Homestake Mining Company of California
P.O. Box 98
Grants, NM 87020

Tel +1 505 287 4456
Fax +1 505 287 4457

May 19, 2022

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

ATTN: Mr. Ron C. Linton
Project Manager / Hydrogeologist
U.S. Nuclear Regulatory Commission
Decommissioning, Uranium Recovery & Waste Programs
Office of Nuclear Materials Safety and Safeguards
MS T-5A10, 11545 Rockville Pike
Rockville, MD 20852

RE: Correction to Radon Monitoring Data and Public Radon Dose Information Provided in the 2021 2nd Half Semiannual Effluent and Environmental Monitoring Report (ML22061A035).

Mr. Linton:

Attached, please find a technical memorandum which highlights corrections (shown in yellow) to the radon data presented in the above-referenced report. The corrected data results in a minor decrease in net radon concentrations at some monitoring stations during the second half of 2021.

Thank you for your time and attention on this matter. If you have any questions, please contact me via e-mail at bbingham@homestakeminingcoca.com or via phone at 505.290.8019.

Respectfully,

Brad R. Bingham
Closure Manager
Homestake Mining Company, Grants, New Mexico
Office: 505.287.4456 x35 | Cell: 505.290.8019

BRB

ec: W. Frazier, DOE, Grand Junction, Colorado
M. Purcell, Region VI EPA, Dallas, Texas
A. Maurer, NMED, Santa Fe, New Mexico
M. McCarthy, Barrick, Salt Lake City, Utah
D. Lattin, Barrick, Elko, Nevada

Attachment

Environmental Restoration Group, Inc.
8809 Washington St NE, Suite 150
Albuquerque, NM 87113
ph: (505) 298-4224
www.ERGoffice.com

TECHNICAL MEMORANDUM	
To: Brad Bingham (HMC)	**Date**: March 4, 2022
From: Randy Whicker (ERG)	**Project**: HMC Grants Reclamation Project
Direct: 970-556-1174	**Task(s)**: Radiation Safety Officer
Cc: Jennifer Ortega (HMC); Kyle Martinez (HMC)	
Subject: Corrective addenda for radon monitoring data and public radon dose information provided in 2021 2nd Half Semiannual Effluent and Environmental Monitoring Report.	

Dear Mr. Bingham,

The independent auditor for the 2021 Annual ALARA Audit has identified an error in radon data provided in Attachment 2 of the 2021 2nd Half Semiannual Effluent and Environmental Monitoring Report for the Homestake Mining Company of California (HMC) Grants Reclamation Project that was submitted to the U.S. Nuclear Regulatory Commission (NRC) on February 28, 2022 (NRC ADAMS Accession No. ML22061A035). The third quarter environmental monitoring data for radon were inadvertently not updated from the previous year, leading to small errors in the reported semiannual averages reported in Attachment 2 of the 2021 2nd Half Semiannual Report. This error was then inadvertently carried forward into the public radon dose as reported in Attachment 4 of the 2021 2nd Half Semiannual Report. This technical memorandum provides corrected data for Attachment 2 and revised public radon dose estimates for Attachment 4 of the 2021 2nd Half Semiannual Report. The intent is to provide this information to NRC as corrective addenda to the 2021 2nd Half Semiannual Effluent and Environmental Monitoring Report (ML22061A035).

Please let me know if you have questions or need more information.

Thanks,

Randy Whicker, CHP
Radiation Safety Officer,
HMC Grants Reclamation Project

Environmental Restoration Group, Inc.
8809 Washington St. NE, Suite 150
Albuquerque, NM 87113
Email: RandyWhicker@ergoffice.com

Correction to Attachment 2, 2021 2nd Half Environmental Radon Monitoring Report

Attachment 2 - Radon Gas Monitoring Results
Track-Etch Passive Survey

Location	Monitoring Period	Rn Concentration (µCi/ml)	Uncertainty - 2 S.D. (µCi/ml)	LLD (µCi/ml)
HMC #1(average) N Outer Perimeter	7/1/21 - 1/5/22	9.5E-10	2.0E-10	3.2E-10
HMC #1-A (average) N Outer Perimeter	7/1/21 - 1/5/22	9.0E-10	2.0E-10	3.2E-10
HMC #2 (average) NE Outer Perimeter	7/1/21 - 1/5/22	1.1E-09	2.2E-10	3.2E-10
HMC #3 (average) E Outer Perimeter	7/1/21 - 1/5/22	8.7E-10	1.9E-10	3.2E-10
HMC #4 (average) S Outer Perimeter	7/1/21 - 1/5/22	1.0E-09	2.1E-10	3.2E-10
HMC #5 (average) N of Nearest Residence	7/1/21 - 1/5/22	1.0E-09	2.1E-10	3.2E-10
HMC #6 (average) W of Outer Perimeter	7/1/21 - 1/5/22	9.0E-10	1.9E-10	3.2E-10
HMC #7 (average) S Boundary	7/1/21 - 1/5/22	1.0E-09	2.1E-10	3.2E-10
HMC #16 (average) Background	7/1/21 - 1/5/22	6.5E-10	1.6E-10	3.2E-10

Correction to Attachment 4, 2021 2nd Half Environmental Radon Monitoring Report
(*NOTE: Corrections to text are shown in redline editing mode, and only Table 2-3 has been revised*)

Annual Public Dose Estimates

1.0 Introduction

Operational activities in 2021 at the HMC Grants Reclamation Project (Site) were primarily associated with groundwater restoration, maintenance of containment facilities (e.g. tailings impoundments, ponds, tanks, pipes, etc.) and environmental monitoring. Historic windblown tailings beyond the two tailings impoundments were cleaned up and consolidated with the tailings in 1995 then covered with a minimum of several feet of clean soil. All tailings currently have either an interim or permanent cover in place. In the case of the Small Tailings Pile (STP), a large portion of the tailings are covered by Evaporation Pond 1 (EP-1). Specific activities that occurred on the tailings piles included maintenance of interim soil cover, operation of Zeolite water treatment facilities on the Large Tailings Pile (LTP), enhanced evaporation operations on EP-1, and use/maintenance of trash pits on the STP.

The 10 CFR 20.1301 radiation dose limit for individual members of the public from NRC-licensed facilities is specified as a total effective dose equivalent (TEDE) of 100 mrem/year. In addition, 10 CFR 20.1101 has a constraint on the TEDE from air emissions (excluding Rn-222 and its decay products) to the maximum exposed member of the public of 10 mrem/year. Compliance may be demonstrated by calculations or measurements showing that the individual likely to receive the maximum dose from the facility does not exceed the limit, or by comparing measured effluent concentrations to those specified in Table 2 of Appendix B to 10 CFR Part 20. In addition, radiation from external sources for individuals in the unrestricted area may not deliver a dose equivalent of 0.002 rem in any hour or 0.050 rem in one year.

HMC has submitted semiannual environmental monitoring reports for 2021 as required by 10 CFR 40.65 and License Condition 15 of radioactive materials license (RML) SUA-1471 with the NRC. The data provided in these reports were used in this dose assessment.

2.0 Dose Assessment

The important pathways for assessing the dose to the maximum exposed individual are: 1) inhalation of airborne particulate from the site, 2) exposure to radon generated at the site, and 3) the exposure to direct gamma radiation originating from the site. The nearest residence is located within 100 yards of the HMC-4 and HMC-5 monitoring stations and therefore the exposure may be conservatively assumed to be comparable to that at the monitoring stations. The exposure at both monitoring stations is considered and the station with the highest exposure is used for calculating the TEDE to the maximum exposed individual. Nearby residents are believed to lead typical rural residential lifestyles.

NUREG/CR-5512 recommends default values for the residential scenario. The recommended values for indoor and outdoor occupancy are 200 and 71 effective days/year, respectively. This is approximately equivalent to an effective occupancy near the Site of 75%. These assumptions were used in this analysis for all radiological exposure/dose pathways.

2.1 Inhalation of Radionuclides

The committed effective dose equivalent (CEDE) from inhalation of particulate was calculated for five principal long-lived radionuclides, U-238, U-235, U-234, Th-230, and Ra-226, based on quarterly environmental monitoring data provided in the two 2021 Semiannual Environmental Reports.

The monitoring stations HMC-4 and HMC-5 are considered representative of exposure conditions for the maximally exposed nearest resident location(s) for comparison of calculated doses with public dose limits. These stations are located on the southwestern perimeter of the Site near existing residences. The use of these data to predict the dose to the nearest resident is conservative in that exposure conditions at the nearest resident location are further from Site facilities and should thus be less than that at stations HMC-4 and HMC-5 near Site perimeter boundaries.

The CEDE per Unit Intake via Inhalation factors were taken from ICRP 30 tables. The values are given below:

Nuclide	CEDE (mrem/µCi)
U-234	13.2E4
U-235	12.3E4
U-238	11.8E4
Th-230	32.6E4
Ra-226	8.6E3

The measured annual average radionuclide concentration in airborne particulates for each monitoring station are shown in Table 2-1. Isotopic uranium concentrations were derived from the expected activity abundances in natural (total) uranium (U-nat) (48.9% each for U-238 and U-234, and 2.2% for U-235) for calculation of the dose per net annual unit intake of each radionuclide. Net doses were summed to determine the total CEDE from inhalation of the net (above background)[1] concentrations of airborne particulate radionuclides in 2021 at each air monitoring station (Table 2-2). Continuous occupancy and an average breathing rate of 20,000 liters/day (Table A-1, NUREG-0859) were assumed for the calculation. The calculated above-background CEDE at locations HMC-4 and HMC-5 for 100% occupancy was 0.11 mrem/year and 0.19 mrem/y (Table 2-2). Accounting for an assumed occupancy of 75% results in a dose rate of 0.08 and 0.14 mrem/year at HMC-4 and HMC-5, respectively. The nearby monitoring station with the highest calculated TEDE from all pathways (in this case 49 mrem/yr at Station HMC-4) is assumed representative of the TEDE to the nearest member of the public in 2021 (Table 2-3), and the dose from airborne particulate radiation (0.1 mrem/yr) at HMC-4 (excluding radon) meets the 10 mrem/yr constraint per 10 CFR 20.1101. The maximum external radiation dose to any member of the public (24 mrem/yr at HMC-4) is well below the limits mentioned in Section 1 (equivalent to 2 mrem/hr or 50 mrem/yr).

[1] The average background concentration (considered to be air station HMC-6) was subtracted from the annual average concentration for each radionuclide at other stations to obtain the average net concentration of each radionuclide at each air monitoring station for use in determining the net dose estimates.

2.2 Exposure to Radon

Outdoor radon levels in the Grants Uranium Belt are known to be somewhat elevated and variable, depending on the location relative to mine vents, naturally mineralized geologic deposits at or near the surface, and topographical features. Natural background radon concentrations, arising from the calm winds during the early morning hours and at times from temperature inversions, generally follow a downgradient drainage path. The HMC site is situated along the bottom of the San Mateo Creek valley, a relatively flat area where nocturnal drainage flow converges from adjacent, nearfield upland source areas. In addition, the valley floor is known to contain naturally elevated Ra-226 concentrations from eons of erosion of upgradient mineralized uranium outcrops, and this depositional geomorphic feature likely contributes to naturally elevated radon levels in the vicinity of the Site.

The radon data for each semiannual monitoring period are provided in Attachment 2 of corresponding semiannual monitoring reports. Monitoring Station 16 has historically been used as the radon background location for the Site. The overall annual average radon concentration for 2021 at HMC-4 and HMC-5 was 0.80 and 0.84 pCi/L respectively. The average annual concentration at the background location (HMC-16) was 0.47 pCi/L. Subtracting the background concentration from the measured concentrations at HMC-4 and HMC-5 results in net radon concentrations of 0.33 and 0.37 pCi/L, respectively.

Since the nearest residence is within a few hundred feet of the site perimeter and within 3500 feet of the major sources of onsite releases of radon (the tailings piles), the radon progeny/gas equilibrium ratio is expected to be low due to a relatively short time of atmospheric migration to reach the location of the nearest residence. HMC has historically assumed a 20% radon equilibrium ratio for public dose calculations. NRC regulations assume a continuous exposure to 0.1 pCi/L Rn-222, in equilibrium with its decay products, will result in a committed effective dose equivalent (CEDE) of 50 mrem/y (10 CFR Part 20, Appendix B). At 20% equilibrium, the corresponding radon dose conversion factor is 100 mrem/pCi/L. Considering the 75% occupancy factor, the net (above background) radon concentrations at HMC-4 and HMC-5 resulted in calculated CEDE values of 24.6 and 27.6 mrem/y respectively for 2021.

The NRC has issued a request for additional information (RAI) concerning this public dose calculation method for radon based on identified inconsistencies with NRC's recently finalized Interim Staff Guidance (ISR) for determination of public dose from radon. In response, on December 18, 2020, HMC submitted a directly related license amendment request (ML20356A288) to move the background radon monitoring station (HMC-16) to a more representative location on the floor of the San Mateo Creek valley. At this time, this issue is still under review by HMC and NRC because the background radon station (HMC-16) is known to have a significant low bias relative to the valley in which the Site is situated. HMC is currently in the process of responding to a request for additional information (RAI) (ML21237A454) regarding HMC's December 18, 2020 amendment request (ML20356A288). Until this issue is resolved, HMC will continue using the current/historical method for calculating public dose from facility radon emissions.

2.3 Dose from Exposure to Direct Radiation

An estimate of the dose equivalent from direct exposure to radiation sources at the site is obtained from optically stimulated luminescence (OSL) dosimeters placed at each monitoring station. The direct radiation measurements for the two semiannual monitoring periods are provided in Attachment 3 of the 1st and 2nd half semiannual monitoring reports, respectively. The total annual effective dose equivalents measured at HMC-4 and HMC-5 were 133 and 121 mrem/year, respectively. The average annual effective dose equivalent at the background location (HMC-16) was 100 mrem/year. The net annual effective dose equivalent for HMC-4 and HMC-5, assuming 100% occupancy, was 33 and 20 mrem/year, respectively. Considering the 75% occupancy factor, the calculated net annual effective dose equivalent was 24 and 15 mrem/year for HMC-4 and HMC-5, respectively. The maximum external radiation dose to any member of the public (24 mrem/yr at HMC-4) is well below the limits mentioned in Section 1 (equivalent to 2 mrem/hr or 50 mrem/yr).

2.4 Total Effective Dose Equivalent to the Nearest Resident

The TEDE to the Nearest Resident was calculated by adding the CEDE from inhalation of airborne particulate, the CEDE from the exposure to radon coming from the site, and the dose equivalent from direct gamma radiation (Table 2-3). The TEDE at HMC-4 was 49 mrem/year and at HMC-5 was 43 mrem/year. This is within the 100 mrem/year limit and the air particulate CEDE is well below the 10 mrem/y constraint limit on airborne particulate emissions. The dose from combined dose from external gamma and air particulates at HMC-4 and HMC-5 (24.1 and 15.1 mrem/yr respectively), are each below the 25 mrem/yr whole-body dose limit specified 40 CFR 190 for nuclear fuel cycle facilities.

Table 2-1: Measured average airborne radionuclide concentrations

Sample ID	Radionuclide	Q1 Conc. (µCi/mL)	Q2 Conc. (µCi/mL)	Q3 Conc. (µCi/mL)	Q4 Conc. (µCi/mL)	Total Annual Average Conc. (µCi/mL)
HMC-1	U-nat	1.3E-16	1.3E-15	1.9E-15	1.5E-15	1.2E-15
	Th-230	7.3E-18	4.5E-17	2.3E-17	4.8E-17	3.1E-17
	Ra-226	2.2E-17	5.4E-17	2.4E-17	3.7E-17	3.4E-17
HMC-1-A	U-nat	1.2E-16	6.6E-16	3.4E-15	1.5E-15	1.4E-15
	Th-230	5.3E-18	2.9E-17	3.3E-17	1.7E-17	2.1E-17
	Ra-226	1.2E-17	3.7E-17	3.2E-17	3.3E-17	2.9E-17
HMC-2	U-nat	2.6E-16	3.0E-16	5.5E-16	1.4E-16	3.1E-16
	Th-230	1.6E-17	2.8E-17	2.5E-17	1.2E-17	2.0E-17
	Ra-226	3.9E-17	2.9E-17	2.1E-17	1.7E-17	2.7E-17
HMC-3	U-nat	4.0E-16	5.6E-16	7.8E-16	6.2E-16	5.9E-16
	Th-230	1.3E-17	5.0E-17	1.8E-17	1.7E-17	2.5E-17
	Ra-226	3.5E-17	6.3E-17	1.7E-17	1.9E-17	3.4E-17
HMC-4	U-nat	4.2E-16	8.3E-16	7.8E-16	2.6E-16	5.7E-16
	Th-230	5.7E-17	1.4E-16	1.6E-17	1.4E-17	5.7E-17
	Ra-226	1.1E-16	2.1E-16	1.9E-17	2.1E-17	9.0E-17
HMC-5	U-nat	1.2E-16	9.1E-16	1.7E-15	3.6E-16	7.7E-16
	Th-230	2.0E-17	3.1E-17	1.7E-17	1.4E-17	2.1E-17
	Ra-226	2.1E-17	4.7E-16	2.1E-17	1.3E-17	1.3E-16
HMC-6	U-nat	7.1E-17	6.2E-16	1.3E-15	2.4E-16	5.6E-16
	Th-230	1.3E-17	3.5E-17	1.2E-17	1.9E-17	2.0E-17
	Ra-226	1.8E-17	4.6E-17	1.9E-17	2.8E-17	2.8E-17

Table 2-2: Calculation of net internal dose (CEDE) due to radionuclides in air particulates from Site operations.

Sample ID	Radionuclide (Isotopic)	Calculated Istotopic Conc. (µCi/mL)*	Net Annual Average Conc. (µCi/mL)**	Inhalation DCF from ICRP 30 (mrem/µCi)	Calculated net CEDE (mrem/yr)	Total net CEDE by Station @100% Occupancy (mrem/yr)	Total net CEDE by Station @75% Occupancy (mrem/yr)
HMC-1	U-234	5.9E-16	3.2E-16	1.32E+05	3.1E-01	1.5E+00	1.1E+00
	U-235	2.7E-17	1.4E-17	1.23E+05	1.3E-02		
	U-238	5.9E-16	3.2E-16	1.18E+05	2.7E-01		
	Th-230	3.9E-16	3.7E-16	3.26E+05	8.9E-01		
	Ra-226	4.0E-16	3.7E-16	8.60E+03	2.3E-02		
HMC-1-A	U-234	6.9E-16	4.2E-16	1.32E+05	4.1E-01	7.9E-01	5.9E-01
	U-235	3.1E-17	1.9E-17	1.23E+05	1.7E-02		
	U-238	6.9E-16	4.2E-16	1.18E+05	3.6E-01		
	Th-230	2.1E-17	1.3E-18	3.26E+05	3.2E-03		
	Ra-226	2.9E-17	7.5E-19	8.60E+03	4.7E-05		
HMC-2	U-234	1.5E-16	0.0E+00	1.32E+05	0.0E+00	1.2E-03	8.9E-04
	U-235	6.9E-18	0.0E+00	1.23E+05	0.0E+00		
	U-238	1.5E-16	0.0E+00	1.18E+05	0.0E+00		
	Th-230	2.0E-17	5.0E-19	3.26E+05	1.2E-03		
	Ra-226	2.7E-17	0.0E+00	8.60E+03	0.0E+00		
HMC-3	U-234	2.9E-16	1.6E-17	1.32E+05	1.5E-02	4.1E-02	3.1E-02
	U-235	1.3E-17	7.1E-19	1.23E+05	6.4E-04		
	U-238	2.9E-16	1.6E-17	1.18E+05	1.4E-02		
	Th-230	2.5E-17	4.8E-18	3.26E+05	1.1E-02		
	Ra-226	3.4E-17	5.8E-18	8.60E+03	3.6E-04		
HMC-4	U-234	2.8E-16	7.2E-18	1.32E+05	7.0E-03	1.1E-01	7.9E-02
	U-235	1.3E-17	3.2E-19	1.23E+05	2.9E-04		
	U-238	2.8E-16	7.2E-18	1.18E+05	6.2E-03		
	Th-230	5.7E-17	3.7E-17	3.26E+05	8.8E-02		
	Ra-226	9.0E-17	6.2E-17	8.60E+03	3.9E-03		
HMC-5	U-234	3.7E-16	9.7E-17	1.32E+05	9.4E-02	1.9E-01	1.4E-01
	U-235	1.7E-17	4.4E-18	1.23E+05	3.9E-03		
	U-238	3.7E-16	9.7E-17	1.18E+05	8.4E-02		
	Th-230	2.1E-17	7.5E-19	3.26E+05	1.8E-03		
	Ra-226	1.3E-16	1.0E-16	8.60E+03	6.5E-03		
HMC-6 (Bkg. Station)	U-234	2.7E-16	N/A	N/A	N/A	N/A	N/A
	U-235	1.2E-17					
	U-238	2.7E-16					
	Th-230	2.0E-17					
	Ra-226	2.8E-17					

*Measured U-nat converted to isotopic concentrations assuming natural abundances of 2.2% for U-235, and 48.9% for U-234 and U-238

**Isotopic average values for Station HMC-6 subtracted from measured result at other stations to obtain the net concentration.

Table 2-3: Estimated dose by pathway and calculated TEDE (mrem/yr)

Sample ID	Internal CEDE Air Particulates (mrem/yr)	Internal CEDE Radon (mrem/yr)	Exernal EDE (mrem/yr)	TEDE (mrem/yr)
HMC-4	0.1	25	24	49
HMC-5	0.1	28	15	43