Technical Specification 5.6.2

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102-08595-MSC/SMK
April 13, 2023

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

Subject: **Palo Verde Nuclear Generating Station Units 1, 2, and 3**
Renewed Operating License Nos. NPF-41, NPF-51, and NPF-74
Docket Nos. STN 50-528, STN 50-529, and STN 50-530
Annual Radiological Environmental Operating Report 2022

Enclosed please find the Palo Verde Nuclear Generating Station (PVNGS) Units 1, 2, and 3 Annual Radiological Environmental Operating Report for 2022. Arizona Public Service Company is submitting this report pursuant to the PVNGS Technical Specification Reporting Requirement, Section 5.6.2.

No new commitments are being made to the Nuclear Regulatory Commission by this letter.

Should you need further information regarding this submittal, please contact me at (623) 393-5753.

Sincerely,

Cox, Matthew S(Z05628)

Digitally signed by Cox, Matthew S(Z05628)
Date: 2023.04.13 15:39:26 -07'00'

Matthew S. Cox
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MSC/SMK/cr

Enclosure: Palo Verde Nuclear Generating Station
Annual Radiological Environmental Operating Report 2022

cc: R. J. Lewis — Acting NRC Region IV Regional Administrator
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Enclosure

Palo Verde Nuclear Generating Station
Annual Radiological Environmental Operating Report 2022

PALO VERDE NUCLEAR GENERATING STATION ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2022

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

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ABSTRACT

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

During 2022, the following categories of samples were collected by APS:

- Broadleaf vegetation
- Groundwater
- Drinking water
- Surface water
- Airborne particulate and radioiodine
- Goat milk
- Sludge

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

The Arizona Department of Health Services, Bureau of Radiation Control (BRC) performs radiochemistry analyses on various duplicate samples provided to them by APS. Samples analyzed by BRC include onsite samples from the Reservoirs, Evaporation Ponds, and two (2) Deep Wells. Offsite samples analyzed by BRC include two (2) local resident wells. BRC 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 2022. All references are specifically identified in Section 12.

1.1 Overview

The Radiological Environmental Monitoring Program (REMP) provides representative measurements of radiation and radioactive materials in exposure pathways. REMP measures radionuclides that lead to the highest potential radiation exposures to members of the public resulting from station operation. This monitoring program implements Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix I, Section IV.B.2., 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 (i.e., 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. The interlaboratory comparisons 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 10 CFR 50, Appendix I, Section IV.B.2.

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.

1.2 Radiation and Radioactivity

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

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 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 millirem per year. 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 man-made sources is medical procedures. Diagnostic x-rays and nuclear medicine procedures, such as those that use iodine-131 or cesium-137, are examples of man-made medical sources.

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

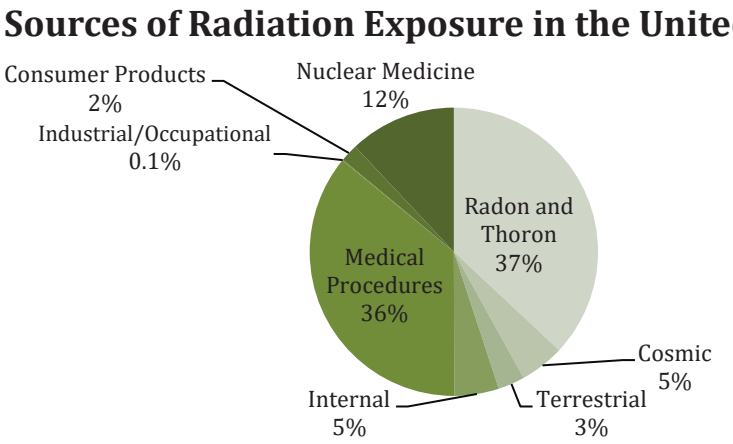


Figure 1-1 Sources of Radiation Exposure in the United States

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 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. 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 process personnel ionizing radiation dosimeters.

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 2022

Changes to the REMP occurred in October 2022. The PVNGS REMP lost a long-time milk and vegetation donor (Site 51) due to relocation outside the 5-mile radius. A donor who has been in the REMP as a Drinking Water (Site 49) donor agreed to participate as a Milk and Vegetation donor in addition to Drinking Water. Groundwater sample locations have been updated in the ODCM to reflect current well availability; Site 58 (Well 34abb) has been capped and was removed from the ODCM and Site 58A (Well 27dcb) has been added to the ODCM. Well 27dcb has been sampled as a supplemental sampling location since it went into service, and became an official ODCM Sampling Location in 2022.

2.3 REMP Deviations/Abnormal Events Summary

During calendar year 2022, there were fifteen (15) deviations/abnormal events with regards to the monitoring program. Refer to Table 2-3 for more detail and corrective actions taken.

There were three (3) events involving environmental dosimetry. The 2nd quarter dosimetry from Site 8 was not turned in for processing with the remainder of the quarterly dosimetry; once

identified, the dosimetry from Site 8 was processed with an adjusted transit dose. The remaining 2 events involving environmental dosimetry were due to missing stanchion and dosimetry for Site 44 during the 2nd Quarter changeout. Dosimetry data was unavailable for Site 44 for 2nd Quarter. The location was evaluated for a more discrete location, resulting in delayed placement for Site 44 for 3rd Quarter and an adjusted transit dose for the Site 44 3rd Quarter data.

One (1) event involved the June Drinking Water Samples. All weekly samples for the monthly composite drinking water samples were collected; however, the gamma isotopic analysis was not completed as scheduled. The failure to analyze was not identified in time to conduct the analysis with reasonable lower limits of detection capabilities. Gross beta and tritium analysis were performed with as-expected results. The sampling periods immediately preceding and following the June sample period had less than detectable gamma isotopic activity and it is reasonable to conclude that there would have been similar results for the June samples of well drinking water

Two (2) events were due to power interruptions to the Multi-Channel Analyzer (MCA) while analyzing Milk Samples. Both events occurred while analyzing Milk from Site 54, April and June respectively. Both samples resulted in a higher than desired MDA for I-131; however, both samples, when reduced to one (1) significant figure, met the ODCM required LLD of 1 pCi/L.

Nine (9) events involved Air Sample data collection; four (4) of the events resulted in INVALID data and five (5) of the events resulted in data that remained VALID. Two (2) of the events were due to loss of power at Site 15, resulting in insufficient data collection over the span of 2 sampling periods. Two (2) events, one at Site 29 and one at 35 resulted from an inoperable pump with a running ETM, limiting the determination of sample collection time. Three (3) events, one (1) at Site 7 and two (2) at Site 29, were due to malfunctioning ETM; sample collection time was calculated, enabling successful analysis of VALID air sample data. One (1) event was the identification and degraded airflow at Air Sample Site 40; data was sufficient for data collection and analysis and pump was replaced, successfully restoring desired pump flow. One (1) event was due to a mass flow meter that was found to be out of tolerance during normal calibration. Mass Flow Meter, used to adjust air flow of the air sampling pumps, was found to be out of tolerance, impacting data for sample collection Weeks 17-33. Impacted sample data was reviewed and found to have sufficient margin to accommodate for the recorded variance of the mass flow meter. Adjusted data met the required LLDs. All data is VALID. Event documented through CRs 22-11503; evaluation documented through Level 3 Evaluations 22-11503-001.

2.4 Groundwater Protection

PVNGS has implemented a groundwater protection initiative developed by the Nuclear Energy Institute (NEI). The implementing guidance of this initiative, NEI 07-07 (Industry Ground Water Protection Initiative – Final Guidance Document, August 2007), and later revised in March of 2019, provides added assurance that groundwater will not be adversely affected by PVNGS operations.

Monitoring wells have been installed to monitor the subsurface water and shallow aquifer at Units 1, 2, and 3. Many of these wells were previously monitored in accordance with the State of Arizona Aquifer Protection Permit (Area-Wide) No. P-100388 (APP). The APP was revised in 2018, which included the removal of several of the wells from mandated sampling. Now referred to as Legacy Wells, they continue to be sampled for data continuity and in support of the

Groundwater Protection Initiative. Sample results for the shallow aquifer wells are reported in the PVNGS Annual Radioactive Effluent Release Report (ARERR). No changes to the APP occurred in 2022.

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 Radiologically Controlled Area (RCA). These samples were analyzed for hard-to-detect radionuclides (i.e., 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 Milk- goat Vegetation	N2	Local resident
53*	Milk- goat	NE30	Local resident
54	Milk- goat	NNE4	Local resident
55	Drinking Water (Supplemental)	SW3	Local resident
57	Groundwater	ONSITE	Well 27ddc
58	Groundwater	ONSITE	Well 34abb
58A	Groundwater	ONSITE	Well 27dcb
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
65	Groundwater	ONSITE	Well 34aab

NOTES:
***Designates a control site**
(a) Direction and distances are from the centerline 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 (i.e., 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 #	*AIRBORNE 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		M/AA		M/AA		W	
53		M/AA					
54		M/AA					
55						W	
57					Q		
58A					Q		
59 (A,B,&C)							Q
60							Q
61							Q
62				M/AA			
63 (A&B)							Q
64 (A&B)							Q
65					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. Dosimetry for Site 8 was later than scheduled, requiring adjusted transit dose for 2nd Quarter 2022.	Site 8 Dosimetry was found to have been left in the monitoring containers following the processing of the remainder of the Environmental Dosimetry from 2nd Quarter 2022. Once located, the dosimetry was processed, and the transit dose was adjusted accordingly. The data is VALID. Event documented through CR 22-07921 (Table 9-2, Note 1).
2. Dosimetry for monitoring location 44 were missing for the 2nd Quarter, 2022.	The dosimetry and stanchion used for monitoring location 44 were missing for 2nd Quarter, 2022. The M_A and L_A were calculated using 1st, 3rd, and 4th Quarter Data. BA was calculated using B_Q*3. Documented through CR 22-07142 (Table 9-2, Note 2).
3. Placement of dosimetry for monitoring location 44 was delayed for 3rd Quarter, 2022 monitoring cycle, requiring adjusted transit dose.	The dosimetry and stanchion used for monitoring location 44 were missing for 2nd Quarter, 2022. Due to repeated events at this location, the location was evaluated for a more discrete stanchion placement to mitigate future loss of equipment and data. The 3rd Quarter dosimetry was delayed in placement; transit dose was adjusted accordingly. The data is VALID. Event documented through CR 22-07142 (Table 9-2, Note 3).
4. Drinking Water Samples for June Sampling period failed to receive gamma isotopic analysis.	The June Drinking Water Samples for Sites 46, 48, 49, and 55 were collected weekly for the monthly composite sample; however, the monthly gamma isotopic analysis was not conducted. The failure to analyze was in identified in time to conduct the analysis with reasonable lower limits of detection capabilities. Gross beta and tritium analysis were performed with as expected results. The sampling periods immediately preceding and following the June sample had less than detectable gamma isotopic activity and it is reasonable to conclude that there would have been similar results for the June samples of well drinking water. Event Document through CR 22-09005 (Table 8-8, Note 1)
5. Milk Sample Site 54 count interruption during analysis resulting in higher I-131 MDA than desired for April 2022 sample period.	A power interruption resulted in higher than usual MDA for I-131 for Milk Sample Site 54. MDA achieved was 1.43 pCi/L; ODCM requirement is 1 pCi/L. Reporting to 1 significant digit meets the required I-131 LLD; however, the event is still noteworthy for trending. Sample is VALID. Event documented through CR 22-04327 (Table 8-7, Note 1).
6. Milk Sample Site 54 count interruption during analysis resulting in higher I-131 MDA than desired for June 2022 sample period	A power interruption resulted in higher than usual MDA for I-131 for Milk Sample Site 54. MDA achieved was 1.02 pCi/L; ODCM requirement is 1 pCi/L. Reporting to 1 significant digit meets the required I-131 LLD; however, the event is still noteworthy for trending. Sample is VALID. Event documented through CR 22-06461 (Table 8-7, Note 2).
7. Air Sample Site 15 INVALID due to loss of power and insufficient sample collection for sample period 3/8/2022-3/15/2022.	Site was found to be without power; power lost at the pole. Approximately 30 hours of collection time was recorded; insufficient data collection for statistical analysis. Sample is INVALID, and data is for INFO ONLY for Week 11. Event documented through CR 22-02637 (Table 8-1 and Table 8-4, Note 1).
8. Air Sample Site 15 INVALID due to loss of power and insufficient sample collection for sample period 3/15/2022-3/22/2022.	Site was found to be without power; power lost at the pole during Sample Week 11. Power was restored on 3/18/2022; insufficient data collection for statistical analysis. Sample is INVALID, and data is for INFO ONLY for Week 11. Event documented through CR 22-02896 (Table 8-1 and Table 8-4, Note 2).
9. Air Sample Site 35 INVALID due to having an operable ETM with an inoperable pump for sampling period 5/10/2022-5/17/2022.	Site 35 ETM was found to be running with an inoperable pump. The dust loading was lighter than usual and there was no way to accurately estimate the sample volume. The pump was found to have broken carbon vanes. Sample is INVALID and the data is included as INFO ONLY. Event Documented through CR 22-05573 Table 8-1 and Table 8-4, Note 3).

10. Air Sample Site 29 INVALID due to pump failure for sample period 8/17/2022-8/23/2022.	Pump found inoperable at time of sample change out. ETM continued operating, so sample collection time could not be calculated. Pump replaced. Sample volume unknown and conservative values used for analysis; sample is INVALID, and data is for INFO ONLY for Week 34. Event documented through CR 22-08850 (Table 8-1 and Table 8-4, Note 4).
11. Air Sample Site 29 VALID-use of calculated volume due to loss of ETM function for sample period 8/23/2022-8/30/2022.	ETM was found to be nonfunctional at Air Sample Site 29. Pump continued operating; volume was calculated based on document in-service/out-of-service times. Sample is VALID for Week 35. Event documented through CR 22-09144 (Table 8-1 and Table 8-4, Note 5).
12. Air Sample Site 29 VALID-use of calculated volume due to loss of ETM function for sample period 8/30/2022-8/6/2022.	ETM was found to be nonfunctional at Air Sample Site 29. Pump continued operating; volume was calculated based on document in-service/out-of-service times. Sample is VALID for Week 36. Event documented through CR 22-09372 (Table 8-1 and Table 8-4, Note 6).
13. Air Sample Site 7 VALID-ETM value differed from calculated value for sample period 12/13/2022-12/20/2022.	ETM value differed from calculated volume at Air Sample Site 7. ETM was functional and sample appeared to have normal dust loading. Possible cause may be due to temporary power outage at pump site. ETM value used for sample volume for conservatism. Sample is VALID for Week 51. Event documented through CR 22-13436 (Table 8-1 and Table 8-4, Note 7).
14. Air Sample Pump for Site 40 replaced due to degraded flow. No data impacted.	Air Sample Pump at Site 40 was found to have degraded flow on 12/20/2022. Sample had normal dust loading and ample volume for statistical analysis. Event document for trending. Sample data was not impacted and is VALID for Week 51. Event documented through CR 22-13436 (Table 8-1 and Table 8-4, Note 8).
15. Mass Flow Meter, used for air sample pump adjustments, found to be out of tolerance for Weeks 17-33. Data is VALID	Mass Flow Meter, used to adjust air flow of the air sampling pumps, was found to be out of tolerance. The impacted data was for sample collection Weeks 17-33. Pump flow adjustment data was reviewed, and impacted flow meter adjustments appear to be isolated to Week 33. All impacted sample data was reviewed and found to have sufficient margin to accommodate for the recorded variance of the mass flow meter. Adjusted data met the required LLDs. All data is VALID. Event documented through CR 22-11503; evaluation documented through Level 3 Evaluation 22-11503-001.

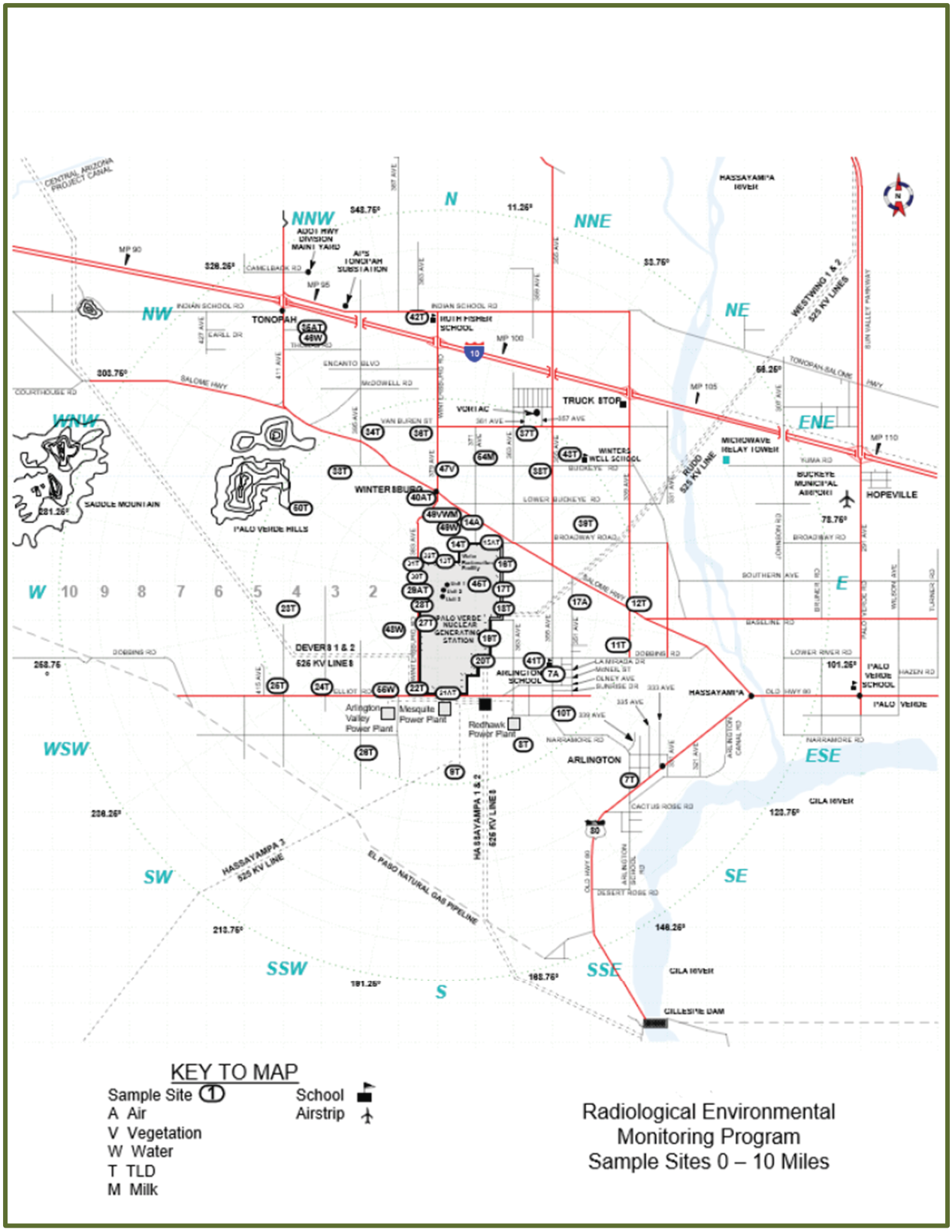


Figure 2-1 REMP Sample Sites- Map (0-10 miles)

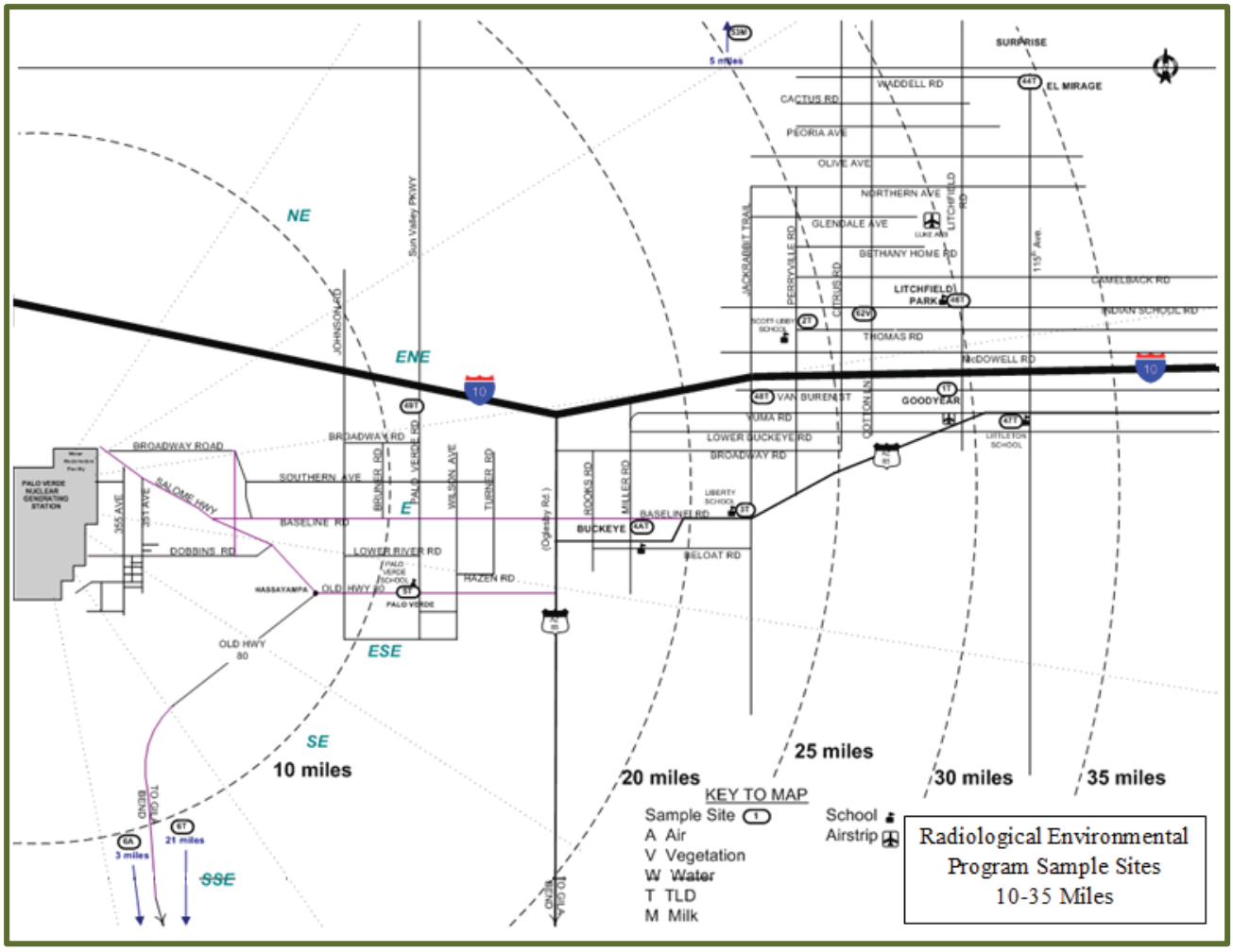


Figure 2-2 REMP Sample Sites- Map (10-35 Miles)

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 (plastic cubitainers) 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-acre and 85-acre Reservoirs, active Evaporation Ponds 1A/B/C, 2A/B, and 3A/B, and onsite wells 27ddc, 34aab, and 27dcb. Samples were collected in one-gallon containers (plastic cubitainers) 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 Resources (WR) 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 Iodine-131. Particulate filters were composited quarterly, by location, and analyzed for gamma-emitting radionuclides.

3.5 Soil, Sludge, and Sediment

Sludge samples were obtained weekly from the WR waste centrifuge (during operational periods) and analyzed for gamma-emitting radionuclides. Cooling tower sludge was analyzed for gamma-emitting radionuclides prior to disposal in the WR 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 a High-purity Germanium (HPGe) detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.2 Airborne Radioiodine

4.2.1 Gamma Spectroscopy

The charcoal cartridge is counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for Iodine-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 and verified by trained technicians.

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 phase 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 and verified by trained technicians.

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 and verified by trained technicians.

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 a HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

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 approximately 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 and verified by trained technicians.

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.

6.2 Data Reporting Criteria

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

Typical MDA values are presented in Table 6-3.

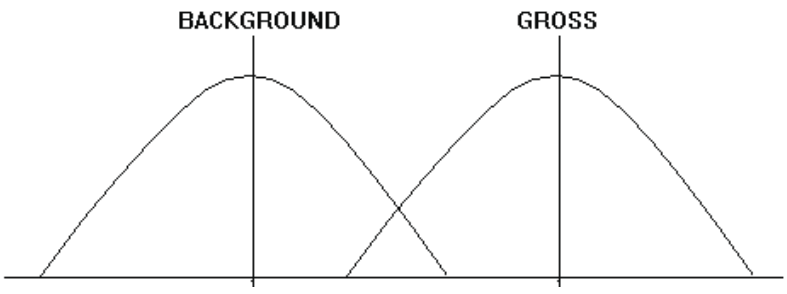
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

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

In these instances, the contributing factors will be noted in the table where the data are presented. A summary of deviations/abnormal events is presented in Table 2-3 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.

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:** The number of observations included in a statistical analysis. Sample size dictates the amount of information available about a studied subject to make accurate inferences.

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

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

4. **Background and Sample Counting Time**: The amount of time devoted to the counting of the background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

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

Table 6-1 ODCM Required Lower Limits of Detection (a priori)

Analysis	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, Revision 1. The program includes 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 2022, 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

2022 Eckert & Ziegler Analytics Environmental Cross Check Results

Sample Type	Analysis Type	Nuclide	PVNGS Value	1 sigma Error	Known Value	Resolution*	Ratio	NRC Range	Results
E13671 DET2	Gamma Water	Ce-141	7.38E+01	1.08E+01	7.61E+01	7	0.97	0.50 - 2.00	Acceptable
		Co-58	1.89E+02	1.79E+01	1.93E+02	11	0.98	0.60 - 1.66	Acceptable
		Co-60	3.48E+02	2.09E+01	3.55E+02	17	0.98	0.75 - 1.33	Acceptable
		Cr-51	4.12E+02	6.62E+01	4.00E+02	6	1.03	0.50 - 2.00	Acceptable
		Cs-134	1.91E+02	1.23E+01	2.14E+02	16	0.89	0.75 - 1.33	Acceptable
		Cs-137	2.44E+02	2.25E+01	2.63E+02	11	0.93	0.60 - 1.66	Acceptable
		Fe-59	2.18E+02	1.72E+01	2.18E+02	13	1.00	0.60 - 1.66	Acceptable
		Mn-54	1.97E+02	1.82E+01	1.93E+02	11	1.02	0.60 - 1.66	Acceptable
		Zn-65	2.96E+02	2.81E+01	2.90E+02	11	1.02	0.60 - 1.66	Acceptable
		I-131	9.53E+01	1.73E+01	8.76E+01	6	1.09	0.50 - 2.00	Acceptable
E13671 DET3	Gamma Water	Ce-141	7.39E+01	8.60E+00	7.61E+01	9	0.97	0.60 - 1.66	Acceptable
		Co-58	1.86E+02	1.41E+01	1.93E+02	13	0.96	0.60 - 1.66	Acceptable
		Co-60	3.56E+02	1.55E+01	3.55E+02	23	1.00	0.75 - 1.33	Acceptable
		Cr-51	3.87E+02	5.97E+01	4.00E+02	6	0.97	0.50 - 2.00	Acceptable
		Cs-134	1.96E+02	9.60E+00	2.14E+02	20	0.92	0.75 - 1.33	Acceptable
		Cs-137	2.53E+02	1.71E+01	2.63E+02	15	0.96	0.60 - 1.66	Acceptable
		Fe-59	2.28E+02	1.53E+01	2.18E+02	15	1.05	0.60 - 1.66	Acceptable
		Mn-54	1.98E+02	1.46E+01	1.93E+02	14	1.03	0.60 - 1.66	Acceptable
		Zn-65	2.91E+02	2.26E+01	2.90E+02	13	1.00	0.60 - 1.66	Acceptable
		I-131	1.01E+02	1.63E+01	8.76E+01	6	1.15	0.50 - 2.00	Acceptable
E13674 DET2	Gamma Filter	Ce-141	4.62E+01	9.61E+00	4.25E+01	5	1.09	0.50 - 2.00	Acceptable
		Co-58	1.15E+02	1.91E+01	1.08E+02	6	1.06	0.50 - 2.00	Acceptable
		Co-60	2.08E+02	1.73E+01	1.98E+02	12	1.05	0.60 - 1.66	Acceptable
		Cr-51	2.13E+02	7.35E+01	2.23E+02	3	0.96	0.40 - 2.50	Acceptable
		Cs-134	1.04E+02	1.24E+01	1.20E+02	8	0.87	0.60 - 1.66	Acceptable
		Cs-137	1.74E+02	2.93E+01	1.47E+02	6	1.18	0.50 - 2.00	Acceptable
		Fe-59	1.45E+02	2.14E+01	1.21E+02	7	1.20	0.50 - 2.00	Acceptable
		Mn-54	1.18E+02	1.82E+01	1.08E+02	6	1.09	0.50 - 2.00	Acceptable
		Zn-65	1.96E+02	3.24E+01	1.62E+02	6	1.21	0.50 - 2.00	Acceptable
E13674 DET3	Gamma Filter	Ce-141	4.97E+01	9.51E+00	4.25E+01	5	1.17	0.50 - 2.00	Acceptable
		Co-58	1.03E+02	2.01E+01	1.08E+02	5	0.95	0.50 - 2.00	Acceptable
		Co-60	2.03E+02	1.77E+01	1.98E+02	11	1.03	0.60 - 1.66	Acceptable
		Cr-51	2.41E+02	6.92E+01	2.23E+02	3	1.08	0.40 - 2.50	Acceptable
		Cs-134	9.60E+01	1.01E+01	1.20E+02	10	0.80	0.60 - 1.66	Acceptable
		Cs-137	1.46E+02	2.22E+01	1.47E+02	7	0.99	0.50 - 2.00	Acceptable
		Fe-59	1.41E+02	2.17E+01	1.21E+02	6	1.17	0.50 - 2.00	Acceptable
		Mn-54	1.27E+02	1.97E+01	1.08E+02	6	1.18	0.50 - 2.00	Acceptable
		Zn-65	1.79E+02	3.22E+01	1.62E+02	6	1.10	0.50 - 2.00	Acceptable
E13673A DET2	I-131 Cartridge	I-131	7.45E+01	7.39E+00	8.74E+01	10	0.85	0.60 - 1.66	Acceptable
E13673A DET3	I-131 Cartridge	I-131	8.37E+01	6.92E+00	8.74E+01	12	0.96	0.60 - 1.66	Acceptable
E13672	Gross Beta Air	g beta	5.37E+01	1.70E+00	6.09E+01	32	0.88	0.75 - 1.33	Acceptable
E13675 DET 2	Gamma Milk	I-131	4.52E+01	4.52E+00	4.42E+01	10	1.02	0.60 - 1.66	Acceptable
		Ce-141	9.72E+00	1.29E+00	1.03E+01	8	0.94	0.60 - 1.66	Acceptable
		Co-58	2.52E+01	2.63E+00	2.60E+01	10	0.97	0.60 - 1.66	Acceptable
		Co-60	4.90E+01	3.32E+00	4.79E+01	15	1.02	0.60 - 1.66	Acceptable
		Cr-51	5.03E+01	1.34E+01	5.39E+01	4	0.93	0.50 - 2.00	Acceptable
		Cs-134	2.66E+01	1.52E+00	2.89E+01	18	0.92	0.75 - 1.33	Acceptable
		Cs-137	3.62E+01	3.54E+00	3.55E+01	10	1.02	0.60 - 1.66	Acceptable
		Fe-59	3.24E+01	2.98E+00	2.93E+01	11	1.11	0.60 - 1.66	Acceptable
		Mn-54	2.67E+01	3.02E+00	2.61E+01	9	1.02	0.60 - 1.66	Acceptable
		Zn-65	4.10E+01	3.88E+00	3.91E+01	11	1.05	0.60 - 1.66	Acceptable
E13675 DET 3	Gamma Milk	I-131	4.61E+01	4.57E+00	4.42E+01	10	1.04	0.60 - 1.66	Acceptable
		Ce-141	1.03E+01	2.28E+00	1.03E+01	5	1.00	0.50 - 2.00	Acceptable
		Co-58	2.67E+01	3.09E+00	2.60E+01	9	1.03	0.60 - 1.66	Acceptable
		Co-60	4.86E+01	3.22E+00	4.79E+01	15	1.01	0.60 - 1.66	Acceptable
		Cr-51	4.86E+01	1.04E+01	5.39E+01	5	0.90	0.50 - 2.00	Acceptable
		Cs-134	2.72E+01	1.70E+00	2.89E+01	16	0.94	0.75 - 1.33	Acceptable
		Cs-137	3.67E+01	3.63E+00	3.55E+01	10	1.03	0.60 - 1.66	Acceptable
		Fe-59	3.16E+01	3.09E+00	2.93E+01	10	1.08	0.60 - 1.66	Acceptable
		Mn-54	2.66E+01	3.16E+00	2.61E+01	8	1.02	0.60 - 1.66	Acceptable
		Zn-65	4.15E+01	5.19E+00	3.91E+01	8	1.06	0.60 - 1.66	Acceptable
E13676	Gross Beta Water	g beta	2.45E+02	5.22E+00	2.22E+02	47	1.10	0.75 - 1.33	Acceptable
E13677	H-3 Water	H-3	1.35E+04	3.74E+02	1.43E+04	36	0.94	0.75 - 1.33	Acceptable

Resolution	Ratio
<4	0.4-2.5
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

* calculated from PVNGS value/1 sigma error value

NRC Acceptance Criteria [1]

[1] From CY-NISP-201, Rev1, Attachment E

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.

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 appears to not 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 (i.e., K-40, Th-234, 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 samples analyzed during 2022 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 0.012 to 0.056 pCi/m^3. Mean quarterly activity is normally calculated using weekly activity over a thirteen (13) week period. Also presented in the tables are the weekly mean values of all the sites as well as the percent relative standard deviation (RSD %) for the data.

Table 8-3 displays the results of gamma spectroscopy on the quarterly composites of the weekly samples. No plant-related activity was identified

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 8.44 pCi/liter. The gross beta activity is attributable to natural (background) radioactive materials.

8.6 Groundwater

Groundwater samples were analyzed from three 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 is sometimes observed in Reservoirs and Evaporation Ponds, which is the result of radiopharmaceutical I-131 in the Phoenix sewage effluent and is not attributable to plant effluents. However, I-131 was not observed in these surface water samples during 2022.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration was 999 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 (i.e., 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.

Evaporation Pond 3A has been drained for liner repairs and has not received any influent from the plant since 2016. Due to the negligible inventory and lack of influent in the past 7 years, no sample was obtained from Evaporation Pond 3A.

8.8 Sludge and Sediment

8.8.1 Water Resources Centrifuge Waste Sludge

Sludge samples were obtained from the Water Resources (WR) 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 WR Influent. The concentration of I-131 ranged from "no detectable" to 1020 pCi/kg.

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

8.8.2 Cooling Tower Sludge

Sludge/sediment originating from the Unit 1 and Unit 2 Cooling Towers and Circulating Water canals was disposed of in the WR sludge landfill during 2022. 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 (i.e., 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

PARTICULATE GROSS BETA IN AIR 1st QUARTER

ODCM required samples denoted by *

units are pCi/m^3

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	28-Dec-21	4-Jan-22	0.015	0.015	0.015	0.014	0.012	0.013	0.014	0.013	0.014	0.014	0.014	5.9	
2	4-Jan-22	11-Jan-22	0.044	0.044	0.039	0.039	0.040	0.041	0.037	0.041	0.038	0.039	0.040	5.9	
3	11-Jan-22	18-Jan-22	0.041	0.043	0.038	0.038	0.033	0.038	0.039	0.039	0.036	0.033	0.038	8.6	
4	18-Jan-22	25-Jan-22	0.051	0.045	0.048	0.039	0.045	0.044	0.044	0.046	0.042	0.046	0.045	7.2	
5	25-Jan-22	1-Feb-22	0.041	0.043	0.037	0.035	0.036	0.039	0.040	0.036	0.037	0.037	0.038	7.1	
6	1-Feb-22	8-Feb-22	0.033	0.032	0.032	0.028	0.026	0.027	0.030	0.028	0.027	0.028	0.029	8.1	
7	8-Feb-22	15-Feb-22	0.025	0.028	0.023	0.022	0.023	0.024	0.027	0.023	0.021	0.022	0.024	8.6	
8	15-Feb-22	22-Feb-22	0.026	0.025	0.022	0.023	0.023	0.023	0.023	0.023	0.023	0.022	0.023	5.6	
9	22-Feb-22	1-Mar-22	0.027	0.027	0.026	0.023	0.026	0.027	0.026	0.026	0.026	0.023	0.026	5.7	
10	1-Mar-22	8-Mar-22	0.032	0.030	0.025	0.027	0.026	0.028	0.028	0.027	0.025	0.027	0.028	7.8	
11	8-Mar-22	15-Mar-22	0.025	0.028	0.026	0.024	±0.0054	0.026	0.026	0.025	0.024	0.023	0.025	5.6	1
12	15-Mar-22	22-Mar-22	0.027	0.026	0.019	0.023	±0.0218	0.022	0.024	0.025	0.022	0.021	0.023	11.4	2
13	22-Mar-22	29-Mar-22	0.022	0.022	0.020	0.022	0.019	0.019	0.022	0.022	0.020	0.020	0.021	5.8	
	Mean		0.031	0.031	0.028	0.028	0.028	0.029	0.029	0.029	0.027	0.027	0.029	5.3	

Note 1: Site 15 found without power. Power loss was at the pole. Approximately 30 hours of data was collected and not sufficient for data retrieval. Sample is INVALID and sample analyzed using default; volume data provided is for INFO ONLY. CR 22-02637

Note 2: Site 15 did not regain power until 3/18/2022. Insufficient data for statistical analysis for this sampling period. Sample counted for INFO ONLY. CR 22-02896

PARTICULATE GROSS BETA IN AIR 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

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	29-Mar-22	5-Apr-22	0.021	0.018	0.020	0.020	0.019	0.020	0.018	0.019	0.018	0.019	0.019	5.3	
15	5-Apr-22	12-Apr-22	0.024	0.022	0.023	0.022	0.023	0.023	0.022	0.021	0.023	0.018	0.022	7.9	
16	12-Apr-22	19-Apr-22	0.030	0.030	0.026	0.022	0.022	0.027	0.027	0.028	0.027	0.026	0.027	10.3	
17	19-Apr-22	26-Apr-22	0.023	0.023	0.023	0.019	0.020	0.023	0.020	0.017	0.021	0.013	0.020	15.5	
18	26-Apr-22	3-May-22	0.040	0.039	0.037	0.038	0.028	0.035	0.038	0.041	0.036	0.023	0.035	16.0	
19	3-May-22	10-May-22	0.027	0.026	0.028	0.025	0.024	0.024	0.025	0.025	0.026	0.017	0.025	11.9	
20	10-May-22	17-May-22	0.028	0.029	0.024	0.025	0.025	0.029	0.027	0.024	±0.0241	0.024	0.026	7.6	3
21	17-May-22	24-May-22	0.026	0.025	0.022	0.017	0.022	0.023	0.017	0.022	0.021	0.020	0.021	13.8	
22	24-May-22	31-May-22	0.024	0.024	0.021	0.023	0.024	0.027	0.024	0.024	0.022	0.023	0.024	7.2	
23	31-May-22	7-Jun-22	0.023	0.025	0.024	0.020	0.024	0.024	0.022	0.025	0.022	0.022	0.023	6.9	
24	7-Jun-22	14-Jun-22	0.029	0.024	0.021	0.022	0.021	0.026	0.021	0.025	0.027	0.028	0.024	13.1	
25	14-Jun-22	21-Jun-22	0.026	0.027	0.030	0.031	0.029	0.030	0.031	0.022	0.027	0.027	0.028	10.3	
26	21-Jun-22	28-Jun-22	0.022	0.024	0.022	0.021	0.021	0.021	0.023	0.022	0.023	0.022	0.022	3.6	
	Mean		0.026	0.026	0.025	0.023	0.023	0.026	0.024	0.024	0.024	0.022	0.024	5.7	

Note 3: Site 35 ETM was found to be running with an inoperable pump. The dust loading was lighter than usual and there was no way to accurately estimate the sample volume. The pump was found to have broken carbon vanes. Sample is INVALID and the data is included as INFO ONLY. CR 22-05573

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

PARTICULATE GROSS BETA IN AIR 3rd 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	28-Jun-22	5-Jul-22	0.026	0.028	0.024	0.024	0.026	0.027	0.022	0.024	0.025	0.023	0.025	7.1	
28	5-Jul-22	12-Jul-22	0.025	0.023	0.025	0.024	0.024	0.025	0.024	0.025	0.026	0.025	0.025	3.4	
29	12-Jul-22	19-Jul-22	0.030	0.028	0.029	0.031	0.021	0.026	0.024	0.030	0.030	0.028	0.028	11.4	
30	19-Jul-22	26-Jul-22	0.026	0.030	0.031	0.031	0.029	0.034	0.026	0.029	0.026	0.034	0.029	9.9	
31	26-Jul-22	2-Aug-22	0.026	0.033	0.030	0.025	0.028	0.032	0.026	0.027	0.028	0.029	0.028	9.5	
32	2-Aug-22	9-Aug-22	0.033	0.030	0.033	0.033	0.026	0.031	0.034	0.035	0.033	0.032	0.032	7.6	
33	9-Aug-22	17-Aug-22	0.025	0.018	0.027	0.028	0.018	0.021	0.015	0.028	0.029	0.025	0.023	21.9	
34	17-Aug-22	23-Aug-22	0.027	0.027	0.029	0.026	0.029	0.026	0.029	⊥0.0329	0.029	0.025	0.027	6.2	3
35	23-Aug-22	30-Aug-22	0.030	0.038	0.038	0.028	0.036	0.040	0.033	0.041	0.037	0.035	0.036	11.9	4
36	30-Aug-22	6-Sep-22	0.034	0.035	0.032	0.028	0.035	0.033	0.030	0.033	0.033	0.033	0.033	6.4	5
37	6-Sep-22	13-Sep-22	0.019	0.019	0.020	0.019	0.017	0.019	0.017	0.021	0.020	0.015	0.019	8.7	
38	13-Sep-22	20-Sep-22	0.029	0.029	0.029	0.028	0.029	0.030	0.024	0.029	0.025	0.029	0.028	7.3	
39	20-Sep-22	27-Sep-22	0.026	0.028	0.028	0.023	0.026	0.029	0.026	0.028	0.026	0.020	0.026	10.3	
	Mean		0.027	0.028	0.029	0.027	0.026	0.029	0.025	0.029	0.028	0.027	0.028	4.9	

Note 4: Site 29 stopped working during Week 34 sample period; however, ETM continued operating. Sample time and volume could not be calculated. Data is for INFO ONLY. CR 22-08850

Note 5: Site 29 ETM stopped working during the Week 35 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09144

Note 6: Site 29 ETM stopped working during the Week 36 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09372

PARTICULATE GROSS BETA IN AIR 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

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	27-Sep-22	4-Oct-22	0.038	0.036	0.037	0.037	0.037	0.038	0.036	0.040	0.039	0.042	0.038	4.9	
41	4-Oct-22	11-Oct-22	0.038	0.039	0.040	0.042	0.038	0.039	0.036	0.041	0.040	0.043	0.039	5.0	
42	11-Oct-22	18-Oct-22	0.035	0.034	0.027	0.032	0.027	0.029	0.035	0.037	0.034	0.036	0.033	11.0	
43	18-Oct-22	25-Oct-22	0.029	0.027	0.025	0.025	0.026	0.029	0.025	0.028	0.025	0.024	0.026	7.2	
44	25-Oct-22	1-Nov-22	0.037	0.039	0.035	0.036	0.027	0.034	0.036	0.034	0.025	0.037	0.034	13.1	
45	1-Nov-22	7-Nov-22	0.030	0.033	0.033	0.029	0.028	0.033	0.030	0.024	0.031	0.030	0.030	9.3	
46	7-Nov-22	15-Nov-22	0.028	0.024	0.024	0.027	0.022	0.025	0.024	0.025	0.025	0.024	0.025	7.5	
47	15-Nov-22	21-Nov-22	0.046	0.040	0.040	0.042	0.037	0.045	0.045	0.035	0.042	0.037	0.041	9.3	
48	21-Nov-22	29-Nov-22	0.053	0.050	0.043	0.048	0.030	0.044	0.042	0.037	0.041	0.049	0.044	15.4	
49	29-Nov-22	6-Dec-22	0.039	0.041	0.040	0.043	0.041	0.039	0.036	0.038	0.036	0.040	0.039	5.2	
50	6-Dec-22	13-Dec-22	0.027	0.027	0.023	0.026	0.018	0.023	0.022	0.024	0.023	0.026	0.024	11.8	
51	13-Dec-22	20-Dec-22	0.045	0.045	0.041	0.040	0.042	0.045	0.038	0.044	0.041	0.040	0.042	6.0	6, 7
52	20-Dec-22	27-Dec-22	0.054	0.061	0.054	0.056	0.045	0.056	0.055	0.050	0.051	0.056	0.054	7.9	

Note 7: Site 7 ETM value differed from calculated run time for Week 51 sample period; however, pump continued operating. Sample time and volume was based on ETM value for conservatism. ETM will be evaluated for functionality at next sample change-out. Data is for VALID. CR 22-13436

Note 8: Site 40 pump replaced due to degraded flow. Data is VALID. CR 22-13455 for trending.

	Mean		0.038	0.038	0.035	0.037	0.032	0.037	0.035	0.035	0.035	0.037	0.036	5.1	
	Annual Average		***0.03089***	***0.03083***	***0.02931***	***0.02868***	***0.02744***	***0.02988***	***0.02857***	***0.02924***	***0.02871***	***0.02827***	***0.0292***	***8.8052***	

Table 8-3 Gamma in Air Filter Composites

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*	Note
29-Mar-22	Cs-134	<0.0023	<0.0023	<0.0019	<0.0018	<0.0011	<0.0027	<0.0018	<0.0011	<0.0032	<0.0024	1,2
	Cs-137	<0.0034	<0.0041	<0.0009	<0.0029	<0.0024	<0.0023	<0.0040	<0.0024	<0.0037	<0.0024	
28-Jun-22	Cs-134	<0.0020	<0.0019	<0.0011	<0.0019	<0.0007	<0.0019	<0.0011	<0.0027	<0.0025	<0.0019	
	Cs-137	<0.0009	<0.0046	<0.0025	<0.0009	<0.0009	<0.0030	<0.0009	<0.0034	<0.0025	<0.0029	
27-Sep-22	Cs-134	<0.0011	<0.0028	<0.0029	<0.0007	<0.0024	<0.0028	<0.0031	<0.0035	<0.0025	<0.0019	3, 4, 5
	Cs-137	<0.0009	<0.0038	<0.0009	<0.0029	<0.0031	<0.0034	<0.0009	<0.0031	<0.0024	<0.0023	
27-Dec-22	Cs-134	<0.0025	<0.0019	<0.0020	<0.0024	<0.0007	<0.0010	<0.0024	<0.0023	<0.0025	<0.0025	6, 7
	Cs-137	<0.0032	<0.0035	<0.0009	<0.0030	<0.0024	<0.0035	<0.0024	<0.0033	<0.0025	<0.0025	

Note 1: Site 15 found without power. Power loss was at the pole. Approximately 30 hours of data was collected and not sufficient for data retrieval. Sample is INVALID and sample analyzed using default; volume data provided is for INFO ONLY. CR 22-02637

Note 2: Site 15 did not regain power until 3/18/2022. Insufficient data for statistical analysis for this sampling period. Sample counted for INFO ONLY. CR 22-02896

Note 3: Site 35 ETM was found to be running with an inoperable pump. The dust loading was lighter than usual and there was no way to accurately estimate the sample volume. The pump was found to have broken carbon vanes. Sample is INVALID and the data is included as INFO ONLY. CR 22-05573

Note 4: Site 29 stopped working during Week 34 sample period; however, ETM continued operating. Sample time and volume could not be calculated. Data is for INFO ONLY. CR 22-08850

Note 5: Site 29 ETM stopped working during the Week 35 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09144

Note 6: Site 29 ETM stopped working during the Week 36 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09372

Note 7: Site 7 ETM value differed from calculated run time for Week 51 sample period; however, pump continued operating. Sample time and volume was based on ETM value for conservatism. ETM will be evaluated for functionality at next sample change-out. Data is for VALID. CR 22-13436

Note 8: Site 40 pump replaced due to degraded flow. Data is VALID. CR 22-13455 for trending.

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

RADIOIODINE IN AIR 1st QUARTER
ODCM required samples denoted by *
units are pCi/m^3

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	required LLD <0.070 Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	±Note
1	28-Dec-22	4-Jan-22	<0.028	<0.015	<0.021	<0.025	<0.023	<0.005	<0.018	<0.021	<0.005	<0.024	
2	4-Jan-22	11-Jan-22	<0.021	<0.022	<0.022	<0.021	<0.025	<0.032	<0.022	<0.025	<0.028	<0.021	
3	11-Jan-22	18-Jan-22	<0.032	<0.032	<0.039	<0.007	<0.036	<0.032	<0.040	<0.023	<0.035	<0.023	
4	18-Jan-22	25-Jan-22	<0.018	<0.027	<0.023	<0.023	<0.055	<0.023	<0.069	<0.026	<0.059	<0.023	
5	25-Jan-22	1-Feb-22	<0.030	<0.023	<0.018	<0.033	<0.029	<0.029	<0.026	<0.019	<0.029	<0.035	
6	1-Feb-22	8-Feb-22	<0.007	<0.018	<0.031	<0.023	<0.033	<0.030	<0.033	<0.029	<0.035	<0.037	
7	8-Feb-22	15-Feb-22	<0.030	<0.034	<0.028	<0.033	<0.031	<0.025	<0.033	<0.028	<0.031	<0.022	
8	15-Feb-22	22-Feb-22	<0.024	<0.027	<0.034	<0.030	<0.018	<0.031	<0.023	<0.024	<0.030	<0.027	
9	22-Feb-22	1-Mar-22	<0.018	<0.040	<0.026	<0.037	<0.026	<0.033	<0.034	<0.035	<0.032	<0.046	
10	1-Mar-22	8-Mar-22	<0.030	<0.034	<0.031	<0.025	<0.021	<0.025	<0.021	<0.024	<0.028	<0.025	
11	8-Mar-22	15-Mar-22	<0.018	<0.023	<0.018	<0.026	±<0.032	<0.041	<0.026	<0.034	<0.018	<0.026	1
12	15-Mar-22	22-Mar-22	<0.018	<0.028	<0.021	<0.022	±<0.039	<0.017	<0.022	<0.025	<0.025	<0.017	2
13	22-Mar-22	29-Mar-22	<0.022	<0.024	<0.021	<0.025	<0.024	<0.017	<0.030	<0.031	<0.025	<0.028	

Note 1: Site 15 found without power. Power loss was at the pole. Approximately 30 hours of data was collected and not sufficient for data retrieval. Sample is INVALID and sample analyzed using default; volume data provided is for INFO ONLY. CR 22-02637

Note 2: Site 15 did not regain power until 3/18/2022. Insufficient data for statistical analysis for this sampling period. Sample counted for INFO ONLY. CR 22-02896

RADIOIODINE IN AIR 2nd QUARTER
ODCM required samples denoted by *
units are pCi/m^3

Week #	DATE	DATE	4	(control) 6A*	7A	required LLD <0.070 14A*	15*	17A	21	29*	35	40*	±Note
14	29-Mar-22	5-Apr-22	<0.023	<0.036	<0.036	<0.018	<0.031	<0.023	<0.041	<0.023	<0.035	<0.018	
15	5-Apr-22	12-Apr-22	<0.026	<0.027	<0.037	<0.018	<0.032	<0.023	<0.026	<0.023	<0.038	<0.022	
16	12-Apr-22	19-Apr-22	<0.007	<0.037	<0.027	<0.036	<0.029	<0.031	<0.030	<0.028	<0.019	<0.024	
17	19-Apr-22	26-Apr-22	<0.029	<0.021	<0.035	<0.038	<0.024	<0.020	<0.029	<0.032	<0.033	<0.025	
18	26-Apr-22	3-May-22	<0.019	<0.007	<0.036	<0.053	<0.041	<0.023	<0.018	<0.028	<0.034	<0.026	
19	3-May-22	10-May-22	<0.018	<0.026	<0.029	<0.028	<0.021	<0.034	<0.029	<0.028	<0.017	<0.021	
20	10-May-22	17-May-22	<0.027	<0.031	<0.017	<0.031	<0.027	<0.032	<0.017	<0.029	±<0.026	<0.035	3
21	17-May-22	24-May-22	<0.007	<0.031	<0.027	<0.023	<0.023	<0.027	<0.024	<0.018	<0.039	<0.007	
22	24-May-22	31-May-22	<0.023	<0.026	<0.026	<0.023	<0.023	<0.024	<0.030	<0.019	<0.024	<0.024	
23	31-May-22	7-Jun-22	<0.030	<0.033	<0.017	<0.026	<0.025	<0.026	<0.022	<0.007	<0.017	<0.026	
24	7-Jun-22	14-Jun-22	<0.024	<0.035	<0.023	<0.034	<0.029	<0.028	<0.026	<0.030	<0.018	<0.034	
25	14-Jun-22	21-Jun-22	<0.026	<0.028	<0.017	<0.037	<0.022	<0.026	<0.017	<0.038	<0.025	<0.029	
26	21-Jun-22	28-Jun-22	<0.022	<0.018	<0.017	<0.026	<0.027	<0.029	<0.017	<0.026	<0.031	<0.029	

Note 3: Site 35 ETM was found to be running with an inoperable pump. The dust loading was lighter than usual and there was no way to accurately estimate the sample volume. The pump was found to have broken carbon vanes. Sample is INVALID and the data is included as INFO ONLY. CR 22-05573

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

RADIOIODINE IN AIR 3rd QUARTER
ODCM required samples denoted by *

				(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
27	28-Jun-22	5-Jul-22	<0.027	<0.030	<0.033	<0.18	<0.027	<0.031	<0.018	<0.024	<0.024	<0.027	
28	5-Jul-22	12-Jul-22	<0.006	<0.017	<0.026	<0.028	<0.022	<0.006	<0.029	<0.025	<0.029	<0.025	
29	12-Jul-22	19-Jul-22	<0.026	<0.017	<0.025	<0.025	<0.026	<0.025	<0.031	<0.031	<0.032	<0.031	
30	19-Jul-22	26-Jul-22	<0.030	<0.021	<0.027	<0.030	<0.023	<0.038	<0.028	<0.028	<0.027	<0.018	
31	26-Jul-22	2-Aug-22	<0.027	<0.007	<0.024	<0.007	<0.019	<0.040	<0.025	<0.025	<0.007	<0.029	
32	2-Aug-22	9-Aug-22	<0.031	<0.030	<0.031	<0.028	<0.027	<0.019	<0.023	<0.023	<0.031	<0.037	
33	9-Aug-22	17-Aug-22	<0.023	<0.033	<0.031	<0.017	<0.034	<0.006	<0.034	<0.006	<0.030	<0.017	
34	17-Aug-22	23-Aug-22	<0.042	<0.040	<0.026	<0.020	<0.038	<0.025	<0.034	⊥<0.064	<0.038	<0.030	3
35	23-Aug-22	30-Aug-22	<0.018	<0.023	<0.023	<0.023	<0.018	<0.007	<0.033	<0.007	<0.030	<0.023	4
36	30-Aug-22	6-Sep-22	<0.034	<0.025	<0.034	<0.036	<0.035	<0.032	<0.026	<0.028	<0.019	<0.029	5
37	6-Sep-22	13-Sep-22	<0.027	<0.032	<0.033	<0.029	<0.047	<0.023	<0.035	<0.027	<0.027	<0.029	
38	13-Sep-22	20-Sep-22	<0.029	<0.035	<0.007	<0.029	<0.019	<0.020	<0.007	<0.026	<0.028	<0.026	
39	20-Sep-22	27-Sep-22	<0.019	<0.038	<0.044	<0.032	<0.028	<0.019	<0.024	<0.030	<0.028	<0.019	

Note 4: Site 29 stopped working during Week 34 sample period; however, ETM continued operating. Sample time and volume could not be calculated. Data is for INFO ONLY. CR 22-

Note 5: Site 29 ETM stopped working during the Week 35 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09144

Note 6: Site 29 ETM stopped working during the Week 36 sample period; however, pump continued operating. Sample time and volume was calculated via records of in/out of service documentation. Data is for VALID. CR 22-09372

RADIOIODINE IN AIR 4th QUARTER
ODCM required samples denoted by *
units are pCi/m^3

				(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
40	27-Sep-22	4-Oct-22	<0.022	<0.034	<0.023	<0.022	<0.025	<0.029	<0.038	<0.025	<0.027	<0.006	
41	4-Oct-22	11-Oct-22	<0.006	<0.025	<0.037	<0.035	<0.027	<0.027	<0.022	<0.031	<0.032	<0.017	
42	11-Oct-22	18-Oct-22	<0.017	<0.027	<0.027	<0.028	<0.019	<0.023	<0.023	<0.022	<0.041	<0.023	
43	18-Oct-22	25-Oct-22	<0.037	<0.028	<0.033	<0.036	<0.039	<0.039	<0.038	<0.028	<0.038	<0.019	
44	25-Oct-22	1-Nov-22	<0.007	<0.007	<0.007	<0.037	<0.034	<0.027	<0.028	<0.018	<0.037	<0.024	
45	1-Nov-22	7-Nov-22	<0.035	<0.031	<0.045	<0.008	<0.036	<0.035	<0.031	<0.037	<0.032	<0.008	
46	7-Nov-22	15-Nov-22	<0.021	<0.025	<0.025	<0.029	<0.025	<0.006	<0.019	<0.028	<0.006	<0.024	
47	15-Nov-22	21-Nov-22	<0.038	<0.032	<0.027	<0.028	<0.021	<0.028	<0.008	<0.036	<0.022	<0.033	
48	21-Nov-22	29-Nov-22	<0.027	<0.016	<0.006	<0.025	<0.028	<0.027	<0.016	<0.020	<0.023	<0.033	
49	29-Nov-22	6-Dec-22	<0.038	<0.028	<0.026	<0.034	<0.030	<0.045	<0.024	<0.023	<0.027	<0.018	
50	6-Dec-22	13-Dec-22	<0.031	<0.032	<0.027	<0.039	<0.032	<0.036	<0.031	<0.028	<0.034	<0.024	
51	13-Dec-22	20-Dec-22	<0.032	<0.007	<0.029	<0.032	<0.023	<0.033	<0.030	<0.033	<0.035	<0.033	6,7
52	20-Dec-22	27-Dec-22	<0.029	<0.030	<0.032	<0.033	<0.038	<0.031	<0.036	<0.029	<0.036	<0.030	

Note 7: Site 7 ETM value differed from calculated run time for Week 51 sample period; however, pump continued operating. Sample time and volume was based on ETM value for conservatism. ETM will be evaluated for functionality at next sample change-out. Data is for VALID. CR 22-13436

Note 8: Site 40 pump replaced due to degraded flow. Data is VALID. CR 22-13455 for trending.

Table 8-6 Vegetation

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

LOCATION	TYPE	DATE COLLECTED	I-131 <60	Cs-134 <60	Cs-137 <80	Note
LOCAL RESIDENCE (Site #47)*		January- NO SAMPLE AVAILABLE				
		February- NO SAMPLE AVAILABLE				
		March- NO SAMPLE AVAILABLE				
	Lettuce	21-Apr-22	<59	<43	<59	
		May- NO SAMPLE AVAILABLE				
		June- NO SAMPLE AVAILABLE				
		July- NO SAMPLE AVAILABLE				
		August- NO SAMPLE AVAILABLE				
		September- NO SAMPLE AVAILABLE				
		October- NO SAMPLE AVAILABLE				
		November- NO SAMPLE AVAILABLE				
		December-NO SAMPLE AVAILABLE				
COMMERCIAL FARM (Site #62)*	Kale	20-Jan-22	<46	<50	<61	
	Spring Mix	20-Jan-22	<57	<26	<56	
	Red Baby Romaine	20-Jan-22	<57	<38	<29	
	Kale	17-Feb-22	<47	< 9	<44	
	Green Oak Leaf Lettuce	17-Feb-22	<33	<39	<57	
	Red Leaf	17-Feb-22	<45	<28	<34	
	Kale	17-Mar-22	<32	<34	<47	
	Green Oak Leaf Lettuce	17-Mar-22	<42	<47	<66	
	Red Romaine	17-Mar-22	<41	<41	<67	
	Organic Romaine	21-Apr-22	<39	<38	<37	
	Organic Baby Tatsoi	21-Apr-22	<42	<57	<40	
	Organic Wild Arugula	21-Apr-22	<41	<46	<49	
		May- NO SAMPLE AVAILABLE				
		June- NO SAMPLE AVAILABLE				
		July- NO SAMPLE AVAILABLE				
		August- NO SAMPLE AVAILABLE				
		September- NO SAMPLE AVAILABLE				
	Arugula	21-Oct-22	<48	<36	<40	
	Red Oak Leaf Lettuce	21-Oct-22	<45	<47	<46	
	Green Leaf Lettuce	17-Nov-22	<51	<37	<51	
	Arugula	17-Nov-22	<58	<45	<34	
	Red Romaine	17-Nov-22	<48	<40	<66	
	Green Leaf Lettuce	8-Dec-22	<43	<48	<52	
	Red Oak Leaf Lettuce	8-Dec-22	<48	<44	<68	
	Red Leaf	8-Dec-22	<59	<48	<63	
LOCAL RESIDENCE (Site #51)		January- NO SAMPLE AVAILABLE				
		February- NO SAMPLE AVAILABLE				
		March- NO SAMPLE AVAILABLE				
		April- NO SAMPLE AVAILABLE				
		May- NO SAMPLE AVAILABLE				
		June- NO SAMPLE AVAILABLE				
		July- NO SAMPLE AVAILABLE				
		August- NO SAMPLE AVAILABLE				
		September- NO SAMPLE AVAILABLE				
		October-Resident Relocated, Removed from the REMP				
		November-Resident Relocated, Removed from the REMP				
		December-Resident Relocated, Removed from the REMP				
LOCAL RESIDENCE (Site #49) *		Resident Entered the REMP October 2022				
		October- NO SAMPLE AVAILABLE				
		November- NO SAMPLE AVAILABLE				
		December-NO SAMPLE AVAILABLE				

Table 8-7 Milk

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	±Note
Local Resident Goats (Site #51)*	January- NO SAMPLE AVAILABLE February- NO SAMPLE AVAILABLE March- NO SAMPLE AVAILABLE April- NO SAMPLE AVAILABLE May- NO SAMPLE AVAILABLE June- NO SAMPLE AVAILABLE July- NO SAMPLE AVAILABLE August- NO SAMPLE AVAILABLE September- NO SAMPLE AVAILABLE October-Resident Relocated, Removed from the REMP November-Resident Relocated, Removed from the REMP December-Resident Relocated, Removed from the REMP						
Local Resident Goats (Site #53)*	January- NO SAMPLE AVAILABLE						
	24-Feb-22	<1	<1	<1	<3	<1	
	24-Mar-22	<1	<1	<1	<3	<1	
	28-Apr-22	<1	<1	<1	<3	<1	
	19-May-22	<1	<1	<1	<3	<1	
	22-Jun-22	<1	<1	<1	<3	<1	
	20-Jul-22	<1	<1	<1	<3	<1	
	18-Aug-22	<1	<1	<1	<3	<1	
	28-Sep-22	<1	<1	<1	<3	<1	
	21-Oct-22	<1	<1	<1	<3	<1	
	22-Nov-22	<1	<1	<1	<3	<1	
	22-Dec-22	<1	<1	<1	<3	<1	
Local Resident Goats (Site #54)*	14-Jan-22	<1	<1	<1	<3	<1	
	10-Feb-22	<1	<1	<1	<3	<1	
	10-Mar-22	<1	<1	<1	<3	<1	
	14-Apr-22	<1	<1	<1	<4	<9	1
	12-May-22	<1	<1	<1	<3	<1	
	09-Jun-22	<1	<1	<1	<3	<1	2
	13-Jul-22	<1	<1	<1	<3	<1	
	11-Aug-22	<1	<1	<1	<3	<1	
	14-Sep-22	<1	<1	<1	<3	<1	
	12-Oct-22	<1	<1	<1	<3	<1	
	10-Nov-22	<1	<1	<1	<3	<1	
	08-Dec-22	<1	<1	<1	<3	<1	
LOCAL RESIDENCE (Site #49) *	Resident Entered the REMP October 2022 October- No Sample Available November- No Sample Available December- No Sample Available						

Note 1: Power interruption resulted in higher than usual I-131 MDA for Site 54. MDA achieved 1.43 pCi/L; ODCM requirement is 1 pCi/L. Reporting to one significant digit meets requirement; however, event is still noteworthy for trending. Sample valid. CR 22-04327

Note 2: Power interruption resulted in higher than usual I-131 MDA for Site 54. MDA achieved 1.02 pCi/L; ODCM requirement is 1 pCi/L. Reporting to one significant digit meets requirement; however, event is still noteworthy for trending. Sample valid. CR 22-06461

Table 8-8 Drinking Water

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	Qtrly Tritium	<4.0 Gross Beta	Note
LOCAL RESIDENCE (Site #48) *	25-Jan-22	<12	<9	<15	<8	<19	<9	<17	<11	<10	<12	<34	<12		<2.88	
	22-Feb-22	<10	<8	<17	<7	<17	<11	<17	<8	<9	<10	<35	<14		<2.83	
	29-Mar-22	<10	<12	<18	<9	<22	<9	<18	<8	<9	<9	<25	<13	<327	4.25±1.77	
	26-Apr-22	<8	<7	<17	<9	<15	<9	<14	<7	<7	<9	<25	<13		<2.50	
	31-May-22	<10	<11	<13	<11	<24	<11	<17	<10	<8	<9	<29	<13		<2.66	
	28-Jun-22	-	-	-	-	-	-	-	-	-	-	-	-	<325	2.70±1.64	1
	26-Jul-22	<10	<7	<16	<9	<20	<8	<14	<9	<8	<8	<26	<12		<3.18	2
	30-Aug-22	<10	<9	<16	<9	<23	<10	<19	<9	<9	<9	<32	<10		<3.24	
	27-Sep-22	<10	<9	<19	<9	<25	<12	<20	<9	<7	<9	<33	<12	<328	3.16±1.81	
	25-Oct-22	<11	<8	<23	<9	<24	<10	<19	<9	<9	<10	<29	<12		<2.86	
	29-Nov-22	<10	<10	<19	<11	<23	<11	<20	<9	<9	<10	<31	<14		7.36±1.92	
	27-Dec-22	<8	<9	<18	<10	<17	<10	<16	<10	<7	<10	<33	<8	<344	2.86±1.70	
LOCAL RESIDENCE (Site #55)	25-Jan-22	<12	<9	<20	<11	<19	<12	<18	<9	<7	<9	<32	<8		<2.69	
	22-Feb-22	<10	<9	<17	<10	<18	<11	<14	<9	<6	<10	<30	<12		4.88±1.76	
	29-Mar-22	<8	<11	<14	<8	<24	<8	<19	<8	<8	<9	<32	<15	<323	3.84±1.66	
	26-Apr-22	<9	<12	<16	<8	<21	<11	<19	<10	<8	<10	<32	<14		4.15±1.59	
	31-May-22	<10	<8	<22	<10	<21	<8	<16	<8	<9	<9	<24	<11		<2.71	
	28-Jun-22	-	-	-	-	-	-	-	-	-	-	-	-	<323	4.28±1.62	1
	26-Jul-22	<10	<10	<17	<7	<20	<10	<18	<9	<8	<9	<32	<15		<2.92	
	30-Aug-22	<11	<11	<19	<8	<19	<10	<17	<7	<9	<9	<22	<11		<2.84	
	27-Sep-22	<8	<9	<18	<11	<19	<11	<17	<9	<9	<12	<32	<14	<326	4.59±1.77	
	25-Oct-22	<11	<11	<21	<9	<22	<9	<18	<10	<10	<12	<28	<15		<2.70	
	29-Nov-22	<7	<10	<21	<2	<23	<11	<18	<10	<7	<10	<31	<12		8.44±1.87	
	27-Dec-22	<11	<9	<23	<8	<27	<11	<17	<10	<8	<8	<34	<11	<344	5.01±1.69	

Note 1: Monthly drinking water samples are collected as weekly composites. The samples for the sample period of June were collected; however, there was a failure to conduct the monthly gamma analysis. The failure to analyze was not identified in time to conduct the analysis with reasonable lower limits of detection capabilities. Gross Beta and Tritium analysis were performed. CR 22-09005

Note 2: Duplicate sample obtained. Gamma isotopic data reported represents the average of the two samples.

Table 8-8 Drinking Water (Continued)

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	Qtrly Tritium	<4.0 Gross Beta	Note
LOCAL RESIDENCE (Site #46) *	25-Jan-22	<10	<14	<16	<8	<25	<14	<22	<12	<12	<14	<45	<9		<2.66	
	22-Feb-22	<12	<8	<24	<7	<17	<10	<16	<8	<8	<10	<34	<12		<2.65	
	29-Mar-22	<10	<10	<17	<10	<24	<10	<19	<9	<6	<11	<31	<15	<326	3.37±1.62	
	26-Apr-22	<8	<7	<15	<8	<15	<8	<13	<7	<7	<9	<27	<15		4.01±1.58	
	31-May-22	<11	<7	<19	<6	<17	<8	<14	<8	<7	<9	<33	<10		<2.62	
	28-Jun-22	-	-	-	-	-	-	-	-	-	-	-	-	<326	5.37±1.64	1
	26-Jul-22	<10	<10	<16	<9	<20	<9	<17	<9	<8	<8	<32	<14		<2.85	
	30-Aug-22	<11	<10	<20	<7	<22	<9	<16	<10	<7	<11	<29	<11		<2.68	
	27-Sep-22	<11	<9	<18	<9	<24	<11	<17	<9	<9	<11	<29	<14	<327	<2.71	
	25-Oct-22	<6	<7	<14	<7	<15	<7	<9	<6	<6	<6	<21	<14		<2.71	
	29-Nov-22	<9	<10	<19	<9	<20	<10	<17	<9	<7	<12	<34	<7		5.83±1.78	
	27-Dec-22	<10	<8	<17	<9	<20	<10	<16	<9	<8	<10	<29	<8	<344	2.70±1.60	
LOCAL RESIDENCE (Site #49) *	25-Jan-22	<12	<11	<13	<10	<23	<13	<17	<12	<10	<12	<35	<14		<2.61	
	22-Feb-22	<10	<10	<17	<10	<23	<10	<18	<8	<7	<11	<36	<10		<2.59	
	29-Mar-22	<10	<8	<18	<8	<18	<10	<17	<9	<8	<7	<31	<15	<327	<2.47	
	26-Apr-22	<6	<7	<13	<7	<16	<8	<13	<7	<7	<7	<23	<13		<2.38	
	31-May-22	<7	<7	<13	<7	<14	<8	<11	<6	<6	<9	<24	<12		<2.59	
	28-Jun-22	-	-	-	-	-	-	-	-	-	-	-	-	<325	<2.41	1
	26-Jul-22	<11	<9	<18	<11	<18	<10	<15	<10	<7	<10	<30	<15		<2.73	
	30-Aug-22	<9	<8	<22	<9	<23	<11	<17	<9	<7	<8	<28	<14		<2.59	2
	27-Sep-22	<10	<9	<17	<7	<20	<9	<14	<9	<7	<7	<25	<15	<329	<2.61	
	25-Oct-22	<10	<11	<16	<9	<22	<11	<18	<9	<8	<9	<30	<11		<2.61	
	29-Nov-22	<12	<8	<21	<7	<23	<11	<17	<9	<8	<10	<29	<8		<2.59	
	27-Dec-22	<9	<8	<21	<11	<21	<9	<20	<8	<9	<10	<25	<11	<346	<2.45	

Note 1: Monthly drinking water samples are collected as weekly composites. The samples for the sample period of June were collected; however, there was a failure to conduct the monthly gamma analysis. The failure to analyze was not identified in time to conduct the analysis with reasonable lower limits of detection capabilities. Gross Beta and Tritium analysis were performed. CR 22-09005

Note 2: Original Gross Beta Analysis of the Site 49 August sample originally reported abnormally high values. A confirmatory analysis was performed; confirmatory analysis reported Gross Beta to be less than the Lower Limits of Detection. No further action is required.

Table 8-9 Groundwater

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	Notes
WELL 27ddc (Site #57)*	25-Jan-22	<10	<8	<17	<9	<15	<11	<14	<9	<7	<8	<28	<14	<332	
	26-Apr-22	<12	<10	<18	<10	<19	<13	<18	<10	<9	<12	<35	<14	<327	
	26-Jul-22	<12	<11	<21	<9	<28	<9	<19	<10	<9	<14	<36	<11	<333	
	25-Oct-22	<9	<9	<17	<9	<16	<10	<16	<8	<7	<11	<33	<15	<340	
Well 34aab (Site #65)*	25-Jan-22	<9	<9	<17	<8	<22	<10	<17	<9	<7	<10	<24	<15	<341	
	26-Apr-22	<9	<8	<20	<12	<24	<13	<22	<9	<9	<10	<35	<12	<329	
	26-Jul-22	<11	<9	<20	<6	<20	<8	<12	<8	<7	<8	<33	<13	<331	
	25-Oct-22	<8	<8	<16	<9	<21	<9	<19	<8	<8	<10	<34	<13	<343	
Well 27dcb (Site #58A)*	25-Jan-22	<10	<7	<17	<9	<19	<10	<14	<13	<9	<11	<33	<9	<333	
	26-Apr-22	<12	<10	<18	<9	<25	<10	<16	<9	<10	<9	<34	<15	<276	
	29-Jul-22	<9	<9	<19	<10	<20	<10	<18	<9	<8	<11	<31	<7	<327	
	25-Oct-22	<9	<9	<16	<9	<14	<10	<13	<8	<7	<9	<24	<13	<341	

Table 8-10 Surface Water

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	±Notes
45 ACRE RESERVOIR (Site #61) *	25-Jan-22	<8	<9	<18	<8	<27	<12	<17	<11	<7	<11	<31	<10	<334	
	26-Apr-22	<10	<11	<15	<10	<26	<10	<16	<10	<7	<8	<29	<14	<338	
	26-Jul-22	<11	<10	<18	<12	<23	<8	<12	<8	<7	<7	<32	<10	<331	
	25-Oct-22	<11	<9	<20	<9	<18	<11	<19	<10	<9	<11	<27	<11	<345	
85 ACRE RESERVOIR (Site #60) *	25-Jan-22	<10	<10	<16	<11	<22	<11	<14	<10	<8	<10	<32	<13	<333	
	26-Apr-22	<10	<10	<18	<8	<17	<9	<17	<9	<9	<8	<25	<10	<333	
	26-Jul-22	<11	<11	<18	<7	<20	<10	<13	<9	<7	<11	<34	<13	<337	
	25-Oct-22	<10	<9	<16	<8	<22	<10	<18	<8	<7	<8	<30	< 3	<360	
EVAP POND 1 (Site #59) *CELL 1A	25-Jan-22	<10	<10	<21	<10	<22	<9	<17	<9	<9	<11	<30	<8	999±216	
	26-Apr-22	<9	<10	<21	<9	<22	<10	<17	<10	<8	<10	<30	<8	797±209	
	26-Jul-22	<11	<8	<18	<14	<17	<9	<17	<10	<7	<10	<31	<9	357±205	
	25-Oct-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
CELL 1B	25-Jan-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Apr-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Jul-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	25-Oct-22	<11	<10	<23	<10	<25	<11	<20	<8	<9	<11	<32	<9	421±212	
CELL 1C	25-Jan-22	<11	<12	<21	<12	<27	<11	<16	<9	<10	<10	<35	<15	819±215	
	26-Apr-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Jul-22	<13	<10	<26	<11	<28	<11	<20	<9	<10	<13	<31	<9	<330	
	25-Oct-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
EVAP POND 2 (Site #63) *CELL 2A	25-Jan-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Apr-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Jul-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	25-Oct-22	<9	<10	<23	<10	<27	<11	<17	<11	<8	<11	<32	<12	411±210	
CELL 2B	25-Jan-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Apr-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Jul-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	25-Oct-22	<12	<8	<23	<14	<23	<12	<21	<9	<8	<10	<35	<11	<344	
CELL 2C	25-Jan-22	<9	<10	<21	<9	<22	<9	<17	<11	<8	<11	<36	<14	862±212	1
	26-Apr-22	NO SAMPLE REQUIRED													
	26-Jul-22	NO SAMPLE REQUIRED													
	25-Oct-22	NO SAMPLE REQUIRED													
EVAP POND 3 (Site #64) *CELL 3A	25-Jan-22	NO SAMPLE REQUIREED- POND IS DRAINED FOR REPAIRS AND HAS NO INFLUENT													
	26-Apr-22	NO SAMPLE REQUIREED- POND IS DRAINED FOR REPAIRS AND HAS NO INFLUENT													
	26-Jul-22	NO SAMPLE REQUIREED- POND IS DRAINED FOR REPAIRS AND HAS NO INFLUENT													
	25-Oct-22	NO SAMPLE REQUIREED- POND IS DRAINED FOR REPAIRS AND HAS NO INFLUENT													
CELL 3B	25-Jan-22	<10	<8	<19	<8	<19	<9	<12	<8	<6	<9	<26	<14	878±212	
	26-Apr-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													
	26-Jul-22	<10	<11	<25	<11	<28	<10	<19	<8	<8	<11	<39	<8	<332	
	25-Oct-22	NO SAMPLE REQUIRED- NO INFLUENT SINCE LAST SAMPLE													

Note 1: Cell 2C is not a required sampling location. Cell 2C is a lined sludge collection point and does not receive influent directly from the plant.

Table 8-10 Surface Water (Continued)

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**	**Notes**
	4-Jan-22	<9	<9	<21	<10	<26	<11	<18	<10	<8	<10	<35	<11		
	11-Jan-22	<10	<8	<15	<7	<19	<10	<17	<10	<9	<10	<29	<14		
	18-Jan-22	<9	<11	<16	<10	<20	<9	<15	<9	<7	<10	<32	<7		
	25-Jan-22	<11	<10	<27	<12	<21	<15	<23	<13	<11	<12	<32	<15	<349	
	1-Feb-22	<10	<9	<20	<8	<17	<11	<16	26±10	<8	<8	<37	<9		
	8-Feb-22	<11	<8	<19	<9	<17	<10	<15	17±8	<7	<8	<26	<15		
	15-Feb-22	<10	<10	<15	<8	<20	<9	<16	<10	<8	<11	<30	<13		
	22-Feb-22	<10	<9	<18	<9	<23	<10	<19	<10	<8	<11	<25	<8	<349	
	1-Mar-22	<11	<8	<19	<9	<16	<10	<19	<10	<8	<10	<30	<14		
	8-Mar-22	<9	<9	<15	<8	<18	<9	<19	<10	<7	<10	<29	<7		
	15-Mar-22	<10	<8	<20	<10	<19	<10	<18	<11	<9	<9	<29	<12		
	22-Mar-22	<9	<8	<17	<10	<19	<10	<15	8±7	<8	<9	<30	<10		
	29-Mar-22	<10	<7	<17	<8	<21	<12	<17	19±10	<8	<11	<30	<8	<338	
WRF	5-Apr-22	<10	<9	<21	<10	<19	<8	<18	<11	<8	<10	<31	<11		
INFLUENT	12-Apr-22	<10	<10	<19	<9	<20	<10	<14	<12	<8	<10	<26	<11	<311	
	19-Apr-22	**NO SAMPLE-WR OUTAGE**													
	26-Apr-22	**NO SAMPLE-WR OUTAGE**													
	3-May-22	<9	<9	<16	<9	<15	<7	<14	27±10	<8	<9	<25	<10		
	10-May-22	<112	<10	<15	<11	<22	<11	<19	<13	<10	<13	<39	<8		
	17-May-22	<8	<11	<19	<11	<13	<10	<16	<10	<7	<11	<30	<11		
	24-May-22	<9	<9	<17	<8	<18	<10	<18	11±8	<8	<10	<32	<11		
	31-May-22	<10	<10	<20	<11	<26	<10	<18	<11	<8	<11	<24	<9	<345	
	7-Jun-22	<11	<10	<15	<8	<20	<8	<16	<10	<8	<10	<30	<11		
	14-Jun-22	<8	<10	<17	<9	<22	<8	<17	<10	<9	<10	<28	<11		
	21-Jun-22	<9	<8	<14	<8	<20	<10	<18	19±9	<7	<11	<30	<9		
	28-Jun-22	<9	<10	<15	<10	<19	<9	<13	<10	<8	<11	<31	<10	<346	

Table 8-10 Surface Water (Continued)

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**
	5-Jul-22	<11	<9	<16	<9	<24	<8	<14	<10	<9	<9	<28	<12		
	12-Jul-22	<10	<9	<16	<10	<21	<10	<17	<10	<6	<10	<33	<12		
	19-Jul-22	<9	<10	<17	<8	<22	<10	<18	<9	<7	<9	<32	<11		
	26-Jul-22	<8	<7	<18	<10	<23	<10	<17	<9	<9	<10	<23	<11	<346	
	2-Aug-22	<10	<9	<21	<8	<26	<10	<14	<12	<9	<9	<26	<8		
	9-Aug-22	<8	<7	<18	<10	<20	<8	<17	10±9	<9	<9	<28	<11		
	17-Aug-22	<11	<8	<19	<10	<22	<12	<18	13±9	<9	<9	<29	<14		
	23-Aug-22	<10	<8	<19	<9	<17	<10	<15	<11	<8	<10	<32	<11		
	30-Aug-22	<10	<9	<21	<9	<19	<10	<19	<11	<9	<11	<35	<14	<347	
	6-Sep-22	<8	<7	<13	<6	<14	<7	<12	14±7	<6	<6	<23	<14		
	13-Sep-22	<11	<7	<18	<7	<21	<9	<15	17±9	<8	<7	<24	<13		
	20-Sep-22	<9	<10	<22	<10	<20	<10	<18	<12	<9	<10	<32	<9		
	27-Sep-22	<11	<10	<14	<10	<22	<10	<28	19±9	<9	<9	<31	<10	<334	
	4-Oct-22	<10	<9	<19	<10	<26	<12	<16	<11	<10	<9	<33	<15		
WRF INFLUENT	11-Oct-22	<9	<10	<17	<9	<19	<11	<17	<13	<8	<9	<33	<11		
	18-Oct-22	**NO SAMPLE-WR OUTAGE**													
	25-Oct-22	<12	<9	<17	<7	<17	<10	<18	<11	<8	<10	<26	<13	<360	
	31-Oct-22	<10	<10	<15	<10	<15	<11	<15	<14	<8	<10	<37	<12		
	7-Nov-22	<11	<9	<18	<9	<22	<10	<15	<9	<8	<10	<27	<15		
	15-Nov-22	<12	<11	<21	<8	<17	<9	<19	10±9	<7	<8	<28	<11		
	21-Nov-22	<9	<9	<16	<9	<26	<9	<17	<12	<8	<10	<32	<12		
	29-Nov-22	<10	<8	<19	<10	<20	<11	<15	<10	<8	<11	<26	<10	<379	
	6-Dec-22	<10	<10	<21	<8	<20	<10	<17	<9	<7	<11	<33	<10		
	13-Dec-22	<11	<10	<16	<11	<25	<9	<17	11±7	<7	<12	<30	<8		
	20-Dec-22	<10	<9	<18	<9	<19	<10	<16	16±9	<7	<8	<31	<8		
	27-Dec-22	<10	<10	<23	<7	<19	<9	<17	<11	<8	<8	<24	<7	<362	

Table 8-10 Surface Water (Continued)

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**
SEDIMENTATION BASIN #2	4-Jan-22	**EMPTY- NO SAMPLE REQUIRED**													
	11-Jan-22	**EMPTY- NO SAMPLE REQUIRED**													
	18-Jan-22	**EMPTY- NO SAMPLE REQUIRED**													
	25-Jan-22	**EMPTY- NO SAMPLE REQUIRED**													
	1-Feb-22	**EMPTY- NO SAMPLE REQUIRED**													
	8-Feb-22	**EMPTY- NO SAMPLE REQUIRED**													
	15-Feb-22	**EMPTY- NO SAMPLE REQUIRED**													
	22-Feb-22	**EMPTY- NO SAMPLE REQUIRED**													
	1-Mar-22	**EMPTY- NO SAMPLE REQUIRED**													
	8-Mar-22	**EMPTY- NO SAMPLE REQUIRED**													
	15-Mar-22	**EMPTY- NO SAMPLE REQUIRED**													
	22-Mar-22	**EMPTY- NO SAMPLE REQUIRED**													
	29-Mar-22	**EMPTY- NO SAMPLE REQUIRED**													
	5-Apr-22	**EMPTY- NO SAMPLE REQUIRED**													
	12-Apr-22	**EMPTY- NO SAMPLE REQUIRED**													
	19-Apr-22	**EMPTY- NO SAMPLE REQUIRED**													
	26-Apr-22	**EMPTY- NO SAMPLE REQUIRED**													
	3-May-22	**EMPTY- NO SAMPLE REQUIRED**													
	10-May-22	**EMPTY- NO SAMPLE REQUIRED**													
	17-May-22	**EMPTY- NO SAMPLE REQUIRED**													
	24-May-22	**EMPTY- NO SAMPLE REQUIRED**													
	31-May-22	**EMPTY- NO SAMPLE REQUIRED**													
	7-Jun-22	**EMPTY- NO SAMPLE REQUIRED**													
	14-Jun-22	**EMPTY- NO SAMPLE REQUIRED**													
	21-Jun-22	**EMPTY- NO SAMPLE REQUIRED**													
	28-Jun-22	**EMPTY- NO SAMPLE REQUIRED**													

Table 8-10 Surface Water (Continued)

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	Note
SEDIMENTATION BASIN #2	5-Jul-22	**EMPTY- NO SAMPLE REQUIRED**													
	12-Jul-22	**EMPTY- NO SAMPLE REQUIRED**													
	19-Jul-22	**EMPTY- NO SAMPLE REQUIRED**													
	26-Jul-22	<9	<9	<16	<9	<17	<10	<14	<10	<7	<10	<25	<13	<347	
	2-Aug-22	**EMPTY- NO SAMPLE REQUIRED**													
	9-Aug-22	**EMPTY- NO SAMPLE REQUIRED**													
	17-Aug-22	<10	<10	<22	<9	<20	<11	<17	<9	<9	<11	<32	<10	<360	
	23-Aug-22	<7	<11	<16	<8	<16	<9	<15	<8	<7	<9	<31	<13	418±207	1
	30-Aug-22	**EMPTY- NO SAMPLE REQUIRED**													
	6-Sep-22	**EMPTY- NO SAMPLE REQUIRED**													
	13-Sep-22	<11	<9	<19	<7	<20	<10	<17	<8	<8	<10	<27	<10	487±210	
	20-Sep-22	**EMPTY- NO SAMPLE REQUIRED**													
	27-Sep-22	<8	<8	<17	<10	<17	<10	<17	<9	<9	<11	<27	<10	<356	
	4-Oct-22	<10	<10	<18	<9	<20	<11	<17	<8	<8	<10	<27	<13	<345	
	11-Oct-22	<8	<11	<15	<9	<20	<9	<17	<9	<7	<10	<31	<7	<340	
	18-Oct-22	<11	<8	<13	<9	<21	<10	<18	<10	<9	<10	<33	<12	<346	
	25-Oct-22	<8	<9	<19	<10	<26	<9	<14	<9	<10	<8	<24	<9	<361	
	1-Nov-22	<10	<10	<15	<9	<22	<10	<19	<9	<8	<8	<29	<15	<343	
	7-Nov-22	<9	<9	<17	<11	<19	<10	<16	<8	<9	<12	<28	<13	<338	
	15-Nov-22	<9	<9	<16	<11	<20	<11	<16	<8	<7	<10	<23	<10	<348	
	21-Nov-22	<9	<9	<17	<9	<22	<10	<15	<9	<9	<9	<27	<12	<361	
	29-Nov-22	**EMPTY- NO SAMPLE REQUIRED**													
	6-Dec-22	**EMPTY- NO SAMPLE REQUIRED**													
	13-Dec-22	**EMPTY- NO SAMPLE REQUIRED**													
	20-Dec-22	**EMPTY- NO SAMPLE REQUIRED**													
	27-Dec-22	**EMPTY- NO SAMPLE REQUIRED**													

Note 1: Duplicate sample obtained. Gamma isotopic and tritium data reported represents the average of the two samples.

Table 8-11 Sludge/Sediment

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

SAMPLE LOCATION	DATE COLLECTED	I-131	<150 Cs-134	<180 Cs-137	In-111	Notes
WRF CENTRIFUGE WASTE SLUDGE	4-Jan-22	207±114	<68	<122		
	11-Jan-22	276±122	<124	<79		
	18-Jan-22		<113	<173		
	25-Jan-22	281±126	<112	<172		
	1-Feb-22	186±122	<122	<107		
	8-Feb-22	545±163	<105	<100		
	15-Feb-22	291±144	<103	<87		
	22-Feb-22	458±174	<114	<112		
	1-Mar-22	310±117	<82	<162		
	8-Mar-22		<37	<31		
	15-Mar-22		<44	<102		
	22-Mar-22	752±183	<31	<103		
	29-Mar-22		<87	<32		
	5-Apr-22	659±168	<26	<32		
	12-Apr-22	930±254	<133	<163		
	19-Apr-22	**NO SAMPLE-WR OUTAGE**				
	26-Apr-22	**NO SAMPLE-WR OUTAGE**				
	3-May-22	685±150	<75	<27		
	10-May-22	487±157	<122	<104		
	17-May-22	653±193	<27	<130		
	24-May-22	536±143	<94	<155		
	31-May-22	311±139	<126	<103		
	7-Jun-22	323±160	<127	<109		
	14-Jun-22	352±137	<32	<134		
	21-Jun-22		<85	<92		
	28-Jun-22	283±112	<64	<79		
WRF CENTRIFUGE WASTE SLUDGE	5-Jul-22	310±99	<71	<128		
	12-Jul-22	460±171	<128	<41		
	19-Jul-22	238±96	<26	<156		
	26-Jul-22	233±113	<104	<128		
	2-Aug-22		<69	<107		
	9-Aug-22	249±105	<117	<81		
	17-Aug-22	506±160	<117	<118		
	23-Aug-22	346±126	<101	<125		
	30-Aug-22	348±140	<80	<148		
	6-Sep-22	311±129	<59	<129		
	13-Sep-22	608±147	<80	<115		
	20-Sep-22	725±172	<126	<32		
	27-Sep-22	540±170	<126	<178		
	4-Oct-22	516±162	<113	<159		
	11-Oct-22	424±125	<100	<95		
	18-Oct-22	**NO SAMPLE-WR OUTAGE**				
	25-Oct-22		<33	<138		
	1-Nov-22	**NO SAMPLE-WR OUTAGE**				
	7-Nov-22	363±141	<92	<133		
	15-Nov-22	387±116	<64	<29		
	21-Nov-22	768±182	<93	<150		
	29-Nov-22	1020±260	<140	<119		
	6-Dec-22	217±108	<35	<102		
	13-Dec-22	193±108	<85	<83		
	20-Dec-22	231±132	<71	<32		
	27-Dec-22	497±159	<125	<117		

Table 8-11 Sludge/Sediment (Continued)
Cooling Tower Sludge

Unit Cycle	Approximate Volume (yd^3)	Isotope	Activity Range (pCi/g)	Sample Type
U2R23	610	All principal gamma-emitters	<MDA	Towers/Canal Sludge
U1R23	261	All principal gamma-emitters	<MDA	Towers/Canal Sludge

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	12/7/2022	<172	<141	<4.55	<1.51
Unit 2 (inside RCA)	H0A	10/21/2022	<180	<121	<4.25	<1.09
Unit 3 (inside RCA)	H11	10/21/2022	<178	<129	<4.35	<1.46

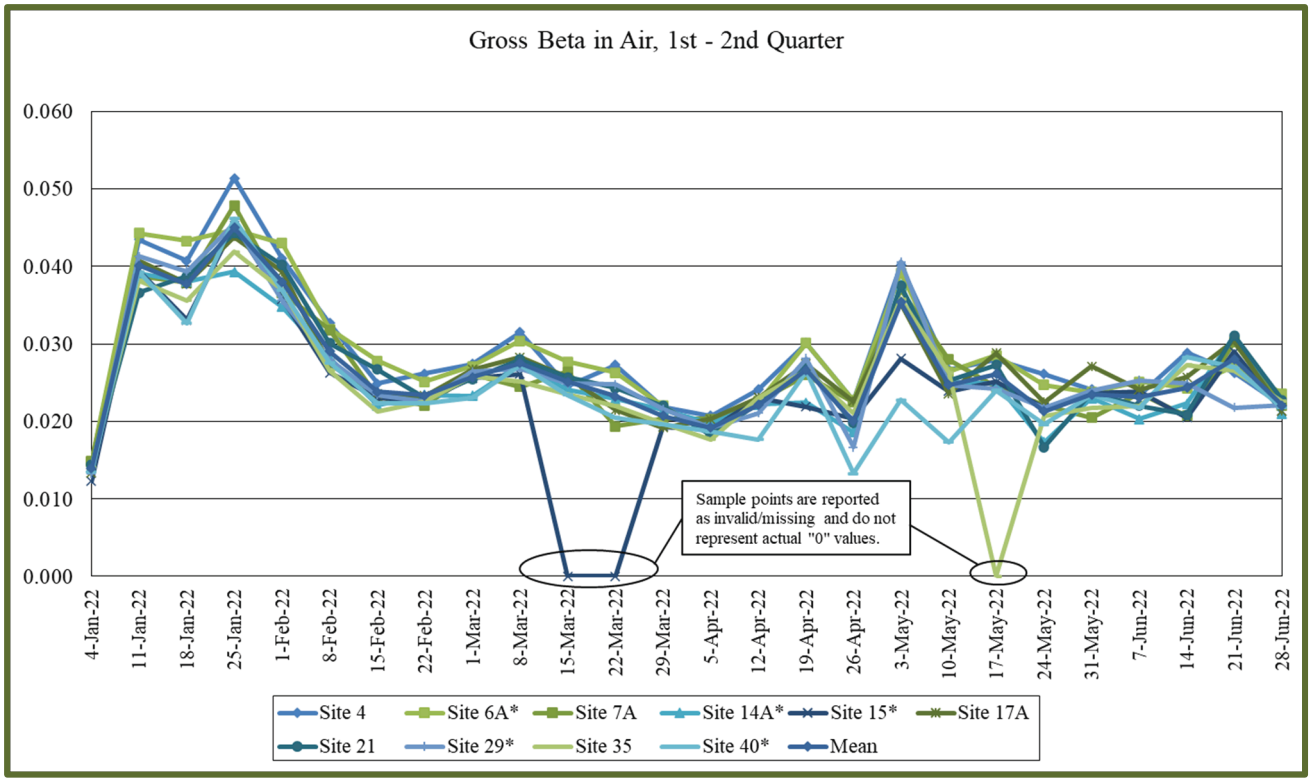


Figure 8-1 Gross Beta in Air, 1st-2nd Quarter

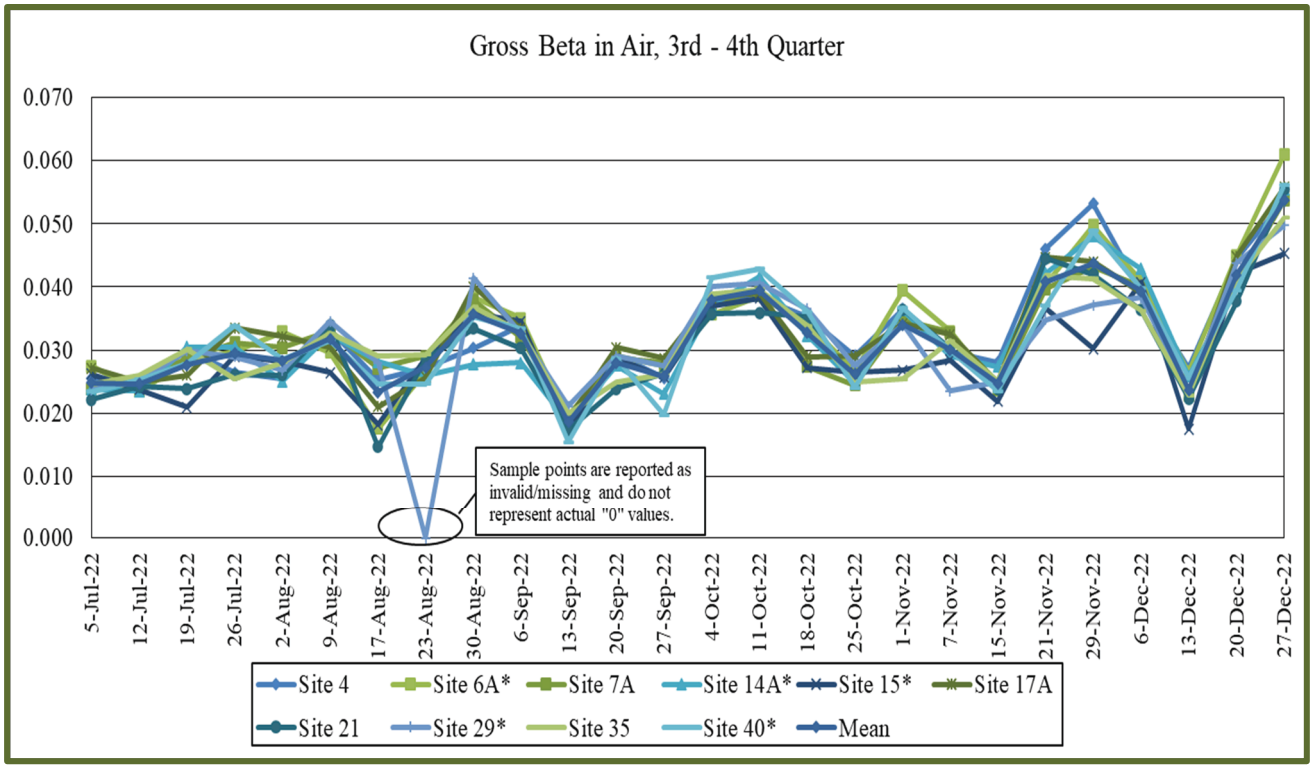


Figure 8-2 Gross Beta in Air, 3rd-4th Quarter

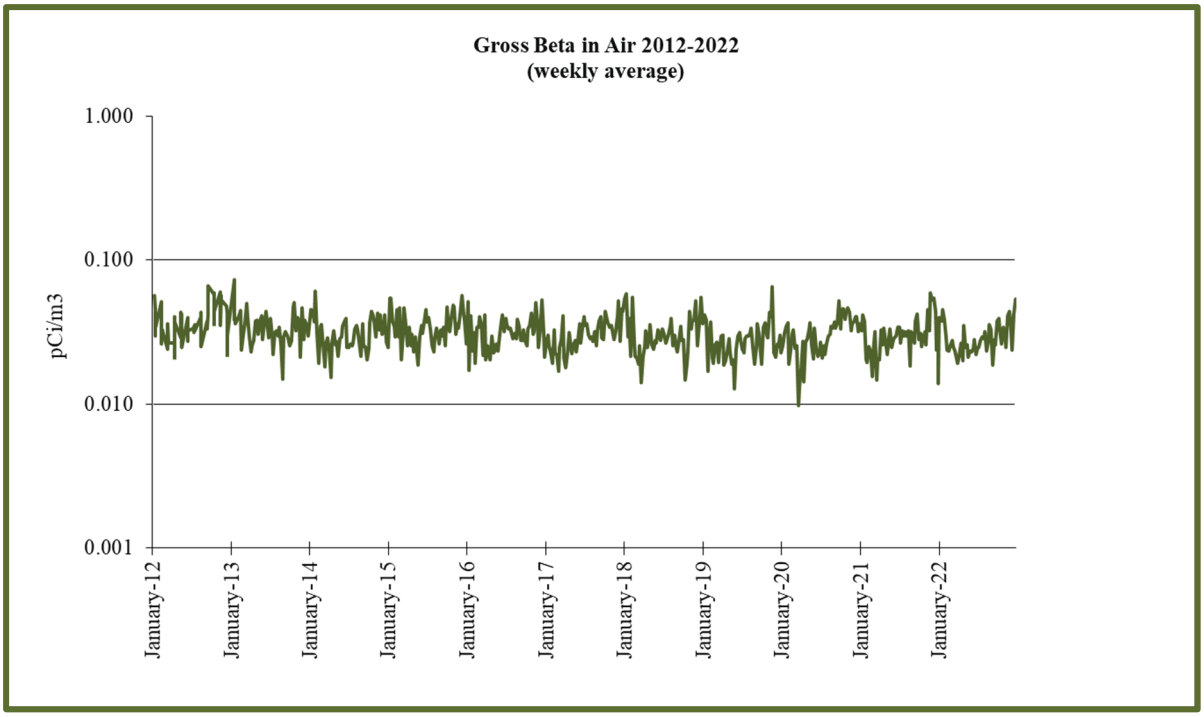


Figure 8-3 Historical Gross Beta in Air (Weekly System Average)

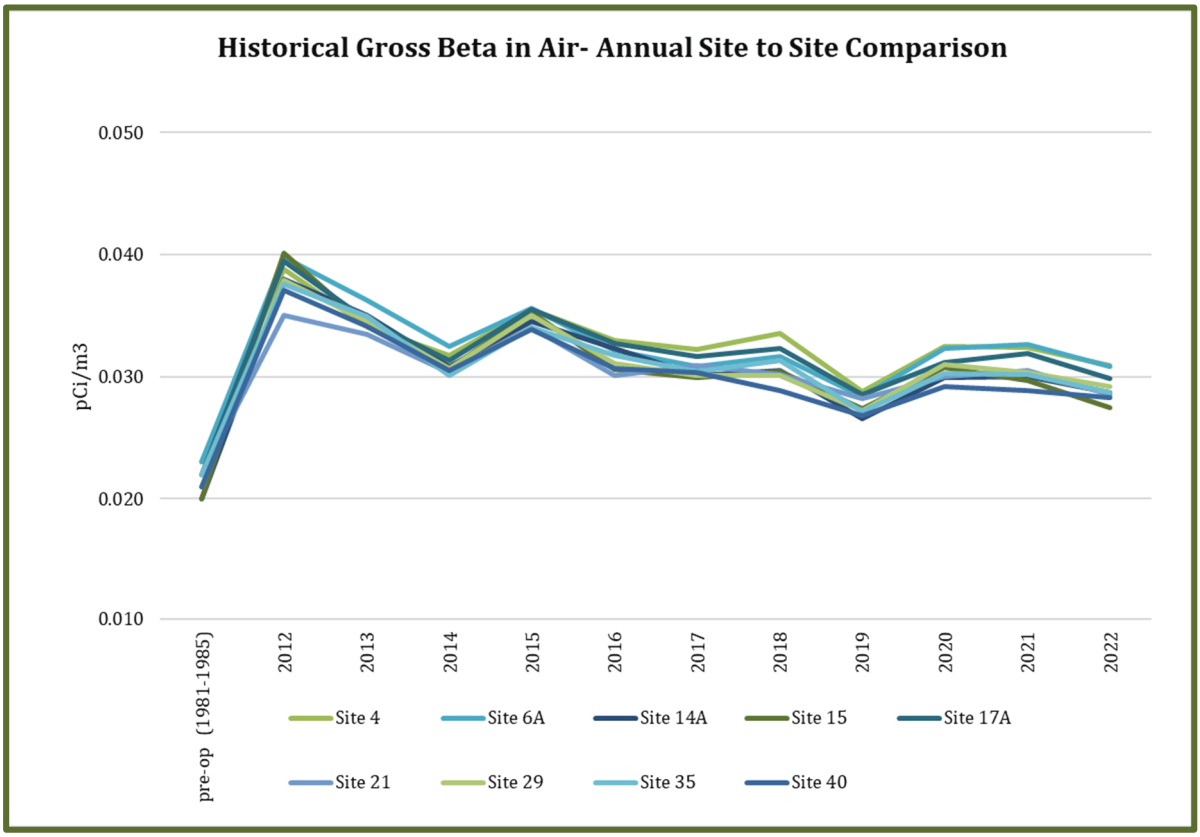


Figure 8-4 Historical Gross Beta in Air (Annual Site to Site Comparisons) Compared to Pre-Op

Note: 7A is not included due to the location change since pre-operational period.

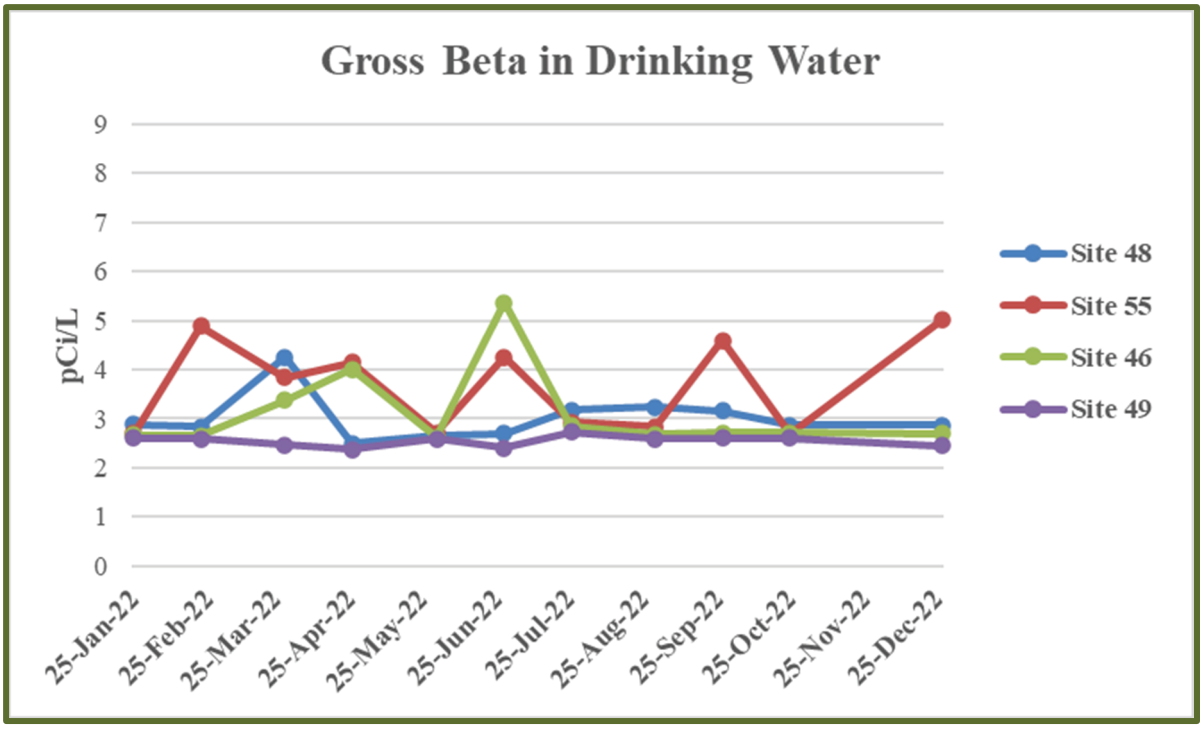


Figure 8-5 Gross Beta in Drinking Water

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

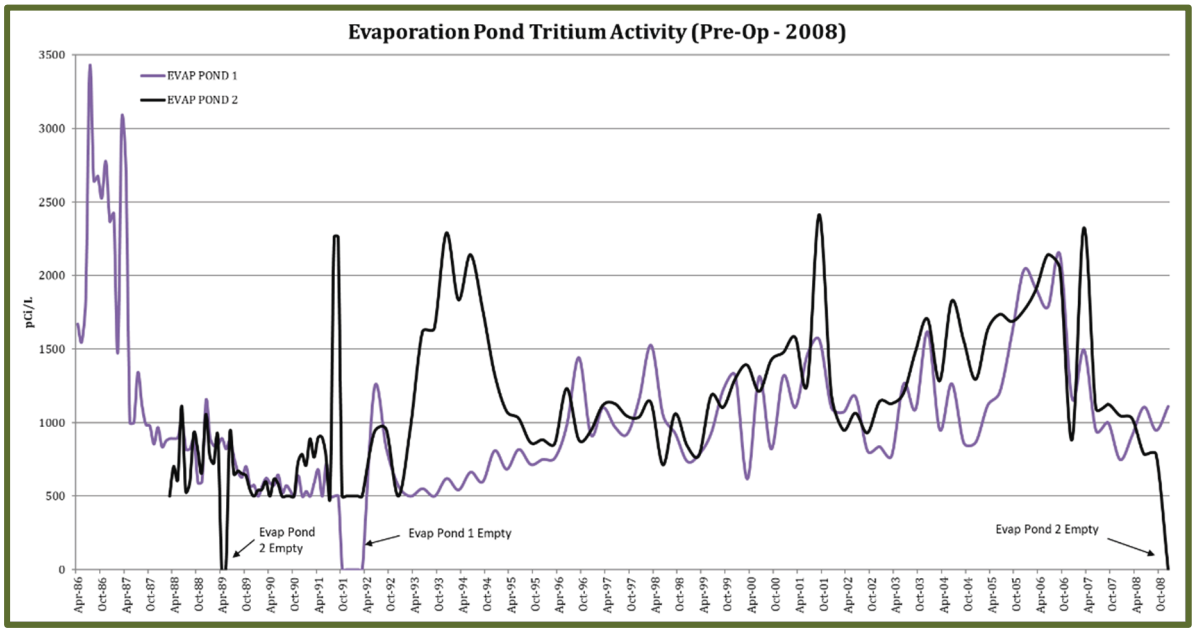


Figure 8-6 Evaporation Pond Tritium Activity (Pre-Op- 2008)

Note: Zero values represent no sample taken for sampling period, per procedural guidance or lack of sample material.

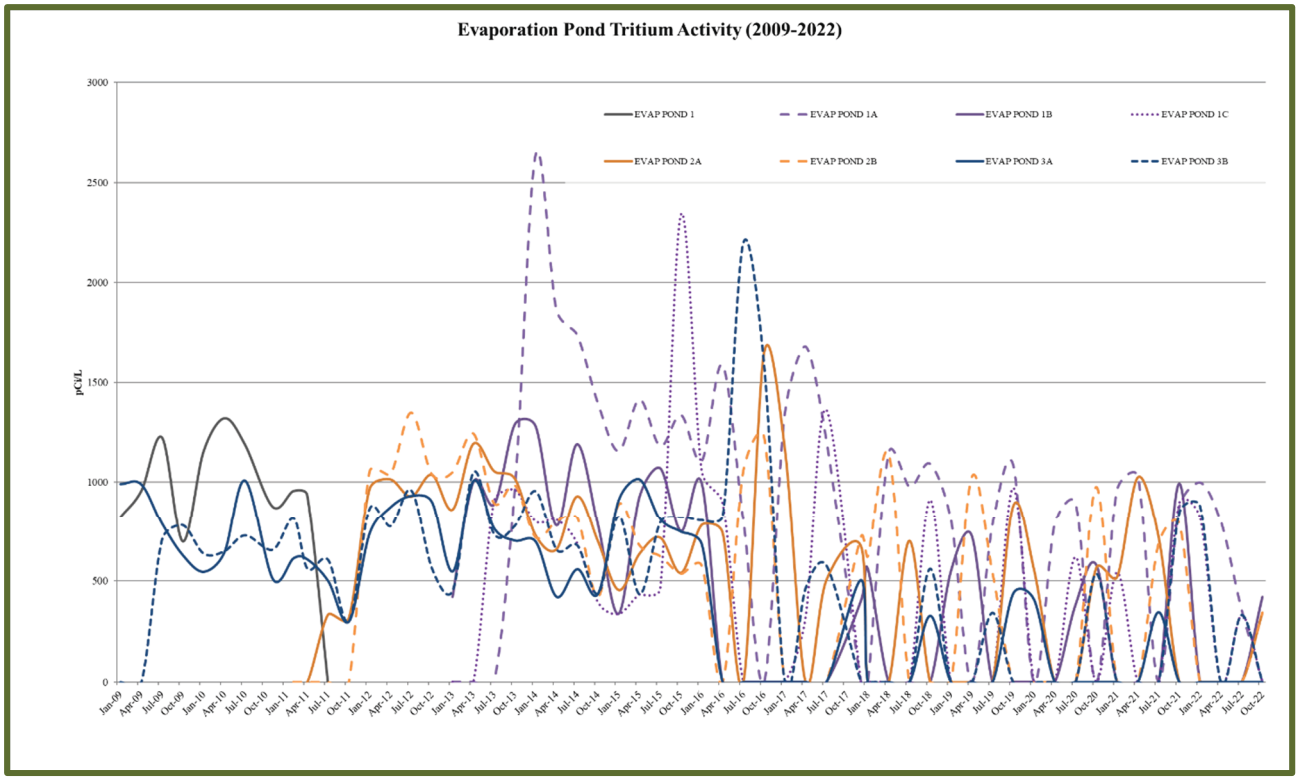


Figure 8-7 Evaporation Pond Tritium Activity (2009-2022)

Note: Zero values represent no sample taken for sampling period, per procedural guidance or lack of sample material.

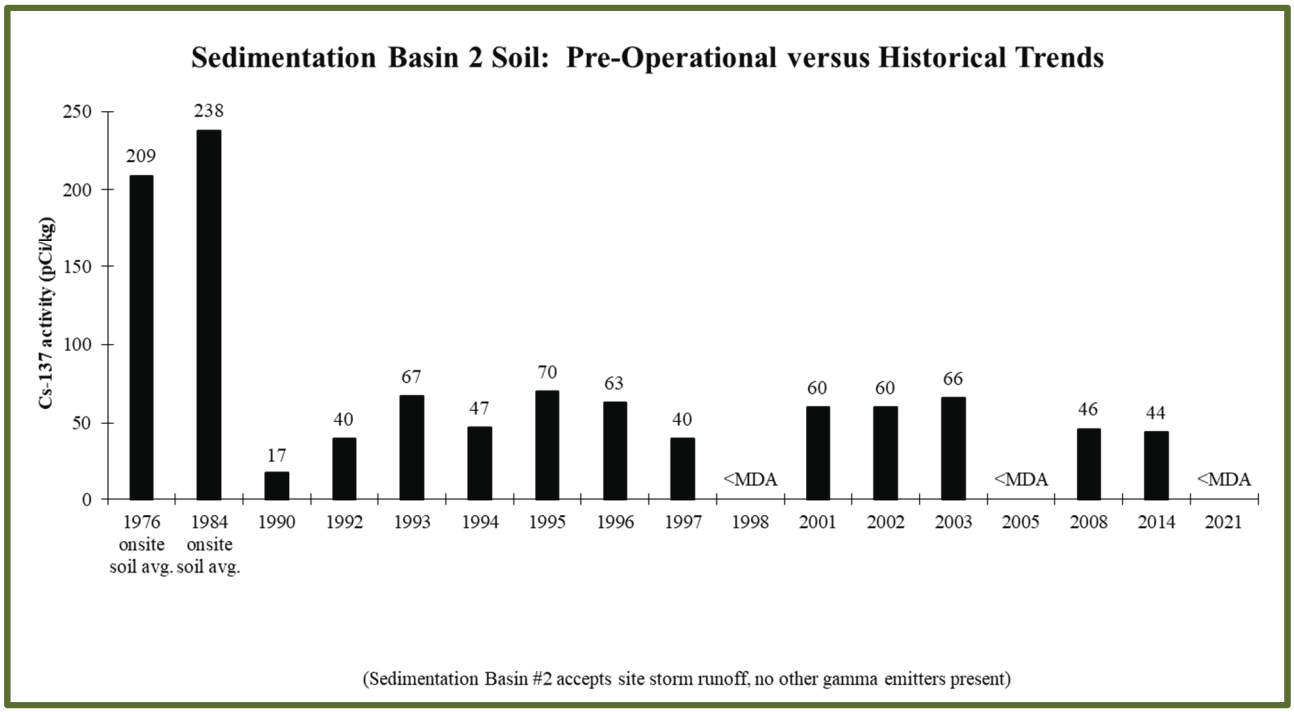


Figure 8-8 Sedimentation Basin 2 Cs-137

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 2022 are presented in Table 9-2. Definitions for Table 9-2 are as follows:

MDD_Q: Minimum differential dose, quarterly, 3 times 90^{th} percentile sQ determined from analysis (mRem).

MDD_A: Minimum differential dose, annual, 3 times 90^{th} percentile sA determined from analysis (mRem).

B_Q: Quarterly baseline (mRem) (average of previous 5 years)

M_Q: Locations 91-day standard quarter normalized dose (mRem per standard quarter)

L_Q: Quarterly investigation level dose (mRem)

B_A: Baseline background dose (mRem) (annual)

M_A: Annual monitoring data – MA determined by normalizing available quarterly data to 4 full quarters

L_A: Annual investigation level dose (mRem)

ND: Non-Detectable

The baseline is calculated as the average of the previous 5-year measurements. The minimum differential dose (MDD) is calculated as 3 times the 90^{th} percentile standard deviation of the data from the previous 5 years; quarterly MDD is calculated using the quarterly data and annual MDD is calculated using the annual summation of the quarterly data. Investigation level is calculated by the difference of the data measurement and the baseline; results less than, or equal to the MDD are Non-Detectable (ND) and any result exceeding the MDD meets the threshold for the investigation level. Locations exceeding the investigation level will be evaluated for cause and impact to the public and environment.

Historical environmental gamma radiation results for 1985 through 2022 are presented in graphical form on Figure 9-1 (excluding transit control TLD #45). Figure 9-2 depicts the environmental TLD results from 2022 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 indicated 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 #	Location	Distance from Unit 2	TLD #	Location	Distance from Unit 2	TLD #	Location	Distance from Unit 2
1	E30	29.13	18	ESE2	1.48	35	NNW8	7.86
2	ENE24	24.18	19	SE2	1.35	36	N5	4.32
3	E21	21.87	20	SSE2	2.04	37	NNE5	4.69
4	E16	16.05	21	S3	2.68	38	NE5	4.21
5	ESE11	11.14	22	SSW3	2.74	39	ENE5	4.71
6	SSE31	31.47	23	W5	4.17	40	N2	2.37
7	SE7	6.87	24	SW4	3.75	41	ESE3	3.39
8	SSE4	4.33	25	WSW5	4.88	42	N8	7.24
9	S5	4.63	26	SSW4	4.13	43	NE5	4.60
10	SE5	3.91	27	SW1	0.93	44	ENE35	35.00
11	ESE5	5.14	28	WSW1	0.66	45	Onsite	0.18
12	E5	4.85	29	W1	0.64	46	ENE30	7.23
13	N1	0.85	30	WNW1	0.74	47	E35	32.35
14	NNE2	155	31	NW1	1.03	48	E24	22.76
15	NE2	1.63	32	NNW1	0.90	49	ENE11	11.32
16	ENE2	1.59	33	NW4	4.05	50	WNW5	4.24
17	E2	1.39	34	NNW5	4.84			

*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

2022 Annual Environmental TLD Monitoring Report
Palo Verde 2022 MDD_Q: 5 mrem Palo Verde 2022 MDD_A: 10 mrem

Location	Location Description	Quarterly (mrem)									Annual (mrem)			NOTE
		B_Q	M_QQ1	M_QQ2	M_QQ3	M_QQ4	L_QQ1	L_QQ2	L_QQ3	L_QQ4	B_A	M_A	L_A	
1	APS Western Division Office, Goodyear	25.0	21.1	20.1	25.0	26.8	ND	ND	ND	ND	99.8	93.0	ND	
2	Scott-Libby School, Perryville and Perryville Roads	21.9	18.8	18.7	19.8	23.2	ND	ND	ND	ND	87.7	80.5	ND	
3	Liberty School, 19800 West Highway 85	23.6	20.5	19.0	21.1	24.8	ND	ND	ND	ND	94.5	85.4	ND	
4	APS Buckeye Office, 615 North 4th Street, Buckeye	24.5	21.6	20.1	21.5	25.5	ND	ND	ND	ND	98.1	88.6	ND	
5	Palo Verde School, 291st Ave and Old US 80	20.0	17.1	16.0	17.1	21.5	ND	ND	ND	ND	79.8	71.8	ND	
6	APS Gila Bend Substation, Service Road west of town off I-8	26.2	23.3	22.1	24.5	29.1	ND	ND	ND	ND	104.8	98.9	ND	
7	Northeast corner of Old US 80 and Arlington School Road	25.7	23.0	20.3	24.9	25.6	ND	ND	ND	ND	102.9	93.7	ND	
8	Southern Pacific Pipeline Road, 1.4 miles SW of 355th Ave	24.2	20.1	19.4	22.7	25.7	ND	ND	ND	ND	96.7	87.9	ND	1
9	Southern Pacific Pipeline Road, 2.5 miles SW of 355th Ave	28.1	25.8	22.1	28.1	30.4	ND	ND	ND	ND	112.6	106.4	ND	
10	Southeast corner of 355th Ave and Elliot Road	24.2	20.8	17.4	21.6	25.9	ND	ND	ND	ND	96.6	85.6	ND	
11	Northwest corner of 339th Ave and Dobbins Road	25.0	21.7	20.1	21.3	27.4	ND	ND	ND	ND	100.0	90.4	ND	
12	Northeast corner of 339th Ave and Buckeye-Salome Road	23.9	21.2	19.8	22.4	25.1	ND	ND	ND	ND	95.6	88.4	ND	
13	North site boundary	25.4	23.0	20.5	22.8	26.7	ND	ND	ND	ND	101.8	93.0	ND	
14	North Northeast site boundary	25.3	21.5	19.7	22.8	25.1	ND	ND	ND	ND	101.2	89.1	ND	
15	Northeast site boundary, on WRF access road	24.1	20.9	18.9	21.5	25.8	ND	ND	ND	ND	96.2	87.1	ND	
16	East Northeast site boundary	23.6	20.6	19.0	21.6	24.2	ND	ND	ND	ND	94.6	85.4	ND	
17	East site boundary	24.9	22.2	19.8	21.1	26.2	ND	ND	ND	ND	99.4	89.3	ND	
18	East Southeast site boundary	23.2	21.1	19.7	20.5	24.2	ND	ND	ND	ND	92.7	85.4	ND	
19	Southeast site boundary	25.1	23.3	20.0	23.7	26.7	ND	ND	ND	ND	100.2	93.8	ND	
20	South Southeast site boundary	24.5	22.5	19.6	22.2	27.1	ND	ND	ND	ND	98.0	91.4	ND	
21	South site boundary	26.0	23.7	21.1	22.8	26.6	ND	ND	ND	ND	104.0	94.2	ND	
22	South Southwest site boundary	26.1	23.9	19.8	23.0	27.1	ND	ND	ND	ND	104.2	93.8	ND	
23	2 miles north of Elliot Road, 3 miles west of Wintersburg Road	23.1	21.1	17.9	22.5	23.5	ND	ND	ND	ND	92.5	85.0	ND	
24	Elliot Road, 2 miles west of Wintersburg at Desert Farms	22.3	20.9	18.0	21.0	24.2	ND	ND	ND	ND	89.2	84.0	ND	
25	Elliot Road, 3.5 miles west of Wintersburg at cattle guard	23.5	21.5	19.4	19.1	26.0	ND	ND	ND	ND	94.1	86.1	ND	
26	Duke Power Plant on entry gate	27.9	26.9	21.9	24.2	29.4	ND	ND	ND	ND	111.7	102.4	ND	
27	Southwest site boundary	27.1	25.0	22.3	26.4	28.0	ND	ND	ND	ND	108.5	101.7	ND	
28	West Southwest site boundary	25.9	24.5	20.3	26.5	24.8	ND	ND	ND	ND	103.6	96.1	ND	
29	West site boundary	24.3	23.6	19.3	22.0	24.5	ND	ND	ND	ND	97.2	89.4	ND	
30	West Northwest site boundary	25.8	23.5	21.3	22.9	25.7	ND	ND	ND	ND	103.0	93.3	ND	
31	Northwest site boundary	23.1	21.5	18.6	22.3	24.6	ND	ND	ND	ND	92.3	86.9	ND	
32	North Northwest site boundary	25.3	23.8	20.0	23.5	26.3	ND	ND	ND	ND	101.2	93.6	ND	
33	Buckeye Road, 0.5 miles west of 359th Ave	25.9	23.5	19.5	23.7	25.4	ND	ND	ND	ND	103.6	92.1	ND	
34	Southeast corner of 395th Ave and Van Buren Road	28.0	25.7	23.6	26.4	29.7	ND	ND	ND	ND	112.1	105.4	ND	
35	Palo Verde Inn Fire Station, 40901 W. Osborn Road, Tonopah	31.1	29.5	26.3	28.1	31.6	ND	ND	ND	ND	124.4	115.5	ND	
36	Southwest corner of Wintersburg and Van Buren Road	26.0	24.3	22.0	24.5	26.5	ND	ND	ND	ND	104.1	97.3	ND	
37	Southeast corner of 363rd Ave and Van Buren Road	24.1	22.7	19.4	21.4	25.0	ND	ND	ND	ND	96.3	88.5	ND	
38	355th Ave, 0.2 miles south of Buckeye Road on east side of rd.	27.3	25.7	23.7	26.4	27.3	ND	ND	ND	ND	109.3	103.1	ND	
39	343rd Ave, 0.5 miles south of Lower Buckeye Road	24.4	23.2	20.6	23.2	24.3	ND	ND	ND	ND	97.7	91.3	ND	
40	Wintersburg, Transmission Road at telephone pole	25.0	24.1	21.6	22.1	24.5	ND	ND	ND	ND	99.9	92.2	ND	
41	New Arlington School	26.6	25.5	22.6	24.3	27.8	ND	ND	ND	ND	106.3	100.1	ND	
42	Ruth Fisher School, Indian School Road and Wintersburg Road	26.5	24.8	23.2	28.7	27.5	ND	ND	ND	ND	105.8	104.2	ND	
43	Winters Well Elementary School	27.3	24.8	23.7	23.8	28.3	ND	ND	ND	ND	109.0	100.6	ND	
44	El Mirage, 12315 NW Grand Ave. inside rental center	24.2	24.9	*	19.4	22.6	ND	*	ND	ND	72.7	66.9	ND	2,3
45	Palo Verde Central Chemistry Lab, Bldg. E, lead pig	5.3	4.1	4.8	5.6	6.1	ND	ND	ND	ND	21.4	20.6	ND	
46	Litchfield Park School, Litchfield & Sagebrush Roads	23.9	20.9	18.5	21.4	25.9	ND	ND	ND	ND	95.4	86.7	ND	
47	Littleton School, 115th Ave and Highway 85, Cashion	23.5	21.8	20.4	22.9	24.1	ND	ND	ND	ND	93.9	89.1	ND	
48	Jackrabbit Trail S. of I-10, W side of road, S of rental center	23.7	22.8	18.8	22.9	25.7	ND	ND	ND	ND	94.8	90.2	ND	
49	Palo Verde Road, 0.25 miles south of I-10	22.5	21.6	17.9	18.9	23.6	ND	ND	ND	ND	90.1	82.0	ND	
50	Olinski Road, 2 miles south of Buckeye-Salome Road	19.5	18.3	16.8	17.5	21.2	ND	ND	ND	ND	77.8	73.6	ND	

NOTE 1: The 2 TLDs used for monitoring location 8 during 2nd Quarter, 2022, were delayed in being delivered to Dosimetry. The transit dose waws adjust accordingly. Documented with CR 22-07921.

NOTE 2: The 2 TLDs used for monitoring location 44 were missing for 2nd Quarter, 2022. The M_A and L_A were calculated using 1st, 3rd, and 4th Quarter Data. B_A was calculated using B_Q*3. Documented with CR 22-07142.

Note 3- Site 44 Transit time adjusted to reflect placement delay for 3rd Qtr monitoring. Transit does for this location was 2.4 mrem, vs 1.4 for all other locations. CR 22-07142.

Figure 9-1 Network Environmental TLD Exposure Rates

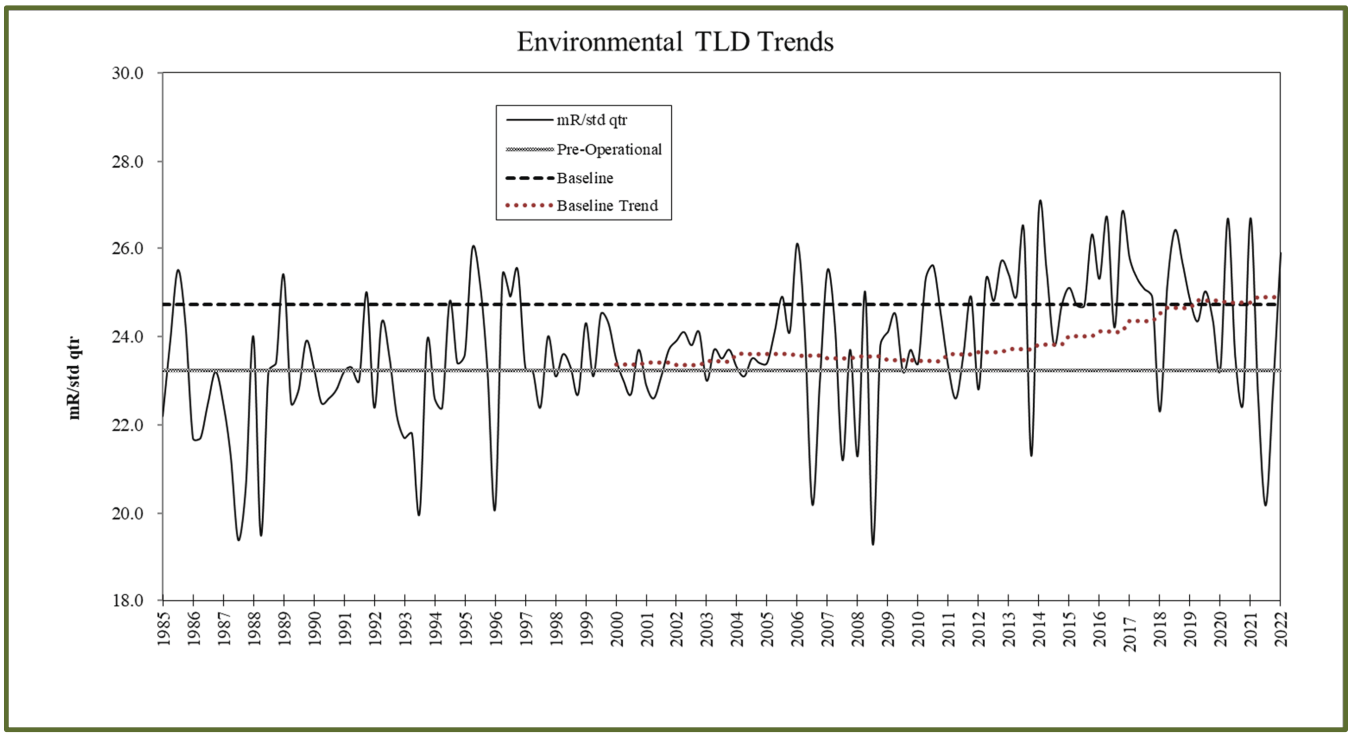
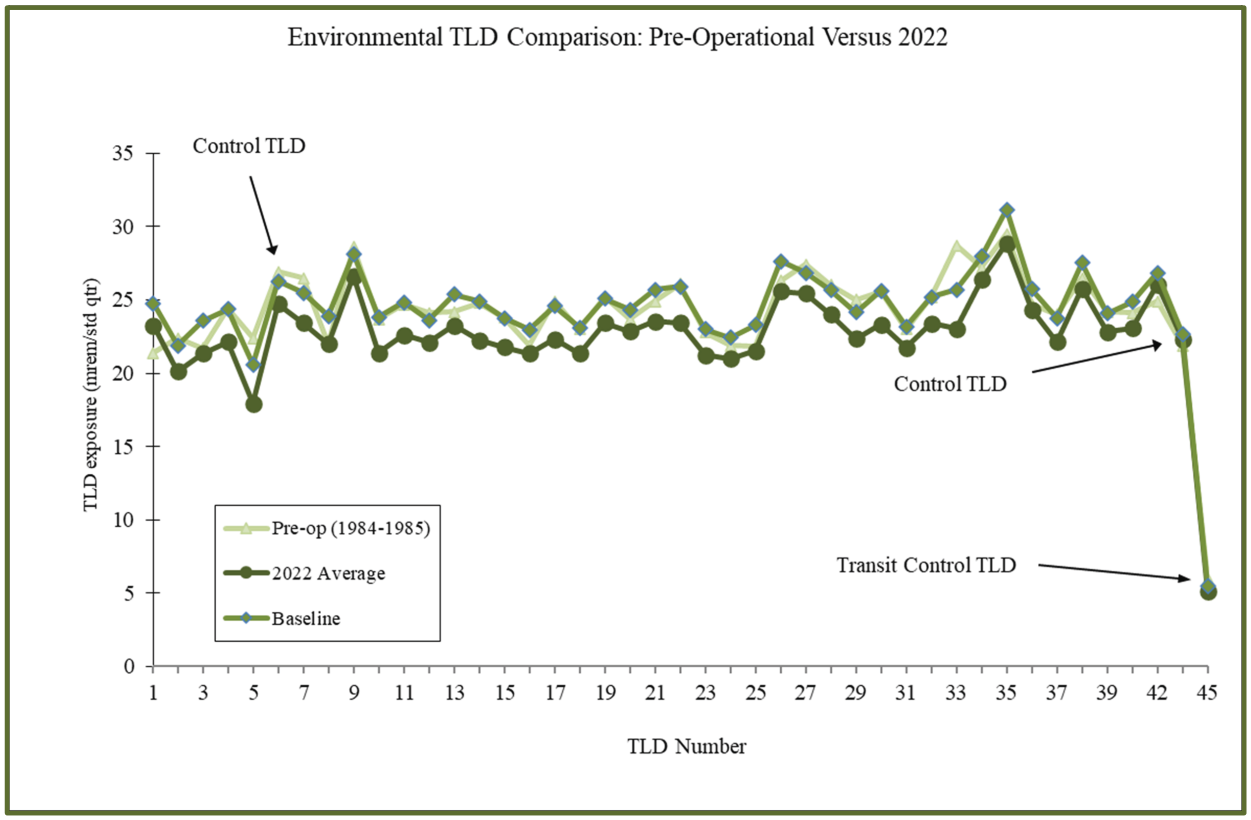


Figure 9-2 Environmental TLD Comparison: Pre-Operational versus 2022



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 field portion of the annual Land Use Census was performed by June 2022.

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

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

10.2 Census Results

The 2022 Land Use Census results identified new potential Radiological Effluent Release Report dose receptor locations. Each location was evaluated. The changes identified, and the evaluation results, are described below.

Nearest Resident

There were no changes in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.143 mrem.

Milk Animal

There were eight (8) changes in milk animal status from the previous year. There were four (4) of the locations that were identified in the census which had the potential for having a dose greater than 20% than that of our current sampling location with the lowest dose potential. The locations were visited by the REMP manager to evaluate program participation potential. As of October 2022, one of the locations had no milk animals. One of the locations potentially had milk animals; however, the animals were obscured by shelter and the property had a closed gate that prevented verifying animals or in-person discussion with owner. Introductory letter was sent via USPS. One property had goats and cows present and the owner was briefed, in-person, about the program. One resident was contacted, in-person, and has agreed to enter the program; resident added to the REMP as Site 49 as a Milk Donor. Dose calculations indicated the highest dose to be 0.669 mrem.

Vegetable Gardens

There were three (3) changes in the nearest gardens identified from the previous year. Two (2) of the locations that was identified in the census which had the potential for having a dose greater than 20% than that of our current sampling location with the lowest dose potential. One of the locations was visited by the REMP manager to evaluate program participation potential. As of October 2022, the garden was not operational and no signs of preparation for the growing season. The other resident was contacted and agree to participate in the REMP; resident has been added to the REMP as Site 49 as a Vegetation Donor. Dose calculations indicated the highest dose to be 0.669 mrem.

See Table 10-1 for a summary of the specific results and Table 2-1 for current sample locations. Figure 10-1 through 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 2022
N	1.55	1.63	1.63	Resident 5.21E-2 Garden 6.69E-1 Milk 6.69E-1	Garden Milk
NNE	1.52	NONE	2.89	Resident 1.29E-1 Milk 3.67E-1	Milk
NE	2.37	NONE	4.89	Resident 1.43E-1 Milk 3.01E-1	Milk
ENE	1.91	3.90	NONE	Resident 1.26E-1 Garden 2.47E-1	Garden Milk
E	2.81	NONE	NONE	Resident 9.08E-2	Milk
ESE	3.03	NONE	3.37	Resident 9.28E-2 Milk 4.63E-1	
SE	3.39	NONE	NONE	Resident 1.20E-1	Milk
SSE	NONE	NONE	NONE	NA	
S	NONE	NONE	NONE	NA	
SSW	NONE	NONE	NONE	NA	
SW	1.48	NONE	NONE	Resident 1.25E-1	
WSW	1.08	NONE	NONE	Resident 9.11E-2	Milk
W	0.79	NONE	NONE	Resident 5.42E-2	
WNW	NONE	NONE	NONE	NA	
NW	0.92	NONE	3.42	Resident 4.49E-2 Milk 5.92E-2	
NNW	1.31	NONE	3.45	Resident 4.43E-2 Milk 5.20E-2	Garden Milk

Comments: Dose calculations were performed using GASPAR code and 2021 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual critical organ dose identified.

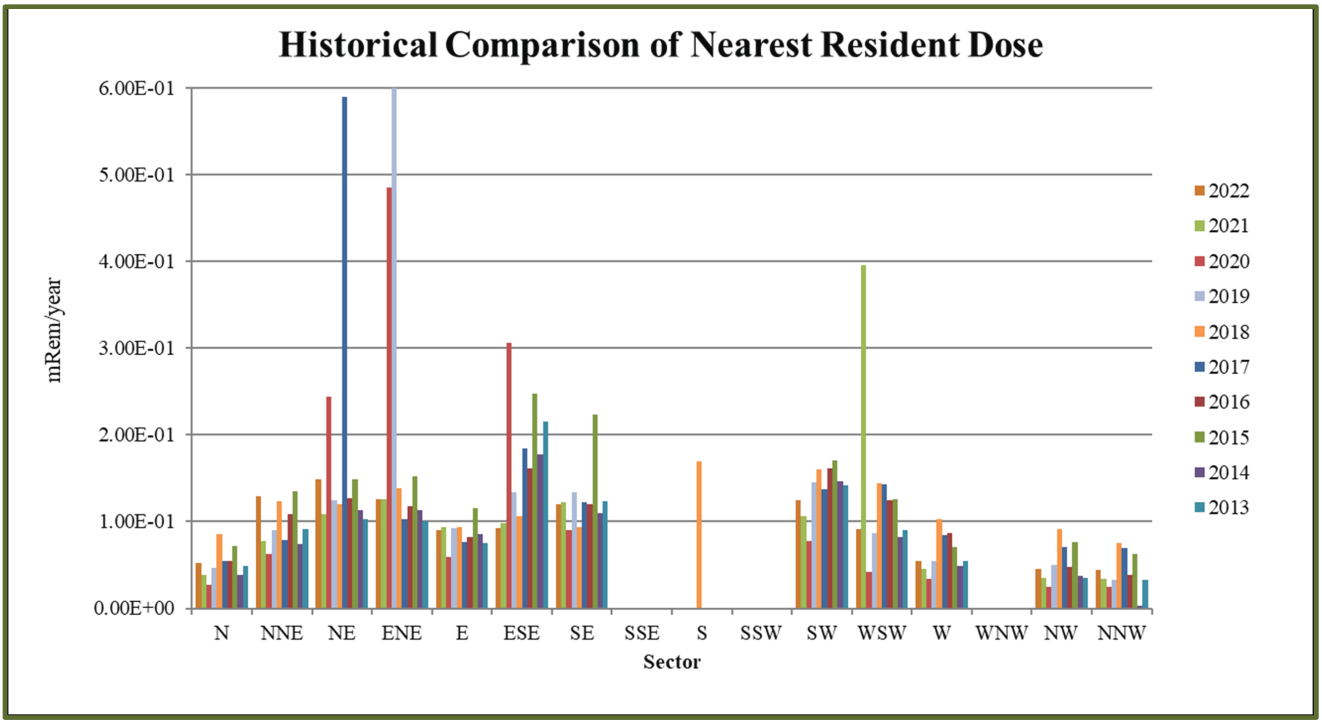


Figure 10-1 Historical Comparison of Nearest Resident Dose

Historical annual average most prevalent wind direction is from the SW; the next highest is from the N. This contributes to the higher doses assigned to residents in the S sector. The 2017 Land Use Census identified potential garden pathway for the nearest resident in the NE Sector, the 2019 and 2020 Land Use Census identified a potential milk pathway for the nearest resident in the ENE sector, and the 2021 Land Use Census identified a potential milk pathway for the nearest resident in the WSW sector; dose is reflective of the assumption of direct radiation and ingestion pathway.

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

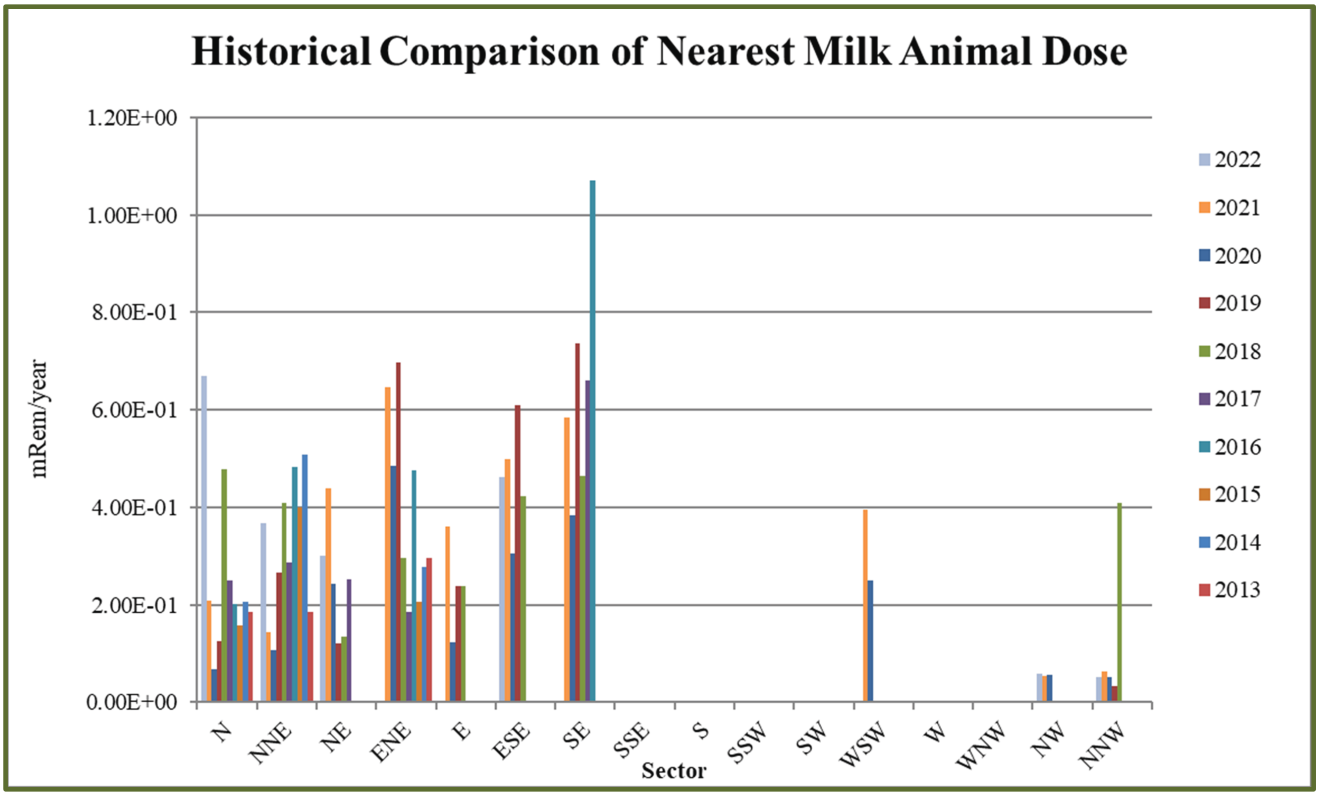


Figure 10-2 Historical Comparison of Nearest Milk Animal Dose

Milk animals include goats and/or cows. No milk samples have indicated any plant-related radionuclides. Additionally, milk animals in the desert environment are normally fed stored feed and are not on pasture. The calculated doses are conservative due to the inclusion of pastured feed as part of the calculation.

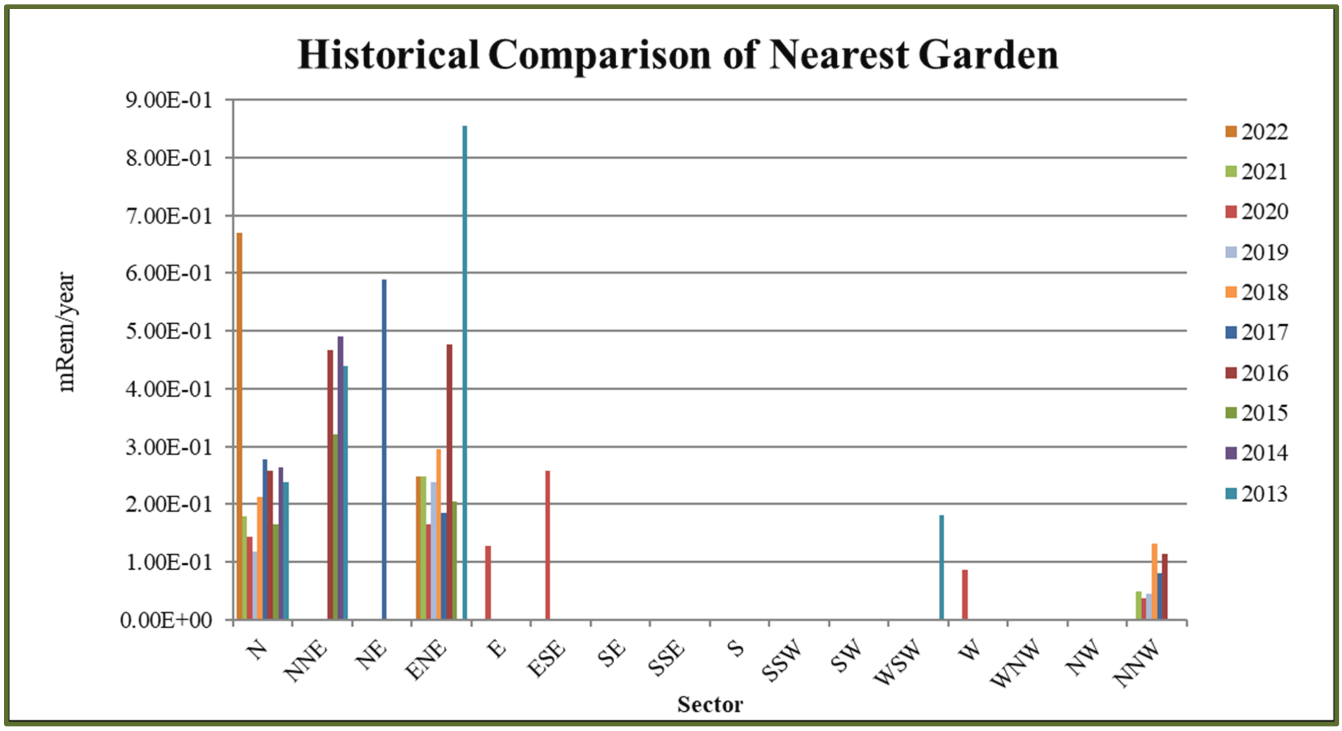


Figure 10-3 Historical Comparison of Nearest Garden Dose

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

11. Summary and Conclusions

Summary

The conclusions are based on a review of the radioassay results and environmental gamma radiation measurements for the 2022 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2022 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 is occasionally identified in the evaporation ponds, Water Resources influent, Water Resources 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.

Conclusion

There was no measurable radiological impact on the environment in 2022 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 2022

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 Range Direction	Mean (f)[a]	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mrem/std. qtr.)	TLD - 198	NA	22.9 (188/188) 16.0 – 31.6	Site #35 8 miles 330°	28.9 (8/8) 26.3 – 31.6	22.3 (6/8) 19.4 – 24.9	0
Air Particulates (pCi/m^3)	Gross Beta - 520	0.01	0.029 (468/468) 0.012 - 0.056	Site # 4 16 miles 92º	0.032 (52/52) 0.014 - 0.064	0.031 (52/52) 0.015 - 0.054	0
	Gamma Spec Composite - 40 Cs-134 (quarterly)	0.05	<LLD	NA	<LLD	<LLD	0
	Cs-137 (quarterly)	0.06	<LLD	NA	<LLD	<LLD	0
Air Radioiodine (pCi/m^3)	Gamma Spec. - 520 I-131	0.07	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 21 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 – 12	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 12						
	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
	Gross Beta – 48	4	4.52 (48/48) 2.70 – 8.44	Site #55 3 miles 214°	5.03 (12/12) 3.84 -8.44	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 44						
Drinking Water (pCi/liter)	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0

Milk (pCi/liter)	Gamma Spec. – 23						
	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
Surface Water (pCi/liter)	Gamma Spec. - 19						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	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
	H-3 - 19	3000	693 (8/19) 357-999	Site #59 Onsite 190°	679 (5/6) 357-999	NA	0

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

NOTE: Miscellaneous samples that are not listed on Tables 2.1 and 9.1 (not ODCM required) are not included on this table.

12. References

1. Pre-Operational Radiological Monitoring Program, Summary Report 1979-1985

2. 1985-2020 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 29, PVNGS Units 1, 2, and 3

5. Offsite Dose Calculation Manual, Revision 30, PVNGS Units 1, 2, and 3

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

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

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

9. "Sources of Radiation." *NRC: Sources of Radiation*. Nuclear Regulatory Commission, 20 March. 2020. Web. 17 Feb. 2023.

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.

11. NEI 07-07, Nuclear Energy Institute, Industry Groundwater Protection Initiative – Final Guidance Document, Rev. 1, March 2019

Appendix A

One abnormal event from 2021 was not identified until after the submittal of the 2021 Annual Radiological Environmental Operating Report (AREOR), and therefore not included in Table 2-3: Summaries of the REMP Deviation/Abnormal Events. EG1531 Sierra Mass Flow Meter was found to be out of tolerance during normal calibration and was documented through Condition Report (CR) 22-04247. Level 3 Evaluation 22-04247-001 documents the evaluation of this event. The EG1531 Mass Flow Meter was used during Radiological Environmental Monitoring Program (REMP) Air Sample changeouts 26 October 2021-22 November 2021. This had the potential to impact sample data for Sample Weeks 43-47, which includes sample collection dates 19 October 2021- 30 November 2021 (Sample Weeks 42-48).

The reference flow rate was higher than the instrument reported, therefore the recorded volume for the impacted samples is underestimated, resulting in conservative activity and MDA results. Per 74RM-0EN02, Radiological Environmental Air Sampling, flow rate must be 25 LPM ≥ 50 LPM. Assuming the most conservative failure, the samples in question would still meet the procedurally required flow rate. The required LLD for I-131 in air sample is 0.07 pCi/m3; the underestimation of total volume resulted in MDAs that were marginally higher than the actual MDAs, and thus still meeting required LLDs.

The impacted sample data for sample collection Weeks 42-48 (2021) was reviewed and found to have sufficient margin to accommodate for the recorded variance of the mass flow meter. Adjusted data met the required LLDs. All data is VALID. Event identified April 2022 and documented through CR 22-04247; evaluation documented through Level 3 Evaluation 22-04247-001.