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Analytical Results for the Community Environmental Monitoring Program (CEMP) Air Sampling and Dosimeter Network: Third Quarter CY2022

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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.

Gross alpha, gross beta, and gamma spectrometry analyses of the air filters collected in 2022 were performed by a new laboratory. The new lab is accredited by the DOE Consolidated Audit Program-Accreditation Program, meaning it has demonstrated successful completion of the American Association for Laboratory Accreditation evaluation process. This includes an assessment of the laboratory's compliance against the Department of Defense (DoD) / Department of Energy (DOE) Consolidated Quality Systems Manual (QSM). The QSM is based on Volume 1 of the NELAC Institute (TNI) Standards (September 2009), which incorporates International Organization for Standardization (ISO) International Electrotechnical Commission (IEC) ISO/IEC 17025:2005 and 17025:2017. More specifically, the new lab is accredited to perform U.S. Environmental Protection Agency (EPA) method 9310 for gross alpha and gross beta, and method (Health and Safety Laboratory) HASL-300 Ga-01-R for gamma spectrometry. The lab demonstrated acceptable Mixed Analyte Performance Evaluation Program performance in 2022 for the detection of americium-241, cesium-134, and cesium-137 for radiological air filters.

The new laboratory 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 third quarter of calendar year (CY) 2022 for the analytes americium-241, cesium-134, cesium-137, cobalt-60, and uranium-235. Americium-241 was detected in one sample (collected on September 25, 2022, from the Caliente station) with a reported activity of 2.28×10^{-15} µCi/mL. The results for these analytes were below the minimum detectable activity for all other samples. Naturally occurring berillium-7 was detected in all but one of the samples.

Table 2 summarizes the gross alpha/beta results for the third quarter of CY2022. The average annual values for the previous year are provided for comparison. The gross alpha results for the third quarter of CY2022 are an approximately fivefold increase from those reported in CY2021. Some degree of deviation from historical results is to be expected with a change of laboratory. The scientific literature demonstrates that it is not unusual that a sample sent to several laboratories will yield widely disparate values of the gross alpha activity, as the measured activity depends appreciably on the radionuclide used as the calibration standard, as well as the geometry of the film of the calibration standard versus that of the sample (Arndt and West, 2004). These and related factors are likely responsible for the disparity between the gross alpha results for all CEMP sampling locations provided by the new lab (beginning with the first quarter of CY2022) versus the historical record, rather than an actual increase in ambient alpha activity.

Table 3 shows the environmental dosimeter results for the third quarter of CY2022. 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 spectrometry results for select analytes for the third quarter of CY2022. 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	below MDA	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	2.28	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	below MDA	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	below MDA	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	below MDA	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 third quarter of CY2022. Data represent one analysis per quarter.

Station	Gross Alpha ($\times 10^{-15}$ µCi/mL)	2021 Average ($\times 10^{-15}$ µCi/mL)	Gross Beta ($\times 10^{-14}$ µCi/mL)	2021 Average ($\times 10^{-14}$ µCi/mL)
Alamo	5.18	1.88	1.30	2.03
Amargosa Valley	6.22	1.99	1.31	2.06
Beatty	6.76	1.85	1.21	2.03
Boulder City	6.10	1.79	1.37	2.05
Caliente	3.64	2.01	1.23	2.10
Cedar City	6.38	1.78	1.42	1.77
Delta	5.11	1.37	1.35	1.99
Duckwater	7.31	1.89	1.34	1.93
Ely	5.15	2.27	1.20	1.96
Goldfield	4.62	1.39	1.15	1.45
Henderson	8.11	2.14	1.52	2.16
Indian Springs	7.00	1.96	1.40	2.23
Las Vegas	6.06	2.33	1.09	2.05
Mesquite	6.91	1.74	1.42	2.08
Milford	4.89	1.83	1.41	2.24
Overton	5.11	1.95	1.38	2.26
Pahrump	8.91	2.71	1.59	1.83
Pioche	5.77	1.88	1.28	2.04
Rachel	4.28	1.96	1.17	1.87
Sarcobatus Flat	6.15	2.21	1.14	2.21
St. George	6.46	1.58	1.61	2.30
Tecopa	5.95	1.78	1.39	2.44
Tonopah	5.93	1.68	1.30	2.02

Table 3. Dosimeter results for the third quarter of CY2022.

Station	Third Quarter Exposure (mR)	Est. Annual Exposure (mR/yr)	2021 Exposure (mR/yr)	2021 PIC Exposure (mR/yr)
Alamo	16	65	53	116
Amargosa Valley	19	71	47	102
Beatty	27	107	85	152
Boulder City	14	61	48	133
Caliente	19	83	57	140
Cedar City	17	68	43	120
Delta	16	65	41	117
Duckwater	14	61	50	139
Ely	13	56	34	111
Goldfield	22	89	66	138
Henderson	17	72	63	120
Indian Springs	13	49	39	105
Las Vegas	STOLEN	N/A	40	92
Mesquite	12	47	47	104
Milford	29	117	88	163
Overton	5	22	19	96
Pahrump	7	25	21	78
Pioche	20	87	63	147
Rachel	27	108	75	138
Sarcobatus Flat	28	111	85	151
St. George	20	82	57	124
Tecopa	12	45	45	100
Tonopah	26	104	83	143

N/A = data not available

REFERENCES

Arndt, M.F., and L.E. West, 2004. A Study of the Factors Affecting the Gross Alpha Measurement and a Radiochemical Analysis of Some Groundwater Samples from the State of Wisconsin Exhibiting an Elevated Gross Alpha Activity. University of Wisconsin–Madison, Madison, Wisconsin.