Technical Specification 5.6.2

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

102-07241-TNW/MDD/TMJ
April 29, 2016

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

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station (PVNGS)**
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Annual Radiological Environmental Operating Report 2015

In accordance with PVNGS Technical Specification (TS) 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2015.

No new commitments are being made to the NRC by this letter. Should you need further information regarding this submittal, please contact Michael DiLorenzo, Licensing Section Leader, at (623) 393-3495.

Sincerely,

Weber, Thomas N(Z00499)

Digitally signed by Weber, Thomas N(Z00499)
DN: cn=Weber, Thomas N(Z00499)
Reason: I am approving this document
Date: 2016.04.29 15:55:58 -07'00'

Thomas N. Weber
Department Leader, Regulatory Affairs

TNW/MDD/TMJ/akf

Enclosure: Annual Radiological Environmental Operating Report 2015

cc:
M. L. Dapas	NRC Region IV Regional Administrator
S. P. Lingam	NRC NRR Project Manager for PVNGS
M. M. Watford	NRC NRR Project Manager
C. A. Peabody	NRC Senior Resident Inspector for PVNGS
A. V. Godwin	Arizona Radiation Regulatory Agency (ARRA)
T. Morales	Arizona Radiation Regulatory Agency (ARRA)

ENCLOSURE

Palo Verde Nuclear Generating Station
UNITS 1, 2, and 3

Annual Radiological
Environmental Operating Report 2015

PALO VERDE NUCLEAR GENERATING STATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
2015

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

Prepared by: Comolli, Michelle (Z09567)
Digitally signed by Comolli, Michelle (Z09567)
DN: cn=Comolli, Michelle (Z09567)
Reason: I am the author of this document
Date: 2016.04.15 09:30:40 -07'00'

Reviewed by: Bungard, James P(Z18012)
Digitally signed by Bungard, James P(Z18012)
DN: cn=Bungard, James P(Z18012)
Reason: I have reviewed this document
Date: 2016.04.15 17:27:01 -07'00'

Approved by: Routolo, Robert M(Z99739)
Digitally signed by Routolo, Robert M(Z99739)
DN: cn=Routolo, Robert M(Z99739)
Date: 2016.04.15 17:33:32 -07'00'

Manager, Radiation Protection

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ABSTRACT

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

During 2015, the following categories of samples were collected by APS:

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

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

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

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

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

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 2015. All references are specifically identified in Section 12.

Overview

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

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

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

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

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

Radiation and Radioactivity

Atoms are the basic building blocks of matter. Unstable atoms emit radiation and material that spontaneously emits radiation is referred to as radioactive. Radioactive material is frequently categorized as either "Natural" or "Manmade"

Natural sources of radiation exist naturally in the environment and include: radon, thoron, cosmic, terrestrial, and internal. The sun and stars are a source of cosmic radiation. Atmospheric conditions, the Earth's magnetic field, and differences in elevation can affect the amount, or dose, of cosmic radiation an individual receives. The Earth is a source of terrestrial radiation. Uranium, thorium, and radium exist naturally in rock and soil. All organic matter contains carbon and potassium and water contains small amounts of dissolved uranium and thorium. The largest contributor of dose to Americans from natural sources is attributed to radon which is found in air. All people are a source of internal radiation. Potassium-40 and carbon-14 are radioactive nuclides and inside all people from birth, making people a source of exposure.

Man-made sources of radiation include: occupations, consumer products, nuclear medicine, and medical procedures. There are a number of occupational areas which result in exposure to individuals of varying amounts of radiation such as: radiography, radiology, radiation oncology, power generation, and research laboratories. The Nuclear Regulatory Commission (NRC) requires licensees to monitor exposure to workers and limit occupational exposure to 5,000 mrem. Several consumer products contain radioactive material such as: some ceramics, thorium lantern mantles, luminous watches containing tritium, smoke detectors, and tobacco. Other consumer product sources of radiation can come from building and road construction materials, combustible fuels (i.e. gas, coal), and x-ray security systems. The most significant contributor to radiation exposure from manmade sources is medical procedures. Diagnostic s-rays and nuclear medicine procedures, such as those that use iodine-131 or cesium-137, are examples of manmade medical sources.

The average member of the public receives a total annual dose of approximately 620 millirem from ionizing radiation. Figure 1-1 illustrates the contribution of various sources of radiation to radiation exposure in the United States (NCRP Report No.160(2009))

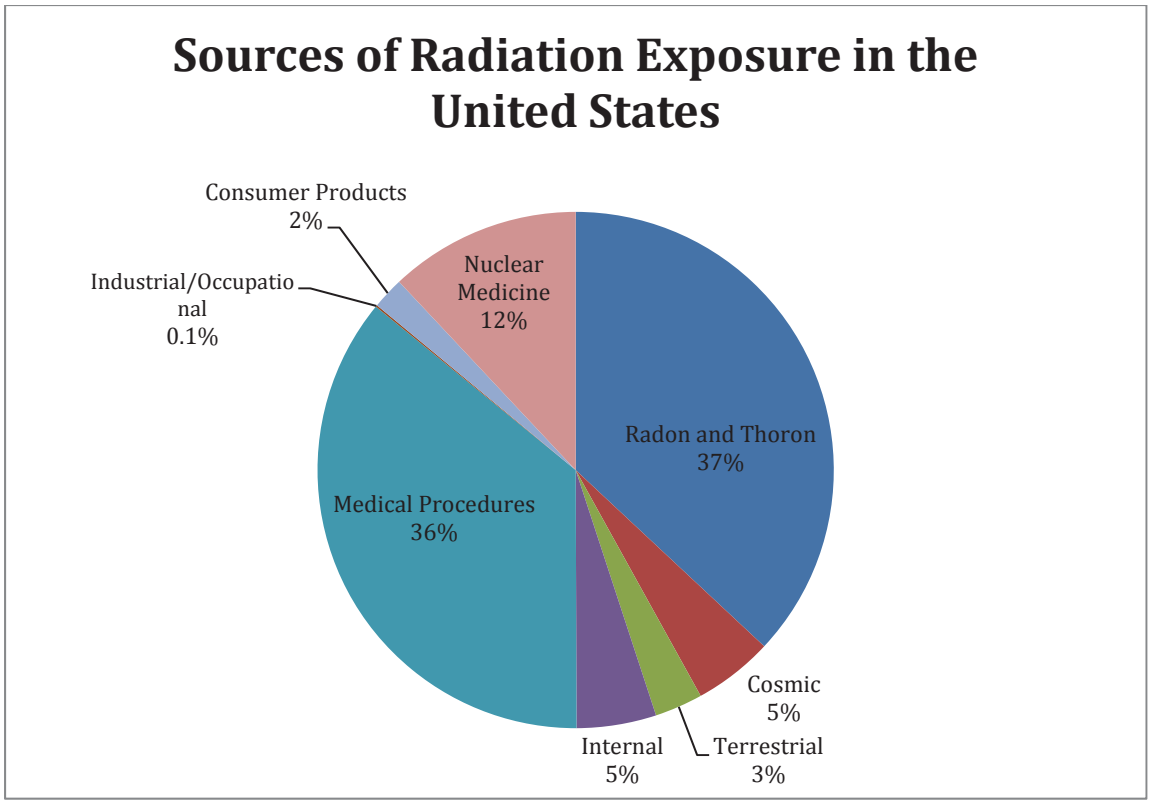

Figure 1-1 Sources of Radiation Exposure in the United States

2. Description of the Monitoring Program

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

2.1 Radiological Environmental Monitoring Program

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

Samples were collected by APS at the monitoring sites shown in Figures 2.1 and 2.2. The specific sample types, sampling locations, and sampling frequencies, as set forth in the PVNGS Offsite Dose Calculation Manual (ODCM), Reference 4, are presented in Tables 2.l, 2.2 and 9.1. Additional onsite sampling (outside the scope of the ODCM) is performed to supplement the REMP. All results are included in this report. Routine sample analyses were performed at the onsite Central Chemistry Laboratory and Operating Unit laboratories. Analyses for hard-to-detect radionuclides were performed by GEL Laboratories LLC.

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

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

2.2 Radiological Environmental Monitoring Program Changes for 2015

New Vegetation Sample Location

> The 2015 Land Use Census results have identified a new Radiological Environmental Monitoring Program (REMP) garden sample location. Per the Land Use Census procedure, 74RM-0EN07 Revision 14, a Condition Report shall be generated if a new sample location is identified that yields a 20% greater dose to an indicator location than current indicator locations. The new vegetation indicator location's calculated dose is 2.05E-01 mRem versus a criterion of 1.99E-01 mRem. This sampling location was included as supplemental data for 2015 and is included in the 2015 AREOR. This sampling location will be included in the REMP, beginning in 2016, as a required location as annotated in the ODCM, Revision 27.

Configuration of Air Sample Stations

The PVNGS Annual Radiological Environmental Operating Report 2013, section 2.3 REMP Deviation/Abnormal Events Summary references Letter 218-03709-JLM and describes the lowering of Radiological Environmental Monitoring Program (REMP) air samples. An evaluation concludes the air sample locations should not be lowered due to measurement variation concerns (CRDR 3805133). In April 2013, CRDR 4385407 was generated to lower the air sample locations based on industrial safety issues. This modification was evaluated, determining the sampling height should be restored to ensure representative monitoring of effluents and the impact on the environment, as well as maintain historical sample continuity (CRDR 4567692).

The configurations of all the air sample monitoring stations were restored to meet the intent of NUREG 1301 and Radiological Assessment Branch Technical Position, Revision 1. Consideration should be given to incorporation of EPA Guidance For Network Design and Optimum Site Exposure For PM2.5 And PM10 and ASTM document Standard Guide for Choosing Locations and sampling Methods to Monitor Atmospheric Deposition at Non-Urban Locations (CRAI 4577972). Changing the configuration to meet these requirements led to placing the air sample collection point to outside of the instrument weather housing, by utilizing a gooseneck sample line extension. This allowed sampling at the pre-operational sample height. The restoration of the sampling height configuration was completed with objective evidence on 2/19/2015.

2.3 REMP Deviations/Abnormal Events Summary

During calendar year 2015, there were eleven (11) deviations/abnormal events with regards to the monitoring program. Refer to Table 2-3 for more detail and any corrective actions taken.

Seven (7) of the events involved air sample stations. Three (3) events were due to defective pump vanes which were discovered due to the failure of pumps following routine maintenance in which the pump vanes had been replaced. The defective vanes remaining in inventory were identified and pulled from the supply and replaced. One (1) of the events involved the validity of several samples being questioned due to water intrusion occurring following the placement of the sample heads outside of the housing. An evaluation conducted in conjunction with the vendor concluded that the samples were valid. To avoid unnecessary wear on the sampling equipment and to ensure public confidence in the air sampling portion of the program, the rain shields were upgraded. No other water intrusion events have happened since the rain shield upgrades. The final three (3) air sample events involved a disconnected suction tube at Site 35, dislodged sample cartage at Site 35, and a loss of power at Site 17A. All events have been evaluated and corrective measures have been taken when necessary to prevent recurrence.

One (1) event was a missed LLD for La-150 for Site 49 drinking water. The missed LLD was attributed to a software malfunction. There was no detectable activity in this sample and the LLD that was achieved was well below the action level.

One (1) event was exceedance of the quarterly I-131 reporting level of 20 pCi/L. This occurred at Evaporation Pond 1C, fourth calendar quarter. The source is radiopharmaceutical I-131 that originates in the Phoenix sewage effluent that supplies makeup to the Reservoirs and Circulating Water system. This water is wasted to the Evaporation Ponds. This is not a plant effluent.

The final two (2) events involved environmental TLD locations, Site 10 and Site 49. Site 10 sampling stanchion was discovered to be missing; however, the TLD and housing were left, undamaged. Site 49 sampling stanchion was temporarily moved, approximately 20 feet, to avoid TLD damage or missing data during road construction in the area.

2.4 Ground Water Protection

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

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

Three subsurface samples were obtained, one each from Units 2 and 3 tritium monitoring wells, and one from the shallow aquifer outside of the Unit 1 radiological controlled area (RCA). These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) as verification that there are no underground leaks from plant systems that may affect groundwater. All results were <MDA. Refer to Table 8-12 for sample results.

Table 2-1 Sample Collection Locations

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

NOTES:

* Designates a control site

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

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

TLD location is the same as site #**4** air sample location)

Table 2-2 Sample Collection Schedule

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

Deviation/Abnormal Event	*Actions Taken*
1. Air Sample Site 17A sample pump lost power between 2/10/2015-2/17/2015.	The air sample pump lost power during the sample period, resulting in the inability to determine the actual sample volume. Results for this sampling period found to be INVALID. Power restored and sample volume for the following sample period was VALID. Event documented through CR 16-04887 (Table 8-1 and Table 8-4 , Note 1)
2. Air Samples stations had water intrusion 2/24/2015-3/3/2015, 3/16/2015-3/23/2015, and 4/28/2015-5/5/2015.	Air sample cartridges were found to have water intrusion following heavy rain, causing the technician to question the sample integrity. These events were documented through CR 15-00990 and 15-01374. An evaluation was completed to determine the ability of the sample cartridge to maintain efficiency under the documented conditions. Vendor verified that the efficiency test data representing the F&J long term scenario is applicable to the facts and circumstances which occurred in these events (EVAL 15-00990-001). Data is considered VALID and is included in this report (Table 8-1 and Table 8-4, Note 2)
3. Air Sample Site 35 cartridge found on ground 8/11/2015	Sample for Site 35 found dislodged from pump and lying on ground- sample determined to be INVALID for sample period 8/4/2015-8/11/2015. Event documented through CR 15-05977 (Table 8-2 and Table 8-5, Note 1).
4. Air Sample Site 35 found with suction tube disconnected on 10/28/2015.	On 10/28/2015, technician found REMP Air Sample Site 35 with the suction tube disconnected. Filter appeared white/as new. Technician believed that the suction tube came loose during the previous sample change-out the week before. Suction restored and pump flow verified. Sample determined to be INVALID for sample period 10/20/2015-10/28/2015. Event documented through CR 16-04924 (Table 8-2 and Table 8-5, Note 2).
5. Air Sample Pump found energized but not running at Site 15 and Site 40 on 11/23/2015.	Technician found REMP Air Sample Pumps at Site 15 and Site 40 energized but not running. Pumps were replaced and confirmed to be satisfactory. Results for these samples found to be INVALID for sample period 11/17/2015-11/23/2015. Event documented through CR 16-04949 (Table 8-2 and Table 8-5, Note 3). Cause later determined to be due to pump vane failures limited to recent shipment of rebuild kits (CR 15-12551)
6. Air Sample Pump found energized but not running at Site 15 on 12/1/2015.	Technician found REMP Air Sample Pump at Site 15 energized but not running. Pump was replaced and confirmed to be satisfactory. Results for these samples found to be INVALID for sample period 11/23/2015-12/1/2015. Event documented through CR 15-11875 (Table 8-2 and Table 8-5, Note 3). Cause later determined to be due to pump vane failures limited to recent shipment of rebuild kits (CR 15-12551)

7. Air Sample Pump found energized but not running at Site 15 on 12/15/2015.	Technician found REMP Air Sample Pumps at Site 15 energized but not running. Pump was replaced and confirmed to be satisfactory. Results for these samples found to be INVALID for sample period 12/8/2015-12/15/2015. Event documented through CR 15-12551 and cause determined to be due to pump vane failures limited to recent shipment of rebuild kits (Table 8-2 and Table 8-5, Note 3).
8. Missed La-140 LLD for Site 49 Drinking Water Sample	On Tuesday 11-24-15 the count-room detectors were not usable due to software (APEX) malfunction. This malfunction resulted in the inability to achieve the required LLD of 15 pCi/L for Site 49. The achieved LLD for Site 49 was <32 pCi/L with a reporting level of 200 pCi/L. This is the only exception for meeting LLDs in drinking water. This event was documented through CR 15-11873 and CR 16-05908 (Table 8-8, Note 1).
9. Evaporation Pond 1C exceeded 4th Quarter I-131 reporting level of 20 pCi/L resulting in a unity value of greater than 1.0 (one). The quarterly tritium value 2341.	Evaporation Pond 1C had an I-131 validated result greater than the ODCM Reporting Level. Low level tritium (2341±193 pCi/L) was detected in Evaporation Pond 1C, which is below the ODCM Reporting Level. If more than one radionuclide from the ODCM Reporting Level table is detected, a unity value calculation must be performed, The elevated I-131 concentrations, originating from radiopharmaceuticals in Phoenix Influent (CRDR 4568037), accounted for 93% of the unity value. This occurrence is documented through CR 16-05005 (Table 8-10).
10. Site 49 TLD Sample Stanchion relocated due to construction.	Technician observed fresh grading in apparent preparation for future road work had been done around the sample stanchion on 9-24-15, while performing the quarterly change-out of environmental TLDs. The technician moved the stanchion ~20 feet to prevent inadvertent damage or loss of the TLDs. The TLD stanchion was returned to original location during the next quarterly TLD change-out. This event and follow-up actions were documented through CR 15-08047 and AI 15-08047-004.
11. Site 10 TLD Sample Stanchion missing.	Technician found the Site 10 TLD field holder, still intact and sealed, lying on the ground near the sample site, on 9-24-15 while performing the quarterly REMP environmental TLD change-out. The pipe and concrete were gone and could not be located. This event and evaluation were documented through CR 15-08042 and EVAL 15-08042-002.
12. Site 50 TLDs missing due to vandalism.	The two TLDs used for monitoring location 50 were missing at the time of exchange due to vandalism. Processing results appear normal and are consistent with historical readings. In addition, no neutron exposure was measured at any of the monitored locations. Intralaboratory comparisons indicated an average bias of 0.001, with a standard deviation of 2.4 percent. This event was documented through Correspondence Letter 218-03835-JER

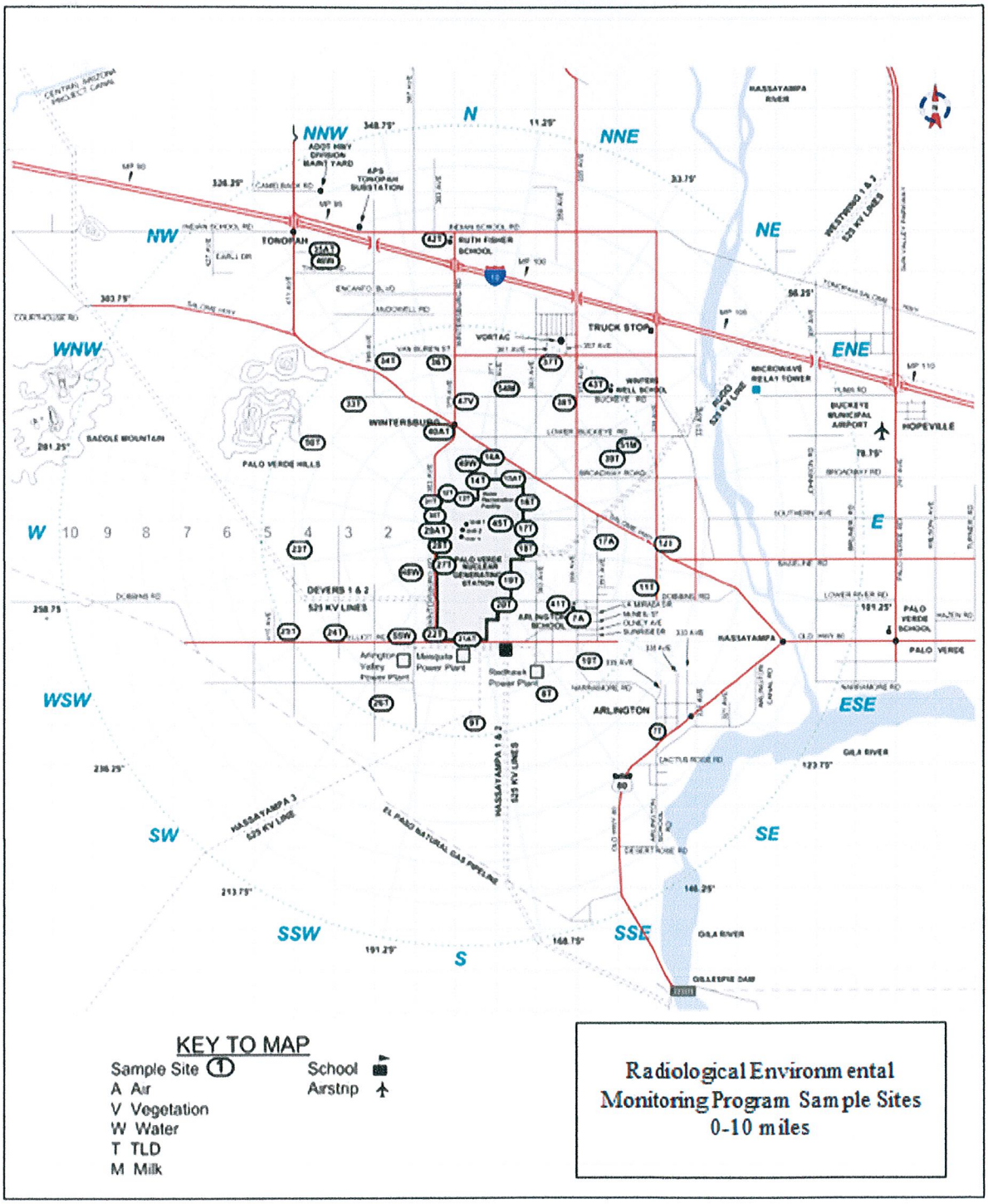

Figure 2-1 REMP Sample Sites- Map (0-10 miles)

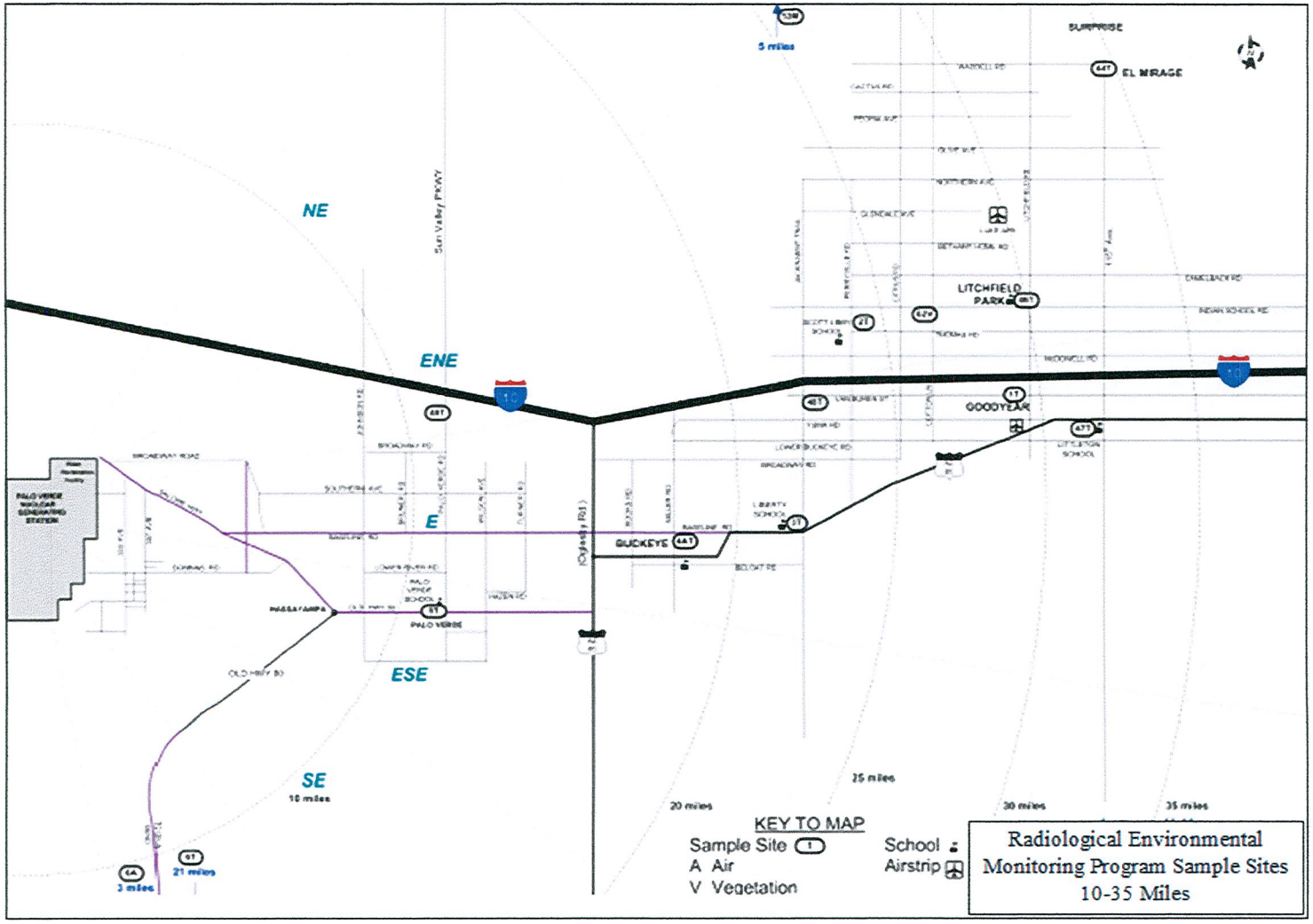

Figure 2-2 REMP Sample Sites- Map (10-35 Miles)

3. Sample Collection Program

APS Personnel using PVNGS procedures collected all samples.

3.1 Water

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

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

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

3.2 Vegetation

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

3.3 Milk

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

3.4 Air

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

3.5 Sludge and Sediment

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

4. Analytical Procedures

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

4.1 Air Particulate

4.1.1 Gross Beta

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

4.1.2 Gamma Spectroscopy

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

4.2 Airborne Radioiodine

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

4.3 Milk

4.3.1 Gamma Spectroscopy

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

4.3.2 Radiochemical I-131 Separation

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

4.4 Vegetation

4.4.1 Gamma Spectroscopy

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

4.5 Sludge/Sediment

4.5.1 Gamma Spectroscopy

The wet/dry 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.

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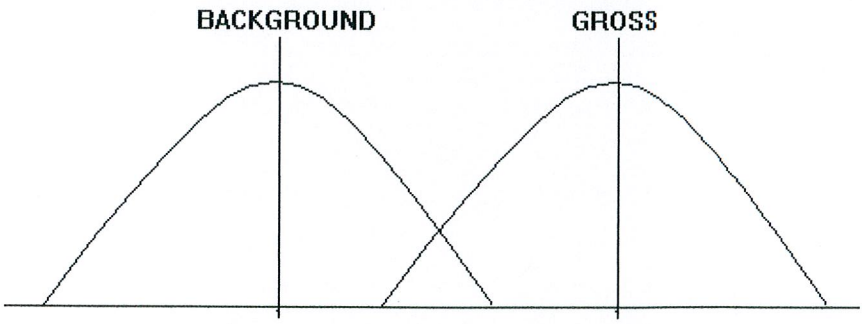
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- 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 Summaries of the REMP Deviations/Abnormal Events 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)

Lower Limit of Detection (LLD)				
Analysis	**Water (pCi/l)**	**Airborne Particulate or Gas (pCi/m^3)**	**Fresh Milk (pCi/l)**	**Food Products (pCi/kg, wet)**
Gross Beta	4	0.01		
H-3	2000*			
Mn-54	15			
Fe-59	30			
Co-58, -60	15			
Zn-65	30			
Zr-95	30			
Nb-95	15			
I-131	1**	0.07	1	60
Cs-134	15	0.05	15	60
Cs-137	18	0.06	18	80
Ba-140	60		60	
La-140	15		15	

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

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

Table 6-2 ODCM Required Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fresh Milk (pCi/l)	Food Products (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	

* For drinking water samples. This is a 40 CFR 141 value. If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

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

Table 6-3 Typical MDA Values

Analysis/Nuclide	Water (pCi/liter)	Milk (pCi/liter)	Airborne Particulate or Gas (pCi/m^3)	Vegetation (pCi/kg, wet)
Gross Beta	2.08		0.004	
H-3	326			
Mn-54	10			
Fe-59	20			
Co-58	9			
Co-60	11			
Zn-65	22			
Zr-95	16			
Nb-95	10			
I-131	10[a]	1	0.04[b]	49
Cs-134	9	1	0.003[b]	47
Cs-137	10	1	0.003[b]	61
Ba-140	33	3		
La-140	13	1		

NOTES:

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

7. Interlaboratory Comparison Program

7.1 Quality Control Program

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

During 2015, APS analyzed the following sample types under the interlaboratory comparison program:

- Beta/Gamma/ in Air Filter
- I-131 in Air
- Beta in Water
- Gamma in Water
- Tritium in Water
- Gamma in Milk

7.2 Intercomparison Results

APS participates in a crosscheck program using vendor supplied blind radionuclide samples. Results for the interlaboratory comparison program are presented in Table 7-1.

Table 7-1 Interlaboratory Comparison Results

Sample ID	Analysis Type	Nuclide	Units	Known Value**	PVNGS Value	1 sigma Error	Resolution*	Ratio	NRC Range	Acceptable?
E11152	Tritium	H-3	pCi/L	1.26E+04	1.21E+04	3.55E+02	34	0.96	0.75 - 1.33	YES
E11153	Gamma Water	I-131	pCi/L	9.67E+01	9.60E+01	8.56E+00	11	0.99	0.60 - 1.66	YES
		Ce-141	pCi/L	1.39E+02	1.59E+02	1.02E+01	16	1.14	0.75 - 1.33	YES
		Cr-51	pCi/L	3.66E+02	2.69E+02	4.74E+01	6	0.73	0.50 - 2.00	YES
		Cs-134	pCi/L	1.26E+02	1.14E+02	7.80E+00	15	0.90	0.60 - 1.66	YES
		Cs-137	pCi/L	1.67E+02	1.76E+02	1.22E+01	14	1.05	0.60 - 1.66	YES
		Co-58	pCi/L	1.80E+02	1.90E+02	1.20E+01	16	1.06	0.75 - 1.33	YES
		Mn-54	pCi/L	1.59E+02	1.75E+02	1.19E+01	15	1.10	0.60 - 1.66	YES
		Fe-59	pCi/L	1.95E+02	1.79E+02	2.19E+01	8	0.92	0.60 - 1.66	YES
		Zn-65	pCi/L	2.99E+02	3.01E+02	2.32E+01	13	1.01	0.60 - 1.66	YES
		Co-60	**pCi/L**	**3.28E+02**	**3.27E+02**	**1.61E+01**	**20**	**1.00**	**0.75 - 1.33**	**YES**
E11154	I-131 Cartridge	I-131	pCi/ea	7.78E+01	8.31E+01	2.70E+00	31	1.07	0.75 - 1.33	YES
E11155	Gamma Filter	Ce-141	pCi/ea	6.96E+01	6.93E+01	3.58E+00	19	1.00	0.75 - 1.33	YES
		Cr-51	pCi/ea	1.83E+02	2.09E+02	1.87E+01	11	1.14	0.60 - 1.66	YES
		Cs-134	pCi/ea	6.31E+01	5.23E+01	3.89E+00	13	0.83	0.60 - 1.66	YES
		Cs-137	pCi/ea	8.34E+01	8.24E+01	5.60E+00	15	0.99	0.60 - 1.66	YES
		Co-58	pCi/ea	8.99E+01	9.17E+01	6.05E+00	15	1.02	0.60 - 1.66	YES
		Mn-54	pCi/ea	7.94E+01	8.66E+01	5.88E+00	15	1.09	0.60 - 1.66	YES
		Fe-59	pCi/ea	9.75E+01	1.08E+02	1.00E+01	11	1.11	0.60 - 1.66	YES
		Zn-65	pCi/ea	1.50E+02	1.78E+02	1.20E+01	15	1.19	0.60 - 1.66	YES
		Co-60	pCi/ea	1.64E+02	1.78E+02	9.30E+00	19	1.09	0.75 - 1.33	YES
E11156	Gamma Milk	I-131	pCi/L	1.42E+01	1.65E+01	1.98E+00	8	1.16	0.60 - 1.66	YES
		Ce-141	pCi/L	1.80E+01	1.73E+01	2.77E+00	6	0.96	0.50 - 2.00	YES
		Cr-51	pCi/L	4.75E+01	6.08E+01	1.06E+01	6	1.28	0.50 - 2.00	YES
		Cs-134	pCi/L	1.63E+01	1.66E+01	1.72E+00	10	1.02	0.60 - 1.66	YES
		Cs-137	pCi/L	2.16E+01	2.16E+01	2.35E+00	9	1.00	0.60 - 1.66	YES
		Co-58	pCi/L	2.33E+01	2.37E+01	2.86E+00	8	1.02	0.60 - 1.66	YES
		Mn-54	pCi/L	2.06E+01	2.04E+01	2.35E+00	9	0.99	0.60 - 1.66	YES
		Fe-59	pCi/L	2.53E+01	2.53E+01	5.40E+00	5	1.00	0.50 - 2.00	YES
		Zn-65	pCi/L	3.88E+01	4.79E+01	5.16E+00	9	1.23	0.60 - 1.66	YES
		Co-60	pCi/L	4.26E+01	4.29E+01	3.25E+00	13	1.01	0.60 - 1.66	YES

Table 7.1 Interlaboratory Comparison Results (Continued)

E11157	Beta Filter	G. Beta	pCi/ea	8.78E+01	9.90E+01	2.20E+00	45	1.13	0.75 - 1.33	YES
E11349	Gamma Filter	Ce-141	pCi/ea	8.12E+01	8.06E+01	8.53E+00	9	0.99	0.60 - 1.66	YES
		Cr-51	pCi/ea	2.05E+02	1.72E+02	4.44E+01	4	0.84	0.50 - 2.00	YES
		Cs-134	pCi/ea	8.07E+01	6.54E+01	4.36E+00	15	0.81	0.60 - 1.66	YES
		Cs-137	pCi/ea	9.71E+01	1.05E+02	1.34E+01	8	1.08	0.60 - 1.66	YES
		Co-58	pCi/ea	1.00E+02	1.06E+02	1.22E+01	9	1.06	0.60 - 1.66	YES
		Mn-54	pCi/ea	1.11E+02	1.33E+02	1.39E+01	10	1.20	0.60 - 1.66	YES
		Fe-59	pCi/ea	8.60E+01	1.05E+02	1.01E+01	10	1.22	0.60 - 1.66	YES
		Zn-65	pCi/ea	1.35E+02	1.64E+02	1.62E+01	10	1.21	0.60 - 1.66	YES
		Co-60	pCi/ea	1.26E+02	1.31E+02	8.18E+00	16	1.04	0.75 - 1.33	YES
E11350	I-131 Cartridge	I-131	pCi/ea	7.46E+01	7.23E+01	1.42E+01	5	0.97	0.50 - 2.00	YES
E11351	Beta Water	G. Beta	pCi/L	2.37E+02	2.73E+02	6.00E+00	46	1.15	0.75 - 1.33	YES
E11352	Beta Filter	G. Beta	pCi/ea	7.87E+01	8.73E+01	1.50E+00	58	1.11	0.80 - 1.25	YES

* calculated from PVNGS value/1 sigma error value

** Eckert & Ziegler Analytics, Inc. NIST-traceable known value

NRC Acceptance Criteria [1]

Resolution	Ratio
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

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

Table 7.1 Interlaboratory Comparison Results (Continued)

Sample Type	Analysis Type	ERA PT Study	Nuclide	Units	PVNGS Value	Assigned Value [1]	Acceptance Limit [2]	Results
Water	Gross Beta	RAD-101	g beta	pCi/L	38.8	32.9	21.3 - 40.8	Acceptable
Water	Tritium	RAD-103	H-3	pCi/L	20,700	21,300	18700 - 23400	Acceptable
Water	Gamma	RAD-103	Ba-133	pCi/L	31	32.5	25.9 - 36.7	Acceptable
			Cs-134	pCi/L	58.1	62.3	50.6 - 68.5	Acceptable
			Cs-137	pCi/L	144	157	141 - 175	Acceptable
			Co-60	pCi/L	72.2	71.1	64.0 - 80.7	Acceptable
			Zn-65	pCi/L	139	126	113 - 149	Acceptable

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

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

8. Data Interpretation 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 2015 are presented in the following sections.

8.1 Air Particulates

Weekly gross beta results, in quarterly format, are presented in Table 8-1 and Table 8-2. Gross beta activity at indicator locations ranged from 0.016 to 0.059 pCi/m3. 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.

Table 8-3 displays the results of gamma spectroscopy on the quarterly composites of the weekly samples.

8.2 Airborne Radioiodine

Table 8-4 and Table 8-5 present the quarterly radioiodine results. Radioiodine was not observed in any samples.

8.3 Vegetation

Table 8-6 presents gamma isotopic data for the vegetation samples. No gamma emitting radionuclides were observed in any of the samples.

8.4 Milk

Table 8-7 presents gamma isotopic data for the goat milk samples. No gamma emitting radionuclides were observed in any of the samples.

8.5 Drinking Water

Samples were analyzed for gross beta, tritium, and gamma emitting radionuclides. Results of these analyses are presented in Table 8-8. No tritium or gamma emitting radionuclides were detected in any samples. Gross beta activity ranged from less than detectable to a high of 6.5 pCi/liter. The gross beta activity is attributable to natural (background) radioactive materials.

8.6 Ground Water

Ground water samples were analyzed from two onsite wells (regional aquifer) for tritium and gamma emitting radionuclides. Results obtained from the analysis of the samples are presented in Table 8-9.

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

8.7 Surface Water

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

Sample results are presented in Table 8-10 . I-131 was observed in both reservoirs and Evaporation Ponds 1B, 1C, and 2A. The I-131 levels ranged from 18 pCi/L – 23 pCi/L. I-131 in these surface water locations is a result of radiopharmaceutical I-131 in the Phoenix sewage effluent and is not attributable to plant effluents.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration was 2341 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.

8.8 Sludge and Sediment

8.8.1 WRF Centrifuge Waste Sludge

Sludge samples were obtained from the WRF centrifuge and analyzed by gamma spectroscopy. I-131 activity in the sludge is consistent with historical values and, as previously discussed, is due to radiopharmaceuticals in the WRF Influent. The concentration of I-131 ranged from "no detectable" to 937 pCi/kg.

Results for WRF centrifuge waste sludge can be found in Table 8-11.

8.8.2 Cooling Tower Sludge

Sludge/sediment originating from the Unit 2 and Unit 3 Cooling Towers and Circulating Water canals was disposed of in the WRF sludge landfill during 2015. Sample results can be found in Table 8-11.

8.9 Data Trends

Figure 8-1 through Figure 8-8 present data in graphical format. Historical data are displayed for comparison where practical.

8.10 Hard-To-Detect Radionuclide Results

Table 8-12 shows the results of the three subsurface samples obtained from 3 tritium monitoring points. These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) and all results were <MDA. These results indicate that no leaks from plant systems have affected groundwater.

Table 8-1 Particulate Gross Beta in Air 1st-2nd Quarter

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
1	30-Dec-14	6-Jan-15	0.047	0.056	0.055	0.053	0.051	0.057	0.058	0.058	0.053	0.057	0.054	6.5	
2	6-Jan-15	13-Jan-15	0.049	0.054	0.055	0.050	0.055	0.057	0.058	0.055	0.053	0.054	0.054	5.1	
3	13-Jan-15	20-Jan-15	0.039	0.040	0.038	0.034	0.035	0.038	0.037	0.039	0.036	0.038	0.037	5.5	
4	20-Jan-15	27-Jan-15	0.032	0.036	0.038	0.034	0.032	0.036	0.034	0.035	0.033	0.035	0.035	5.1	
5	27-Jan-15	3-Feb-15	0.026	0.030	0.027	0.029	0.028	0.028	0.034	0.033	0.028	0.028	0.029	8.3	
6	3-Feb-15	10-Feb-15	0.037	0.053	0.045	0.045	0.045	0.046	0.049	0.048	0.043	0.046	0.046	9.2	
7	10-Feb-15	17-Feb-15	0.030	0.032	0.027	0.031	0.028	*	0.025	0.030	0.031	0.031	0.029	7.9	1
8	17-Feb-15	23-Feb-15	0.048	0.050	0.046	0.046	0.047	0.046	0.045	0.046	0.046	0.049	0.047	3.1	
9	24-Feb-15	3-Mar-15	0.021	0.020	0.020	0.021	0.021	0.020	0.020	0.018	0.022	0.021	0.020	4.8	2
10	3-Mar-15	10-Mar-15	0.032	0.031	0.033	0.033	0.033	0.031	0.034	0.024	0.030	0.028	0.031	10.2	
11	10-Mar-15	16-Mar-15	0.045	0.046	0.046	0.047	0.048	0.048	0.046	0.041	0.045	0.050	0.046	5.1	
12	16-Mar-15	23-Mar-15	0.037	0.036	0.036	0.036	0.037	0.036	0.035	0.035	0.034	0.036	0.036	2.3	2
13	23-Mar-15	31-Mar-15	0.025	0.025	0.025	0.026	0.026	0.026	0.024	0.025	0.023	0.027	0.025	4.7	
	Mean		0.036	0.039	0.038	0.037	0.037	0.039	0.038	0.037	0.037	0.038	0.038	2.6	

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 (%)	Note
14	31-Mar-15	7-Apr-15	0.032	0.034	0.037	0.034	0.032	0.038	0.035	0.034	0.031	0.037	0.034	6.4	
15	7-Apr-15	14-Apr-15	0.026	0.025	0.024	0.025	0.026	0.031	0.024	0.025	0.025	0.025	0.026	7.5	
16	14-Apr-15	21-Apr-15	0.031	0.028	0.031	0.032	0.034	0.031	0.031	0.029	0.031	0.029	0.031	5.6	
17	21-Apr-15	28-Apr-15	0.024	0.021	0.022	0.024	0.022	0.024	0.024	0.024	0.022	0.023	0.023	4.9	
18	28-Apr-15	5-May-15	0.029	0.024	0.028	0.029	0.031	0.032	0.031	0.029	0.029	0.030	0.029	8.0	2
19	5-May-15	12-May-15	0.027	0.023	0.026	0.026	0.022	0.028	0.026	0.024	0.026	0.023	0.025	6.9	
20	12-May-15	19-May-15	0.019	0.016	0.018	0.020	0.016	0.021	0.016	0.021	0.022	0.018	0.019	11.6	
21	19-May-15	26-May-15	0.033	0.029	0.031	0.030	0.028	0.029	0.030	0.027	0.031	0.029	0.030	5.8	
22	26-May-15	2-Jun-15	0.037	0.038	0.041	0.037	0.023	0.043	0.035	0.040	0.032	0.025	0.035	19.1	
23	2-Jun-15	9-Jun-15	0.031	0.032	0.031	0.032	0.029	0.032	0.030	0.033	0.030	0.030	0.031	3.2	
24	9-Jun-15	16-Jun-15	0.039	0.038	0.036	0.038	0.040	0.038	0.036	0.035	0.037	0.035	0.037	4.5	
25	16-Jun-15	23-Jun-15	0.049	0.043	0.045	0.043	0.054	0.037	0.046	0.043	0.046	0.046	0.045	9.8	
26	23-Jun-15	29-Jun-15	0.043	0.036	0.038	0.038	0.034	0.045	0.038	0.028	0.039	0.035	0.037	12.7	
	Mean		0.032	0.030	0.031	0.031	0.030	0.033	0.031	0.030	0.031	0.030	0.031	3.6	

Note:

1. Sample for Site 17-A INVALID due to power loss from line out

2. Weekly samples initially invalidated due to water intrusion; data provided as INFO ONLY. Evaluation 15-00990-001- Vendor confirmed sample media not compromised- conditions within testing criteria. Data included in this report.

Table 8-2 Particulate Gross Beta in Air 3rd-4th Quarter

ODCM required samples denoted by *
units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
27	29-Jun-15	7-Jul-15	0.042	0.045	0.041	0.042	0.038	0.035	0.036	0.044	0.038	0.042	0.040	8.1	
28	7-Jul-15	14-Jul-15	0.034	0.035	0.033	0.033	0.032	0.033	0.031	0.034	0.034	0.035	0.033	4.4	
29	14-Jul-15	21-Jul-15	0.029	0.024	0.029	0.024	0.024	0.024	0.023	0.029	0.025	0.022	0.025	10.9	
30	21-Jul-15	29-Jul-15	0.023	0.021	0.028	0.023	0.022	0.020	0.025	0.029	0.018	0.021	0.023	14.8	
31	29-Jul-15	4-Aug-15	0.032	0.033	0.028	0.025	0.034	0.027	0.031	0.028	0.023	0.027	0.029	12.6	
32	4-Aug-15	11-Aug-15	0.034	0.036	0.033	0.033	0.036	0.034	0.031	0.037	*	0.028	0.034	8.4	1
33	11-Aug-15	18-Aug-15	0.029	0.033	0.030	0.031	0.032	0.033	0.032	0.031	0.031	0.030	0.031	4.0	
34	18-Aug-15	25-Aug-15	0.031	0.020	0.027	0.028	0.027	0.024	0.023	0.027	0.030	0.026	0.026	12.1	
35	25-Aug-15	1-Sep-15	0.034	0.032	0.034	0.035	0.033	0.031	0.034	0.033	0.035	0.028	0.033	6.1	
36	1-Sep-15	8-Sep-15	0.036	0.035	0.029	0.031	0.032	0.032	0.028	0.025	0.028	0.023	0.030	13.6	
37	8-Sep-15	15-Sep-15	0.034	0.034	0.039	0.031	0.031	0.035	0.030	0.035	0.036	0.035	0.034	7.6	
38	15-Sep-15	22-Sep-15	0.024	0.024	0.025	0.026	0.028	0.025	0.024	0.028	0.024	0.026	0.025	6.1	
39	22-Sep-15	29-Sep-15	0.047	0.055	0.049	0.050	0.053	0.032	0.046	0.049	0.047	0.043	0.047	13.3	
	Mean		0.033	0.033	0.033	0.032	0.032	0.030	0.030	0.033	0.031	0.030	0.032	#REF!	

4th 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 (%)	Note
40	29-Sep-15	6-Oct-15	0.033	0.042	0.042	0.038	0.045	0.041	0.034	0.039	0.038	0.039	0.039	9.4	
41	6-Oct-15	13-Oct-15	0.034	0.034	0.034	0.029	0.031	0.031	0.029	0.035	0.031	0.031	0.032	7.0	
42	13-Oct-15	20-Oct-15	0.044	0.043	0.042	0.037	0.048	0.043	0.034	0.041	0.043	0.033	0.041	11.2	
43	20-Oct-15	28-Oct-15	0.047	0.053	0.052	0.046	0.054	0.053	0.039	0.048	*	0.048	0.049	9.5	2
44	28-Oct-15	3-Nov-15	0.051	0.047	0.053	0.041	0.057	0.047	0.039	0.052	0.043	0.043	0.047	12.5	
45	3-Nov-15	9-Nov-15	0.035	0.034	0.028	0.029	0.035	0.037	0.027	0.029	0.027	0.027	0.031	12.5	
46	9-Nov-15	17-Nov-15	0.039	0.035	0.036	0.036	0.038	0.036	0.033	0.034	0.037	0.036	0.036	5.5	
47	17-Nov-15	23-Nov-15	0.033	0.040	0.033	0.033	*0.0254	0.033	0.033	0.032	0.033	*0.0228	0.034	7.5	3
48	23-Nov-15	1-Dec-15	0.043	0.042	0.044	0.042	*	0.045	0.040	0.045	0.044	0.040	0.043	4.3	3
49	1-Dec-15	8-Dec-15	0.059	0.058	0.056	0.055	0.056	0.057	0.057	0.059	0.057	0.058	0.057	2.5	
50	8-Dec-15	15-Dec-15	0.046	0.028	0.046	0.041	*	0.043	0.046	0.040	0.045	0.041	0.042	13.4	3
51	15-Dec-15	21-Dec-15	0.042	0.039	0.039	0.037	0.038	0.036	0.039	0.036	0.036	0.037	0.038	5.6	
52	21-Dec-15	28-Dec-15	0.026	0.030	0.028	0.028	0.028	0.026	0.026	0.024	0.022	0.024	0.026	9.1	
	Mean		0.041	0.040	0.041	0.038	0.043	0.041	0.037	0.039	0.038	0.038	0.040	5.0	
	Annual Average		***0.0355***	***0.0355***	***0.0357***	***0.0345***	***0.0353***	***0.0355***	***0.0341***	***0.0350***	***0.0340***	***0.0338***	***0.0349***	***7.9964***	

min 6A	0.0157	min 7a	0.018	min 17A	0.020	all ind min	0.016	all ind mean	0.034
max 6A	0.0576	max 7a	0.056	max 17A	0.057	all ind max	0.059		

Note:

1. Sample for Site 35 found dislodged from pump and lying on ground- sample determined to be INVALID (CR 15-05977)
2. Sample for Site 35 found with suction tube disconnected Filter showed no signs of sample collection (CR 16-04924)
3. Air Sample Pump found energized but not running at Site 15 and Site 40 (11/23/2015), and at Site 15 (11/15/2015 and 12/15/2015). Samples invalid (CR 16-04949, 15-11875, and 15-12551). Problem identified as faulty vane kits and corrected.

Table 8-3 Gamma in Air Filter Composites

ODCM required samples denoted by *
units are pCi/m^3

QUARTER ENDPOINT	NUCLIDE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*
31-Mar-15	Cs-134	<0.0019	<0.0028	<0.0023	<0.0046	<0.0020	<0.0021	<0.0017	<0.0028	<0.0021	<0.0033
	Cs-137	<0.0029	<0.0028	<0.0025	<0.0040	<0.0020	<0.0011	<0.0023	<0.0043	<0.0020	<0.0040
29-Jun-15	Cs-134	<0.0010	<0.0042	<0.0041	<0.0019	<0.0034	<0.0022	<0.0027	<0.0023	<0.0029	<0.0021
	Cs-137	<0.0033	<0.0027	<0.0044	<0.0016	<0.0046	<0.0023	<0.0047	<0.0016	<0.0041	<0.0023
29-Sep-15	Cs-134	<0.0027	<0.0024	<0.0043	<0.0011	<0.0043	<0.0034	<0.0043	<0.0039	<0.0030	<0.0018
	Cs-137	<0.0041	<0.0038	<0.0053	<0.0009	<0.0053	<0.0028	<0.0062	<0.0028	<0.0032	<0.0061
28-Dec-15	Cs-134	<0.0010	<0.0007	<0.0035	<0.0061	*<0.0031	<0.0019	<0.0025	<0.0028	**<0.0030	<0.0011
	Cs-137	<0.0048	<0.0009	<0.0044	<0.0063	*<0.0033	<0.0016	<0.0031	<0.0024	**<0.0048	<0.0009

* Site 15- two weeks invalid. Filters and volumes added into Quarterly stack

** Site 35 (10/28/2015) Invalid - tube came off inside box. Vol of 1 m^3 and filter included in composit

Table 8-4 Radioiodine in Air 1st - 2nd Quarter

ODCM required samples denoted by *

units are pCi/m^3

1st Quarter

(control) required LLD <0.070

Week #	START DATE	STOP DATE	Site 4	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
1	30-Dec-14	6-Jan-15	<0.0279	<0.0585	<0.0556	<0.0315	<0.0523	<0.0333	<0.0558	<0.0357	<0.0636	<0.0243	
2	6-Jan-15	13-Jan-15	<0.0284	<0.0669	<0.0561	<0.0196	<0.0443	<0.0248	<0.0576	<0.0313	<0.0679	<0.0244	
3	13-Jan-15	20-Jan-15	<0.0548	<0.0526	<0.0320	<0.0493	<0.0376	<0.0625	<0.0509	<0.0295	<0.0680	<0.0376	
4	21-Jan-15	27-Jan-15	<0.0626	<0.0572	<0.0497	<0.0594	<0.0345	<0.0446	<0.0683	<0.0530	<0.0529	<0.0532	
5	27-Jan-15	3-Feb-15	<0.0183	<0.0336	<0.0682	<0.023	<0.0280	<0.0668	<0.0280	<0.0501	<0.0246	<0.0422	
6	3-Feb-15	10-Feb-15	<0.0320	<0.0567	<0.0544	<0.0621	<0.0689	<0.0273	<0.0588	<0.0341	<0.0657	<0.0200	
7	10-Feb-15	17-Feb-15	<0.0218	<0.0329	<0.0539	<0.0295	<0.0534	*	<0.0227	<0.0552	<0.0263	<0.0461	1
8	17-Feb-15	23-Feb-15	<0.0636	<0.0640	<0.0507	<0.0079	<0.0630	<0.0234	<0.0467	<0.0294	<0.0696	<0.0344	
9	23-Feb-15	3-Mar-15	<0.0195	<0.0449	<0.0473	<0.0266	<0.0370	<0.0277	<0.0489	<0.0234	<0.0598	<0.0242	2
10	3-Mar-15	10-Mar-15	<0.0628	<0.0639	<0.0312	<0.0486	<0.0396	<0.0449	<0.0379	<0.0466	<0.0304	<0.0664	
11	10-Mar-15	16-Mar-15	<0.0261	<0.0344	<0.0399	<0.0229	<0.0406	<0.0281	<0.0389	<0.0417	<0.0283	<0.0322	
12	16-Mar-15	23-Mar-15	<0.0346	<0.0676	<0.0418	<0.0251	<0.0578	<0.0300	<0.0457	<0.0253	<0.0457	<0.0321	2
13	23-Mar-15	31-Mar-15	<0.0377	<0.0369	<0.0285	<0.0343	<0.0222	<0.0519	<0.0233	<0.0441	<0.0291	<0.0380	

2nd Quarter

(control) required LLD <0.070

Week #	START DATE	STOP DATE	Site 4	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
14	31-Mar-15	7-Apr-15	<0.0317	<0.0321	<0.0376	<0.0293	<0.0551	<0.0372	<0.0545	<0.0319	<0.0670	<0.0235	
15	7-Apr-15	14-Apr-15	<0.0239	<0.0287	<0.0548	<0.0398	<0.0549	<0.0299	<0.0550	<0.0327	<0.0296	<0.0673	
16	14-Apr-15	21-Apr-15	<0.0340	<0.0328	<0.0424	<0.0284	<0.0694	<0.0378	<0.0338	<0.0306	<0.0394	<0.0299	
17	21-Apr-15	28-Apr-15	<0.0627	<0.0305	<0.0658	<0.0266	<0.0670	<0.0255	<0.0685	<0.0295	<0.0602	<0.0196	
18	28-Apr-15	5-May-15	<0.0281	<0.0538	<0.0458	<0.0273	<0.0548	<0.0242	<0.0557	<0.0339	<0.0674	<0.0335	2
19	5-May-15	12-May-15	<0.0346	<0.0531	<0.0419	<0.0225	<0.0416	<0.0348	<0.0491	<0.0328	<0.0647	<0.0263	
20	12-May-15	19-May-15	<0.0125	<0.0489	<0.0591	<0.0296	<0.0339	<0.0217	<0.0669	<0.0687	<0.0277	<0.0188	
21	19-May-15	26-May-15	<0.0395	<0.0370	<0.0664	<0.0395	<0.0614	<0.0299	<0.0626	<0.0301	<0.0441	<0.0340	
22	26-May-15	2-Jun-15	<0.0402	<0.0450	<0.0171	<0.0376	<0.0207	<0.0550	<0.0237	<0.0562	<0.0217	<0.0602	
23	2-Jun-15	9-Jun-15	<0.0465	<0.0477	<0.0635	<0.0640	<0.0504	<0.0359	<0.0688	<0.0554	<0.0633	<0.0661	
24	9-Jun-15	16-Jun-15	<0.0443	<0.0445	<0.0586	<0.0514	<0.0367	<0.0444	<0.0307	<0.0435	<0.0288	<0.0563	
25	16-Jun-15	23-Jun-15	<0.0345	<0.0302	<0.0318	<0.0304	<0.0334	<0.0364	<0.0346	<0.0266	<0.0272	<0.0334	
26	23-Jun-15	29-Jun-15	<0.0437	<0.0558	<0.0466	<0.0369	<0.0664	<0.0287	<0.0387	<0.0325	<0.0490	<0.0310	

Note:

1. Sample for Site 17-A INVALID due to power loss from line out

2. Weekly samples initially invalidated due to water intrusion; data provided as INFO ONLY. Evaluation 15-00990-001- Vendor confirmed sample media not compromised-conditions within testing criteria. Data included in this report.

Table 8-5 Radioiodine in Air 3rd - 4th Quarter

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15* 0.070	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
27	29-Jun-15	7-Jul-15	<0.0231	<0.0446	<0.0375	<0.0221	<0.0590	<0.0263	<0.0274	<0.0237	<0.0466	<0.0248	
28	7-Jul-15	14-Jul-15	<0.0334	<0.0582	<0.0685	<0.0245	<0.0510	<0.0299	<0.0699	<0.0305	<0.0505	<0.0192	
29	14-Jul-15	21-Jul-15	<0.0353	<0.0638	<0.0422	<0.0265	<0.0651	<0.0273	<0.0562	<0.0326	<0.0392	<0.0183	
30	21-Jul-15	29-Jul-15	<0.0602	<0.0366	<0.0435	<0.0506	<0.0475	<0.0567	<0.0521	<0.0601	<0.0522	<0.0422	
31	29-Jul-15	4-Aug-15	<0.0347	<0.0496	<0.0673	<0.0354	<0.0676	<0.0341	<0.0609	<0.0258	<0.0665	<0.0226	
32	4-Aug-15	11-Aug-15	<0.0211	<0.0643	<0.0355	<0.0321	<0.0386	<0.0282	<0.0323	<0.0260	*	<0.0663	1
33	11-Aug-15	18-Aug-15	<0.0302	<0.0296	<0.0178	<0.0292	<0.0229	<0.0350	<0.0386	<0.0313	<0.0331	<0.0251	
34	18-Aug-15	25-Aug-15	<0.0275	<0.0569	<0.0619	<0.0254	<0.0419	<0.0304	<0.0690	<0.0299	<0.0520	<0.0318	
35	25-Aug-15	1-Sep-15	<0.0366	<0.0374	<0.0295	<0.0364	<0.0358	<0.0296	<0.0207	<0.0187	<0.0073	<0.0323	
36	1-Sep-15	8-Sep-15	<0.0380	<0.0196	<0.0521	<0.0378	<0.0367	<0.0289	<0.0403	<0.0379	<0.0282	<0.0370	
37	8-Sep-15	15-Sep-15	<0.0579	<0.0581	<0.0123	<0.0421	<0.0112	<0.0304	<0.0440	<0.0281	<0.0336	<0.0343	
38	15-Sep-15	22-Sep-15	<0.0282	<0.0342	<0.0558	<0.0347	<0.0341	<0.0348	<0.0390	<0.0330	<0.0447	<0.0303	
39	22-Sep-15	29-Sep-15	<0.0532	<0.0265	<0.0123	<0.0391	<0.0610	<0.0413	<0.0537	<0.0382	<0.0265	<0.0224	

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*	Note
40	29-Sep-15	6-Oct-15	<0.0472	<0.0278	<0.0353	<0.0347	<0.0573	<0.0382	<0.0546	0.053	<0.0404	<0.0521	
41	6-Oct-15	13-Oct-15	<0.0358	<0.0223	<0.0481	<0.0312	<0.0387	<0.0269	<0.0513	<0.0370	<0.0320	<0.0411	
42	13-Oct-15	20-Oct-15	<0.0233	<0.0468	<0.0402	<0.0261	<0.0386	<0.0183	<0.0353	<0.0255	<0.0428	<0.0385	
43	20-Oct-15	28-Oct-15	<0.0370	<0.0376	<0.0321	<0.0359	<0.0301	<0.0223	<0.0332	<0.0387	*	<0.0275	2
44	28-Oct-15	3-Nov-15	<0.0338	<0.0411	<0.0683	<0.0384	<0.0651	<0.0481	<0.0558	<0.0362	<0.0206	<0.0307	
45	3-Nov-15	9-Nov-15	<0.0578	<0.0532	<0.0517	<0.0277	<0.0388	<0.0453	<0.0358	<0.0559	<0.0356	<0.0.296	
46	9-Nov-15	17-Nov-15	<0.0206	<0.0220	<0.0287	<0.0247	<0.0562	<0.0240	<0.0296	<0.0263	<0.0223	<0.0282	
47	17-Nov-15	23-Nov-15	<0.0315	<0.0427	<0.0363	<0.0268	*	<0.0399	<0.0289	<0.0379	<0.0366	*	3
48	23-Nov-15	1-Dec-15	<0.0346	<0.0408	<0.0122	<0.0579	*<0.0334	<0.0420	<0.0492	<0.0425	<0.0492	<0.0335	3
49	1-Dec-15	8-Dec-15	<0.0429	<0.0221	<0.0421	<0.0294	<0.0348	<0.0487	<0.0240	<0.0517	<0.0292	<0.0235	
50	8-Dec-15	15-Dec-15	<0.0302	<0.0261	<0.0553	<0.0413	*<0.0352	<0.0303	<0.0322	<0.0263	<0.0347	<0.0208	3
51	15-Dec-15	21-Dec-15	<0.0378	<0.0351	<0.0272	<0.0392	<0.0374	<0.0222	<0.0425	<0.0083	<0.0466	<0.0368	
52	21-Dec-15	28-Dec-15	<0.0428	<0.0340	<0.0409	<0.0265	<0.0449	<0.0492	<0.0692	<0.0450	<0.0203	<0.0316	

Note:

1. Sample for Site 35 found dislodged from pump and lying on ground- sample determined to be INVALID (CR 15-05977)
2. Sample for Site 35 found with suction tube disconnected Filter showed no signs of sample collection (CR 16-04924)
3. Air Sample Pump found energized but not running at Site 15 and Site 40 (11/23/2015), and at Site 15 (11/15/2015 and 12/15/2015). Samples invalid (CR 16-04949, 15-11875, and 15-12551). Problem identified as faulty vane kits and corrected.

Table 8-6 Vegetation

ODCM required samples denoted by *
units are pCi/kg, wet
Vegetation 2015

LOCATION	TYPE	DATE COLLECTED	I-131	Cs-134	Cs-137
			<60	<60	<80
LOCAL RESIDENCE (Site #47)*		**NONE AVAILABLE**			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
COMMERCIAL FARM (Site #62)*	Red Cabbage	22-Jan-15	<54	<59	<65
	Green Cabbage	22-Jan-15	<42	<44	<73
	Green Cabbage	12-Feb-15	<55	<59	<57
	Savory Cabbage	12-Feb-15	<39	<41	<34
	Savory Cabbage	12-Mar-15	<45	<56	<54
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
		NONE AVAILABLE			
	Green Cabbage	22-Oct-15	<59	<44	<62
	Green Cabbage	20-Nov-15	<42	<42	<75
	Green Cabbage	10-Dec-15	<50	<31	<62
LOCAL RESIDENCE (Site #51)	Lettus	22-Jan-15	<57	<50	<73
	Red Lettuce	12-Feb-15	<53	<48	<54
	Kale	12-Mar-15	<59	<51	<69
	Broccoli Greens	16-Apr-15	<42	<58	<63
	Swiss Chard	16-Apr-15	<39	<59	<52
	Swiss Chard	14-May-15	<47	<45	<57
	Swiss Chard	18-Jun-15	<43	<37	<50
	Swiss Chard	15-Jul-15	<55	<36	<80
	Basil	12-Aug-15	<48	<54	<48
	Basil	23-Sep-15	<54	<48	<70
		NONE AVAILABLE			
		NONE AVAILABLE			
	Lettus	10-Dec-15	<54	<31	<54

Table 8-7 Milk

ODCM required samples denoted by * units are pCi/liter						
SAMPLE LOCATION	**DATE COLLECTED**	**<1 I-131**	**<15 Cs-134**	**<18 Cs-137**	**<60 Ba-140**	**<15 La-140**
Local Resident Goats (Site #51)*	22-Jan-15	<1	<0.8	<0.9	<3	<1
	12-Feb-15	**No Sample Available: newborn goats**				
	12-Mar-15	<1	<0.8	<0.9	<3	<1
	16-Apr-15	<1	<0.8	<0.9	<3	<1
	14-May-15	<1	<0.8	<1	<3	<1
	18-Jun-15	<1	<0.8	<0.9	<3	<1
	15-Jul-15	<1	<0.8	<0.9	<3	<1
	12-Aug-15	<1	<0.8	<1	<3	<0.9
	23-Sep-15	<1	<1	<1	<4	<1.6
	08-Oct-15	<1	<0.7	<0.8	<3	<1
	20-Nov-15	<1	<0.8	<0.9	<3	<1
	10-Dec-15	<1	<0.8	<1	<3	<1
Local Resident Goats (Site #53)*	15-Jan-15	**No Sample Available**				
	20-Feb-15	<1	<0.8	<1	<3	<1
	24-Mar-15	<1	<0.8	<1	<3	<1
	23-Apr-15	<1	<0.8	<1	<3	<1
	21-May-15	<1	<0.8	<1	<3	<1
	19-Jun-15	<1	<0.8	<1	<3	<1
	23-Jul-15	<1	<0.8	<1	<3	<1
	27-Aug-15	<1	<0.8	<1	<3	<0.9
	17-Sep-15	<1	<0.6	<1	<3	<1
	22-Oct-15	<1	<0.9	<1	<4	<1.5
	20-Nov-15	<1	<0.8	<1	<3	<1
	10-Dec-15	<1	<1	<1	<3	<1
Local Resident Goats (Site #54)	15-Jan-15	<1	<0.8	<1	<3	<1
	12-Feb-15	<1	<0.8	<1	<3	<1
	12-Mar-15	<1	<0.7	<0.9	<3	<1
	09-Apr-15	<1	<0.8	<1	<3	<1
	07-May-15	<1	<0.8	<1	<3	<1
	11-Jun-15	<1	<0.8	<1	<3	<0.9
	09-Jul-15	<1	<0.8	<1	<3	<0.9
	13-Aug-15	<1	<0.8	<0.9	<3	<1
	18-Sep-15	<1	<0.7	<0.8	<3	<1
	08-Oct-15	<1	<0.6	<0.7	<3	<1
	12-Nov-15	<1	<0.8	<0.9	<3	<1
	10-Dec-15	<1	<0.8	<0.9	<3	<1

Table 8-8 Drinking Water

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Qtrly Tritium	<4.0 Gross Beta	Note
LOCAL RESIDENCE (Site #48) *	27-Jan-15	<10	<9	<17	<12	<24	<12	<16	<10	<9	<11	<30	<15		<3.33	
	23-Feb-15	<12	<10	<24	<10	<29	<9	<16	<10	<9	<10	<41	<14		<3.09	
	31-Mar-15	<10	<9	<18	<13	<30	<10	<15	<8	<10	<10	<26	<11	<324	3.63±2.11	
	28-Apr-15	<12	<9	<21	<10	<25	<11	<17	<11	<8	<12	<41	<15		3.71±2.02	
	26-May-25	<11	<14	<30	<13	<21	<13	<18	<12	<14	<13	<44	<13		<3.42	
	29-Jun-15	<12	<10	<20	<14	<25	<11	<20	<10	<9	<13	<32	<15	<324	<3.35	
	29-Jul-15	<13	<15	<27	<12	<30	<13	<21	<14	<14	<8	<41	<12		6.09±1.90	
	25-Aug-15	<10	<8	<16	<8	<19	<7	<16	<9	<10	<10	<32	<12		3.65±1.96	
	29-Sep-15	<7	<7	<15	<8	<16	<8	<14	<7	<6	<7	<25	<15	<328	3.65±1.97	
	27-Oct-15	<3	<3	<7	<4	<7	<4	<6	<4	<3	<4	<15	<10		4.26±1.84	
	23-Nov-15	<9	<8	<16	<11	<20	<11	<16	<6	<7	<9	<19	<9		3.96±1.83	
	28-Dec-15	<5	<5	<8	<5	<11	<5	<9	<5	<4	<5	<15	<10	<334	3.17±1.87	
LOCAL RESIDENCE (Site #55)	27-Jan-15	<8	<8	<15	<8	<15	<10	<12	<9	<6	<9	<32	<15		5.24±1.65	
	23-Feb-15	<11	<15	<25	<13	<30	<13	<22	<12	<12	<13	<43	<14		5.34±1.49	
	31-Mar-15	<11	<12	<22	<13	<30	<11	<20	<10	<10	<13	<38	<15	<319	4.24±1.52	
	28-Apr-15	<13	<12	<22	<11	<29	<14	<23	<12	<12	<12	<45	<15		5.34±1.55	
	26-May-25	<11	<11	<20	<10	<24	<13	<17	<11	<11	<13	<37	<15		3.42±1.56	
	29-Jun-15	<13	<13	<21	<11	<25	<10	<18	<10	<12	<12	<34	<15	<323	4.28±1.50	
	29-Jul-15	<11	<8	<17	<12	<19	<10	<17	<9	<10	<11	<31	<15		3.49±1.48	
	25-Aug-15	<9	<11	<22	<13	<25	<11	<19	<10	<10	<9	<36	<15		3.87±1.48	
	29-Sep-15	<8	<9	<14	<7	<17	<9	<14	<7	<7	<9	<26	<15	<328	4.41±1.56	
	28-Oct-15	<5	<5	<10	<6	<13	<5	<8	<6	<5	<6	<18	<15		4.14±1.63	
	23-Nov-15	<10	<10	<21	<10	<21	<10	<17	<9	<9	<12	<33	<9		6.05±1.58	
	28-Dec-15	<10	<10	<19	<10	<20	<8	<17	<10	<8	<11	<32	<15	<335	<2.38	

Table 8.8 Drinking Water

ODCM required samples denoted by *

units are pCi/liter

SAMPLE LOCATION	MONTH ENDPOINT	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Qtrly Tritium	<4.0 Gross Beta	Note
LOCAL RESIDENCE (Site #46) *	27-Jan-15	<9	<8	<19	<9	<18	<10	<16	<8	<8	<9	<35	<12		<2.17	
	23-Feb-15	<13	<15	<27	<15	<26	<14	<22	<14	<11	<11	<46	<14		2.00±1.22	
	31-Mar-15	<8	<9	<23	<13	<29	<12	<19	<11	<11	<15	<37	<15	<320	2.29±1.33	
	28-Apr-15	<12	<12	<27	<14	<24	<13	<24	<10	<12	<13	<44	<13		4.28±1.41	
	26-May-25	<9	<13	<27	<13	<27	<12	<20	<12	<12	<14	<34	<12		3.48±1.50	
	29-Jun-15	<8	<9	<16	<12	<26	<9	<14	<10	<10	<9	<29	<15	<324	<2.08	
	29-Jul-15	<9	<11	<17	<11	<22	<9	<13	<9	<9	<8	<33	<15		2.73±1.40	
	25-Aug-15	<10	<15	<19	<15	<27	<15	<21	<13	<12	<15	<43	<4		<2.07	
	29-Sep-15	<9	<8	<18	<8	<18	<10	<14	<9	<7	<8	<31	<13	<328	3.27±1.44	
	28-Oct-15	<3	<3	<6	<3	<6	<3	<5	<4	<3	<3	<12	<8		2.39±1.44	
	23-Nov-15	<7	<9	<19	<7	<14	<10	<16	<8	<7	<9	<26	<12		3.17±1.38	
	28-Dec-15	<12	<9	<18	<9	<26	<12	<22	<11	<8	<13	<37	<14	<332	<2.24	
LOCAL RESIDENCE (Site #49) *	27-Jan-15	<8	<9	<19	<12	<25	<10	<14	<9	<9	<9	<31	<15		<2.15	
	23-Feb-15	<11	<11	<14	<12	<23	<7	<16	<9	<11	<10	<33	<15		<1.83	
	31-Mar-15	<10	<8	<19	<15	<19	<12	<18	<9	<10	<10	<41	<15	<319	<2.01	
	28-Apr-15	<11	<8	<20	<12	<27	<13	<20	<11	<10	<12	<37	<14		<1.98	
	26-May-25	<11	<10	<25	<12	<25	<11	<17	<9	<11	<12	<37	<13		<2.18	
	29-Jun-15	<10	<11	<21	<13	<27	<12	<21	<10	<10	<13	<42	<15	<325	<2.07	
	29-Jul-15	<11	<8	<17	<10	<23	<10	<16	<9	<9	<10	<34	<14		<2.08	
	25-Aug-15	<12	<13	<18	<8	<25	<15	<22	<14	<10	<13	<44	<11		<2.06	
	29-Sep-15	<8	<7	<14	<7	<15	<8	<11	<7	<6	<8	<22	<15	<325	<2.09	
	28-Oct-15	<5	<6	<10	<6	<11	<6	<9	<6	<5	<6	<23	<14		<2.17	
	23-Nov-15	<1	<1	<2	<1	<2	<1	<2	<2	<1	<1	<4	*<32		3.53±1.40	1
	28-Dec-15	<8	<7	<14	<8	<16	<8	<12	<7	<6	<8	<25	<9	<333	3.04±1.46	

Note:

1. LLD for La-140 not met due to APEX error. CR 15-11873

Table 8-9 Groundwater

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<2000 Tritium
WELL 27ddc (Site #57)*	27-Jan-15	<12	<12	<21	<12	<23	<13	<18	<13	<9	<10	<44	<15	<316
	28-Apr-15	<13	<14	<28	<14	<24	<14	<23	<11	<11	<13	<35	<15	<313
	28-Jul-15	<11	<11	<23	<15	<23	<14	<19	<13	<12	<13	<45	<13	<324
	27-Oct-15	<5	<5	<12	<6	<14	<6	<8	<6	<5	<6	<20	<15	<328
WELL 34abb (Site #58)*	27-Jan-15	<10	<11	<24	<12	<25	<12	<13	<12	<10	<12	<41	<15	<319
	28-Apr-15	<10	<9	<22	<11	<25	<10	<17	<10	<9	<10	<31	<15	<315
	28-Jul-15	<12	<11	<23	<12	<19	<10	<18	<12	<10	<10	<40	<15	<321
	27-Oct-15	<4	< 3	<7	<4	<9	<5	<7	<4	<4	<4	<16	<13	<325

Table 8-10 Surface Water

ODCM required samples denoted by * units are pCi/liter														
SAMPLE LOCATION	**DATE COLLECTED**	**<15 Mn-54**	**<15 Co-58**	**<30 Fe-59**	**<15 Co-60**	**<30 Zn-65**	**<15 Nb-95**	**<30 Zr-95**	**<15 I-131**	**<15 Cs-134**	**<18 Cs-137**	**<60 Ba-140**	**<15 La-140**	**<3000 Tritium**
45 ACRE RESERVOIR (Site #61) *	*27-Jan-15	<11	<9	<20	<11	<22	<12	<19	19±10	<10	<12	<41	<15	<321
	28-Apr-15	<13	<12	<25	<12	<27	<11	<20	<12	<10	<12	<36	<15	<324
	28-Jul-15	<10	<10	<16	<11	<19	<10	<16	13±7	<9	<10	<35	<15	<329
	27-Oct-15	<5	<5	<13	<6	<12	<5	<9	<7	<5	<5	<20	<14	<330
85 ACRE RESERVOIR (Site #60) *	*27-Jan-15	<11	<11	<26	<11	<21	<11	<21	14±12	<10	<12	<44	<14	<327
	28-Apr-15	<10	<9	<19	<15	<23	<9	<17	<12	<10	<14	<33	<12	<338
	*28-Jul-15	<12	<11	<23	<13	<22	<12	<18	19±11	<10	<13	<39	<15	<330
	27-Oct-15	<5	<5	<9	<5	<10	<5	<8	4±4	<4	<5	<19	<14	<328
EVAP POND 1 (Site #59) * CELL 1A	27-Jan-15	<8	<9	<25	<13	<30	<11	<16	<11	<9	<12	<37	<13	1156±222
	28-Apr-15	<11	<10	<26	<10	<29	<11	<21	<11	<11	<13	<43	<14	1415±216
	28-Jul-15	<13	<14	<22	<15	<30	<12	<17	<12	<12	<12	<38	<12	1181±214
	27-Oct-15	<8	<6	<15	<8	<17	<7	<12	<7	<6	<8	<25	<8	1337±220
CELL 1B	27-Jan-15	<10	<12	<25	<10	<21	<11	<18	<11	<11	<9	<38	<14	<338
	*4/28/2015	<11	<11	<22	<10	<26	<12	<21	18±11	<11	<11	<44	<15	926±206
	28-Jul-15	<11	<11	<25	<15	<26	<11	<15	<9	<8	<11	<33	<12	1070±210
	27-Oct-15	<11	<9	<21	<12	<17	<11	<21	<11	<11	<12	<44	<11	748±192
CELL 1C	27-Jan-15	<13	<14	<28	<15	<30	<13	<20	<11	<10	<14	<37	<13	<337
	28-Apr-15	<13	<12	<27	<15	<28	<13	<22	<10	<11	<15	<39	<15	433±198
	28-Jul-15	<9	<11	<28	<13	<30	<10	<20	<12	<9	<13	<36	<10	461±199
	*10/27/2015	<7	<8	<18	<10	<19	<8	<14	23±8	<7	<9	<28	<11	2341±193
	*Recounted and averaged													

Table 8.10 Surface Water

ODCM required samples denoted by * units are pCi/liter														
EVAP POND 2 (Site #63) * CELL 2A	27-Jan-15	<12	<11	<26	<13	<25	<13	<21	<13	<11	<11	<38	<15	456±209
	28-Apr-15	<11	<8	<23	<11	<30	<12	<18	<10	<10	<14	<37	<10	636±201
	*28-Jul-15	<12	<13	<27	<12	<30	<13	<20	14±10	<10	<13	<38	<13	716±205
	27-Oct-15	<4	<4	<9	<5	<9	<5	<7	<5	<4	<5	<17	<7	541±205
CELL 2B	27-Jan-15	<14	<12	<29	<14	<30	<13	<21	<13	<10	<13	<40	<12	889±218
	28-Apr-15	<10	<8	<20	<13	<30	<11	<18	<12	<10	<10	<34	<15	678±202
	28-Jul-15	<11	<10	<22	<12	<26	<10	<17	<11	<9	<10	<39	<15	624±204
	27-Oct-15	<4	<4	<10	<7	<12	<6	<10	<5	<5	<6	<23	<10	537±205
EVAP POND 3 (Site #64) * CELL 3A	27-Jan-15	<12	<12	<29	<13	<26	<11	<19	<13	<10	<12	<41	<15	912±217
	28-Apr-15	<12	<11	<28	<13	<30	<12	<16	<11	<10	<12	<42	<11	1014±208
	28-Jul-15	<12	<11	<24	<13	<30	<11	<23	<11	<10	<14	<36	<14	809±208
	27-Oct-15	<6	<6	<13	<7	<15	<6	<10	<6	<6	<7	<22	<15	745±208
CELL 3B	27-Jan-15	<11	<9	<22	<12	<24	<10	<18	<10	<9	<11	<37	<15	824±215
	28-Apr-15	<11	<11	<27	<14	<30	<11	<19	<10	<10	<13	<46	<15	435±196
	28-Jul-15	<10	<9	<23	<12	<30	<9	<18	<10	<11	<12	<33	<12	793±208
	27-Oct-15	<8	<7	<18	<9	<22	<8	<13	<7	<7	<9	<26	<15	819±210

*Recounted and averaged

Table 8.10 Surface Water

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium **
	6-Jan-15	<12	<10	<23	<15	<23	<11	<18	19 ± 9	<10	<11	<36	<13	
	13-Jan-15	<15	<11	<23	<12	<27	<9	<18	18 ± 12	<10	<12	<36	<13	
	20-Jan-15	<11	<11	<19	<12	<30	<9	<21	15 ± 7	<10	<12	<40	<14	
	27-Jan-15	<12	<8	<24	<15	<27	<13	<22	33±11	<10	<11	<39	<15	<331
	3-Feb-15	<11	<12	<24	<15	<23	<13	<16	45±11	<10	<13	<42	<10	
	10-Feb-15	<13	<12	<23	<11	<29	<11	<21	48±13	<10	<11	<36	<12	
	17-Feb-15	<12	<12	<30	<15	<22	<14	<21	40±13	<12	<11	<44	<13	
	23-Feb-15	<9	<9	<19	<12	<20	<12	<18	48±12	<9	<11	<40	<15	<344
	3-Mar-15	<11	<10	<18	<15	<24	<9	<20	36±12	<10	<12	<33	<13	
	10-Mar-15	<10	<13	<21	<12	<27	<12	<20	42±13	<10	<10	<38	<12	
	16-Mar-15	<11	<10	<19	<10	<17	<12	<19	67±14	<9	<11	<34	<14	
	23-Mar-15	<11	<11	<25	<13	<30	<9	<18	46±11	<9	<11	<34	<12	
	31-Mar-15	<11	<8	<23	<11	<27	<10	<22	39±12	<8	<11	<33	<15	<342
WRF	7-Apr-15	<11	<9	<21	<12	<22	<10	<16	43±12	<10	<12	<31	<12	
INFLUENT	14-Apr-15	NO SAMPLE- WRF OUTAGE												
	21-Apr-15	NO SAMPLE- WRF OUTAGE												
	28-Apr-15	<11	<11	<22	<10	<19	<9	<18	<11	<10	<10	<34	<14	<326
	5-May-15	<11	<12	<26	<13	<28	<12	<19	18±11	<11	<14	<35	<15	
	12-May-15	<13	<12	<24	<11	<29	<13	<18	18±9	<11	<13	<39	<8	
	19-May-15	<11	<15	<21	<13	<23	<14	<19	<12	<13	<12	<47	<15	
	26-May-15	<9	<10	<27	<11	<26	<10	<16	12±9	<10	<11	<35	<15	<329
	2-Jun-15	<12	<8	<18	<14	<19	<10	<18	17±11	<9	<11	<40	<15	
	9-Jun-15	<11	<10	<28	<11	<29	<12	<18	26±9	<10	<11	<38	<13	
	16-Jun-15	<13	<13	<25	<13	<26	<13	<20	33±14	<12	<13	<38	<15	
	23-Jun-15	<8	<9	<23	<10	<23	<9	<16	11±9	<9	<11	<37	<15	
	29-Jun-15	<11	<10	<20	<11	<26	<9	<15	17±10	<10	<10	<29	<15	<334
	7-Jul-15	<12	<13	<27	<15	<25	<13	<21	18±10	<10	<15	<42	<15	
	14-Jul-15	<12	<11	<28	<14	<30	<14	<23	24±9	<11	<13	<45	<15	
	21-Jul-15	<9	<10	<20	<13	<24	<9	<19	20±11	<8	<13	<36	<15	

** monthly composite

Table 8.10 Surface Water

**ODCM required samples denoted by *
units are pCi/liter**

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<3000 Tritium **	Note
	28-Jul-15	<10	<13	<20	<12	<30	<14	<20	30±11	<11	<13	<34	<13	<332	
	4-Aug-15	<11	<9	<22	<13	<30	<10	<18	25±10	<10	<11	<38	<13		
	11-Aug-15	<12	<14	<25	<14	<29	<15	<22	12±13	<12	<15	<48	<14		
	18-Aug-15	<12	<13	<17	<15	<28	<10	<25	<12	<12	<12	<37	<15		
	25-Aug-15	<12	<14	<16	<15	<21	<12	<20	<12	<11	<12	<32	<14		
	1-Sep-15	<13	<11	<27	<15	<29	<13	<22	<13	<12	<13	<42	<9		
	8-Sep-15	<8	<8	<17	<9	<19	<8	<14	9±6	<8	<8	<29	<24		1
	15-Sep-15	<6	<6	<11	<6	<12	<6	<10	<6	<6	<6	<20	<8		
	22-Sep-15	<1	<1	<2	<1	<2	<1	<2	9±3	<1	<1	<6	*<13	<334	
	29-Sep-15	<6	<6	<14	<7	<13	<6	<10	17±6	<6	<6	<22	<10	<341	
	6-Oct-15	<9	<7	<17	<8	<18	<8	<16	<23±9	<8	<10	<32	<10		
	13-Oct-15	<7	<6	<13	<6	<14	<7	<11	7±5	<5	<8	<20	<10		
WRF	20-Oct-15	NO SAMPLE- WRF OUTAGE													
INFLUENT	27-Oct-15	<7	<7	<13	<7	<13	<7	<10	14±8	<6	<7	<26	<14	<338	
	3-Nov-15	<4	<4	<8	<3	<8	<4	<6	4±3	<3	<4	<11	<4		
	9-Nov-15	<9	<7	<13	<11	<15	<11	<17	5±6	<7	<11	<35	<12		
	17-Nov-15	<6	<6	<11	<6	<16	<6	<11	8±6	<5	<6	<20	<7		
	23-Nov-15	<3	<3	<6	<2	<5	<3	<5	16±6	<2	<3	<14	<158	<336	1
	1-Dec-15	<6	<6	<12	<5	<9	<5	<10	<7	<4	<5	<20	<14		
	8-Dec-15	<9	<9	<16	<10	<18	<9	<13	<8	<6	<11	<24	<9		
	*12/15/2015	<7	<6	<11	<7	<12	<6	<12	9±4	<6	<7	<20	<7		
	21-Dec-15	<7	<8	<14	<9	<15	<6	<12	7±7	<6	<6	<21	<11		
	28-Dec-15	<3	<3	<6	<4	<7	<4	<6	15±4	<3	<4	<11	<6	<346	

*Recounted and averaged

** monthly composite

1. LLD for La-140 not met due to APEX software issue documented in CR 15-11873. WRF Influent source is Phoenix Sewage; samples taken prior to interface with plant. Not ODCM sample location; reported for trending.

Table 8.10 Surface Water

**ODCM required samples denoted by *
units are pCi/liter**

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium
SEDIMENTATION BASIN #2	6-Jan-15							**EMPTY**						
	13-Jan-15							**EMPTY**						
	20-Jan-15							**EMPTY**						
	27-Jan-15	<8	<9	<18	<12	<25	<11	<16	<10	<9	<11	<33	<15	<331
	3-Feb-15	<13	<15	<29	<15	<28	<12	<20	<10	<12	<13	<38	<12	<362
	10-Feb-15	<13	<11	<29	<11	<30	<12	<23	<10	<10	<12	<47	<14	<363
	17-Feb-15	<10	<13	<23	<12	<24	<13	<19	<11	<11	<13	<37	<14	542±215
	23-Feb-15	<14	<12	<26	<11	<30	<14	<19	<10	<12	<12	<40	<13	362±219
	3-Mar-15	<11	<12	<19	<7	<29	<12	<18	<10	<11	<13	<31	<15	483±208
	10-Mar-15	<11	<14	<21	<11	<25	<12	<22	<10	<9	<15	<37	<14	515±212
	16-Mar-15	<13	<11	<26	<15	<28	<14	<21	<10	<10	<13	<43	<12	569±210
	23-Mar-15	<12	<12	<22	<13	<24	<11	<15	<11	<11	<10	<30	<15	416±213
	31-Mar-15							**EMPTY**						
	7-Apr-15							**EMPTY**						
	14-Apr-15							**EMPTY**						
	21-Apr-15							**EMPTY**						
	28-Apr-15							**EMPTY**						
	5-May-15	<10	<13	<18	<15	<22	<13	<23	<11	<10	<12	<50	<15	<342
	12-May-15							**EMPTY**						
	19-May-15	<7	<7	<19	<10	<19	<7	<14	<7	<7	<9	<32	<12	433±208
	27-May-15	<10	<9	<19	<10	<24	<11	<17	<10	<9	<12	<34	<12	<343
	2-Jun-15							**EMPTY**						
	9-Jun-15							**EMPTY**						
	16-Jun-15							**EMPTY**						
	23-Jun-15							**EMPTY**						
	29-Jun-15							**EMPTY**						

Table 8.10 Surface Water

ODCM required samples denoted by * units are pCi/liter														
SEDIMENTATION BASIN #2	7-Jul-15							**EMPTY**						
	14-Jul-15							**EMPTY**						
	21-Jul-15	<14	<14	<25	<13	<20	<15	<19	<11	<10	<10	<46	<3	<353
	*7/28/2015	<10	<9	<20	<12	<24	<11	<18	<9	<9	<11	<36	<15	<348
	4-Aug-15	<10	<10	<17	<14	<24	<10	<21	<9	<11	<11	<37	<15	<341
	11-Aug-15							**EMPTY**						
	18-Aug-15							**EMPTY**						
	22-Sep-15							**EMPTY**						
	1-Sep-15							**EMPTY**						
	8-Sep-15							**EMPTY**						
	15-Sep-15							**EMPTY**						
	22-Sep-15							**EMPTY**						
	29-Sep-15							**EMPTY**						
	6-Oct-15							**EMPTY**						
	13-Oct-15							**EMPTY**						
	20-Oct-15							**EMPTY**						
	27-Oct-15							**EMPTY**						
	3-Nov-15							**EMPTY**						
	9-Nov-16							**EMPTY**						
	17-Nov-15							**EMPTY**						
	23-Nov-15							**EMPTY**						
	1-Dec-15							**EMPTY**						
	8-Dec-15							**EMPTY**						
	15-Dec-15							**EMPTY**						
	21-Dec-15							**EMPTY**						
	28-Dec-15							**EMPTY**						
	* Duplicate on Gamma only; results avereraged													

Table 8-11 Sludge/Sediment

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

SAMPLE LOCATION	DATE COLLECTED	<6,000 I-131	<150 Cs-134	<180 Cs-137	In-111
WRF CENTRIFUGE WASTE SLUDGE	6-Jan-15	167 ± 81	<122	<107	
	13-Jan-15	374 ± 149	<108	<136	
	20-Jan-15	296 ± 122	<98	<83	
	27-Jan-15	354±148	<125	<173	
	3-Feb-15	461±140	<104	<80	
	10-Feb-15	875±186	<103	<110	
	17-Feb-15	441±133	<103	<123	
	23-Feb-15	405±181	<102	<176	
	3-Mar-15	457±178	<147	<140	
	10-Mar-15	507±165	<101	<125	
	16-Mar-15	377±119	<96	<140	
	23-Mar-15	538±146	<117	<141	
	31-Mar-15	526±139	<111	<105	
	7-Apr-15	588±163	<149	<167	
	14-Apr-15	NO SAMPLE- WRF OUTAGE			
	21-Apr-15	NO SAMPLE- WRF OUTAGE			
	28-Apr-15	265±155	<146	<171	
	5-May-15	None Detected	<143	<98	
	12-May-15	399±150	<150	<162	
	19-May-15	229±115	<96	<128	
	26-May-15	None Detected	<101	<169	
	2-Jun-15	344±131	<136	<158	
	9-Jun-15	166±131	<146	<180	
	16-Jun-15	396±154	<28	<161	
	23-Jun-15	937±193	<117	<100	
	29-Jun-15	686±203	<143	<164	
	7-Jul-15	635±152	<105	<132	
	14-Jul-15	311±122	<102	<113	
	21-Jul-15	512±127	<84	<127	
	28-Jul-15	772±192	<128	<175	
	4-Aug-15	680±149	<80	<78	
	11-Aug-15	475±140	<117	<82	
	18-Aug-15	487±123	<107	<29	

Table 8.11 Sludge/Sediment

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

SAMPLE LOCATION	DATE COLLECTED	I-131	Cs-134	Cs-137	In-111
WRF CENTRIFUGE WASTE SLUDGE	25-Aug-15	284±133	<145	<169	
	1-Sep-15	368±119	<68	<114	
	8-Sep-15	399±103	<42	<52	
	15-Sep-15	586±143	<79	<120	
	22-Sep-15	540±178	<149	<173	
	29-Sep-15	569±144	<146	<168	
	6-Oct-15	431±146	<116	<151	
	13-Oct-15	661±184	<117	<132	
	20-Oct-15	NO SAMPLE- WRF OUTAGE			
	27-Oct-15	NO SAMPLE- WRF OUTAGE			
	3-Nov-15	None Detected	<122	<106	
	9-Nov-15	175±116	<84	<103	
	17-Nov-15	409±138	<113	<177	
	24-Nov-15	296±150	<82	<30	
	1-Dec-15	452±155	<99	<174	
	8-Dec-15	None Detected	<102	<137	
	15-Dec-15	267±150	<134	<128	
	21-Dec-15	160±76	<68	<69	
	29-Dec-15	341±84	<63	<47	
SEDIMENTATION BASIN #2	No Sample				

Table 8.11 Sludge/Sediment
Cooling Tower Sludge

Unit Cycle	Approximate Volume (yd^3)	Isotope	Activity Range (pCi/g)	Sample Type
U3R17	375	All principal gamma emitters	<MDA	Towers/Canal Sludge
U3R18	295	All principal gamma emitters	Cs-137/ 2.48 E-1	Towers/Canal Sludge
U2R19	338	All principal gamma emitters	<MDA	Towers/Canal Sludge

Note: The Cs-137 identified in U3R18 cooling tower sludge is atypical and meets ARRA SAL 7-368 criteria for onsite landfill disposal. ARRA analysis found all samples to meet criteria for disposal in the onsite landfill per SAL 7-368.

Table 8-12 Hard -To-Detect Radionuclide Results

Hard-To-Detect Radionuclide (pCi/Liter)						
Sample Location	**Well number**	**Sample Date**	**C-14**	**Fe-55**	**Ni-63**	**Sr-90**
Unit 1 (outside RCA)	APP-12	12/22/2015	<60.2	<145	<3.62	<1.92
Unit 2 (inside RCA)	H0A	12/31/2015	<58.3	<148	<3.90	<1.99
Unit 3 (inside RCA)	H2	12/29/2015	<58.7	<162	<3.58	<1.90

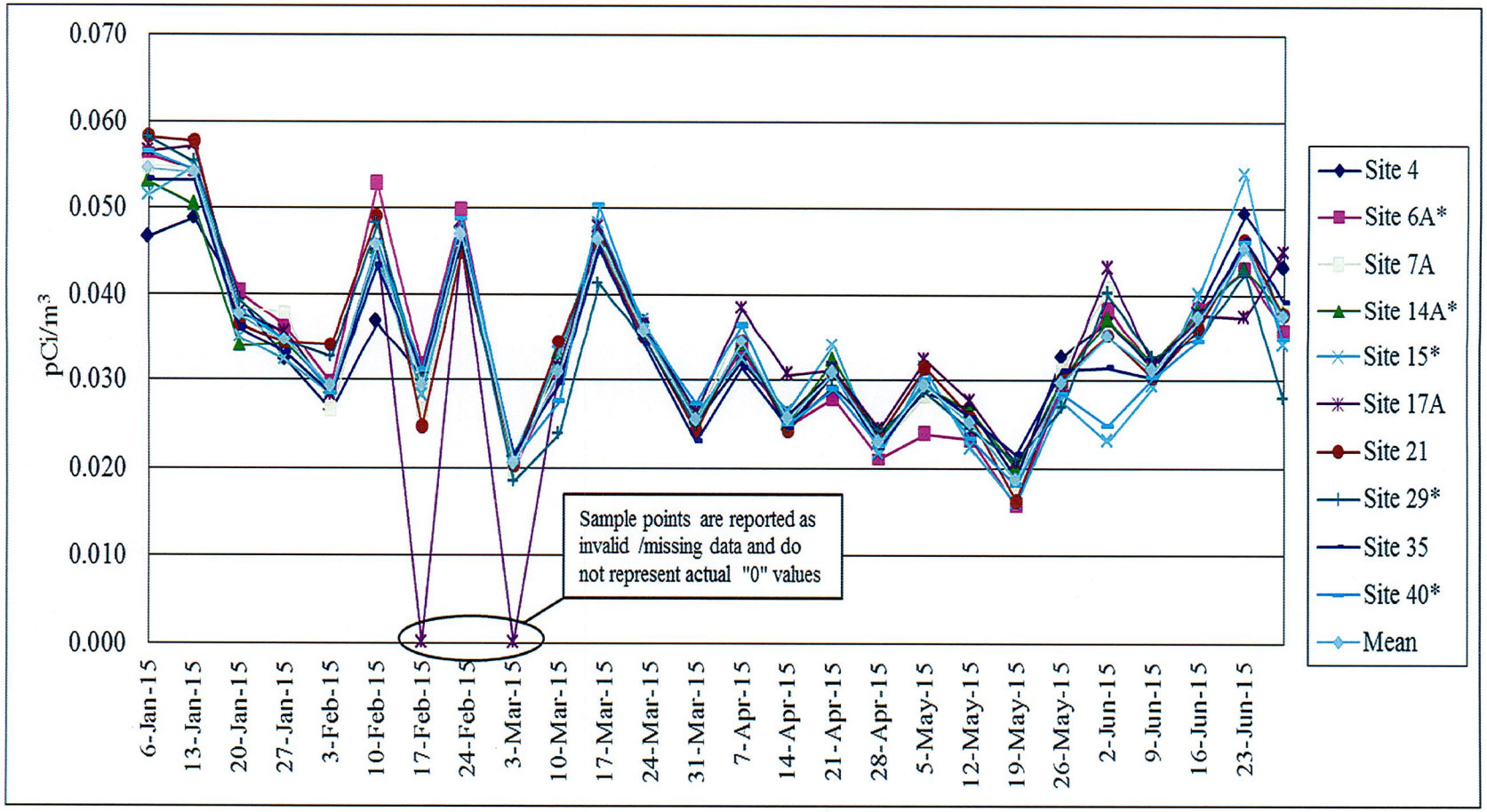


Figure 8-1 Gross Beta in Air, 1st - 2nd Quarter

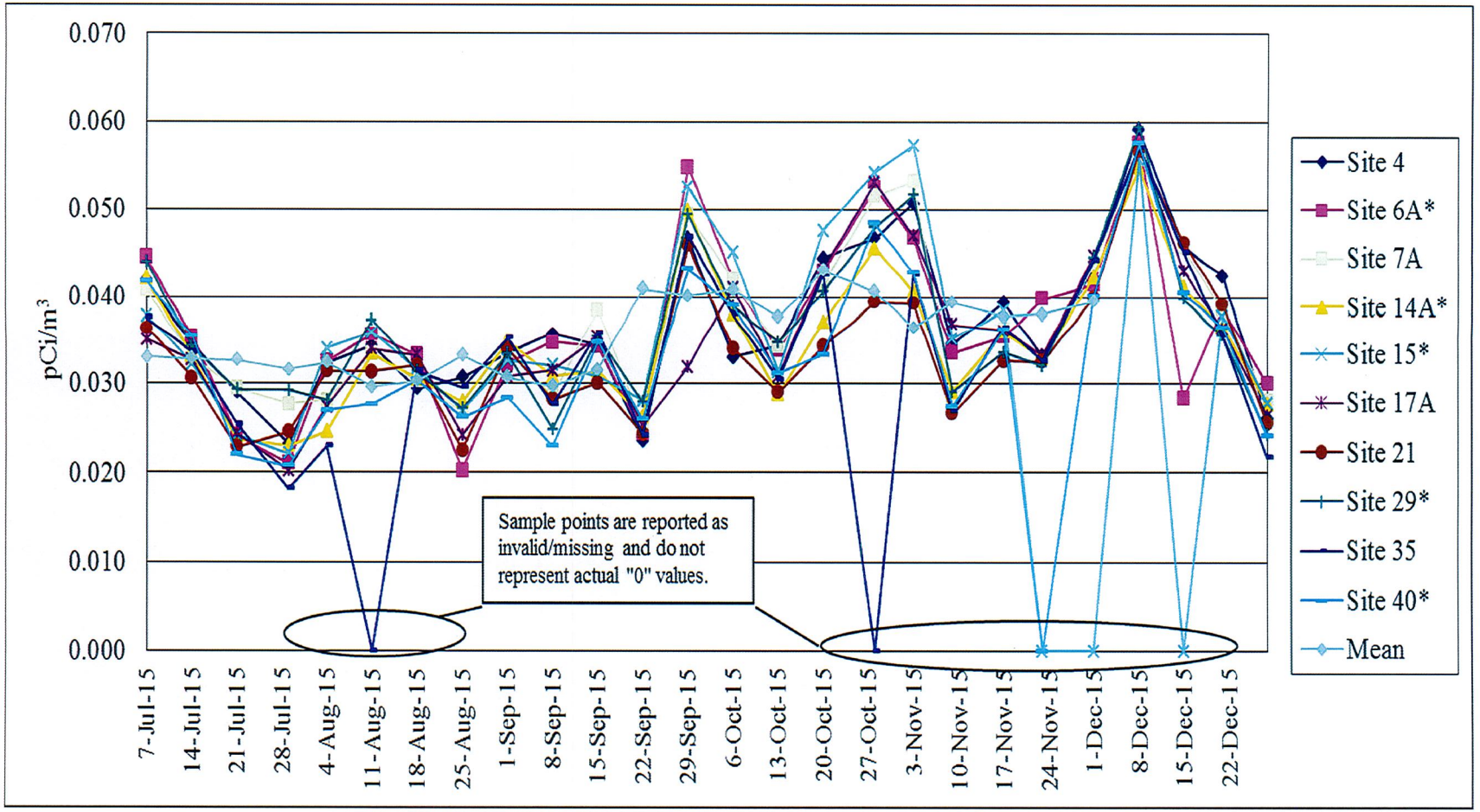


Figure 8-2 Gross Beta in Air, 3rd - 4th Quarter

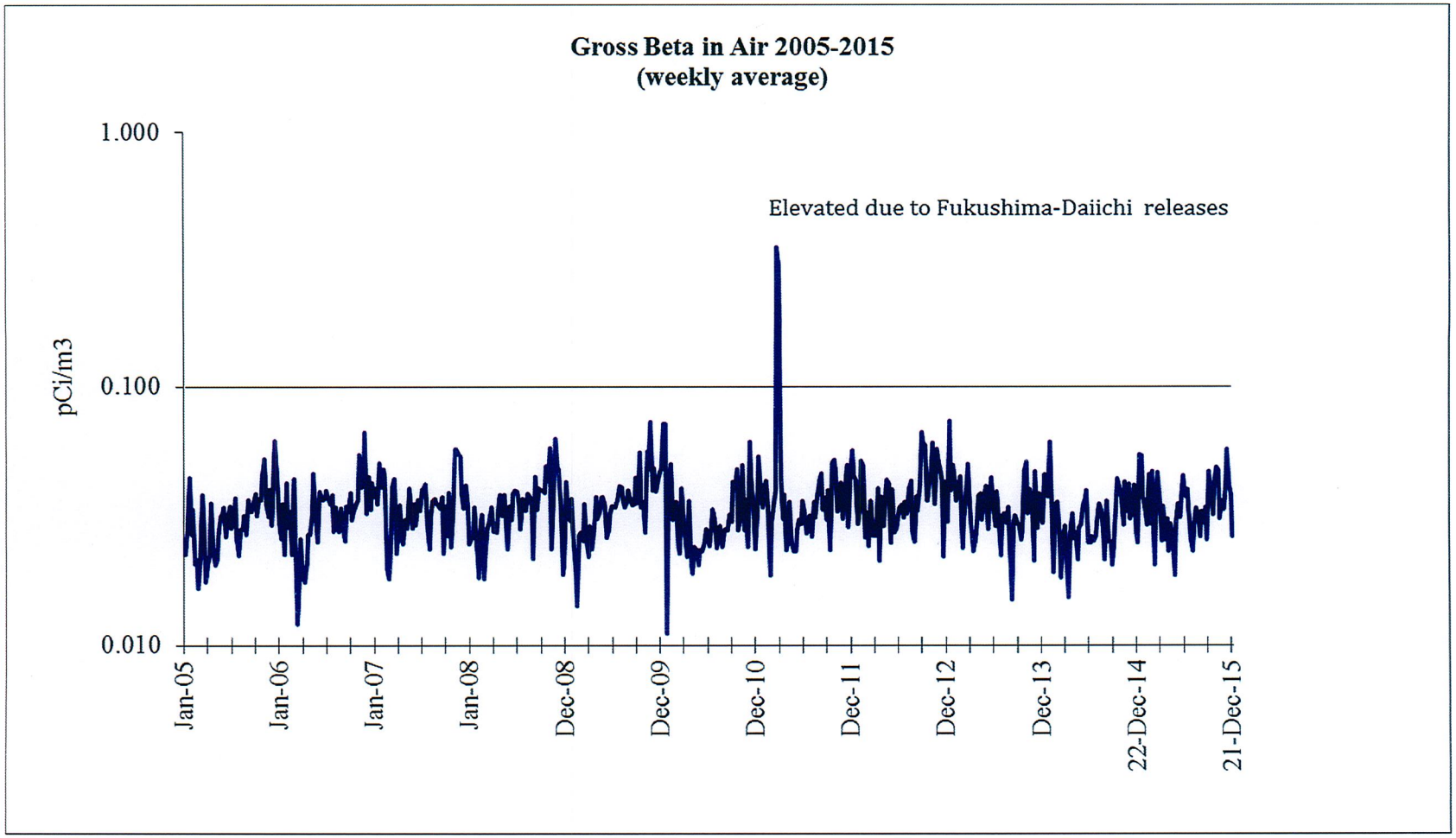


Figure 8-3 Historical Gross Beta in Air (Weekly System Average)

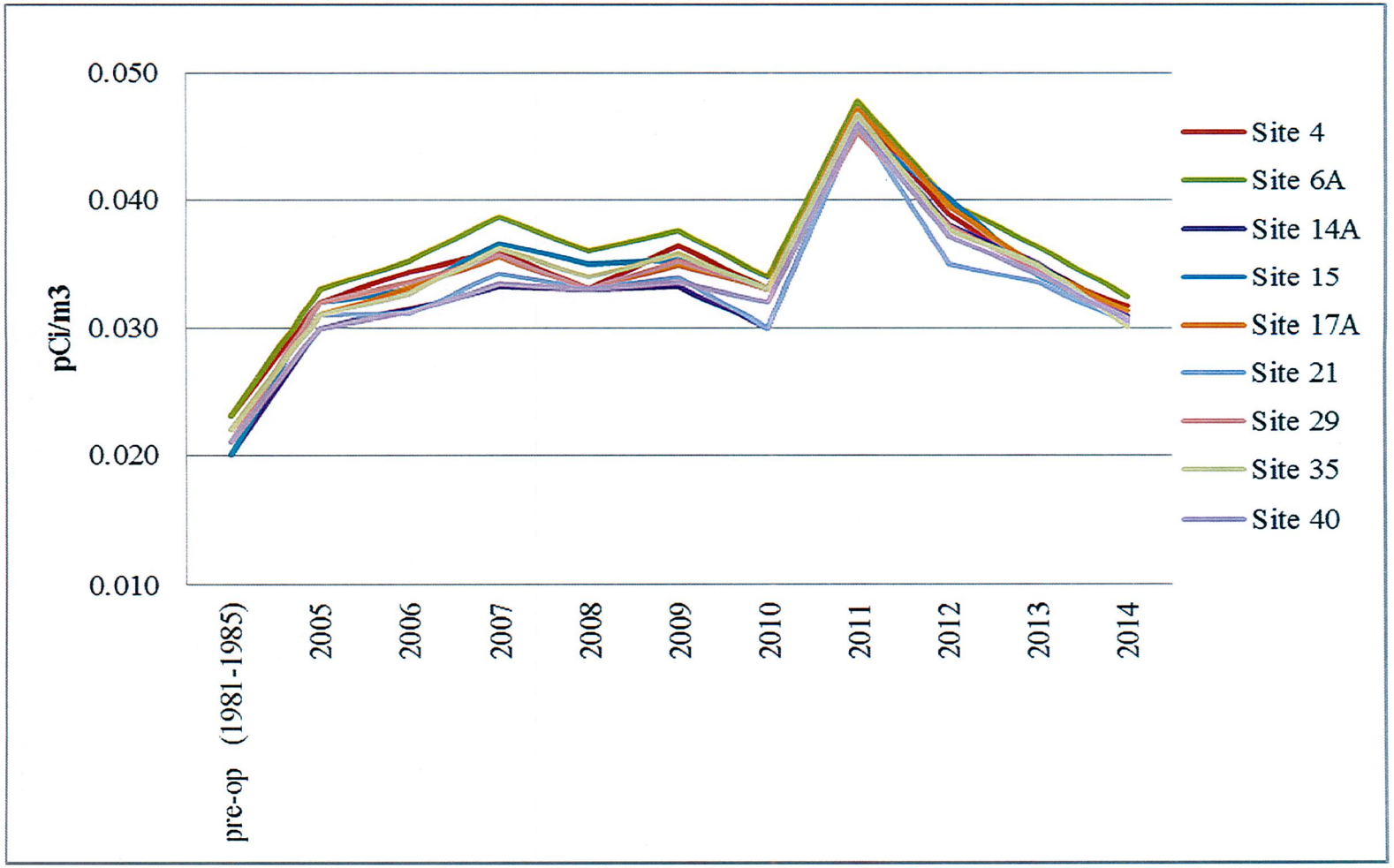


Figure 8-4 Historical Gross Beta in Air (Annual Site to Site Comparisons) Compared to Pre-Op

Note: 7A is not included due to the location change since pre-operational period. The elevated 2011 annual average values are attributed to the Fukushima-Daiichi release.

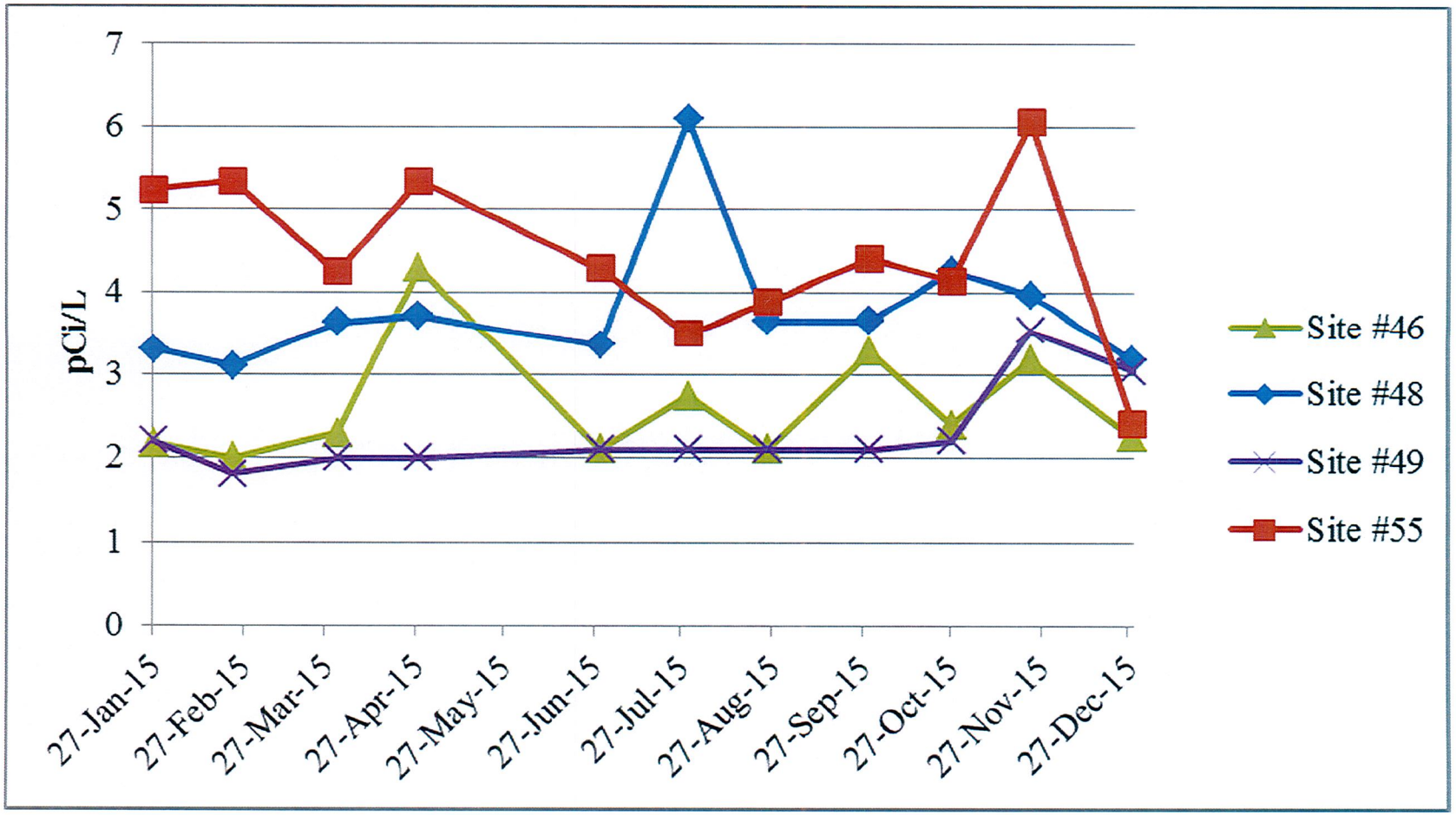


Figure 8-5 Gross Beta in Drinking Water

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

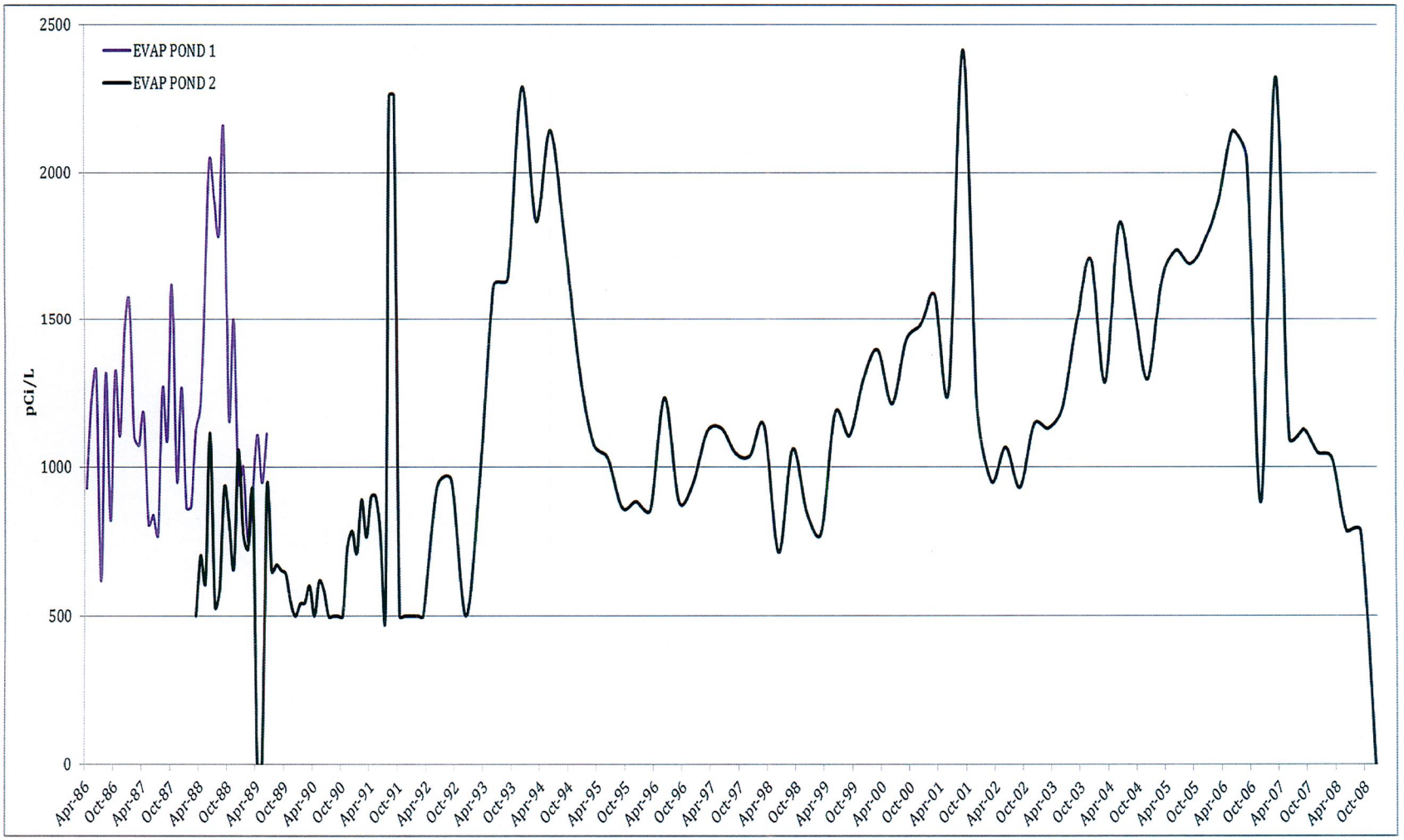


Figure 8-6 Evaporation Pond Tritium Activity (Pre-Op- 2008)

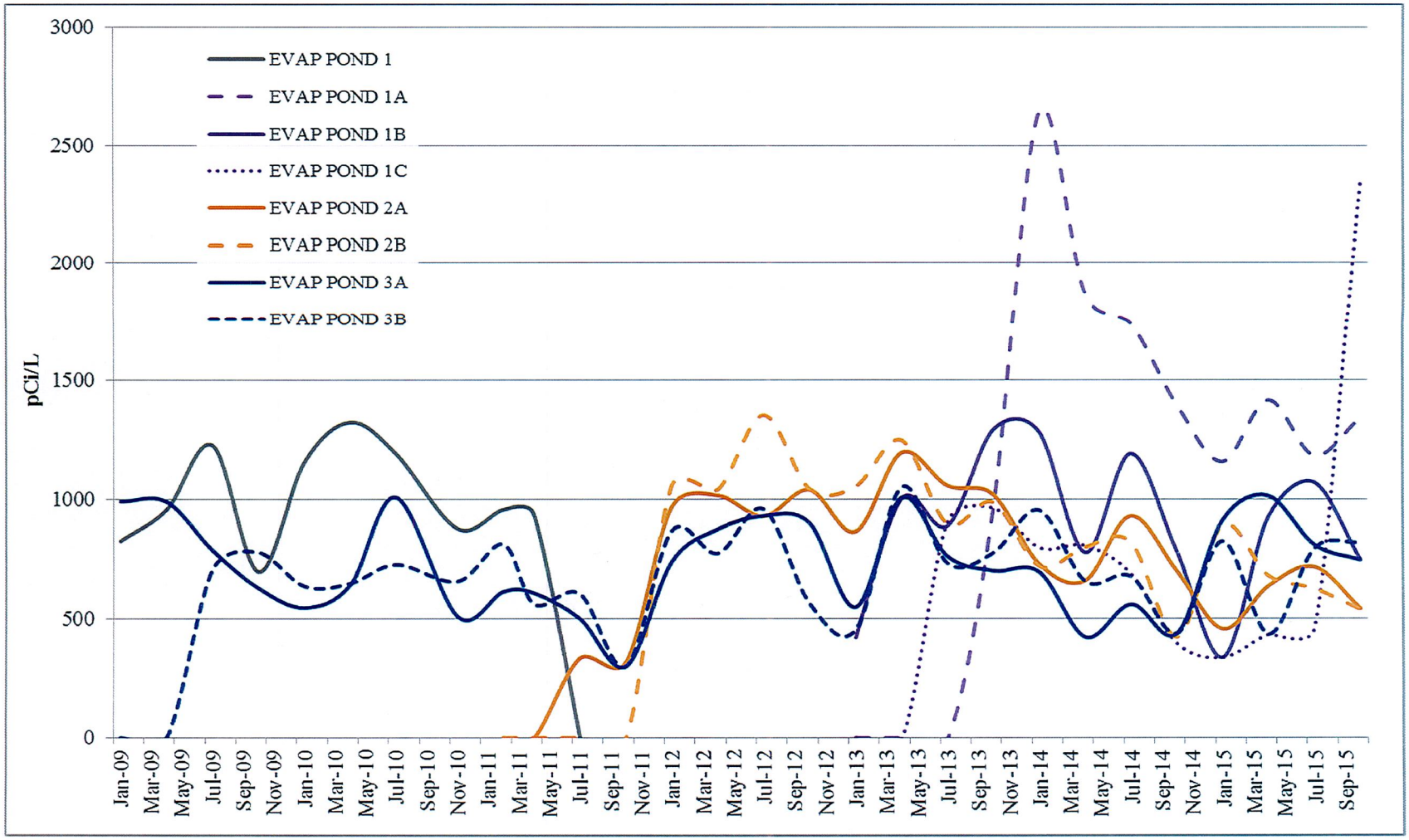


Figure 8-7 Evaporation Pond Tritium Activity (2009-2015)

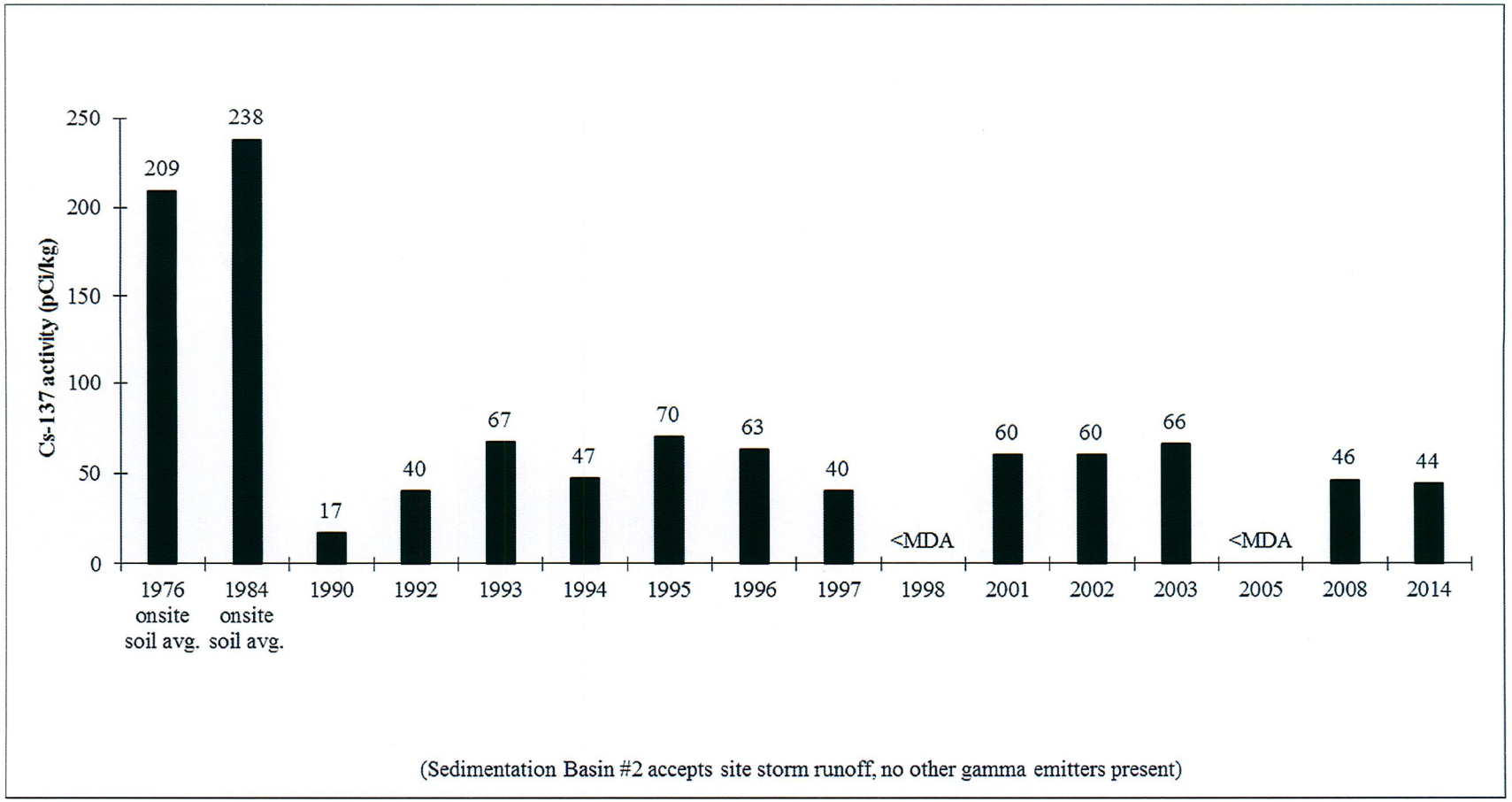


Figure 8-8 Sedimentation Basin 2 Cs-137

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 Figure 2-1 and Figure 2-2 and are described in Table 9-1. TLD results for 2015 are presented in Table 9-2. Historical environmental gamma radiation results for 1985 through 2015 are presented in graphical form on Figure 9-1 (excluding transit control TLD #45).

Figure 9-2 depicts the environmental TLD results from 2015 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

(Distance and direction 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.

Table 9 1 TLD Site Locations

(Distance and direction are relative to Unit 2 in miles)

TLD Site	Location	Location Description
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
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	22.8	24.6	24.3	26.7	24.6
2	21.3	20.8	21.6	23.7	21.9
3	23.6	23.7	23.3	24.8	23.9
4	24.7	25.2	24.3	26.1	25.1
5	23.4	21.9	21.4	23.3	22.5
6 (control)	25.8	25.8	25.0	28.0	26.2
7	25.4	25.1	25.1	27.4	25.8
8	23.5	23.2	23.1	25.9	23.9
9	27.8	28.0	27.5	29.8	28.3
10	24.2	23.0	23.9	25.2	24.1
11	24.5	24.1	23.9	27.1	24.9
12	23.6	23.7	23.8	24.8	24.0
13	26.6	25.0	26.3	26.8	26.2
14	24.8	25.1	24.4	25.6	25.0
15	23.3	23.7	23.3	24.2	23.6
16	23.0	21.8	21.3	23.3	22.4
17	24.2	24.1	24.6	25.7	24.7
18	22.9	22.1	24.4	25.0	23.6
19	26.6	24.2	26.1	26.7	25.9
20	24.8	24.4	24.2	26.2	24.9
21	25.9	25.8	25.9	26.8	26.1
22	27.6	25.9	25.9	27.0	26.6
23	22.8	22.8	22.8	24.4	23.2
24	22.7	23.4	22.2	25.3	23.4
25	23.6	24.1	22.4	26.1	24.1
26	27.9	27.3	28.5	29.5	28.3
27	26.4	27.1	26.9	28.1	27.1
28	26.2	26.0	25.3	26.8	26.1
29	24.4	24.3	24.6	24.9	24.6
30	27.1	25.4	25.2	28.0	26.4
31	23.4	22.4	22.8	24.4	23.3
32	24.9	26.0	25.6	27.3	26.0
33	27.3	25.4	25.7	27.9	26.6
34	28.2	28.5	28.1	29.9	28.7
35	29.9	31.8	31.8	33.9	31.9
36	26.0	26.2	24.9	27.4	26.1
37	23.7	24.2	23.4	25.7	24.3
38	27.8	26.4	27.2	30.2	27.9
39	25.5	23.6	23.7	25.3	24.5
40	24.9	25.8	25.3	27.3	25.8
41	26.1	25.9	27.3	27.6	26.7
42	27.4	26.3	27.4	28.9	27.5
43	27.2	26.2	28.7	28.9	27.8
44 (control)	22.9	22.8	24.4	24.6	23.7
45 (transit control)	5.5	5.5	5.3	6.0	5.6
46	23.5	24.7	24.1	23.3	23.9
47	23.9	23.8	23.5	25.1	24.1
48	25.7	24.9	24.2	23.9	24.7
49	23.5	22.4	22.2	23.7	23.0
50	*	18.3	19.1	20.8	19.4

***TLDs missing due to vandalism**

Figure 9-1 Network Environmental TLD Exposure Rates

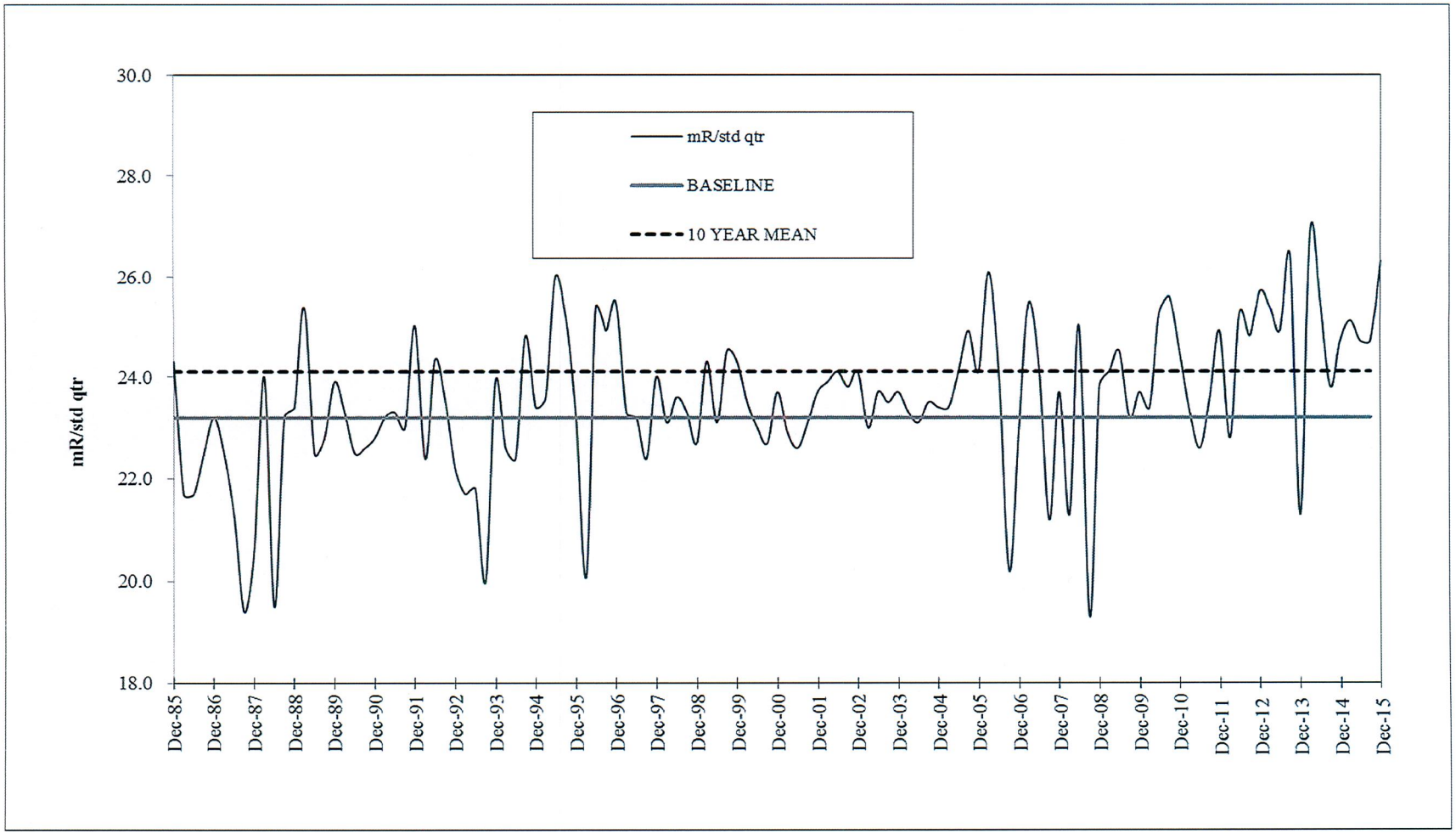
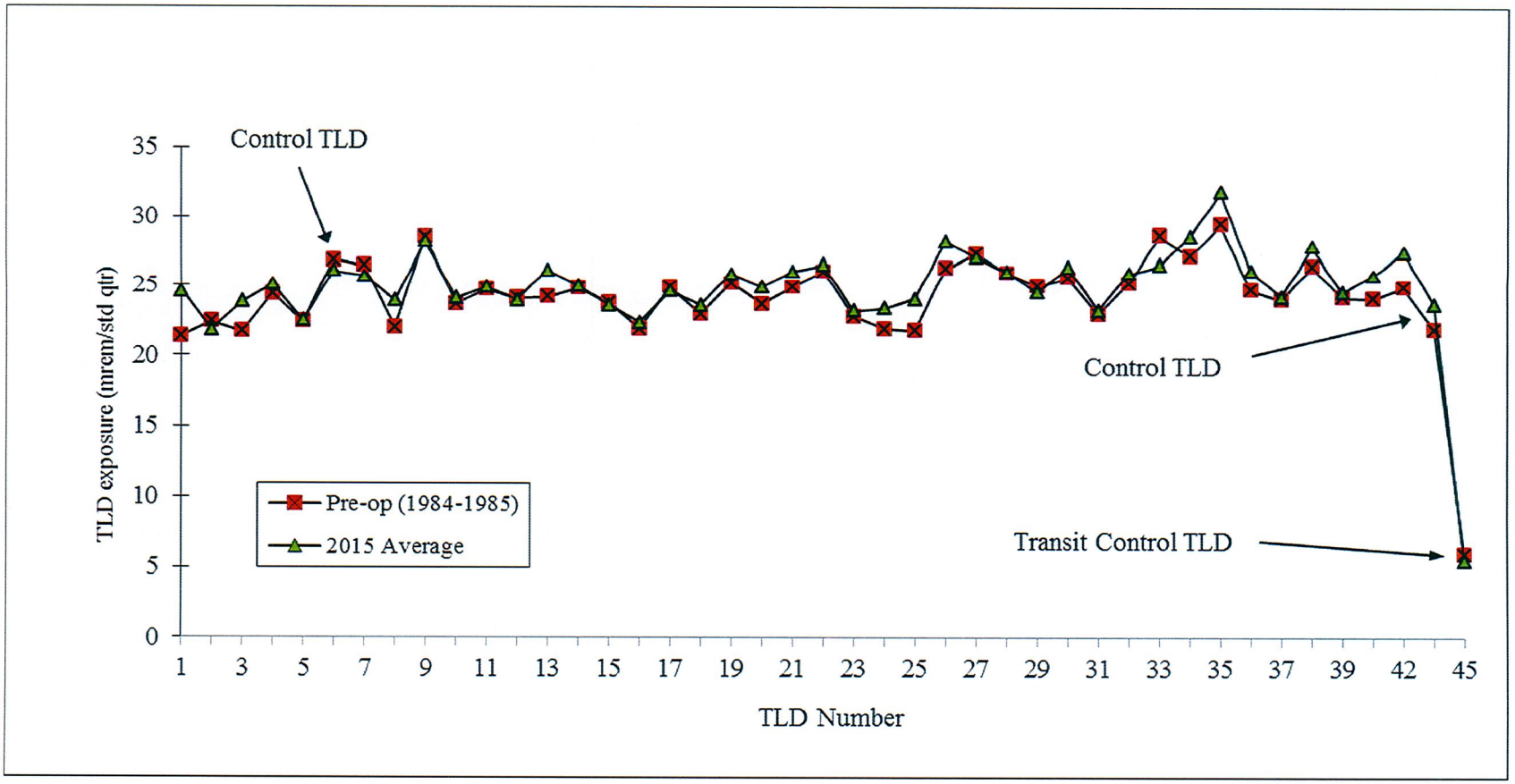


Figure 9-2 Environmental TLD Comparison- Pre-Operational VS 2015



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 replaced at a 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 June 2015.

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 Land Use Census Table 10-1 and discussed below. The directions and distances listed are in sectors and miles from the Unit 2 containment.

10.2. Census Results

Nearest Resident

There was no change in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.248 mRem.

Milk Animal

There was no change in milk animal status from the previous year. Dose calculations indicated the highest dose to be 0.399 mRem.

Vegetable Gardens

One garden was added to the ODCM as a required sampling location. This location was identified as part of the 2014 Land Use Census; however, due to the garden not meeting the required size of 500 square feet, it was sampled as a Supplemental sample. In 2015, the garden was identified as meeting the minimum 500 square foot size and added to the ODCM. Dose calculations indicated the highest dose to be 0.321 mRem.

See Table 10-1for a summary of the specific results and Table 2-1 for current sample locations.

Figure 10-1through Figure 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, and temperature)
- Concurrent meteorology at the time of effluent releases
- Exposure pathways

Table 10-1 Land Use Census

(Distance and direction are relative to Unit 2 in miles)

Sector	Nearest Resident	Nearest Garden	Nearest Milk Animal (Cow/Goat)	Calculated Dose (mRem)	Change from 2014
N	1.55	3.10	3.66	Resident 7.24E-2 Garden 1.66E-1 Milk 1.57E-1	
NNE	1.52	3.30	3.05	Resident 1.35E-1 Garden 3.21E-1 Milk 3.99E-1	
NE	2.16	NONE	NONE	Resident 1.49E-1	
ENE	2.05	4.84	4.84	Resident 1.52E-1 Garden 2.05E-1 Milk 2.05E-1	Garden location added.
E	2.81	NONE	NONE	Resident 1.15E-1	
ESE	1.95	NONE	NONE	Resident 2.48E-1	
SE	3.36	NONE	NONE	Resident 2.23E-1	
SSE	NONE	NONE	NONE	NA	
S	NONE	NONE	NONE	NA	
SSW	NONE	NONE	NONE	NA	
SW	1.39	NONE	NONE	Resident 1.71E-1	
WSW	0.75	NONE	NONE	Resident 1.26E-1	
W	0.70	NONE	NONE	Resident 7.09E-2	
WNW	NONE	NONE	NONE	NA	
NW	0.93	NONE	NONE	Resident 7.70E-2	
NNW	1.30	NONE	NONE	Resident 6.21E-2	

Comments:

Dose calculations were performed using GASPAR code and 2015 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.

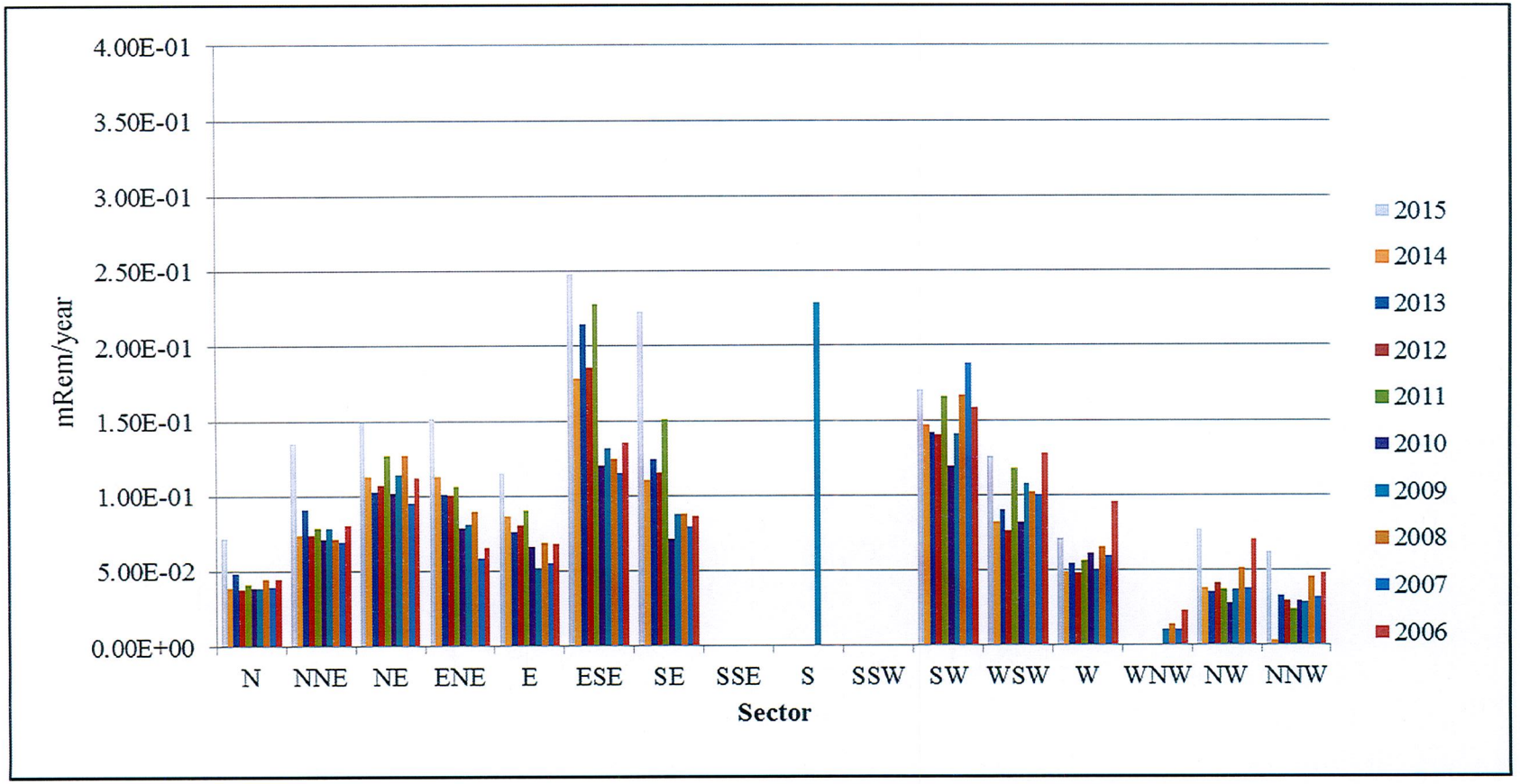


Figure 10-1 Historical Comparison of Nearest Resident Dose

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

Historical annual average least prevalent wind direction is from the SE; the second least prevalent is from the ESE. This attributes to the lower doses assigned to the residents in the WNW, NW, and NNW sectors.

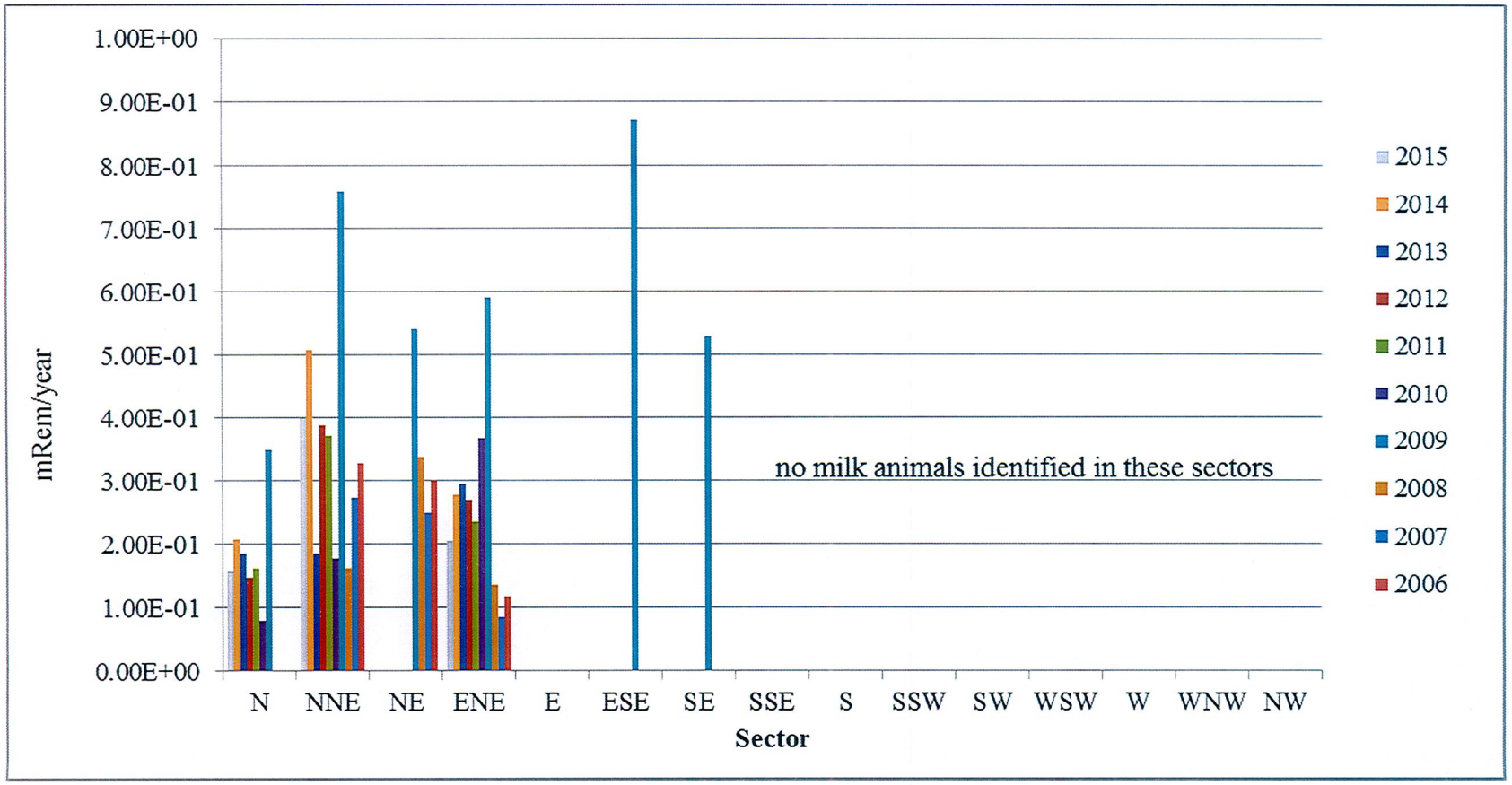


Figure 10-2 Historical Comparison of Nearest Milk Animal Dose

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.

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 does are conservative due to the inclusion of pastured feed as part of the calculation.

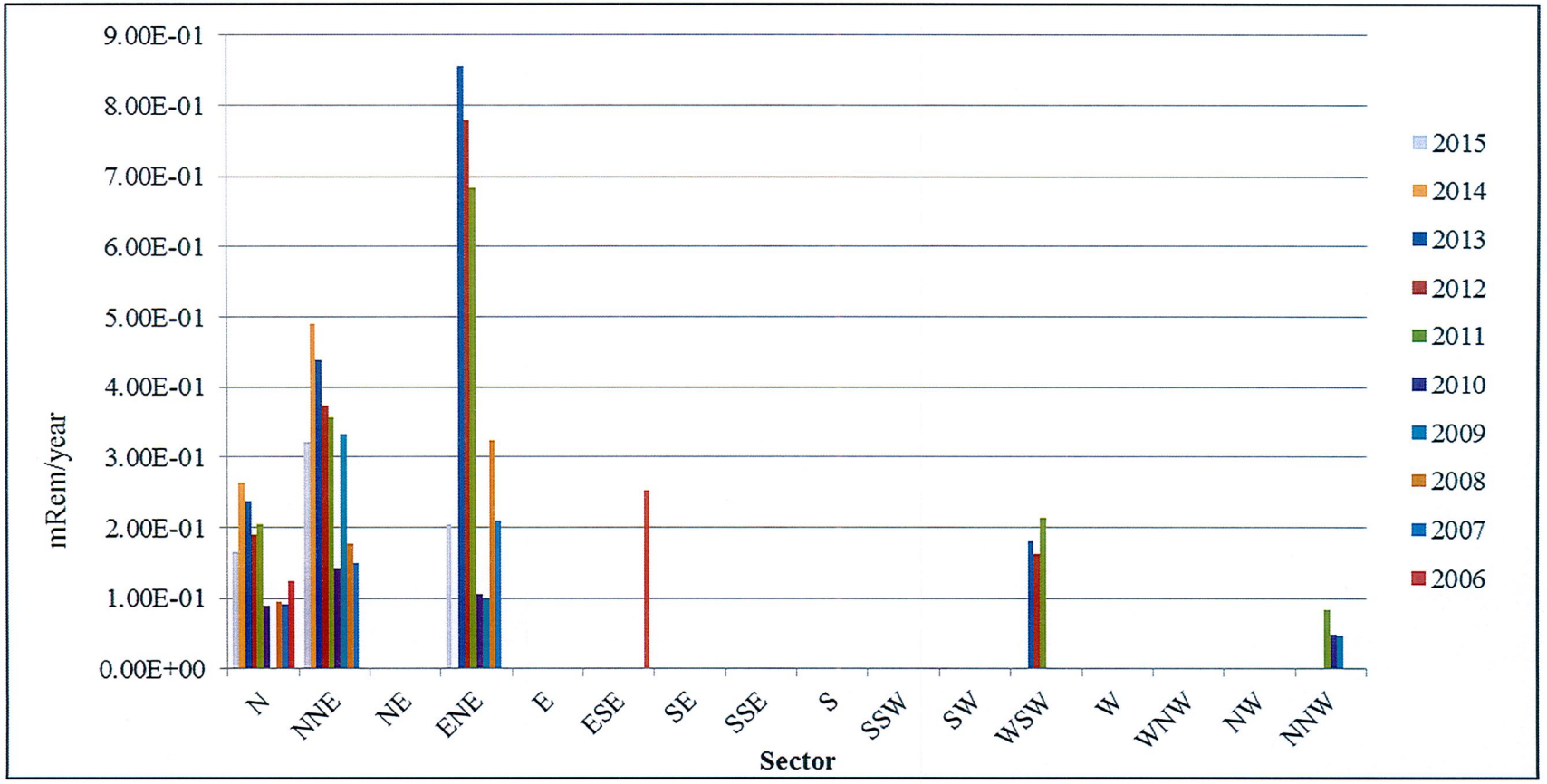


Figure 10-3 Historical Comparison of Nearest Garden Dose

Gardens have been sporadically identified from year to year. Gardening is not prevalent in the desert environment.

11. Summary and Conclusions

The conclusions are based on a review of the radio assay results and environmental gamma radiation measurements for the 2015 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2015 are presented in Table 8-1 through Table 8-12 and do not include observations of naturally occurring radionuclides, with the exception of gross beta in air and gross beta in drinking water. Table 11-1 summarizes the ODCM required samples and is in the format required by the NRC BTP on Environmental Monitoring.

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

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

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

There was no measurable radiological impact on the environment in 2015 resulting from the operation of PVNGS.

Table 11-1 Environmental Radiological Monitoring Program Annual Summary

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 2015

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	25.2 (187/188) 18.3 – 33.9	Site #35 8 miles 330°	31.9 (4/4) 29.9 – 33.9	24.9(8/8) 22.8 - 28.0	1
Air Particulates (pCi/m^3)	Gross Beta - 519	0.01	0.035 (545/552) 0.016 - 0.059	Site # 29 1 mile 270º	0.035 (52/52) 0.018 - 0.059	0.035 (52/52) 0.016 - 0.058	7
	Gamma Spec Composite - 40						
	Cs-134 (quarterly)	0.05	<LLD <LLD	NA NA	<LLD <LLD	<LLD <LLD	0
	Cs-137 (quarterly)	0.06	<LLD <LLD	NA NA	<LLD <LLD	<LLD <LLD	0
Air Radioiodine (pCi/m^3)	Gamma Spec. - 519 I-131	0.07	<LLD <LLD	NA NA	<LLD <LLD	<LLD <LLD	4
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 10						
	I-131	60	<LLD	NA	<LLD	<LLD	0
	Cs-134	60	<LLD	NA	<LLD	<LLD	0
	Cs-137	80	<LLD	NA	<LLD	<LLD	0

Groundwater (pCi/liter)	H-3 – 8	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 8						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	Gross Beta – 48	4	3.9 (29/48) 2.0 – 6.1	Site #55 3 miles 214°	4.5 (11/12) 3.4 -6.5	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 48						
Drinking Water (pCi/liter)	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	1

	Gamma Spec. – 27						
Milk (pCi/liter)	I-131	1	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-134	15	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-137	18	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Ba-140	60	<LLD	NA	<LLD	<LLD	0
	La-140	15	<LLD	NA	<LLD	<LLD	0
	Gamma Spec. - 30						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
Surface Water (pCi/liter)	I-131	15	15 (7/36)	Site #59	21 (2/12)	NA	0
			13-23	Onsite 180°	18-23		
	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	865 (26/36)	Site #59	1107 (10/12)	NA	0
			433 - 2341	Onsite 180°	433 - 2341		

(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. 1985-2013 Annual Radiological Environmental Operating Reports, Palo Verde Nuclear Generating Station

3. Palo Verde Nuclear Generating Station Technical Specifications and Technical Reference Manual

4. Offsite Dose Calculation Manual, Revision 26, PVNGS Units 1, 2, and 3

5. Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants

6. Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants

7. NRC Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 (Incorporated into NUREG-1301)

8. NEI 07-07, Nuclear Energy Institute, Industry Ground Water Protection Initiative – Final Guidance Document, August 2007

9. "Sources of Radiation." *NRC: Sources of Radiation*. Nuclear Regulatory Commission, 17 Oct. 2014. Web. 08 Apr. 2016.

10. "NCRP Report No. 160: Ionizing Radiation Exposure of the Population of the United States." *Journal of Radiological Protection J. Radiol. Prot.* 29.3 (2009): 465. Web.