

Analytical Results for the Community Environmental Monitoring Program (CEMP) Air Sampling and Dosimeter Network Fourth Quarter CY2021

The CEMP air-sampling network is designed to monitor and collect radioactive airborne particles from NNSS and non-NNSS related activities, as well as background environmental sources. This report is compiled by the Desert Research Institute (DRI) and summarizes the results from the analysis of the air samples collected by CEMP station managers as part of the community environmental monitoring program. In general, the CEMP air-sampling network is comprised of 24 continuously operating environmental sampling stations. A total of 23 stations are equipped with a low volume air sampler/totalizer configuration to collect particulate radionuclides on glass fiber filter paper. Prior to October 1, 2013 all air samples were collected on a bi-weekly basis with a target collection time of 336 hours (two weeks). After October 1, 2013, approximately half of the stations were converted to 'stand by' status in which only one two-week sample was collected and analyzed every quarter year. Beginning October 1, 2017 all CEMP stations are again operating full time with samples being collected every two weeks. Now the procedure is to submit one sample set per quarter year for analysis. The remaining samples are archived to be accessed if needed. This protocol will be followed unless an important event were to occur on or off the NNSS (major fires, transportation incident or an unusual result are a few examples). Archived samples would be used to assess conditions before and after an event. The samplers are calibrated on a quarterly basis by DRI to maintain a collection rate of 1.75 cfm (@ STP). All relevant information such as collection times, variations in flow rate, actual flow volumes, power outages, and other information documenting the integrity of the sample are recorded by the station managers. This allows for the proper interpretation of the analytical results. The air filters are analyzed by a commercial laboratory for gross alpha/beta activity as well as by high-resolution gamma spectrometry.

In the U.S., the principal reporting unit for the measurement of radioactivity in the atmospheric environment is pCi/m³ (picocuries per cubic meter). DRI receives its data from the lab as picocuries per filter. DRI converts the laboratory data unit of measurement to pCi/m³ for the ease in comparison of data for this report. A summary of the fourth quarter CY2021 analytical results for gross alpha and beta analyses are found in Table 1. This table documents the results of the quarterly analyses for each of the 23 air-sampling network stations. The average annual value from the previous year (CY2020) is provided for comparison purposes. Overall, the gross alpha results for the fourth quarter of CY2021 reflect similar values to previous quarters. The fourth quarter CY2021 beta results are also consistent with previous results. The fourth quarter gamma results for CY2021 are shown in Table 2. All of the samples were gamma spectrum negligible. Overall, these data are consistent with previous analytical results.

Prior to the fourth quarter of 2021, thermoluminescent dosimeters (TLDs) have been used at the monitoring stations. Beginning in the fourth quarter of 2021, the decision was made to change from using TLDs to dosimeters featuring optically stimulated luminescence (OSL) technology. OSL dosimeters offer several operational advantages over TLDs (e.g., no annealing or maintenance of the detectors' sensitivity required, etc.). These dosimeters measure radiation with aluminum oxide detectors. The readout process

uses a light emitting diode (LED) array to stimulate the detectors on the dosimeter and the light emitted by the OSL material is measured by a photomultiplier tube; the amount of light emitted during optical stimulation is directly proportional to the radiation dose. The OSL dosimeters meet the standards of the American National Standards Institute and Health Physics Society.

Before presenting the fourth quarter 2021 dosimetry results, a discussion regarding the reported dosimeter results for previous years is warranted. Dosimeters measure ionizing radiation from all sources, including natural radioactivity from cosmic and terrestrial sources and from man-made radioactive sources. Consequently, the dosimeters utilized for the CEMP stations measure radiation present during use at the monitoring stations, as well as from sources other than that which occur at the monitoring stations themselves. For example, the dosimeters record radiation exposure that occurs in the mail when they are shipped from the manufacturer to DRI and back, while being transported in DRI vehicles to and from the stations during quarterly retrieval/deployment, and during use at the station itself (approximately 3 months). For purposes of clarity, we will refer to these radiation exposures as occurring during 1) shipping, 2) deployment, and 3) station use. It is solely the exposure that is recorded by the dosimeter during its actual use at the station that is of interest; exposure that occurs during shipping and deployment is extraneous as it does not occur at the station. Every result reported by the analytical lab for a dosimeter used at a station will include exposure incurred during shipment and deployment. Accordingly, to determine the exposure that occurred solely at the station, the extraneous shipping and deployment exposures must be removed or “subtracted out” from the gross result value provided by the analytical lab. DRI uses a set of “control” dosimeters to track exposures occurring during shipping and deployment.

During a recent QA review of historical analytical procedures, it was determined that in the early 2000s a convention was adopted to not “correct” the station dosimeter results by subtracting out the extraneous shipping exposures. As a result, dosimeter results for the stations have been overestimated since that time. Starting in the fourth quarter of 2021 and going forward all dosimeter results will be corrected by removing extraneous exposure values so that the reported values will reflect only the exposure that occurred at the monitoring station itself.

The environmental dosimeter results for the fourth quarter of CY2021 are shown in Table 3. Data for the environmental dosimeters are reported in milliroentgens (mR). The 2020 pressurized ion chamber (PIC) exposure rate and dosimeter data are also provided for comparison. Dosimeter values are commonly lower than the PIC results, as the PIC offers greater sensitivity.

DRI welcomes and encourages input from the station managers regarding the content of the CEMP quarterly reports. If there is anything you feel we could provide to help you interpret the data or enable you to explain the information to someone in your community not familiar with the program, please let us know.

Table 1. Gross Alpha/Beta Analytical Results for the Fourth Quarter of Calendar Year 2021. (Data represents one analysis per quarter.)

Station	Gross Alpha (pCi/m ³)	2020 Average	Gross Beta (pCi/m ³)	2020 Average
Alamo	0.0023	0.0029	0.0198	0.0219
Amargosa	0.0021	0.0027	0.0223	0.0246
Beatty	0.0027	0.0022	0.0200	0.0213
Boulder City	0.0026	0.0026	0.0224	0.0256
Caliente	0.0027	0.0029	0.0214	0.0262
Cedar City	0.0021	0.0023	0.0183	0.0205
Delta	0.0016	0.0019	0.0206	0.0202
Duckwater	0.0016	0.0025	0.0201	0.0196
Ely	0.0020	0.0019	0.0190	0.0173
Goldfield	0.0024	0.0022	0.0223	0.0192
Henderson	0.0025	0.0030	0.0265	0.0253
Indian Springs	0.0029	0.0027	0.0206	0.0252
Las Vegas	0.0044	0.0023	0.0198	0.0229
Mesquite	0.0024	0.0033	0.0218	0.0262
Milford	0.0032	0.0020	0.0228	0.0223
Overton	0.0021	0.0031	0.0247	0.0273
Pahrump	0.0049	0.0028	0.0198	0.0221
Pioche	0.0026	0.0021	0.0228	0.0207
Rachel	0.0024	0.0019	0.0191	0.0211
Sarcobatus	0.0020	0.0021	0.0191	0.0244
St. George	0.0025	0.0023	0.0279	0.0280
Tecopa	0.0031	0.0023	0.0252	0.0281
Tonopah	0.0020	0.0018	0.0192	0.0209

Average analytical error gross alpha +/- 0.00061 (pCi/m³)

Average analytical error gross beta +/- 0.00249 (pCi/m³)

Table 2. Gamma Spectroscopy Results for the Fourth Quarter of Calendar Year 2021.
(Data represents one analysis per quarter.)

Station	Cs-137 (pCi/m ³)	Cs-137 MDC, (pCi/m ³)	Be-7 (pCi/m ³)	Be-7 MDC, (pCi/m ³)	Pb-210 (pCi/m ³)
Alamo	<MDC	0.005	N.D.	N/A	N.D.
Amargosa	<MDC	0.006	N.D.	N/A	N.D.
Beatty	<MDC	0.006	N.D.	N/A	N.D.
Boulder City	<MDC	0.006	N.D.	N/A	N.D.
Caliente	<MDC	0.006	N.D.	N/A	N.D.
Cedar City	<MDC	0.006	N.D.	N/A	N.D.
Delta	<MDC	0.006	N.D.	N/A	N.D.
Duckwater	<MDC	0.001	N.D.	N/A	N.D.
Ely	<MDC	0.004	N.D.	N/A	N.D.
Goldfield	<MDC	0.006	N.D.	N/A	N.D.
Henderson	<MDC	0.007	N.D.	N/A	N.D.
Indian Springs	<MDC	0.007	N.D.	N/A	N.D.
Las Vegas	<MDC	0.004	N.D.	N/A	N.D.
Mesquite	<MDC	0.008	N.D.	N/A	N.D.
Milford	<MDC	0.005	N.D.	N/A	N.D.
Overton	<MDC	0.008	N.D.	N/A	N.D.
Pahrump	<MDC	0.008	N.D.	N/A	N.D.
Pioche	<MDC	0.006	N.D.	N/A	N.D.
Rachel	<MDC	0.005	N.D.	N/A	N.D.
Sarcobatus	<MDC	0.004	N.D.	N/A	N.D.
St. George	<MDC	0.006	N.D.	N/A	N.D.
Tecopa	<MDC	0.007	N.D.	N/A	N.D.
Tonopah	<MDC	0.006	N.D.	N/A	N.D.

MDC = Minimum detectable concentration

N.D. = Not detected

Table 3. Corrected Dosimeter Analytical Results for the Fourth Quarter of Calendar Year 2021.

Station	Fourth Quarter Exposure (mR)	Est. Annual Exposure (mR/yr)	2020 Dosimeter Exposure (mR/yr)	2020 PIC Exposure (mR/yr)
Alamo	16	63	55	117
Amargosa	14	62	50	102
Beatty	23	94	79	149
Boulder City	12	50	46	133
Caliente	21	84	48	144
Cedar City	11	43	33	116
Delta	10	40	41	114
Duckwater	17	69	53	137
Ely	11	44	41	109
Goldfield	18	70	56	141
Henderson	19	83	56	118
Indian Springs	12	52	32	102
Las Vegas	10	42	37	92
Mesquite	15	59	40	104
Milford	28	113	80	162
Overton	5	22	17	97
Pahrump	5	21	18	75
Pioche	21	86	56	144
Rachel	26	103	64	137
Sarcobatus	24	96	75	148
St. George	17	68	52	125
Tecopa	15	65	42	117
Tonopah	27	110	74	146