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Analytical Results for the Community Environmental Monitoring Program (CEMP) Air Sampling and Dosimeter Network: First Quarter CY2023

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The Community Environmental Monitoring Program (CEMP) air sampling network is designed to monitor and collect radioactive airborne particles from Nevada National Security Site (NNSS) and non-NNSS activities, as well as background environmental sources. This report compiled by Desert Research Institute (DRI) summarizes the results from the analysis of air samples collected by CEMP station managers.

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 every two weeks with a target collection time of 336 hours. After October 1, 2013, approximately half of the stations were converted to "standby status," which means only one two-week sample was collected and analyzed each quarter during the year.

Beginning on October 1, 2017, all CEMP stations resumed full-time operation with samples being collected every two weeks. Currently, the procedure is to submit one set of samples per quarter 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 (e.g., major fires, a transportation incident, or an unusual result). 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 cubic feet per minute at Standard Temperature and Pressure (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) is recorded by the station managers. This allows for proper interpretation of the analytical results.

An accredited commercial laboratory analyzes the air filters for gross alpha/beta activity and uses high-resolution gamma spectrometry to detect the following isotopes:

- Actinium-228 (Ra-228)
- Americium-241
- Antimony-124
- Beryllium-7
- Bismuth-212
- Bismuth-214 (Ra-226)
- Cesium-134
- Cesium-137
- Cobalt-60
- Iridium-192
- Lead-212
- Lead-214
- Potassium-40
- Scandium-46
- Thallium-208
- Thorium-234 (U-238)
- Uranium-235

Table 1 contains the gamma results for the first quarter of calendar year (CY) 2023 for the analytes americium-241, cesium-134, cesium-137, cobalt-60, and uranium-235. Cesium-137 was detected in four samples collected from Alamo, Henderson,

Pioche, and St. George with activities (i.e., "concentrations") of 2.77, 2.63, 1.59, and 3.24×10^{-15} µCi/mL, respectively. Cesium-137 results for all other samples were below the minimum detectable activity. Cesium-137 in the environment is substantially anthropogenic (human-made) and largely a result of historical nuclear weapons tests and some nuclear accidents (including the Chernobyl and Fukushima disasters). According to the Environmental Protection Agency's cesium-137 Fact Sheet (https://semspub.epa.gov/work/HQ/176308.pdf), "Large amounts of cesium-137 were produced during atmospheric nuclear weapons tests conducted in the 1950s and 1960s. As a result of atmospheric testing and radioactive fallout, this cesium was dispersed and deposited worldwide." Therefore, detection of cesium-137 in CEMP samples is not entirely unexpected.

To put these four cesium-137 results into perspective, a brief discussion is warranted. The U.S. Department of Energy (DOE) National Nuclear Security Administration, Nevada Field Office (NNSA/NFO) conducts radiological air monitoring on the NNSS using equipment and methods similar to the CEMP to verify compliance with the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP). Compliance at a given monitoring station on the NNSS for a particular radionuclide is achieved when the annual average concentration (rather than individual measurements) is below the NESHAP concentration level (CL) for that radionuclide. The NESHAP CL for cesium-137 is 19×10^{-15} µCi/mL. Bearing in mind that the CEMP stations are not subject to NESHAP compliance and that the four cesium-137 results discussed here represent an approximately two-week monitoring period rather than an annual average, these results are all less than 20% of the cesium-137 CL.

The results for americium-241, cesium-134, cobalt-60, and uranium-235 were all below the minimum detectable activity for all samples. Naturally occurring berillium-7 was detected in all the samples. Table 2 summarizes the gross alpha/beta results for the first quarter of CY2023. The average annual values for the previous year are provided for comparison. Table 3 shows the environmental dosimeter results for the first quarter of CY2023. The dosimeter results are reported in milliroentgens (mR). The pressurized ion chamber (PIC) exposure rate and dosimeter data from the previous year are also provided for comparison. Dosimeter values are commonly lower than the PIC results because the PIC offers greater sensitivity.

Table 1. Gamma spectroscopy results for select analytes for the first quarter of CY2023. Data represent one analysis per quarter.

Station	Americium-241 ($\times 10^{-15}$ µCi/mL)	Cesium-134 ($\times 10^{-15}$ µCi/mL)	Cesium-137 ($\times 10^{-15}$ µCi/mL)	Cobalt-60 ($\times 10^{-15}$ µCi/mL)	Uranium-235 ($\times 10^{-15}$ µCi/mL)
Alamo	below MDA	below MDA	2.77	below MDA	below MDA
Amargosa Valley	below MDA	below MDA	below MDA	below MDA	below MDA
Beatty	below MDA	below MDA	below MDA	below MDA	below MDA
Boulder City	below MDA	below MDA	below MDA	below MDA	below MDA
Caliente	below MDA	below MDA	below MDA	below MDA	below MDA
Cedar City	below MDA	below MDA	below MDA	below MDA	below MDA
Delta	below MDA	below MDA	below MDA	below MDA	below MDA
Duckwater	below MDA	below MDA	below MDA	below MDA	below MDA
Ely	below MDA	below MDA	below MDA	below MDA	below MDA
Goldfield	below MDA	below MDA	below MDA	below MDA	below MDA
Henderson	below MDA	below MDA	2.63	below MDA	below MDA
Indian Springs	below MDA	below MDA	below MDA	below MDA	below MDA
Las Vegas	below MDA	below MDA	below MDA	below MDA	below MDA
Mesquite	below MDA	below MDA	below MDA	below MDA	below MDA
Milford	below MDA	below MDA	below MDA	below MDA	below MDA
Overton	below MDA	below MDA	below MDA	below MDA	below MDA
Pahrump	below MDA	below MDA	below MDA	below MDA	below MDA
Pioche	below MDA	below MDA	1.59	below MDA	below MDA
Rachel	below MDA	below MDA	below MDA	below MDA	below MDA
Sarcobatus Flat	below MDA	below MDA	below MDA	below MDA	below MDA
St. George	below MDA	below MDA	3.24	below MDA	below MDA
Tecopa	below MDA	below MDA	below MDA	below MDA	below MDA
Tonopah	below MDA	below MDA	below MDA	below MDA	below MDA

MDA = minimum detectable activity

Table 2. Gross alpha/beta results for the first quarter of CY2023. Data represent one analysis per quarter.

Station	Gross Alpha ($\times 10^{-15}$ µCi/mL)	2022 Average ($\times 10^{-15}$ µCi/mL)	Gross Beta ($\times 10^{-14}$ µCi/mL)	2022 Average ($\times 10^{-14}$ µCi/mL)
Alamo	4.55	6.72	0.98	1.34
Amargosa Valley	3.55	7.79	0.74	1.35
Beatty	4.47	9.09	1.05	1.44
Boulder City	6.16	10.02	1.16	1.55
Caliente	3.59	13.13	0.86	1.69
Cedar City	4.21	8.93	1.03	1.45
Delta	5.24	10.92	1.12	1.77
Duckwater	5.12	8.69	0.96	1.35
Ely	4.38	7.15	0.83	1.11
Goldfield	4.63	8.34	0.93	1.38
Henderson	4.21	10.31	1.03	1.63
Indian Springs	4.55	8.73	0.88	1.40
Las Vegas	4.72	17.40	1.05	1.54
Mesquite	4.67	8.85	1.09	1.66
Milford	6.77	10.95	1.40	1.79
Overton	4.98	8.24	1.47	1.65
Pahrump	3.58	12.38	1.09	1.48
Pioche	5.73	9.04	0.98	1.41
Rachel	4.82	7.30	0.99	1.40
Sarcobatus Flat	4.04	8.90	0.98	1.56
St. George	5.91	9.07	1.49	1.81
Tecopa	4.42	8.88	1.14	1.73
Tonopah	4.27	11.18	0.80	1.50

Table 3. Dosimeter results for the first quarter of CY2023.

Station	First Quarter Exposure (mR)	Est. Annual Exposure (mR/yr)	2022 Exposure (mR/yr)	2022 PIC Exposure (mR/yr)
Alamo	23	71	65	113
Amargosa Valley	16	64	64	102
Beatty	36	111	112	143
Boulder City	15	66	66	131
Caliente	Could not access station due to construction.	N/A	81	136
Cedar City	11	40	56	117
Delta	14	51	56	113
Duckwater	14	78	80	134
Ely	5	26	53	104
Goldfield	27	82	90	138
Henderson	20	88	76	122
Indian Springs	9	40	52	98
Las Vegas	21	90	62	93
Mesquite	20	74	50	101
Milford	24	90	115	166
Overton	6	28	28	96
Pahrump	5	21	25	74
Pioche	15	88	90	136
Rachel	26	78	102	136
Sarcobatus Flat	31	95	109	146
St. George	19	69	76	122
Tecopa	18	77	64	109
Tonopah	36	112	96	140

N/A = data not available