASES

units are pCi/m^3
1st Quarter

START DATE	STOP DATE	SITE	I-131	I-132	Cs-134	Cs-137	Te-132
15-Mar-11	22-Mar-11	4	**0.29 ± 0.08**		**0.04 ± 0.02**	**0.07 ± 0.03**	
		6A	**0.22 ± 0.06**		**0.06 ± 0.03**	**0.08 ± 0.03**	**0.06 ± 0.03**
		7A	**0.23 ± 0.06**		**0.06 ± 0.03**	**0.07 ± 0.02**	
		14A	**0.28 ± 0.07**		**0.03 ± 0.02**	**0.04 ± 0.03**	
		15	**0.24 ± 0.08**		**0.06 ± 0.03**	**0.075 ± 0.03**	
		17A	**0.30 ± 0.07**		**0.08 ± 0.03**	**0.06 ± 0.03**	
		21	**0.33 ± 0.07**		**0.05 ± 0.05**	**0.08 ± 0.05**	**0.03 ± 0.02**
		29	**0.31 ± 0.06**		**0.06 ± 0.03**	**0.09 ± 0.03**	**0.03 ± 0.03**
		35	**0.37 ± 0.08**	**0.06 ± 0.03**	**0.06 ± 0.03**	**0.07 ± 0.03**	**0.05 ± 0.03**
		40	**0. 22 ± 0.05**	**0.03 ± 0.03**	**0.06 ± 0.03**	**0.07 ± 0.04**	**0.04 ± 0.03**
22-Mar-11	29-Mar-11	4	**0.14 ± 0.06**		**0.07 ± 0.03**	**0.07 ± 0.03**	
		6A	**0.10 ± 0.06**		**0.05 ± 0.02**	**0.05 ± 0.02**	
		7A	**0.14 ± 0.60**		**0.03 ± 0.02**	**0.06 ± 0.03**	
		14A	**0.12 ± 0.07**		**0.05 ± 0.03**	**0.08 ± 0.03**	
		15	**0.16 ± 0.08**		**0.05 ± 0.03**	**0.06 ± 0.03**	
		17A	**0.16 ± 0.05**		**0.07 ± 0.02**	**0.06 ± 0.03**	
		21	**0.17 ± 0.05**		**0.03 ± 0.02**	**0.08 ± 0.03**	
		29	**0.16 ± 0.06**		**0.07 ± 0.03**	**0.05 ± 0.03**	
		35	**0.10 ± 0.06**		**0.05 ± 0.03**	**0.05 ± 0.02**	
		40	**0.12 ± 0.07**		**0.05 ± 0.03**	**0.05 ± 0.03**	
29-Mar-11	5-Apr-11	4	none detected, no required LLD		<0.019	<0.041	
		6A	none detected, no required LLD		<0.024	<0.030	
		7A	none detected, no required LLD		<0.019	<0.028	
		14A	none detected, no required LLD		<0.026	<0.025	
		15	none detected, no required LLD		<0.026	<0.043	
		17A	none detected, no required LLD		<0.024	<0.043	
		21	none detected, no required LLD		<0.020	<0.033	
		29	none detected, no required LLD		<0.025	<0.030	
		35	none detected, no required LLD		<0.020	<0.029	
		40	none detected, no required LLD		<0.025	<0.032	

All positive sample results have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program document CRDR 3739206.

TABLE 8.5 RADIOIODINE IN AIR 1st - 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	required LLD <0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
1	28-Dec-10	4-Jan-11	<0.051	<0.056	<0.067	OOS [a]	<0.062	<0.044	<0.035	<0.045	<0.066	<0.035
2	4-Jan-11	11-Jan-11	<0.045	<0.035	<0.063	OOS [a]	<0.064	<0.057	<0.064	<0.054	<0.047	<0.046
3	11-Jan-11	18-Jan-11	<0.050	<0.056	<0.033	OOS [a]	<0.049	<0.043	<0.034	<0.048	<0.042	<0.050
4	18-Jan-11	25-Jan-11	<0.061	<0.067	<0.069	<0.069	<0.038	<0.057	<0.049	<0.068	<0.049	<0.064
5	25-Jan-11	1-Feb-11	<0.047	<0.058	<0.065	<0.053	<0.046	<0.060	<0.065	<0.045	<0.054	<0.060
6	1-Feb-11	8-Feb-11	<0.014	<0.051	<0.045	<0.052	<0.053	<0.037	<0.060	<0.063	<0.065	<0.046
7	8-Feb-11	15-Feb-11	<0.054	<0.040	<0.040	<0.054	<0.041	<0.046	<0.070	<0.062	<0.066	<0.057
8	15-Feb-11	22-Feb-11	<0.043	<0.055	<0.038	<0.061	<0.022	<0.034	<0.044	<0.042	<0.036	<0.041
9	22-Feb-11	1-Mar-11	<0.052	<0.013	<0.052	<0.058	<0.053	<0.041	<0.053	<0.044	<0.059	<0.039
10	1-Mar-11	8-Mar-11	<0.057	<0.036	<0.041	<0.034	<0.029	<0.052	<0.039	<0.043	<0.037	<0.043
11	8-Mar-11	15-Mar-11	<0.038	<0.038	<0.048	<0.054	<0.066	<0.059	<0.043	<0.051	<0.062	<0.054
12	15-Mar-11	22-Mar-11	**0.92 ± 0.17**	**1.26 ± 0.15**	**1.18 ± 0.19**	**1.19 ± 0.14**	**1.17 ± 0.14**	**1.24 ± 0.16**	**1.17 ± 0.13**	**1.14 ± 0.14**	**1.00 ± 0.14**	**0.97 ± 0.12**
13	22-Mar-11	29-Mar-11	**0.53 ± 0.12**	**0.53 ± 0.12**	**0.55 ± 0.12**	**0.61 ± 0.13**	**0.55 ± 0.13**	**0.57 ± 0.13**	**0.61 ± 0.14**	**0.51 ± 0.11**	**0.66 ± 0.13**	**0.58 ± 0.12**

2nd Quarter

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	required LLD <0.070 Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
14	29-Mar-11	5-Apr-11	**0.05 ± 0.04**	**0.10 ± 0.03**	**0.06 ± 0.04**	**0.04 ± 0.04**	**0.06 ± 0.03**	**0.10 ± 0.05**	**0.04 ± 0.03**	**<0.068**	**0.06 ± 0.05**	**0.06 ± 0.04**
15	5-Apr-11	12-Apr-11	<0.056	<0.065	<0.056	<0.049	<0.070	<0.068	<0.065	<0.052	<0.054	<0.053
16	12-Apr-11	19-Apr-11	<0.035	<0.066	<0.042	<0.061	<0.049	<0.054	<0.053	<0.067	<0.050	<0.048
17	19-Apr-11	26-Apr-11	<0.066	<0.059	<0.068	<0.042	<0.059	<0.068	<0.060	<0.064	<0.055	<0.064
18	26-Apr-11	3-May-11	<0.047	<0.038	<0.049	<0.046	<0.048	<0.046	<0.058	<0.023	<0.053	<0.047
19	3-May-11	10-May-11	<0.055	<0.052	<0.065	<0.038	<0.047	<0.045	<0.051	<0.057	<0.059	<0.053
20	10-May-11	17-May-11	<0.047	<0.047	<0.041	<0.042	<0.049	<0.040	<0.045	<0.043	<0.041	<0.047
21	17-May-11	24-May-11	<0.038	<0.039	<0.038	<0.038	<0.039	<0.048	<0.030	<0.048	<0.048	<0.047
22	24-May-11	31-May-11	<0.049	<0.056	<0.050	<0.057	<0.049	<0.032	<0.021	<0.050	<0.062	<0.048
23	31-May-11	7-Jun-11	<0.034	<0.069	<0.064	<0.038	<0.037	<0.040	<0.047	<0.047	<0.059	<0.050
24	7-Jun-11	14-Jun-11	<0.039	<0.060	<0.038	<0.035	<0.038	<0.034	<0.054	<0.051	<0.061	<0.050
25	14-Jun-11	21-Jun-11	<0.048	<0.062	<0.059	<0.038	<0.046	<0.059	<0.063	<0.042	<0.061	<0.044
26	21-Jun-11	28-Jun-11	<0.054	<0.052	<0.067	<0.044	<0.067	<0.043	<0.054	<0.048	<0.064	<0.041

a Power was lost to equipment. Corrective Action Program CRDR 3574902 and CMWO 3573475 initiated.

All positive sample results in weeks 12, 13, and 14 have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program document CRDR 3739206.

TABLE 8.6 RADIOIODINE IN AIR 3rd - 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15* 0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
27	28-Jun-11	5-Jul-11	<0.041	<0.038	<0.043	<0.053	<0.056	<0.021	<0.054	<0.068	<0.058	<0.018
28	5-Jul-11	12-Jul-11	<0.041	<0.061	<0.039	<0.047	<0.046	<0.049	<0.039	<0.045	<0.046	<0.047
29	12-Jul-11	19-Jul-11	<0.025	<0.046	<0.038	<0.033	<0.044	<0.044	<0.049	<0.044	<0.042	<0.040
30	19-Jul-11	26-Jul-11	<0.050	<0.052	<0.045	<0.044	<0.069	<0.050	<0.065	<0.048	<0.063	<0.040
31	26-Jul-11	1-Aug-11	<0.039	<0.059	<0.058	<0.047	<0.058	<0.052	<0.041	<0.039	<0.052	<0.027
32	1-Aug-11	9-Aug-11	<0.046	<0.060	<0.055	<0.039	<0.039	<0.040	<0.031	<0.037	<0.051	<0.032
33	9-Aug-11	16-Aug-11	<0.036	<0.038	<0.026	<0.051	<0.038	<0.040	<0.043	<0.039	<0.033	<0.036
34	16-Aug-11	23-Aug-11	<0.047	<0.031	<0.040	<0.041	<0.047	<0.036	<0.043	<0.033	<0.044	<0.039
35	23-Aug-11	30-Aug-11	<0.031	<0.067	<0.050	<0.054	<0.048	<0.046	<0.041	<0.041	<0.065	<0.031
36	30-Aug-11	6-Sep-11	<0.038	<0.051	<0.043	<0.028	<0.050	<0.039	<0.044	<0.039	<0.042	<0.060
37	6-Sep-11	13-Sep-11	<0.051	<0.040	<0.045	<0.046	<0.044	<0.052	<0.065	<0.056	<0.054	<0.068
38	13-Sep-11	20-Sep-11	<0.047	<0.064	<0.064	<0.053	<0.052	<0.053	<0.059	<0.053	<0.053	<0.064
39	20-Sep-11	27-Sep-11	<0.057	<0.061	<0.054	<0.041	<0.049	<0.042	<0.049	<0.049	<0.051	<0.038

4th Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15* 0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*
40	27-Sep-11	4-Oct-11	<0.045	<0.049	<0.051	<0.064	<0.055	<0.034	<0.066	<0.045	<0.060	<0.035
41	4-Oct-11	11-Oct-11	<0.062	<0.061	<0.013	<0.035	<0.061	<0.052	<0.045	<0.046	<0.068	<0.068
42	11-Oct-11	18-Oct-11	<0.056	<0.050	<0.059	<0.056	<0.053	<0.067	<0.062	<0.064	<0.060	<0.062
43	18-Oct-11	25-Oct-11	<0.055	<0.067	<0.060	<0.042	<0.067	<0.059	<0.041	<0.053	<0.053	<0.068
44	25-Oct-11	1-Nov-11	<0.066	<0.042	<0.064	<0.034	<0.034	<0.048	<0.034	<0.052	<0.020	<0.053
45	1-Nov-11	7-Nov-11	<0.031	<0.068	<0.008	<0.069	<0.049	<0.024	<0.066	<0.024	<0.067	<0.046
46	7-Nov-11	15-Nov-11	<0.053	<0.016	<0.029	<0.029	<0.029	<0.027	<0.044	<0.020	<0.043	<0.024
47	15-Nov-11	21-Nov-11	<0.029	<0.068	<0.067	<0.033	<0.068	<0.033	<0.043	<0.029	<0.069	<0.037
48	21-Nov-11	29-Nov-11	<0.024	<0.042	<0.029	<0.026	<0.050	<0.021	<0.037	<0.015	<0.056	<0.023
49	29-Nov-11	6-Dec-11	<0.032	<0.033	<0.034	<0.055	<0.039	<0.041	<0.036	<0.059	<0.027	<0.055
50	6-Dec-11	13-Dec-11	<0.033	invalid[a]	<0.014	<0.049	<0.039	<0.049	<0.050	<0.020	<0.041	<0.029
51	13-Dec-11	20-Dec-11	<0.026	<0.018	<0.027	<0.030	<0.034	<0.030	<0.034	<0.039	<0.029	<0.031
52	20-Dec-11	27-Dec-11	<0.032	<0.049	<0.033	<0.038	<0.042	<0.017	<0.041	<0.017	<0.046	<0.026

a Sample invalidated due to sample pump malfunction.

TABLE 8.7 VEGETATION

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

LOCATION	TYPE	DATE COLLECTED	<60 I-131	<60 Cs-134	<80 Cs-137
LOCAL RESIDENCE (Site #47)*	NONE AVAILABLE				
COMMERCIAL FARM (Site #62)*	red cabbage	20-Jan-11	<49	<36	<70
	green cabbage	24-Mar-11	**53 ± 20**	<17	<20
	red cabbage	22-Apr-11	<52	<33	<52
	green cabbage	22-Apr-11	<59	<46	<64
	green cabbage	20-Oct-11	<26	<41	<28
	red cabbage	17-Nov-11	<53	<38	<68
	green cabbage	17-Nov-11	<39	<51	<48
	green cabbage	1-Dec-11	<55	<48	<76
	red cabbage	1-Dec-11	<44	<12	<40

All positive results have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program documents CRDR 3739206 and 3812184.

TABLE 8.8 MILK

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<1 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140
Local Resident Goats (Site #51)*	NONE AVAILABLE					
Local Resident Goats (Site #52)*	NONE AVAILABLE, DELETED 9/30/11					
Local Resident Goats (Site #53)*	20-Jan-11	<1	<1	<1	<3	<1
	18-Feb-11	<1	<1	<1	<3	<1
	24-Mar-11	**4.6 ± 0.9**	<1	<1	<3	<1
	22-Apr-11	**5.0 ± 1.1**	<1	<1	<3	<1
	20-May-11	<1	<1	<1	<3	<1
	23-Jun-11	<1	<1	<1	<3	<1
	22-Jul-11	<1	<1	<1	<4	<1
	18-Aug-11	<1	<1	<1	<3	<1
	22-Sep-11	<1	<1	<1	<3	<1
	20-Oct-11	<1	<1	<1	<3	<1
	17-Nov-11	<1	<1	<1	<3	<1
	15-Dec-11	<1	<1	<1	<3	<1
Local Resident Goats (Site #54)	31-Mar-11	**2.0 ± 0.7**	<1	<1	<3	<1
	14-Apr-11	**1.3 ± 0.7**	<1	<1	<3	<1
	13-May-11	<1	<1	<1	<3	<1
	09-Jun-11	<1	**1.5 ± 0.6**	**2.0 ± 0.7**	<3	<1
	07-Jul-11	<1	<1	<1	<3	<1
	12-Aug-11	<1	**1.7 ± 0.6**	**2.0 ± 0.7**	<3	<1
	09-Sep-11	<1	<1	<1	<3	<1
	13-Oct-11	<1	<1	<1	<3	<1
	10-Nov-11	<1	**1.3 ± 0.6**	**1.9 ± 0.9**	<3	<1
	15-Dec-11	<1	<1	<1	<3	<1

Notes:
All positive results have been attributed to the Fukushima-Daiichi event. Refer to Corrective Action Program documents CRDR 3739206 and 3812184.

TABLE 8.9 DRINKING WATER

ODCM required samples denoted by *

units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Qtrly Tritium	<4.0 Gross Beta
LOCAL RESIDENCE (Site #48) *	25-Jan-11	<13	<12	<22	<14	<27	<14	<24	<12	<13	<14	<45	<14		<3.8
	22-Feb-11	<12	<11	<25	<13	<29	<12	<21	<12	<11	<14	<42	<15		<3.6
	29-Mar-11	<14	<11	<26	<15	<27	<12	<16	<10	<10	<11	<37	<14	<262	5.6 ± 2.4
	26-Apr-11	<12	<12	<26	<14	<30	<13	<23	<13	<11	<13	<45	<15		5.9 ± 2.5
	31-May-11	<12	<11	<23	<12	<24	<11	<18	<10	<10	<12	<34	<13		3.8 ± 2.1
	28-Jun-11	<15	<11	<25	<15	<27	<12	<15	<9	<11	<11	<31	<15	<253	<3.1
	26-Jul-11	<12	<12	<24	<12	<29	<11	<20	<12	<11	<12	<39	<12		3.7 ± 2.0
	30-Aug-11	<11	<11	<23	<13	<30	<12	<20	<12	<10	<13	<38	<13		<3.1
	27-Sep-11	<10	<11	<23	<13	<22	<10	<17	<8	<9	<11	<30	<15	<254	<3.6
	25-Oct-11	<10	<9	<23	<11	<24	<11	<18	<9	<8	<10	<34	<14		<3.8
	29-Nov-11	<10	<12	<24	<15	<23	<11	<19	<11	<10	<12	<40	<14		8.4 ± 2.2
	27-Dec-11	<14	<11	<25	<15	<25	<15	<19	<11	<11	<12	<39	<28	<269	<3.0
LOCAL RESIDENCE (Site #55)	25-Jan-11	<15	<14	<28	<14	<25	<15	<27	<11	<12	<14	<46	<15		3.2 ± 1.7
	22-Feb-11	<13	<10	<24	<15	<28	<12	<20	<11	<10	<13	<40	<14		4.8 ± 1.7
	29-Mar-11	<15	<13	<25	<13	<29	<13	<17	<11	<12	<14	<32	<11	<261	6.0 ± 1.7
	26-Apr-11	<12	<10	<21	<13	<25	<11	<19	<11	<10	<12	<39	<15		4.1 ± 1.6
	31-May-11	<13	<12	<28	<15	<24	<13	<18	<10	<10	<12	<39	<12		4.3 ± 1.5
	28-Jun-11	<11	<12	<20	<13	<26	<13	<21	<11	<10	<10	<40	<15	<251	3.3 ± 1.4
	26-Jul-11	<15	<11	<24	<10	<24	<11	<18	<11	<10	<11	<43	<11		3.6 ± 1.4
	30-Aug-11	<15	<9	<27	<15	<26	<11	<24	<11	<13	<11	<33	<14		3.8 ± 1.4
	27-Sep-11	<9	<12	<18	<12	<20	<11	<17	<9	<10	<12	<38	<15	<255	3.6 ± 1.6
	25-Oct-11	<12	<10	<23	<11	<25	<12	<17	<10	<9	<9	<37	<15		<2.6
	29-Nov-11	<9	<11	<16	<13	<20	<11	<16	<9	<10	<10	<36	<15		2.8 ±1.4
	27-Dec-11	<13	<12	<26	<13	<24	<12	<21	<11	<10	<13	<36	<15	<271	5.1 ±1.5

TABLE 8.9 DRINKING WATER

ODCM required samples denoted by *

units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Qtrly Tritium	<4.0 Gross Beta
LOCAL RESIDENCE (Site #46) *	25-Jan-11	<15	<13	<29	<14	<24	<8	<26	<13	<14	<14	<44	<15		<2.4
	22-Feb-11	<15	<13	<22	<11	<28	<9	<25	<11	<12	<15	<29	<15		3.5 ± 1.5
	29-Mar-11	<14	<13	<26	<11	<30	<11	<22	<15	<13	<14	<53	<13	<261	<2.3
	26-Apr-11	<10	<10	<25	<11	<23	<11	<18	<9	<10	<11	<36	<15		2.5 ± 1.4
	31-May-11	<10	<11	<20	<14	<23	<10	<21	<11	<8	<13	<28	<15		2.7 ± 1.4
	28-Jun-11	<14	<14	<28	<15	<27	<13	<24	<13	<12	<12	<49	<15	<250	<2.0
	26-Jul-11	<10	<10	<21	<10	<20	<11	<15	<10	<9	<9	<32	<10		3.5 ± 1.4
	30-Aug-11	<12	<11	<22	<14	<28	<12	<20	<12	<12	<13	<42	<12		3.8 ± 1.4
	27-Sep-11	<10	<11	<23	<8	<30	<12	<22	<10	<11	<11	<35	<10	<254	<2.3
	25-Oct-11	<13	<12	<25	<13	<29	<14	<22	<15	<15	<14	<51	<11		<2.4
	29-Nov-11	<11	<11	<23	<12	<24	<10	<20	<11	<9	<12	<40	<15		3.3 ± 1.3
	27-Dec-11	<11	<11	<20	<13	<24	<11	<20	<10	<9	<10	<37	<15	<271	2.6 ± 1.3
LOCAL RESIDENCE (Site #49) *	25-Jan-11	<12	<9	<20	<9	<25	<11	<18	<10	<11	<9	<34	<15		<2.5
	22-Feb-11	<13	<11	<25	<15	<24	<12	<22	<10	<10	<13	<37	<14		<2.3
	29-Mar-11	<12	<12	<27	<11	<30	<14	<22	<11	<11	<12	<44	<13	<263	<2.3
	26-Apr-11	<11	<12	<23	<13	<27	<15	<18	<12	<11	<12	<38	<14		<2.2
	31-May-11	<13	<13	<27	<15	<30	<13	<20	<13	<12	<15	<48	<12		<2.0
	28-Jun-11	<9	<10	<25	<14	<24	<11	<15	<10	<10	<11	<36	<14	<247	<2.0
	26-Jul-11	<12	<13	<27	<14	<28	<14	<21	<15	<13	<13	<51	<15		<2.0
	30-Aug-11	<12	<9	<19	<12	<25	<12	<17	<11	<10	<10	<44	<14		<2.0
	13-Sep-11[a]	<10	<8	<19	<11	<21	<9	<16	<15	<8	<9	<44	<12	<252	<2.4
	27-Dec-11[b]	<10	<12	<17	<14	<30	<13	<17	<11	<11	<13	<41	<15	<272	2.8 ± 1.3

[a] Permanently unavailable as of 9/20/11, refer to Corrective Action Program document CRDR 3882110. [b] New location as of 12/6/11.

TABLE 8.10 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)*	15-Feb-11	<14	<13	<25	<15	<28	<15	<22	<14	<12	<14	<46	<15	<271
	26-Apr-11	<10	<10	<19	<12	<21	<11	<16	<11	<9	<11	<39	<12	<260
	26-Jul-11	<13	<13	<28	<9	<30	<13	<23	<13	<12	<14	<44	<13	<250
	25-Oct-11	<10	<10	<21	<15	<23	<11	<15	<10	<8	<8	<35	<13	<260
WELL 34abb (Site #58)*	15-Feb-11	<12	<10	<22	<12	<26	<12	<19	<10	<10	<12	<37	<15	<269
	26-Apr-11	<11	<12	<21	<12	<24	<12	<20	<11	<8	<10	<40	<15	<263
	26-Jul-11	<12	<10	<19	<11	<27	<12	<19	<11	<10	<10	<40	<15	<250
	26-Oct-11	<9	<9	<17	<9	<26	<11	<15	<10	<15	<10	<34	<10	<260

TABLE 8.11 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) *	15-Feb-11	<12	<12	<25	<11	<23	<13	<21	27 ± 10[a]	<10	<13	<44	<12	<278
	26-Apr-11	<11	<12	<21	<11	<24	<12	<20	<15	<10	<12	<41	<13	<264
	26-Jul-11	<13	<12	<24	<10	<26	<12	<24	<15	<12	<13	<41	<12	<245
	25-Oct-11	<10	<11	<24	<13	<23	<12	<21	<12	<10	<12	<35	<13	<263
85 ACRE RESERVOIR (Site #60) *	15-Feb-11	<10	<12	<24	<15	<28	<13	<19	<12	<11	<12	<44	<14	<273
	26-Apr-11	<11	<11	<26	<15	<29	<13	<22	<15	<11	<11	<48	<11	<264
	26-Jul-11	<11	<11	<17	<13	<28	<10	<21	<10	<11	<11	<40	<15	<248
	25-Oct-11	<11	<12	<22	<11	<30	<12	<21	<14	<12	<13	<45	<12	<264
EVAP POND 1 (Site #59) *	15-Feb-11	<13	<11	<27	<13	<24	<11	<21	<11	<11	<14	<41	<14	956 ± 172
	26-Apr-11	<13	<12	<30	<12	<29	<11	<23	<15	<10	<12	<43	<10	936 ± 181
	26-Jul-11	empty for re-lining												
	25-Oct-11	empty for re-lining												
EVAP POND 2 (Site #63) *	15-Feb-11	empty for re-lining												
	26-Apr-11	empty for re-lining												
CELL 2A	26-Jul-11	<13	<13	<24	<15	<30	<12	<23	18 ± 10	<12	<13	<40	<14	334 ± 176
	25-Oct-11	<10	<10	<21	<11	<22	<11	<19	<12	<10	<11	<39	<10	317 ± 189
CELL 2B	15-Feb-11	empty for re-lining												
	26-Apr-11	empty for re-lining												
	26-Jul-11	empty for re-lining												
	25-Oct-11	empty for re-lining												
EVAP POND 3 (Site #64) *	15-Feb-11	<9	<11	<23	<12	<30	<11	<21	<9	<9	<12	<35	<11	613 ± 167
	26-Apr-11	<12	<13	<25	<12	<30	<13	<21	<13	<11	<13	<46	<14	607 ± 171
CELL 3A	26-Jul-11	<12	<13	<24	<15	<29	<12	<23	<11	<12	<15	<45	<14	500 ± 179
	25-Oct-11	<14	<12	<29	<15	<29	<12	<20	<10	<10	<13	<43	<15	<308
CELL 3B	15-Feb-11	<10	<10	<23	<14	<30	<11	<18	<9	<9	<12	<35	<9	812 ± 171
	26-Apr-11	<9	<9	<24	<11	<24	<9	<16	<9	<7	<11	<34	<12	561 ± 170
	26-Jul-11	<10	<11	<23	<11	<30	<11	<17	<9	<9	<12	<35	<10	604 ± 179
	25-Oct-11	<10	<11	<29	<13	<30	<11	<18	<10	<9	<13	<36	<7	<308

a Verification analysis result was 24 ± 10 pCi/liter. Refer to Corrective Action Program document CRDR 3739206 for evaluation of Reporting Level exceedance.

TABLE 8.11 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 **
	4-Jan-11	<11	<11	<20	<11	<29	<12	<17	13 ± 11	<10	<12	<33	<15	
	11-Jan-11	<13	<12	<26	<13	<29	<11	<21	43 ± 11	<9	<13	<35	<9	
	18-Jan-11	<13	<9	<25	<14	<27	<12	<22	22 ± 11	<11	<11	<44	<15	
	25-Jan-11	<12	<11	<21	<15	<27	<15	<20	13 ± 10	<11	<13	<40	<13	<278
	1-Feb-11	<14	<15	<27	<11	<25	<11	<19	31 ± 14	<11	<12	<48	<15	
	8-Feb-11	<14	<11	<28	<12	<22	<10	<22	25 ± 10	<13	<12	<43	<15	
	15-Feb-11	<12	<14	<19	<14	<26	<11	<17	16 ± 9	<10	<14	<36	<12	
	22-Feb-11	<8	<9	<18	<9	<23	<10	<16	15 ± 8	<8	<9	<34	<15	<274
WRF	1-Mar-11	<12	<9	<20	<10	<29	<9	<20	43 ± 13	<10	<12	<34	<15	
INFLUENT	8-Mar-11	<12	<13	<29	<14	<27	<11	<18	23 ± 13	<12	<13	<36	<15	
	15-Mar-11	<10	<12	<23	<13	<28	<9	<19	23 ± 11	<10	<11	<37	<12	
	22-Mar-11	<14	<13	<25	<12	<29	<14	<19	15 ± 9	<11	<13	<43	<15	
	29-Mar-11	<11	<11	<26	<12	<25	<13	<21	<13	<11	<13	<39	<14	<272
	5-Apr-11	<12	<10	<24	<14	<30	<12	<19	23 ± 12	<9	<11	<42	<15	
		WRF OOS												
grab sample	19-Apr-11	<11	<12	<23	<15	<25	<10	<16	18 ± 9	<11	<11	<33	<14	
	26-Apr-11	<12	<13	<25	<14	<28	<14	<22	42 ± 15	<11	<13	<46	<10	<267
	3-May-11	<15	<11	<25	<12	<29	<14	<23	33 ± 11	<7	<12	<42	<13	
	10-May-11	<11	<13	<24	<12	<25	<11	<17	37 ± 11	<10	<11	<37	<13	
	17-May-11	<14	<14	<26	<13	<30	<13	<21	17 ± 13	<13	<14	<39	<14	
	24-May-11	<13	<12	<26	<15	<29	<12	<21	18 ± 9	<12	<11	<40	<14	
	31-May-11	<12	<11	<24	<15	<27	<13	<19	25 ± 11	<10	<11	<39	<14	<264
	7-Jun-11	<12	<12	<23	<11	<24	<12	<19	<15	<11	<12	<45	<12	
	14-Jun-11	<13	<12	<25	<15	<26	<13	<23	<13	<14	<14	<43	<13	
	21-Jun-11	<11	<9	<23	<13	<21	<10	<20	13 ± 8	<11	<10	<31	<15	
	28-Jun-11	<10	<11	<27	<13	<30	<13	<20	19 ± 11	<13	<13	<40	<15	<256
	5-Jul-11	<11	<11	<21	<11	<28	<12	<18	20 ± 9	<9	<12	<36	<14	
	12-Jul-11	<12	<12	<24	<13	<25	<9	<18	<12	<9	<12	<39	<15	
	19-Jul-11	<10	<12	<27	<14	<29	<15	<23	12 ± 10	<13	<14	<43	<14	

** monthly composite

TABLE 8.11 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	26-Jul-11	<14	<13	<27	<14	<30	<13	<21	14 ± 12	<13	<15	<45	<11	<268
	2-Aug-11	<9	<10	<19	<11	<21	<10	<16	20 ± 9	<10	<13	<33	<15	
	9-Aug-11	<11	<10	<23	<13	<19	<10	<17	35 ± 11	<11	<11	<38	<14	
	16-Aug-11	<14	<13	<25	<13	<29	<15	<23	22 ± 13	<12	<14	<48	<13	
	23-Aug-11	<13	<12	<25	<15	<22	<11	<22	26 ± 12	<11	<14	<44	<15	
	30-Aug-11	<9	<9	<23	<12	<21	<9	<17	33 ± 9	<9	<10	<34	<12	<259
	6-Sep-11	<12	<12	<25	<15	<23	<11	<24	51 ± 13	<11	<13	<36	<10	
	13-Sep-11	<11	<11	<23	<11	<26	<11	<21	33 ± 12	<13	<13	<40	<12	
	20-Sep-11	<11	<11	<24	<12	<20	<12	<21	20 ± 9	<10	<12	<39	<15	
	27-Sep-11	<13	<11	<24	<13	<30	<13	<23	22 ± 13	<14	<15	<43	<13	<261
	4-Oct-11	<13	<9	<24	<14	<26	<12	<18	<12	<10	<14	<32	<15	
	11-Oct-11	<15	<11	<22	<13	<29	<10	<23	9 ± 10	<13	<12	<43	<15	
	18-Oct-11	WRF OOS												
	25-Oct-11	<11	<11	<24	<14	<25	<12	<20	20 ± 11	<10	<12	<39	<15	<268
	1-Nov-11	<11	<11	<23	<10	<23	<7	<20	33 ± 11	<10	<11	<35	<15	
	8-Nov-11	<11	<11	<26	<10	<24	<13	<20	17 ± 8	<11	<12	<26	<13	
	15-Nov-11	<11	<11	<24	<15	<22	<10	<24	16 ± 8	<10	<11	<40	<15	
	22-Nov-11	<10	<10	<21	<13	<30	<11	<16	21 ± 10	<9	<11	<34	<13	
	29-Nov-11	<9	<8	<15	<13	<21	<8	<15	23 ± 10	<8	<10	<31	<9	<269
	6-Dec-11	<12	<13	<24	<15	<20	<11	<15	15 ± 10	<11	<12	<36	<15	
	13-Dec-11	<12	<13	<22	<14	<30	<13	<20	44 ± 14	<10	<12	<41	<10	
	20-Dec-11	<14	<13	<25	<10	<27	<14	<19	23 ± 12	<12	<15	<47	<15	
	27-Dec-11	<10	<8	<17	<13	<26	<13	<20	33 ± 11	<10	<11	<39	<8	<281

** monthly composite

TABLE 8.11 SURFACE WATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium
SEDIMENTATION BASIN 2	4-Jan-11	<14	<13	<26	<12	<30	<14	<24	<11	<11	<15	<42	<13	343 ± 171
	1-Mar-11	<12	<12	<26	<14	<27	<12	<20	<12	<13	<14	<47	<12	<280
	7-Nov-11	<14	<15	<26	<14	<25	<13	<18	<12	<11	<14	<46	<13	425 ± 174
	13-Dec-11	<11	<10	<20	<10	<21	<10	<16	<9	<9	<11	<33	<15	<274
	20-Dec-11	<11	<11	<24	<14	<25	<13	<18	<11	<11	<12	<36	<15	291 ± 166

The tritium in Sedimentation Basin 2 can be attributed to the rain washout effect during gaseous effluent releases. Normally, Boric Acid Concentrator (BAC) operations are curtailed during rain events to prevent this from occurring. Additionally, the Unit cooling towers re-entrain tritium and some washout of cooling tower vapor also contributes to the low levels of tritium identified in Sedimentation Basin 2.

TABLE 8.12 SLUDGE/SEDIMENT

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

SAMPLE LOCATION	DATE COLLECTED		I-131	<150 Cs-134	<180 Cs-137	In-111
WRF CENTRIFUGE WASTE SLUDGE	3-Jan-11		1019 ± 139	<29	<30	35 ± 43
	11-Jan-11		612 ± 94	<30	<32	
	17-Jan-11		863 ± 117	<21	<34	
	24-Jan-11		761 ± 113	<16	<30	
	1-Feb-11		658 ± 99	<19	<33	
	7-Feb-11		478 ± 195	<133	<163	
	15-Feb-11		497 ± 131	<120	<171	
	22-Feb-11		812 ± 221	<150	<103	
	28-Feb-11		613 ± 195	<56	<141	
	7-Mar-11		743 ± 214	<145	<151	
	15-Mar-11		374 ± 192	<150	<168	
	21-Mar-11		559 ± 242	<141	<123	
	29-Mar-11		560 ± 243	<138	<177	
	5-Apr-11		541 ± 170	<111	<148	
	WRF OOS					
	19-Apr-11		211 ± 106	<110	<174	
	26-Apr-11		None detected	<104	<139	
	3-May-11		None Detected	<128	<177	
	10-May-11		397 ± 170	<189	<184	
	10-May-11	Grab sample	839 ± 182	<148	<135	
	17-May-11		472 ± 150	<145	<82	
	24-May-11		424 ± 134	<98	<178	
	31-May-11		421 ± 162	<135	<165	
	7-Jun-11		538 ± 180	<114	<138	
	14-Jun-11		520 ± 169	<119	<174	
	21-Jun-11		456 ± 147	<148	<152	
	28-Jun-11		324 ± 118	<108	<169	
	5-Jul-11		332 ± 125	<146	<148	
	12-Jul-11		262 ± 105	<100	<36	
	19-Jul-11		379 ± 159	<103	<137	
	26-Jul-11		413 ± 148	<143	<99	
	2-Aug-11		744 ± 201	<123	<165	
	9-Aug-11		878 ± 189	<90	<164	

TABLE 8.12 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	16-Aug-11		912 ± 203	<147	<179	
	23-Aug-11		1070 ± 206	<126	<174	
	30-Aug-11		1455 ± 277	<99	<172	
	6-Sep-11		1030 ± 242	<149	<145	
	13-Sep-11		1423 ± 277	<143	<133	
	20-Sep-11		1734 ± 251	<142	<132	
	26-Sep-11		1057 ± 268	<148	<52	
	3-Oct-11		850 ± 207	<134	<177	
	11-Oct-11		441 ± 113	<146	<132	
	WRF OOS					
	25-Oct-11		322 ± 139	<144	<169	
	1-Nov-11		178 ± 103	<134	<140	
	8-Nov-11		248 ± 116	<106	<114	
	15-Nov-11		431 ± 125	<94	<115	
	22-Nov-11		521 ± 172	<116	<169	
	29-Nov-11		816 ± 223	<149	<165	
	6-Dec-11		627 ± 190	<143	<177	
	13-Dec-11		618 ± 150	<85	<161	
	20-Dec-11		793 ± 174	<116	<118	
	27-Dec-11		648 ± 211	<137	<134	
SEDIMENTATION BASIN 2	4-Oct-11	sample 1	<11	<12	49 ± 13	
		sample 2	<19	<36	90 ± 17	

TABLE 8.12 SLUDGE/SEDIMENT

COOLING TOWER SLUDGE

UNIT CYCLE	APPROXIMATE VOLUME (yd^3)	ISOTOPE	ACTIVITY RANGE (pCi/g)	SAMPLE TYPE
U2R16	253	Co-60 Cs-134 Cs-137	<MDA to 0.090 0.085 to 0.199 0.182 to 0.395	Towers/canal sludge
U3R15	379	All <MDA	NA	Towers/canal sludge

Note: The Cs-134 identified in U2R16 cooling tower sludge is atypical and is attributed to the effect of air being drawn across the cascading water containing radioactivity from the Fukushima-Daiichi event.

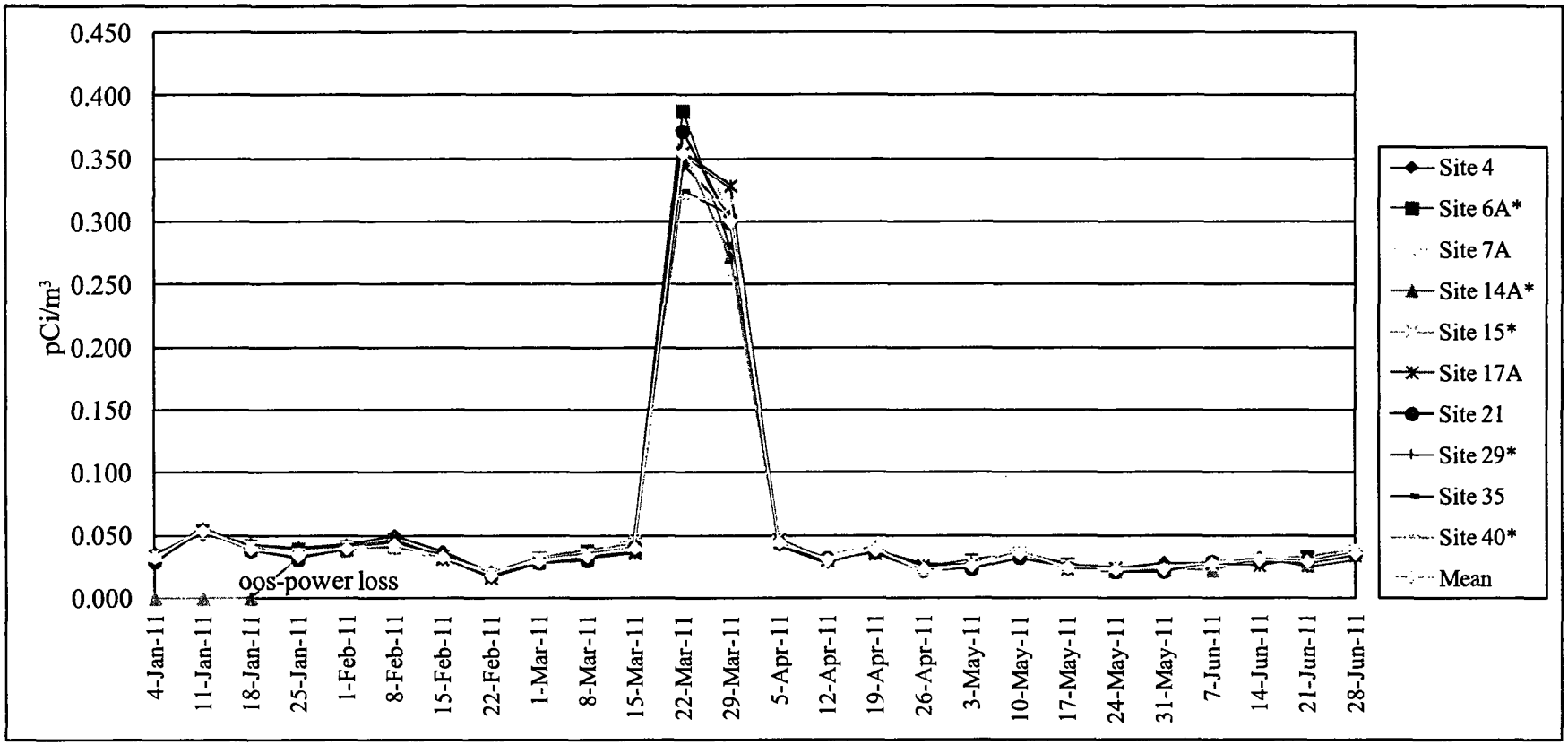
TABLE 8.13 HARD-TO-DETECT RADIONUCLIDE RESULTS

Units are pCi/liter

Sample Location	Well number	Sample Date	C-14	Fe-55	Ni-63	Sr-90
Unit 1 (outside RCA)	APP-12	10/28/2011	<36	<8	<3	<0.19
Unit 2 (inside RCA)	H0B	10/21/2011	<37	<19	<3	<0.24
Unit 3 (inside RCA)	H11	10/19/2011	<35	<22	<3	<0.31

LOGDATE	ENTRY
11/6/2010 12:26:46 PM	Entered LCO: 3.6.3 Condition C Equip OOS None Declared SGE-UV-169 and SGE-UV-183 INOPERABLE in anticipation of entering Mode 4. SGE-UV-169 and SGE-UV-183 are not analyzed to close against full system D/P. Entered Condition C and complying with Required Action C.1 with 3.6.3 permit #175197. TSCCR #3473269. - Un-planned LCO entry: - NO - RMAL Impact: -NO- - PVAR: N/A *Initiate a PVAR for emergent issues that result in a LCO entry with an action time of <=72 hours or any shutdown LCO.
3/19/2011 2:02:38 AM	Surveillance completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated once per 31 days. SGE-UV-169 and SGE-UV-183 remain closed and deactivated under permit #175197. Reference TSCCR #3473269. Performed: 40ST-9ZZ13 Section 8.0 CONTAINMENT ISOLATION VALVES
7/9/2011 3:08:28 AM	Surveillance 40ST-9ZZ13 (STWO348950) completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated once per 31 days. SGE-UV-169 and SGE-UV-183 remain closed and deactivated under permit #175197. Reference TSCCR #3473269. This also satisfies LCO 3.6.3, Required Action A.2 to verify the containment penetration associated with INOPERABLE valve SGA-UV220 is isolated by 3.6.3 permit #218568 (Reference TSCCR #3803984) and INOPERABLE valve SGB-UV226 is isolated by 3.6.3 permit #218548 (Reference TSCCR#3803969).
8/6/2011 5:53:45 AM	Surveillance 40ST-9ZZ13 (STWO3465074) completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated once per 31 days. SGE-UV-169 and SGE-UV-183 remain closed and deactivated under permit #175197. Reference TSCCR #3473269.
10/29/2011 3:24:47 AM	Surveillance completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated once per 31 days remain closed and deactivated under permit #175197 and LCO 3.6.3, Required Action A.2 for SGB-UV-226 under permit #218548. Reference TSCCRS #3473269 & #3803969. Performed: 40ST-9ZZ13 Section 8.0 CONTAINMENT ISOLATION VALVES
11/26/2011 4:13:00 AM	Surveillance completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated once per 31 days remain closed and deactivated under permit #175197 and LCO 3.6.3, Required Action A.2 for SGB-UV-226 under permit #218548. Reference TSCCRS #3473269 & #3803969. Performed: 40ST-9ZZ13 Section 8.0 CONTAINMENT ISOLATION VALVES
12/24/2011 3:15:22 AM	Surveillance Test 40ST-9ZZ13 completed satisfactorily thereby satisfying LCO 3.6.3, REQUIRED ACTION C.2 to verify the containment penetration flow paths associated with SGE-UV-169 and SGE-UV-183 remain isolated, under administrative control of permit #175197. Also satisfying LCO 3.6.3, REQUIRED ACTION A.2 to verify the containment penetration flow paths associated with SGB-UV-226 remains isolated, under administrative control of permit #218548. Reference TSCCR# 3473269 & TSCCR# 3803969.

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



The abnormally high gross beta results between March 15 and April 5 are attributed to the Fukushima-Daiichi releases.

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

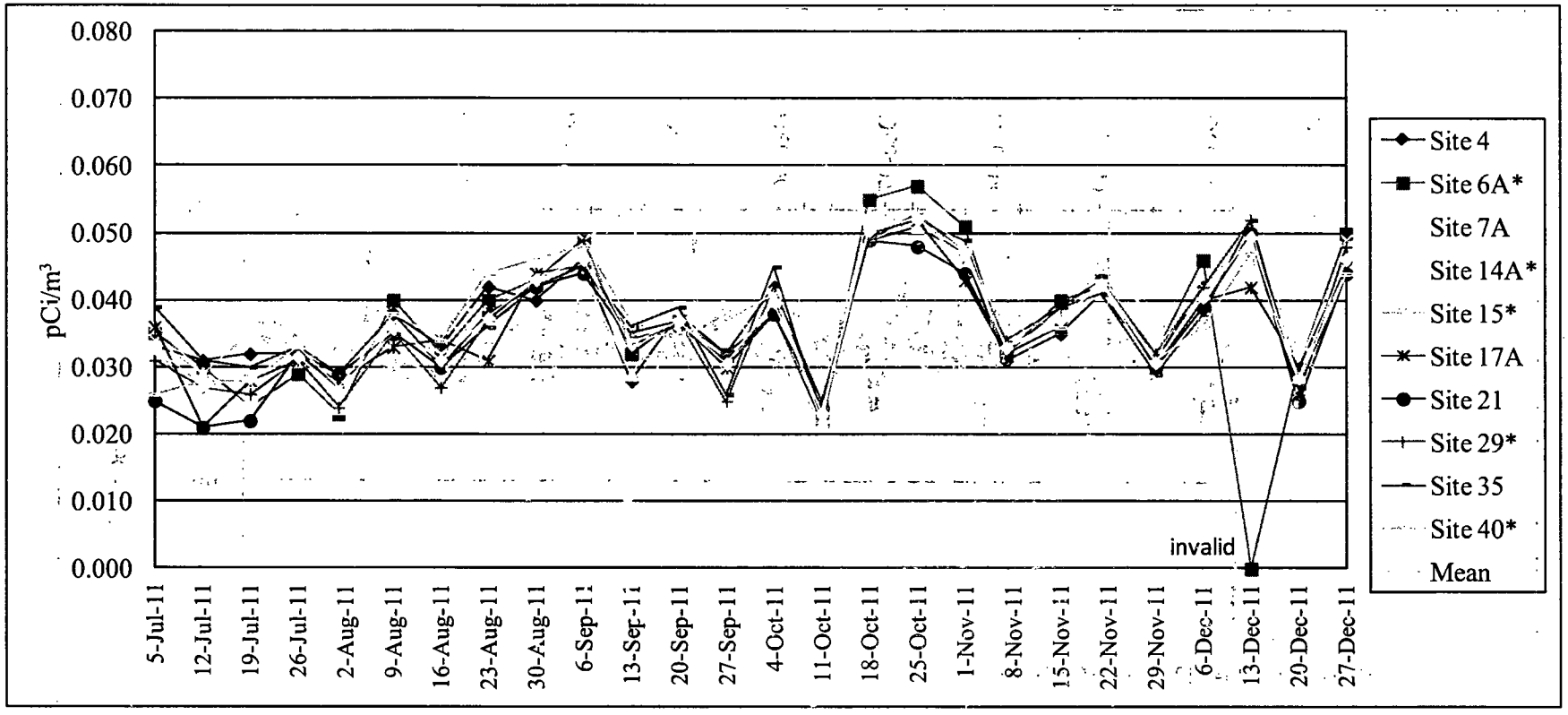


FIGURE 8.3 HISTORICAL GROSS BETA IN AIR (WEEKLY SYSTEM AVERAGES)

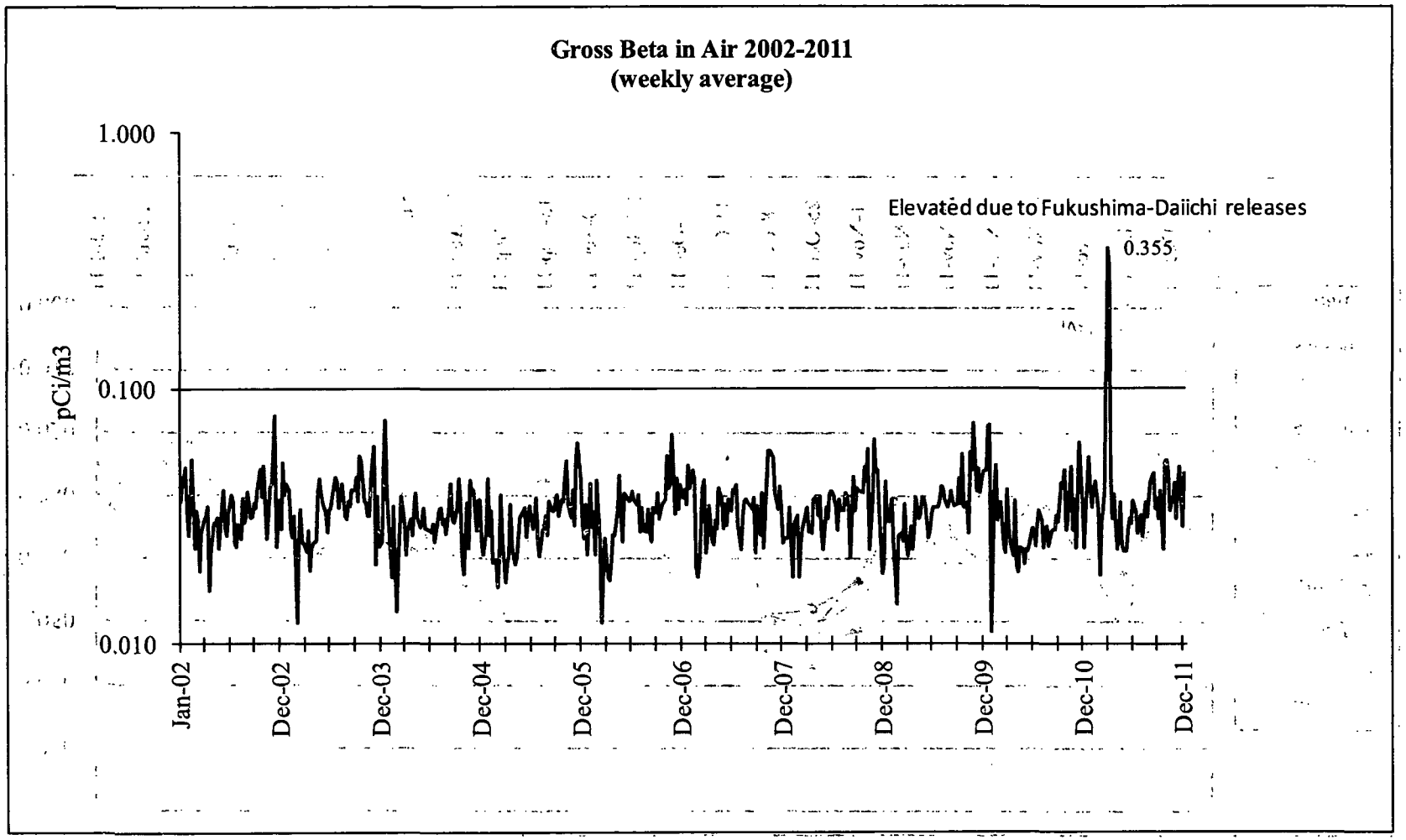
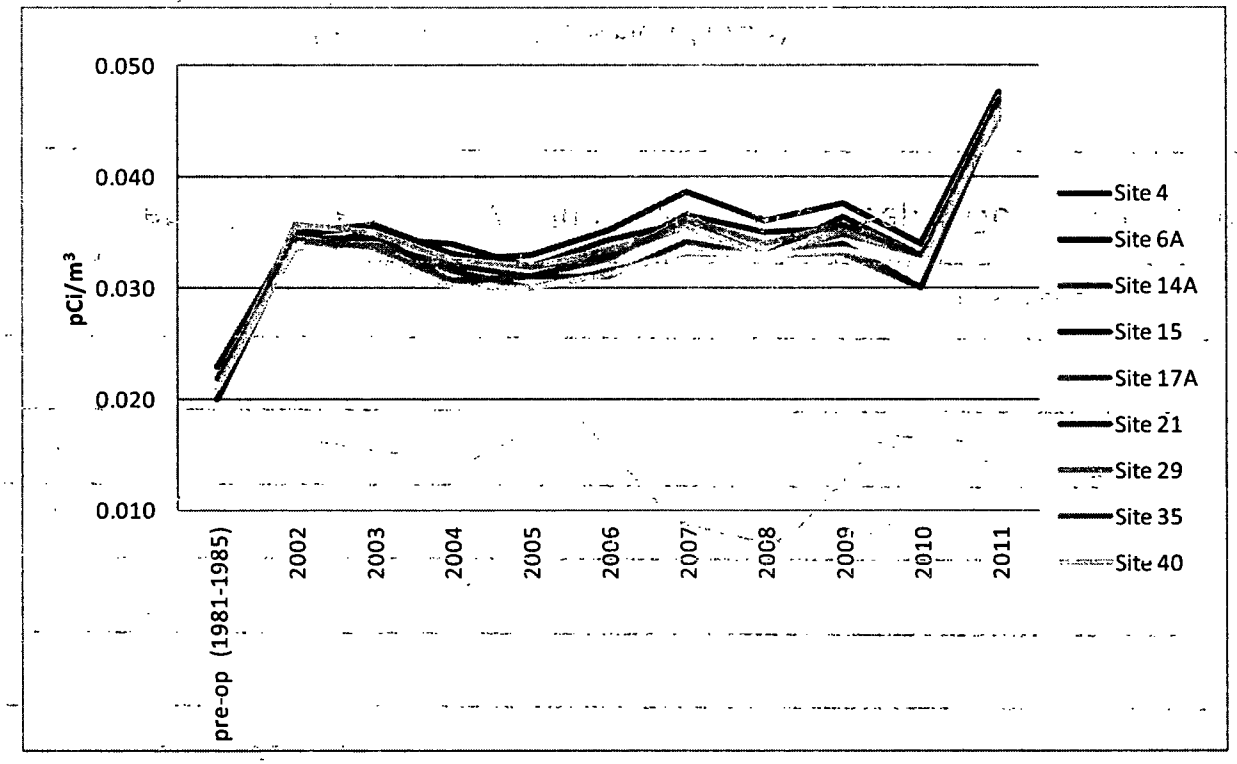
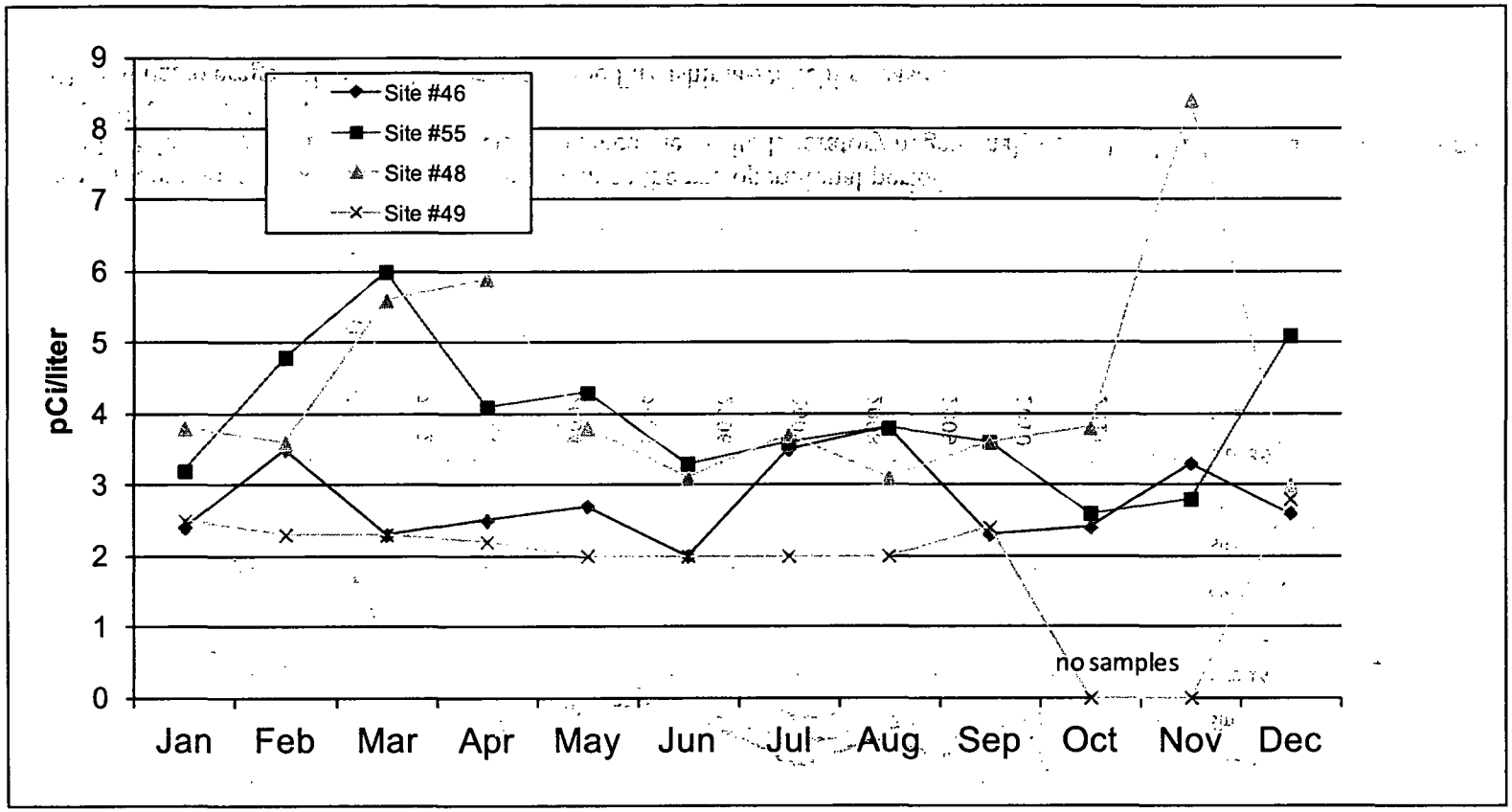


FIGURE 8.4 HISTORICAL GROSS BETA IN AIR (ANNUAL SITE TO SITE COMPARISONS) COMPARED TO PRE-OP



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

FIGURE 8.5 GROSS BETA IN DRINKING WATER



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

FIGURE 8.6 EVAPORATION POND TRITIUM ACTIVITY

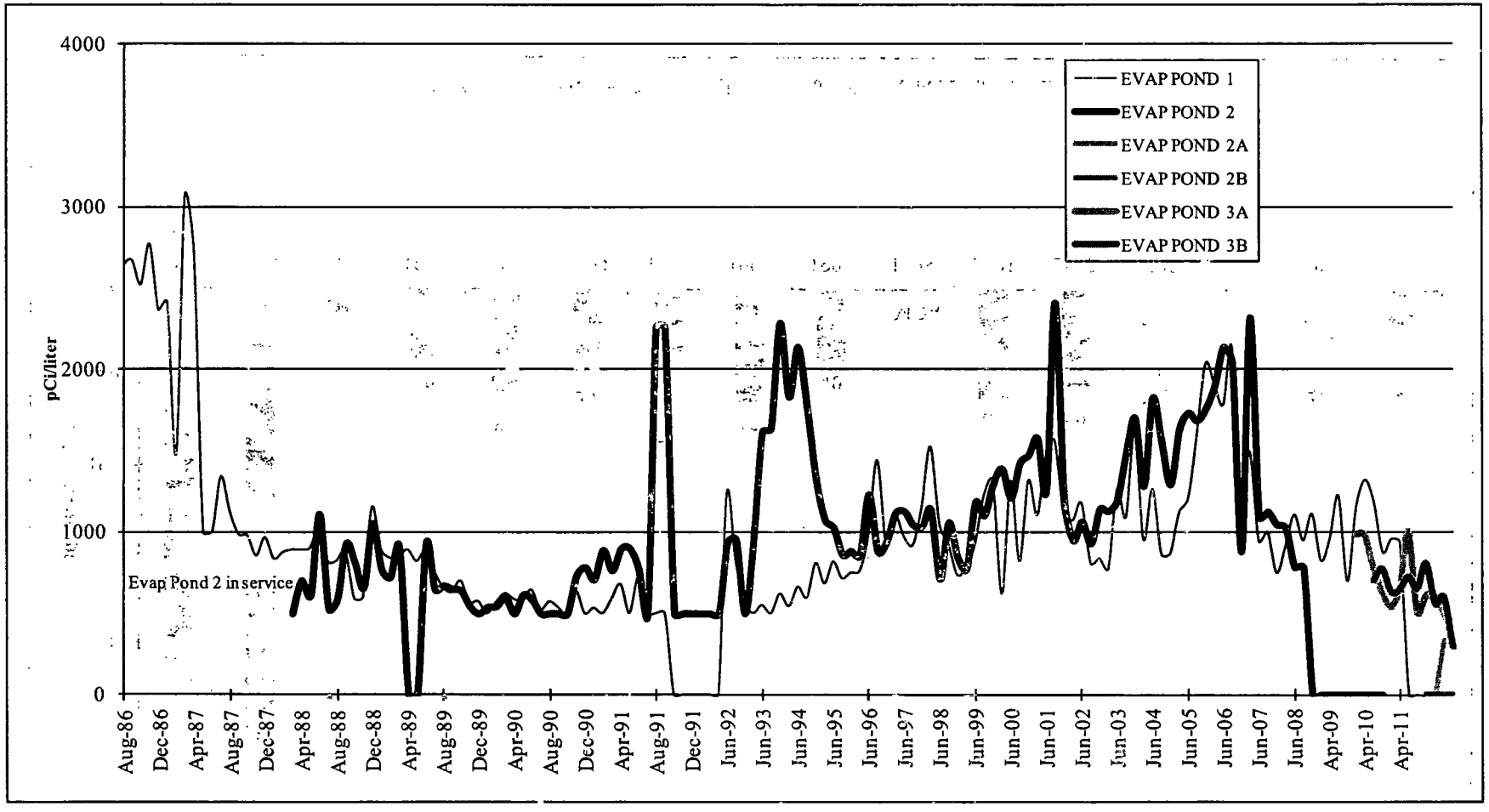
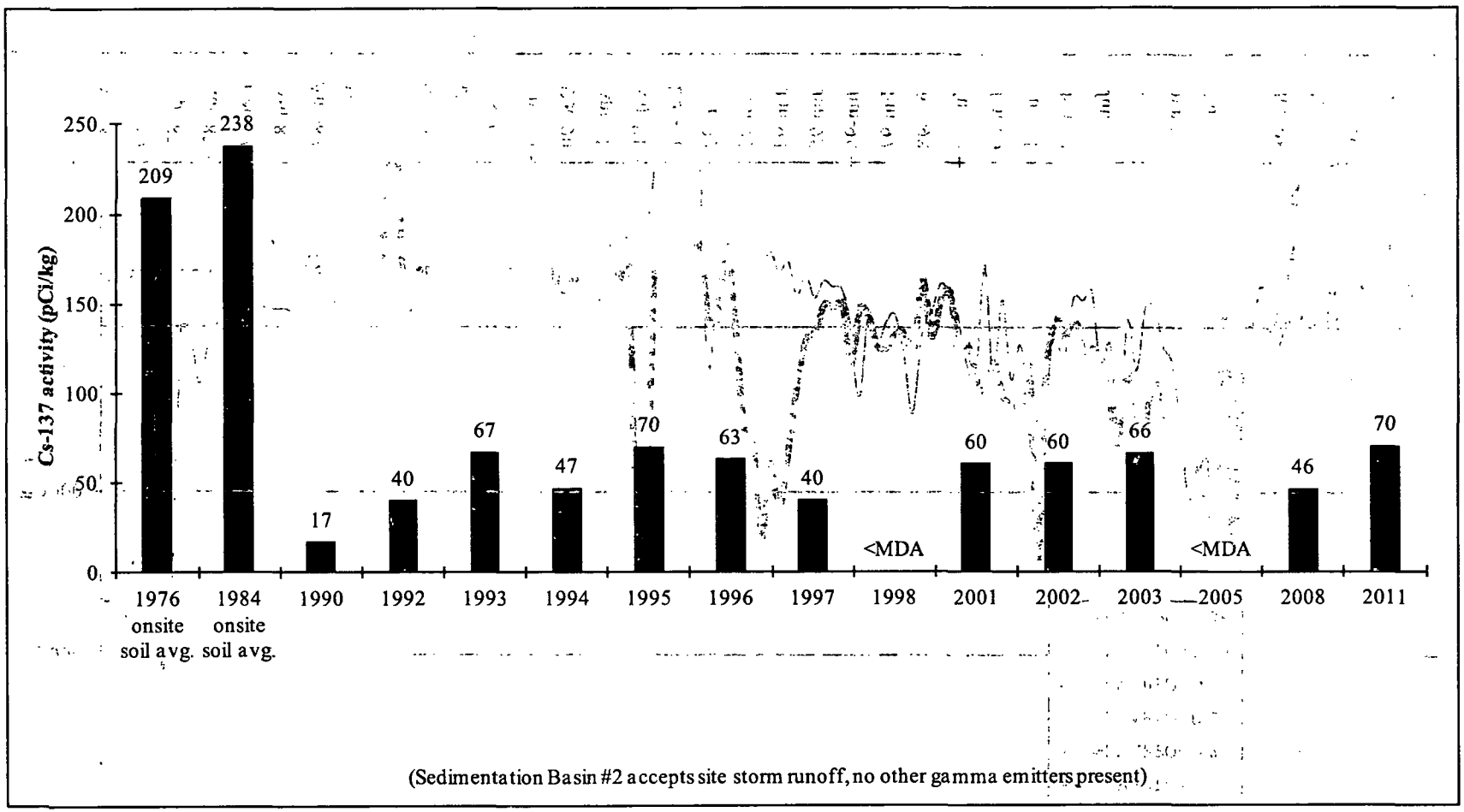


FIGURE 8.7 SEDIMENTATION BASIN 2 Cs-137



9. Thermoluminescent Dosimeter (TLD) Results and Data

The environmental TLD used at PVNGS is the Panasonic Model 812 Dosimeter. The Model 812 is a multi-element dosimeter combining two elements of lithium borate and two elements of calcium sulfate under various filters.

TLDs were placed in fifty locations from one to thirty-five miles from the PVNGS. TLD locations are shown in Figures 2.1 and 2.2 and are described in Table 9.1. TLD results for 2011 are presented in Table 9.2. Historical environmental gamma radiation results for 1985 through 2011 are presented in graphical form on Figure 9.1 (excluding transit control TLD #45).

Figure 9.2 depicts the environmental TLD results from 2011 as compared to the pre-operational TLD results (excluding sites #41 and #43, as they were deleted and later assigned to a new location, and #46-50, as they had no pre-op TLD at the location for comparison). The site to site comparisons indicate a direct correlation with respect to pre-operational results. It is evident that the offsite dose, as measured by TLDs, has not changed since Palo Verde became operational.

TABLE 9.1 TLD SITE LOCATIONS

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

TLD SITE	LOCATION	LOCATION DESCRIPTION
1	E30	Goodyear
2	ENE24	Scott-Libby School
3	E21	Liberty School
4	E16	Buckeye
5	ESE11	Palo Verde School
6*	SSE31	APS Gila Bend substation
7	SE7	Old US 80 and Arlington School Rd
8	SSE4	Southern Pacific Pipeline Rd.
9	S5	Southern Pacific Pipeline Rd.
10	SE5	355th Ave. and Elliot Rd.
11	ESE5	339th Ave. and Dobbins Rd.
12	E5	339th Ave. and Buckeye-Salome Rd.
13	N1	N site boundary
14	NNE2	NNE site boundary
15	NE2	NE site boundary, WRF access road
16	ENE2	ENE site boundary
17	E2	E site boundary
18	ESE2	ESE site boundary
19	SE2	SE site boundary
20	SSE2	SSE site boundary
21	S3	S site boundary
22	SSW3	SSW site boundary
23	W5	N of Elliot Rd
24	SW4	N of Elliot Rd
25	WSW5	N of Elliot Rd
26	SSW4	S of Elliot Rd
27	SW1	SW site boundary
28	WSW1	WSW site boundary
29	W1	W site boundary
30	WNW1	WNW site boundary
31	NW1	NW site boundary
32	NNW1	NNW site boundary
33	NW4	S of Buckeye Rd
34	NNW5	395th Ave. and Van Buren St.
35	NNW8	Tonopah
36	N5	Wintersburg Rd. and Van Buren St.
37	NNE5	363rd Ave. and Van Buren St.
38	NE5	355th Ave. and Buckeye Rd.
39	ENE5	343rd Ave. N of Broadway Rd.
40	N2	Wintersburg
41	ESE3	Arlington School
42	N8	Ruth Fisher School
43	NE5	Winters Well School
44*	ENE35	El Mirage

TABLE 9.1 TLD SITE LOCATIONS

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

TLD SITE	LOCATION	LOCATION DESCRIPTION
45**	Onsite	Central Laboratory (lead pig)
46	ENE30	Litchfield Park School
47	E35	Littleton School
48	E24	Jackrabbit Trail
49	ENE11	Palo Verde Rd.
50	WNW5	S of Buckeye-Salome Rd.

* Site #6 and site #44 are the control locations.

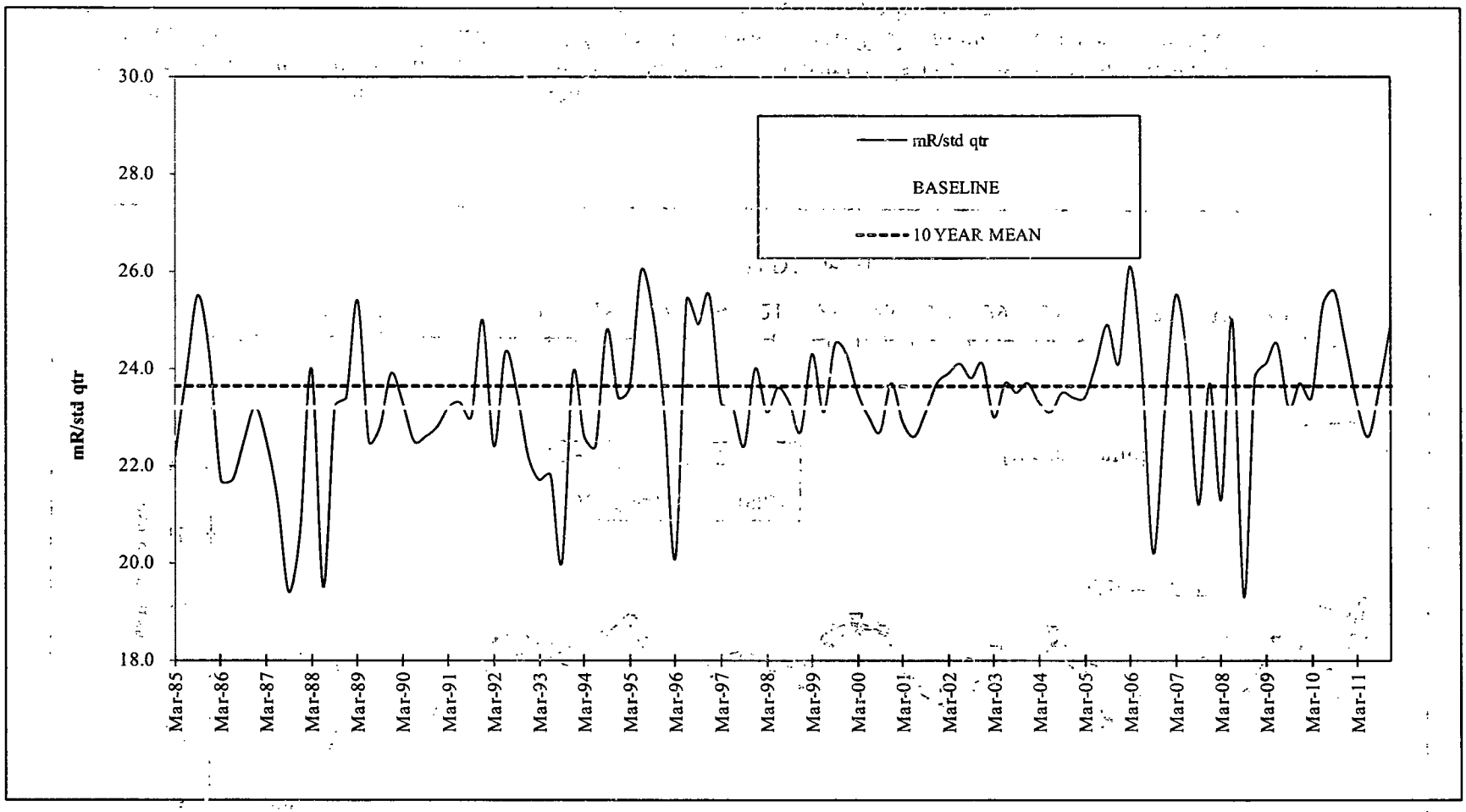
** Site #45 is the transit control TLD (stored in lead pig).

TABLE 9.2 ENVIRONMENTAL TLD RESULTS

Units are mrem/std qtr

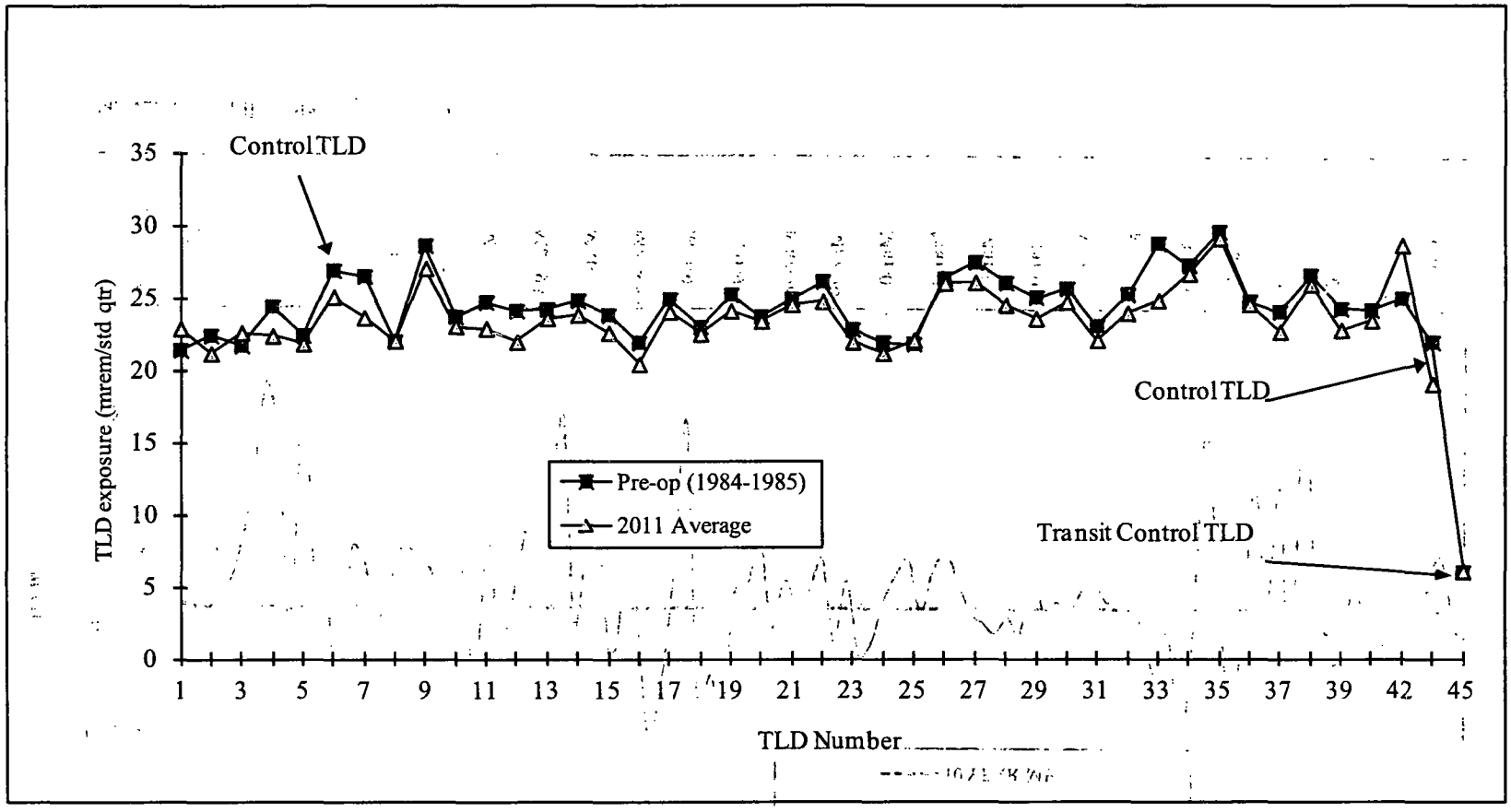
TLD Site #	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Average
1	21.8	21.8	21.9	26.1	22.9
2	21.8	19.4	21.0	22.5	21.2
3	22.6	20.5	22.1	25.3	22.6
4	21.0	20.8	23.5	24.3	22.4
5	21.5	20.8	21.5	23.6	21.9
6 (control)	25.5	24.1	23.9	26.9	25.1
7	23.3	22.7	23.5	25.1	23.7
8	21.5	20.7	22.8	23.3	22.1
9	25.9	25.0	29.2	28.1	27.1
10	22.3	21.2	23.4	25.3	23.1
11	22.2	23.2	22.3	23.9	22.9
12	21.6	21.2	22.3	22.8	22.0
13	24.3	22.4	23.9	23.8	23.6
14	23.3	22.7	24.8	24.5	23.8
15	22.3	21.5	21.8	24.8	22.6
16	18.1	20.4	21.4	21.8	20.4
17	23.3	22.6	24.4	25.9	24.1
18	22.5	21.3	23.2	23.1	22.5
19	24.0	22.9	23.4	26.1	24.1
20	22.9	21.5	24.1	25.1	23.4
21	24.6	22.6	24.7	26.3	24.6
22	25.1	23.5	25.6	24.8	24.8
23	21.4	20.6	22.6	23.2	22.0
24	21.9	20.4	20.4	22.0	21.2
25	22.4	20.8	21.3	23.8	22.1
26	25.7	25.0	26.0	27.3	26.0
27	27.0	25.0	25.2	27.0	26.1
28	24.9	23.2	24.7	25.2	24.5
29	23.0	21.7	24.0	25.5	23.6
30	25.0	23.6	23.8	26.4	24.7
31	21.8	21.2	21.8	23.4	22.1
32	23.1	22.8	24.3	25.5	23.9
33	23.5	23.4	25.2	27.1	24.8
34	26.8	25.5	25.8	28.5	26.7
35	28.5	27.7	30.2	30.0	29.1
36	23.7	24.6	24.9	25.0	24.6
37	23.2	22.3	21.7	23.4	22.7
38	24.4	25.2	25.6	28.4	25.9
39	22.5	21.8	23.0	23.7	22.8
40	23.9	22.5	23.8	23.4	23.4
41	25.2	25.0	25.8	26.9	25.7
42	28.0	29.1	27.5	29.8	28.6
43	25.9	25.5	26.9	28.0	26.6
44 (control)	18.7	18.6	18.9	20.0	19.1
45 (transit control)	5.2	5.8	5.8	7.6	6.1
46	25.5	25.0	24.3	25.9	25.2
47	21.7	22.7	22.1	22.9	22.4
48	22.1	23.0	22.4	23.8	22.8
49	20.0	20.6	20.5	21.4	20.6
50	18.5	17.8	17.0	19.6	18.2

FIGURE 9.1 NETWORK ENVIRONMENTAL TLD EXPOSURE RATES



The 10-year mean value is for the date range 2002-2011.

FIGURE 9.2 ENVIRONMENTAL TLD COMPARISON - PRE-OPERATIONAL VS 2011



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 2011.

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

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

10.2. Census Results

Nearest Resident

There was one (1) change in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.228 mrem.

Milk Animal

There was one (1) change in milk animal status from the previous year. Dose calculations indicated the highest dose to be 0.371 mrem.

Vegetable Gardens

There were three (3) changes in nearest garden status. Dose calculations indicated the highest dose to be 0.683 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

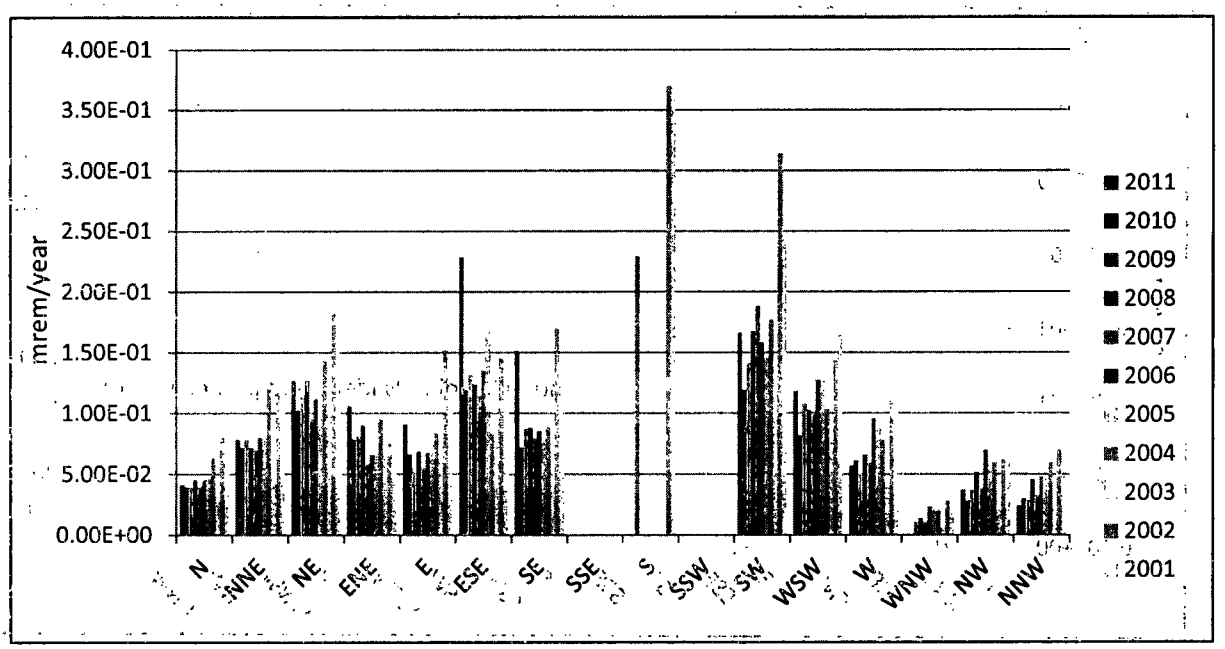
(Distances and directions are relative to Unit 2 in miles)

SECTOR	NEAREST RESIDENT	NEAREST GARDEN	NEAREST MILK ANIMAL (COW/GOAT)	CALCULATED DOSE (mrem)	CHANGE FROM 2010
N	1.55	**3.10**	3.66	Resident 4.15E-02 Garden 2.05E-01 Milk 1.62E-01	**Garden**
NNE	1.52	3.30	3.05	Resident 7.87E-02 Garden 3.56E-01 Milk 3.71E-01	
NE	2.16	NONE	NONE	Resident 1.27E-01	
ENE	2.16	**2.63**	**4.84**	Resident 1.06E-01 Garden 6.83E-01 Milk 2.36E-01	**Garden Milk**
E	2.81	NONE	NONE	Resident 9.06E-02	
ESE	**1.89**	NONE	NONE	Resident 2.28E-01	**Resident**
SE	3.36	NONE	NONE	Resident 1.51E-01	
SSE	NONE	NONE	NONE	NA	
S	NONE	NONE	NONE	NA	
SSW	NONE	NONE	NONE	NA	
SW	1.39	NONE	NONE	Resident 1.66E-01	
WSW	0.75	**4.82**	NONE	Resident 1.18E-01 Garden 2.13E-01	**Garden**
W	0.70	NONE	NONE	Resident 5.66E-02	
WNW	NONE	NONE	NONE	NA	
NW	0.93	NONE	NONE	Resident 3.70E-02	
NNW	1.30	4.34	NONE	Resident 2.42E-02 Garden 8.38E-02	

COMMENTS:

Dose calculations were performed using the GASPAR code and 2010 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual organ dose identified.

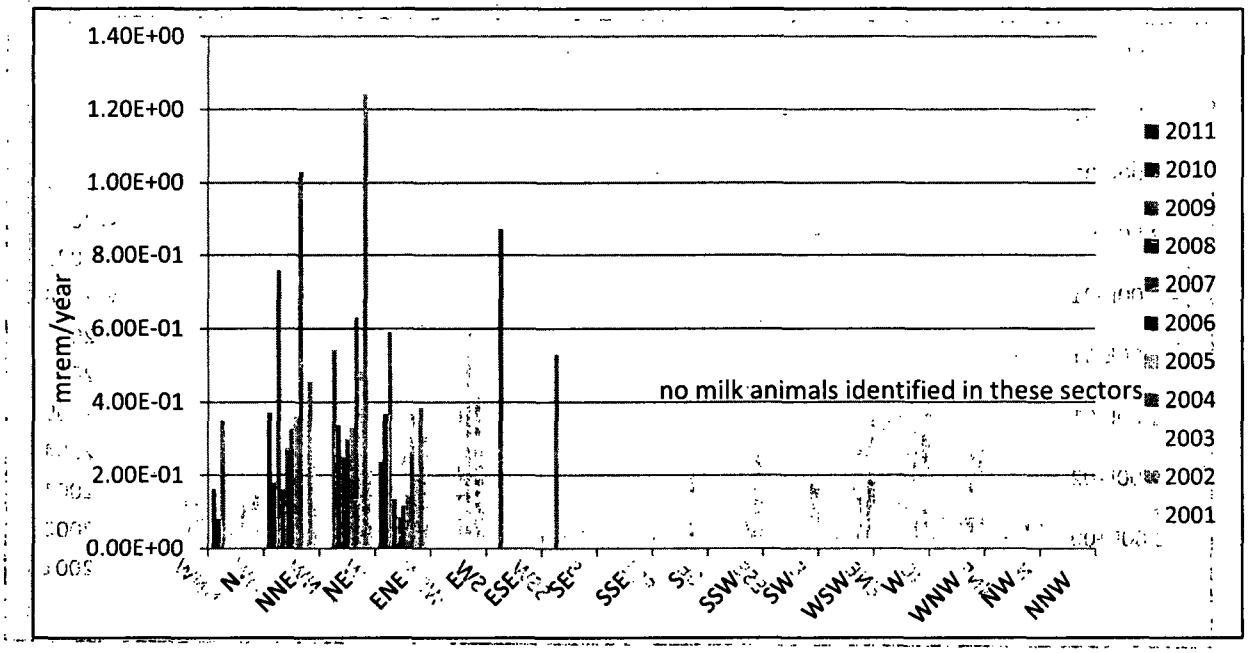
FIGURE 10.1 HISTORICAL COMPARISON OF NEAREST RESIDENT DOSE



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

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

FIGURE 10.2 HISTORICAL COMPARISON OF NEAREST MILK ANIMAL DOSE

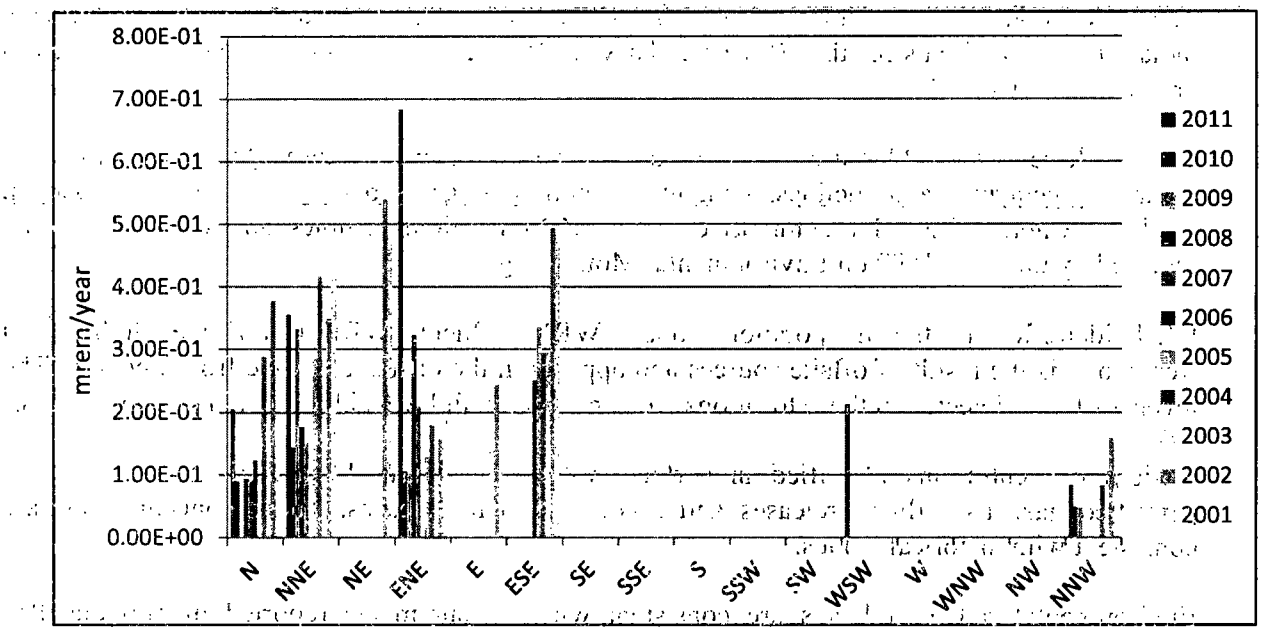


Milk animals include goats and/or cows. Several new milk animals were identified in 2009 that were closer to the power plant than in the past, resulting in generally higher calculated doses in that calendar year.

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

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

FIGURE 10.3 HISTORICAL COMPARISON OF NEAREST GARDEN DOSE



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

11. Summary and Conclusions

The conclusions are based on a review of the radio assay results and environmental gamma radiation measurements for the 2011 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2011 are presented in Tables 8.1-8.13 and do not include observations of naturally occurring radionuclides, with the exception of gross beta in air and gross beta in drinking water. Table 11.1 summarizes the ODCM required samples and is in the format required by the NRC BTP on Environmental Monitoring.

I-131 identified in the Evaporation Ponds, WRF Influent, WRF Centrifuge sludge, and Reservoirs is the result of offsite sources and appears in the effluent sewage from Phoenix. The levels of I-131 detected in these locations are consistent with levels identified in previous years.

Tritium concentrations identified in surface water onsite have been attributed to PVNGS permitted gaseous effluent releases and secondary plant releases. These concentrations are consistent with historical values.

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

There was no measurable radiological impact on the environment in 2011 resulting from the operation of PVNGS.

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station — Docket Nos. STN 50-528/529/530
Maricopa County, Arizona — Calendar Year 2011

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mrem/std. qtr.)	TLD - 200	NA	23.6 (188/188) 17.0 – 30.2	Site #35 8 miles 330°	29.1 (4/4) 27.7 – 30.2	22.1 (8/8) 18.6 - 26.9	0
Air Particulates (pCi/m^3)	Gross Beta - 516	0.010	0.046 (465/465) 0.016 - 0.372	Site #6A 13 miles 158°	0.048 (51/51) 0.018 - 0.388	0.048 (51/51) 0.018 - 0.388	0
	Gamma Spec. - 70 I-131 (weekly)	NA	0.213 (18/27) 0.100 – 0.370	Site #21 3 miles 180°	0.250 (2/3) 0.170 – 0.330	0.160 (2/3) 0.100 – 0.220	30
	I-132 (weekly)	NA	0.045 (2/27) 0.030 – 0.060	Site #35 8 miles 330°	0.060 (1/3) 0.060-0.060	<LLD	30
	Te-132 (weekly)	NA	0.038 (4/27) 0.030 – 0.050	Site #6A 13 miles 158°	0.060 (1/3) 0.060 – 0.060	0.060 (1/3) 0.060 – 0.060	30
	Cs-134 (weekly)	0.05	0.054 (18/27) 0.030 – 0.080	Site #17A 3 miles 90°	0.075 (2/3) 0.070 – 0.080	0.055 (2/3) 0.050 – 0.060	30
	Cs-137 (weekly)	0.06	0.066 (18/27) 0.040 – 0.090	Site #21 3 miles 180°	0.080 (2/3) 0.080 – 0.080	0.065 (2/3) 0.050 – 0.080	30
	I-131 (quarterly)	NA	0.021 (9/36) 0.016 – 0.029	Site #6A 13 miles 158°	0.032 (1/4) 0.032 – 0.032	0.032 (1/4) 0.032 – 0.032	0
	Cs-134 (quarterly)	0.05	0.009 (7/36) 0.007 – 0.010	Site #7A 3 miles 124°	0.010 (1/4) 0.010 – 0.010	0.008 (1/4) 0.008 – 0.008	0
	Cs-137 (quarterly)	0.06	0.009 (5/36) 0.007 – 0.011	Site #40 2 miles 358°	0.011 (1/4) 0.011 – 0.011	0.006 (1/4) 0.006 – 0.006	0

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Palo Verde Nuclear Generating Station
Maricopa County, Arizona

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Calendar Year 2011

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Air Radioiodine (pCi/m^3)	Gamma Spec. - 516 I-131	0.07	0.601 (27/464) 0.040 – 1.240	Site #29 1 mile 270°	0.825 (2/52) 0.510 – 1.140	0.630 (3/51) 0.100 – 1.260	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 9 I-131	60	<LLD	Site #62 26 miles 75°	53 (1/9) 53 – 53	53 (1/9) 53 – 53	0
	Cs-134	60	<LLD	NA	<LLD	<LLD	0
	Cs-137	80	<LLD	NA	<LLD	<LLD	0
Ground Water (pCi/liter)	H-3 – 8	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 8						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	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

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Palo Verde Nuclear Generating Station
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Docket Nos. STN 50-528/529/530
Calendar Year 2011

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	Gross Beta – 46	4.0	4.0 (24/46) 2.5 – 8.4	Site #48 1 mile 236°	5.5 (5/12) 3.8 – 8.4	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 46						
Drinking Water (pCi/liter)	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 22						
Milk (pCi/liter)	I-131	1.0	1.7 (2/10) 1.3 – 2.0	Site #53 30 miles 45°	4.8 (2/12) 4.6 – 5.0	4.8 (2/12) 4.6 – 5.0	0
	Cs-134	15	1.5 (3/10) 1.3 – 1.7	Site #54 4 miles 22°	1.5 (3/10) 1.3 – 1.7	<LLD	0
	Cs-137	18	2.0 (3/10) 1.9 – 2.0	Site #54 4 miles 22°	2.0 (3/10) 1.9 – 2.0	<LLD	0
	Ba-140	60	<LLD	NA	<LLD	<LLD	0
	La-140	15	<LLD	NA	<LLD	<LLD	0

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Calendar Year 2011

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name Distance and Direction	Mean (f)[a] Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
	Gamma Spec. - 20						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
Surface Water (pCi/liter)	I-131	15	23 (2/20) 18 - 27	Site #61 Onsite 67°	27 (1/4) 27 - 27	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	H-3 - 20	3000	624 (10/20) 317 - 956	Site #59 Onsite 180°	946 (2/2) 936 - 956	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. 1985-2010 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