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

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

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Document Control Desk
U.S. Nuclear Regulatory Commission
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Mr. Ron Linton, Project Manager
Project Manager, Materials Decommissioning Branch
Decommissioning, Uranium Recovery & Waste Programs
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
MS T-5A10, 11545 Rockville Pike
Rockville, MD 20852

RE: Homestake Mining Company of California Response to U.S. NRC Comments on Revised Reply to RAI on HMC's Proposed Methodology for Demonstrating Compliance with 10 CFR 20.1301 and 20.1302 (Docket Number 04008903, License Number SUA-1471)

Dear Mr. Linton:

Homestake Mining Company of California (HMC) is submitting this response to a July 23, 2021 request for additional information (RAI) from the U.S. Nuclear Regulatory Commission (NRC) (ADAMS Accession No. ML21162A303) concerning HMC's March 31, 2020 revised reply (ML20094F859) to NRC's August 30, 2019 RAI letter (ML19239A165) regarding demonstration of compliance with the public dose limits as specified in 10 CFR 20.1301 and 20.1302. Please find attached HMC's response to the July 23, 2021 RAI from NRC.

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

Brad R. Bingham
Closure Manager
Homestake Mining Company of California
Office: 505.287.4456 x35 | Cell: 505.290.8019

Copy To:

M. McCarthy, Barrick, Salt Lake City, Utah (electronic copy)
D. Lattin, Barrick, Elko, Nevada (electronic copy)
R. Whicker, ERG, Albuquerque, New Mexico (electronic copy)

Enclosures

Attachment 1: HMC Response to July 23, 2021 RAI from the NRC Regarding Demonstration of Compliance with 10 CFR 20.1301 and 20.1302.

ATTACHMENT 1

HMC Response to July 23, 2021 RAI from the NRC Regarding Demonstration of Compliance with 10 CFR 20.1301 and 20.1302

NRC Staff Comments on Revised RAI #2 Response

Issue: HMC proposed postponing demonstrating its compliance determination with the public dose limits, specified in Title 10 Code of Federal Regulations (10 CFR) 20.1301, by predicating its determination on the approval of a license amendment request, currently under NRC staff review, to move its present background radon monitoring station.

Comment: HMC has not adequately demonstrated a method for compliance with 10 CFR 20.1301 under its current licensing basis. In its most recent semiannual environmental monitoring report, HMC states "Until this issue is resolved, NRC has directed HMC to continue using the current/historical method for calculating public dose from facility radon emissions." [1] *However, the NRC staff has not been able to confirm this statement. HMC should either justify its current methodology at this time, in accordance with comments already presented by the NRC staff, or otherwise demonstrate compliance with 10 CFR 20.1301. This demonstration may include, for example, an application for authorization under 10 CFR 20.1301(d).*

HMC Response

In response to NRC staff's August 30, 2019 rejection (ML19239A165) of HMC's August 20, 2018 proposal to use MILDOS modeling to demonstrate compliance with public dose limits (ML18240A143), HMC's March 31, 2020 submittal (ML20094F859) proposed continuation of the historic/current method based on measurements, but with more conservative dose conversion parameters and use of a representative background monitoring location in accordance with the specifications of NRC Interim Staff Guidance "*Evaluation of Uranium Recovery Facility Surveys of Radon and Radon Progeny in Air and Demonstrations of Compliance with 10 CFR 20.1301*" (USNRC, 2019) ("Radon ISG ").

As indicated in HMC's March 31, 2020 submittal (ML20094F859), compliance with the specifications of the Radon ISG cannot be achieved at the HMC site unless the current background radon monitoring location (HMC-16) is replaced with a location representative of background radon conditions along the floor of the San Mateo Creek valley in which the HMC facility is situated. Without approval of a representative background monitoring location, measurement-based demonstration of compliance with public dose limits will remain inconsistent with the Radon ISG. This ISG is explicit about the necessity and characteristics of a representative background location, and because NRC staff are currently evaluating HMC's March 31, 2020 license amendment request (LAR) to address this specific issue (ML20094F627), HMC maintains that it is inappropriate to impose an interim requirement for HMC to justify or revise its current/historic method for calculation of public radon dose because 1) it involves use of a non-representative background monitoring location (HMC-16), and 2) HMC has already proposed revisions to HMC's current/historic method of calculating public dose from radon to address previous RAI comments from NRC staff, and to bring HMC's method for public dose calculation into alignment with the Radon ISG.

NRC staff comments suggest that the staff is directing HMC to move forward on an interim basis with use of more conservative dose conversion factors in accordance with previous staff comments on this RAI issue, but without a change in the approved background radon monitoring station location. As indicated in HMC's March 31, 2020 submittal (ML20094F859), this would result in systemic overestimation of public dose from radon that could routinely exceed the 100 mrem/yr public dose limit. Presumably to address this circumstance, NRC staff has suggested that HMC consider applying for authorization for a higher public dose limit as described in 10 CFR 20.1301(d). While such authorization would accommodate inflated estimates of net effluent radon and resulting overestimation of public dose from radon emissions (due to a non-representative background monitoring location), the approach is untenable as it would

[1] *Refer to Section 2.2 of Agencywide Documents Access and Management System (ADAMS) Accession No. ML21067A499*.

incorrectly imply that HMC cannot currently meet the regulatory public dose limit, which could falsely alarm the public and lead to unwarranted regulatory or legal action against HMC. The approach would essentially sanction inaccurate estimates of public radon dose, and lacking a representative background monitoring station, would remain inconsistent with the Radon ISG.

With respect to statements in previous semiannual reports regarding HMC's belief that NRC staff has previously given HMC direction to continue using the current/historic method of determining public dose from effluent radon until this open issue is resolved, HMC has reviewed related staff communications dating back to the original 2015 RAI on this matter (ML15264B052), and while direct written statements about this have not been identified, a number of NRC inspection reports since 2015 have stated that "*Because the NRC's program office is currently evaluating this open issue, the inspectors did not evaluate the licensee's calculated doses for compliance with the annual public dose limit of 100 millirems per year as specified in 10 CFR 20.1301(a)*." While such statements are not a directive to continue using the current/historic method for calculation of public dose from radon, they do imply regulatory acceptance of the status quo as NRC staff has never directed HMC to deviate from the current/historical method of calculation until this open issue is resolved, and the staff has intentionally avoided inspection of HMC's public dose calculations pending resolution of this open issue.

Staff comments on HMC's Revised RAI #2 Response state that "*HMC should either justify its current methodology at this time, in accordance with comments already presented by the NRC staff, or otherwise demonstrate compliance with 10 CFR 20.1301*". While HMC's current method for demonstrating compliance with 10 CFR 20.1301 cannot be justified in accordance with the Radon ISG without moving the background radon monitoring station to a representative location, HMC has concluded that demonstration of compliance with 10 CFR 20.1301 based on modeling alone is legally permissible under 10 CFR 20.1302 regulations as described below.

The reason given by NRC staff for rejection of HMC's August 20, 2018 proposal to use MILDOS modeling alone to determine of public dose from Site radon emissions (ML18240A143), was that the approach is inconsistent with any of the "acceptable methods" listed in the Radon ISG (USNRC, 2019). This ISG specifies that if modeling will be used for demonstration of compliance with public dose limits, measurements to "confirm or compare" modeling results are also expected. However, this guidance is inconsistent with the plain language of 10 CFR 20.1302(b)(1) which states that demonstration of compliance with public dose limits may be based on "*measurement **or** calculation*" (emphasis added). In addition, as noted in the Radon ISG, the "survey" requirement specified in 10 CFR 20.1302(a) is explained in 10 CFR 20.1003 definitions as "*an evaluation of radiological conditions that includes measurements **or** calculations of levels of radiation or concentrations or quantities of radioactive material present*." (emphasis added).

To address this inconsistency between the Radon ISG and 10 CFR 20.1302 specifications, the ISG provides an assessment of relevant information identified in NRC Regulatory Guide 3.59 and NUREG-0859 to conclude that modeling alone is not acceptable to NRC staff for demonstrating compliance with 10 CFR 20.1301. However, like all NRC guidance documents, the Radon ISG indicates that "*This ISG is not a substitute for NRC regulations, and compliance with it is not required*", provided that the licensee provides acceptable justification for deviating from the specified methods. In this case, the plain language in 10 CFR 20.1302 regarding "*measurement **or** calculation*" provides direct regulatory justification for use of modeling alone to demonstrate compliance as previously proposed by HMC (ML18240A143).

Aside from the inconsistency between the Radon ISG and codified NRC regulation, HMC is still proposing use of measurements alone to demonstrate compliance with public dose limits in accordance with the Radon ISG as described in HMC's March 31, 2020 response to RAIs on this matter (ML20094F859). However, consistency with the Radon ISG is contingent on moving the background radon monitoring station to a representative location on the floor of the San Mateo Creek valley. In the event that NRC staff

rejects HMC's LAR to move the background radon station to a representative location, HMC has not identified a viable alternative to the use of MILDOS modeling alone to determine public dose from Site radon emissions for demonstration of compliance with 10 CFR 20.1301.

In light of the above information, HMC respectfully requests that NRC staff complete deliberations on the LAR to move the background radon monitoring location before rendering a decision on HMC's March 31, 2020 RAI response and proposed method to demonstrate compliance with 10 CFR 20.1301 in accordance with the methods specified in the Radon ISG (ML20094F859). In addition, HMC requests that NRC staff rescind the new interim directive for HMC to justify or revise its current/historic method for calculation of public radon dose (without a change in the approved background monitoring location) pending resolution of this open issue.

NRC Staff Comments on Revised RAI #3 Response

Issue: HMC described methods to estimate the magnitude of unmonitored releases of radon from locations in the groundwater treatment systems that are most likely to discharge radon gas to the atmosphere but did not discuss the potential for dissolved radon in groundwater not in equilibrium with radium.

Comment: Although HMC stated that they would base regulatory compliance on measurements, instead of modeling, HMC developed estimates of radon effluent quantities from the spray evaporators, the clarifier tanks outside the reverse osmosis building, and other sources of radon. Because compliance with public dose limits will not be based on the estimates HMC developed, the NRC staff is not requesting a response to this comment. The NRC staff comments, however, may be helpful for HMC preparing reports to comply with 10 CFR 40.65 and preclude additional responses to NRC staff comments at a later date.

HMC Response

Because HMC's August 20, 2018 proposal to use MILDOS modeling alone for annual demonstration of compliance with 10 CFR 20.1301 (as permitted under 10 CFR 20.1302) was rejected by NRC staff, estimates of radon releases from individual source terms are not relevant, and as suggested by the staff, HMC will not respond to additional agency comments concerning HMC's previous calculated estimates of radon releases from individual sources at the facility. In the event that in the future, HMC again proposes MILDOS modeling for annual determination of public dose from radon, HMC's previous calculated estimates of radon source term releases will be revisited with attention to the staff's comments on this matter.

Additional Comments on HMC's Environmental Monitoring Program (ACEMP):

ACEMP #1

After reviewing the results of HMC's Environmental Monitoring Program (EMP) particulate sampling results, certain descriptions by the licensee in its semiannual environmental monitoring reports appear to be incorrect. The following statement has appeared for at least the last several years in Section 2.1, "Air Particulate Monitoring", of HMC's semiannual environmental monitoring reports:

"Those locations identified as HMC-1, HMC-1 A, HMC-2, and HMC-3 are areas at the property boundary expected to have the highest predictable concentrations of airborne radioactive particulate. The predominant wind direction is from the southwest; accordingly, HMC-1, HMC-2 and HMC-3 are generally located downwind from Homestake's reclamation activities. HMC-1 A is northeast of EP-3 located north of the mill site. The location identified as HMC-6 represents background conditions for air particulates and is located due west of the large tailings pile at the western most side of the property boundary. Locations HMC-4 and HMC-5 are site proximal to the nearest residences."

The following NRC staff observations describe deficiencies in the semiannual report descriptions. These observations are derived from the summary of onsite wind data described above and data provided in the licensee's semiannual environmental monitoring reports:

1. *Onsite meteorological data (Figure 1 above) shows predominant, low speed, and high atmospheric stability, winds from the NE and ENE, and not from the SW, as stated by HMC in its semiannual environmental reports. HMC should revise either the statement in future semiannual environmental monitoring reports, or revise the data provided in the LAR, depending on which is determined to be correct.*

   HMC Response

   While prevailing low-velocity, high atmospheric stability winds generally flow from the NE and ENE, this represents a nocturnal down-drainage flow regime that is primarily associated with transport of radon gas, not air particulates. As noted by Kok et al. (2012), transport of soil particles by wind can be crudely separated into several physical regimes: long-term suspension (≤20μm diameter), short-term suspension (≈20-70μm), saltation (≈70-500μm), and reptation or creep (≥500μm). Dust particles <20 μm are not entrained directly by wind, but by impacts from saltating particles that eject dust particles to air (Kok et al., 2012). Whicker et al. (2002), found that a threshold windspeed of approximately 7 meters per second (m/s) is required to entrain particle sizes small enough to become suspended in air due to wind erosion. Similarly, threshold windspeeds measured at various sites in New Mexico by Webb, et al. (2016) were in general agreement with the value reported by Whicker et al. (2002), ranging from 6.3 - 9.7 m/s at 2.4 m above the ground surface.

   According to the wind roses shown in NRC staff's Figure 1 under ACEMP #1, nocturnal drainage flow from the NE and ENE directions seldom has sufficient velocity to entrain and suspend air particulates from the HMC Site as windspeeds in this flow regime are predominantly less than 4 m/s. Thus, monitoring stations HMC-4 and HMC-5 are not situated "downwind" of the tailings piles and other Site facilities with respect to air particulate emissions as suggested by the staff. As also shown in NRC staff's Figure 1 under ACEMP #1, prevailing wind directions with velocities exceeding an approximate particle entrainment threshold of 7 m/s occur most frequently from the W and WSW wind directions. This indicates that HMC-6 is an appropriate "background" monitoring location with respect to air particulates, and that air monitoring stations *HMC-1A, HMC-1, HMC-2, and HMC-*3 are located generally downwind of major source terms with respect to air particulate emissions from the Site (tailings piles and evaporation ponds). HMC will modify related statements in future semiannual reports to make clear the distinction between high-speed prevailing wind directions for air particulates, versus low-speed prevailing wind directions for radon gas.

2. *Consistent with the apparent predominant, low speed, and high atmospheric stability winds from the NE and ENE, recent monitoring of particulate matter concentrations in air at HMC-4 and HMC-5 indicate these stations generally detect more uranium (and other particulate radionuclides) in air than upwind (not downwind as described by HMC) locations HMC-1 A, HMC-1, HMC-2, and HMC-3. Figure 3 below presents net concentrations in air for all particulate radionuclides in 2017 and 2018. Figure 4 below presents net uranium concentrations in air for the years 2017-2020. As described here, the licensee's statements that HMC-1, HMC-1 A, HMC-2, and HMC-3 are areas at the property boundary expected to have the highest predictable concentrations of airborne radioactive particulate is contrary to the licensee's air sampling results. HMC should address this apparent discrepancy in future EMP report(s).*

   HMC Response

   As indicated in HMC's response to ACEMP #1.1, the relationship between airborne effluent type (physical form) and applicable prevailing wind directions/velocities must be considered in evaluation of the design of environmental monitoring programs for different effluent types (i.e. air particulates versus radon gas). In addition, as detailed in HMC's LAR to relocate the background radon monitoring station (ML20094F627), air particulate monitoring stations HMC-4 and HMC-5 are located in an area of

somewhat elevated residual radionuclide concentrations in surface soils, possibly associated with a historic release of tailings through a breach in the south berm of the large tailings pile (LTP).[2] The reason for generally higher measured air particulate concentrations at monitoring stations HMC-4 and HMC-5 is likely due to close proximity to residual soil contamination in the immediate vicinity of monitoring stations HMC-4 and HMC-5 (versus other air monitoring stations which are located at much greater distances from any source term at the Site). As explained in HMC's response to ACEMP #1.1, air monitoring stations HMC-1, HMC-1 A, HMC-2, and HMC-3 represent downwind monitoring locations with respect to air particulate releases from the tailings piles and evaporation ponds. HMC will modify related statements in future semiannual reports to accurately describe the relevance of these spatial relationships in terms of the current/historic design of the environmental air particulate monitoring program.

3. *While it appears to be the case, the licensee should confirm in future EMP report(s) that the "nearest" residences are the maximally exposed members of the public used for demonstrating compliance with 10 CFR 20.1301 (refer to 10 CFR 20.1302(b)(1)). This is not the same as calculating a maximum theoretical dose. HMC should determine who, or what group, receives the highest exposure. See NUREG-17365 for additional guidance.*

HMC Response

This comment appears to be referring to potential public doses associated with contractors or vendors that periodically work within Controlled Areas at the Site, versus public dose to members of the public that continually reside closest to Site facilities (near boundary monitoring locations HMC-4 and HMC-5). As reported in the 2020 Annual ALARA Audit Report for the HMC facility (Sopris, 2021), the maximum total occupational radiation dose to Site workers (including contractors) for 2018, 2019, and 2020 ranged from 19 mrem/yr to 40 mrem/yr. This compares with estimated public doses to the nearest residents adjacent to stations HMC-4 and HMC-5 that ranged from 43 mrem/yr to 52 mrem/yr over the same period of record (2018 – 2020).

This comparison shows that if contractors and vendors that periodically work within Controlled Areas of the Site are considered members of the public (despite radiation protection training and exposure monitoring), respective doses are less than estimated public doses for residents living closest to the Site (near air monitoring stations HMC-4 and HMC-5). As shown by NRC staff's graphs of air particulate radionuclide concentrations for each Site boundary air monitoring location, stations HMC-4 and HMC-5 generally have the highest net (above background) air particulate radionuclide concentrations, but as discussed in the above responses to NRC staff comments under ACEMP #1, the reason for higher air particulate concentrations at stations HMC-4 and HMC-5 is likely due to localized releases from residual soil contamination in the immediate vicinity of these monitoring locations, rather than windblown transport from distant tailings piles and evaporation ponds.

Additional Comments on HMC's public dose determination (ACPD):

ACPD #1

Referring to Figures 3 and 4 above, and in light of the discrepancies noted in HMC's statements in its semiannual environmental monitoring reports that appear to be based on previous operations and a different wind rose, the licensee should provide an analysis of background station HMC-6. Specifically, the licensee should assess the relevance of using HMC-6 as a background station for particulate monitoring using monitoring data to demonstrate that HMC-6 is located in the least prevalent wind direction and is not impacted by site operations.

[2] Site records indicate that a portion of this area was impacted in 1977 by an unplanned release of tailings through a breach in the south berm of the LTP (HMC, 2013; UN-HP, 1978).

HMC Response

See HMC responses to NRC staff comments under ACEMP #1 above.

ACPD #2

The regulation in 10 CFR 20.1301(a)(1) states, in part:

The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation…

The definition of "year" in 10 CFR 20.1003 is as follows:

Year means the period of time beginning in January used to determine compliance with the provisions of this part. The licensee may change the starting date of the year used to determine compliance by the licensee provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

The NRC staff reviewed HMC's public dose assessment for the past several years. As a result of this review, the NRC staff compiled the collection periods for the various media that are used to calculate the public dose and tabulated these dates in Table 1 below.

Dose Assessment Year[1]	***Radon***	***Gamma***	***Particulates[3]***
2017	*?[2] -1/9/2018*	*?[2] – 12/31/17*	*12/31/17*
2018	*1/9/18 – 1/7/19*	*1/1/18 – 12/31/18*	*Not provided*
2019	*1/7/19 – 1/3/20*	*1/1/19 – 12/31/19*	*12/31/19*
2020	*1/3/20 – 1/6/21*	*1/1/20 – 12/31/20*	*Not provided*

[1] Data taken from the semiannual environmental monitoring reports for the year indicated

[2] The dates for the first semiannual monitoring period appear to be incorrect (incorrect year)

[3] Last quarterly collection date

Table 1: EMP monitoring and sampling time intervals (beginning and ending dates) used for public dose assessment.

The NRC staff observes that the collection period for direct gamma radiation and particulates appear to be collected and reported on a calendar year basis. However, the collection period for radon monitoring appears to vary from year to year. Although the annual public dose assessment appears to be performed on a calendar year basis (e.g., the 2020 Annual Public Dose Estimates in Attachment 4 of ADAMS Accession No. ML21067A499), it is not clear what HMC is using as the compliance year 6 as the collection dates for radon monitoring results do not match up with the calendar year.

The licensee should provide a description of HMC's compliance year used to demonstrate compliance with 10 CFR20.1301(a)(1) that is consistent with the stated regulations.

HMC Response

It is seldom possible for licensees to deploy/retrieve radon and gamma detectors exactly on the start and end dates of a standard January 1 to December 31 reporting year, and despite a few days of deviation between actual date of field deployment/retrieval of radon/gamma detectors and air sampling filters relative to standard annual reporting period dates, HMC has considered respectively calculated public doses applicable to a January 1 through December 31 reporting period for each year in question. While gamma OSL and radon track-etch detectors are always exchanged in the field on the same date, only

radon and air particulate data are reported by the lab with actual monitoring period start/end dates. OSL data are always reported by the vendor for a standardized quarterly reporting schedule unless the client makes a special request to deviate from this protocol, and requests for deviation from default reporting periods are commonly resisted or denied by dosimetry vendors.

HMC believes that its reporting protocols for annual public dose estimates based on environmental monitoring data are consistent with the definition of a reporting "year" in 10 CFR 20.1003. The regulatory definition does not state a specific start date at the beginning of January, and instead implies flexibility for small variations in monitoring start dates as long as they occur close to the beginning of the calendar year in early January, and provided that no day is omitted or duplicated in consecutive years (i.e. that there is no overlap or gaps between the end date of the previous year and the beginning of the current year, and that close to 365 days are represented by the actual annual monitoring period).

The somewhat vague definition of a reporting "year" in 10 CFR 20.1003 implies an intent to provide reasonable flexibility for the actual annual data collection period to be slightly shifted from a January 1 start date and December 31 end date for each standard reporting year, and HMC concludes that the intent of this regulatory definition is NOT to require licensees to exchange dosimeters, radon detectors, and air particulate filters exactly on January 1 (a national holiday) and on December 31 (New Year's Eve) of each reporting year, or to require licensees to attempt to pro-rate annualized dose estimates to account for a few days of deviation from a fixed reporting period of one standard calendar year.

In addition to the above justification for HMC's protocols for data collection and annual public dose reporting periods, it is reasonable to also consider the potential error introduced by small deviations in actual monitoring periods relative to a standard calendar year. When actual annual public radiation doses from effluent emissions are below the 100 mrem/yr public dose limit (as is generally the case at NRC-licensed facilities), the total propagated uncertainty in estimates of public dose based on environmental monitoring data, along with estimation error associated with assumed exposure and/or dose assessment parameters (e.g. occupancy, radon equilibrium ratios, dose conversion factors, etc.), greatly exceeds any potential inaccuracies due to a few days deviation of actual deployment/retrieval dates relative to a fixed January 1 to December 31 reporting period. Even if HMC were to collect gamma, radon, and air particulate data precisely between the start/end dates for a standard calendar year, the differences in results are unlikely to significantly change the annual reported averages for these parameters or appreciably affect public dose estimates.

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