HOMESTAKE
Grants Project

Homestake Mining Company of California

Thomas Wohlford
Closure Manager

09 January 2018

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Document Control Desk
U.S. Nuclear Regulatory Commission,
Washington, DC 20555–0001

Mr. Ron Linton, Project Manager
Project Manager, Materials Decommissioning Branch (Mail Stop: T-8F5)
Decommissioning, Uranium Recovery & Waste Programs
Office of Nuclear Materials Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

RE: Homestake Mining Company of California – Grants Reclamation Project – Radiological Dose Assessment for Planned 2019 Relining of Evaporation Pond 1

Dear Mr. Linton:

In response to a verbal request from the Nuclear Regulatory Commission (NRC), please see attached a radiological dose assessment for planned 2019 relining of Evaporation Pond 1 on Homestake Mining Company's Grants Reclamation Project. The results from this assessment are that potential exposures are unlikely to result in significant radiological doses to workers or members of the public. A copy of this report will also be submitted to the NRC's Document Control Desk.

Thank you for your time and attention on this matter. If you have any questions, please contact me via e-mail at twohlford@homestakeminingcoca.com or via phone at 505.290.2187.

Respectfully,

Thomas P. Wohlford

Thomas P. Wohlford, CPG
Closure Manager
Homestake Mining Company of California
Office: 505.287.4456 x34 | Cell: 505.290.2187

Copy To:

M. McCarthy, Barrick, Salt Lake City, Utah (electronic copy)
A. Winton, NMED, Santa Fe, New Mexico (electronic copy)
C. Burton, Barrick, Henderson, Nevada (electronic copy)
R. Whicker, Environmental Restoration Group, Albuquerque, New Mexico (electronic copy)

NMSS01

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

TECHNICAL MEMORANDUM

To: Tom Wohlford (HMC)	**Date**: January 8, 2019
From: Randy Whicker (ERG)	**Project**: HMC Grants Reclamation Project
Direct: 970-556-1174	**Task(s)**: Radiation Safety Officer
Cc: Daniel Lattin (HMC); Reggie Shirley (HMC); Brad Bingham (HMC); Chuck Farr (ERG)	
Subject: Radiological dose assessment for planned 2019 relining of Evaporation Pond 1	

Dear Mr. Wohlford,

This Technical Memorandum provides a conservative assessment of potential radiological doses to workers and the nearest member of the public during the planned 2019 relining of Evaporation Pond 1 (EP-1) at the Homestake Mining Company of California (HMC) Grants Reclamation Project. This information will be used to inform the radiation protection measures and monitoring to be used for the project. A Radiation Work Permit (RWP) will be developed accordingly by site radiation protection staff.

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

Thanks,

Randy Whicker

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

Radiological Dose Assessment for Relining of EP-1

1. Introduction

The Grants Reclamation Project (GRP) site (Site) is a Title II Uranium Mill Tailings Radiation Control Act (UMTRCA) facility regulated by the U.S. Nuclear Regulatory Commission (NRC) under radioactive materials license SUA-1471. The Site, owned and operated by Homestake Mining Company of California (HMC), is also regulated under a Discharge Permit (DP-200) with the State of New Mexico Environment Department (NMED), and has been designated as a Federal Superfund site on the National Priority List (NPL) with the U.S. Environmental Protection Agency (EPA).

There are two uranium mill tailings impoundments on the Site, including a large tailing pile (LTP) and small tailing pile (STP). Former milling facilities have been demolished and covered, and the vast majority of wind-blown soil contamination has been excavated and placed in the impoundments. Current operations are limited to environmental monitoring and treatment of impacted groundwater via two zeolite facilities on top of the LTP, along with a reverse osmosis (RO) water treatment plant. Additional Site facilities include three evaporation ponds (EP-1, EP-2, and EP-3) and two collection ponds (East and West).

Constructed on top of the STP in 1990, EP-1 features a single composite liner consisting of 50 mil polyester fabric sheets coated with Deery Oil No. 6 asphaltic emulsion. EP-1 has no internal leak detection system. The existing liner has exceeded its design life span and localized sloughing of some of the internal pond slopes has been observed in recent years. The hazard potential classification for EP-1 was changed from low hazard to significant hazard on March 1, 2018 by the Office of the State Engineer (NMOSE). HMC plans to refurbish EP-1 in 2019 with a modern, double-layered synthetic liner system that includes leak detection capability. The selected approach is to dewater EP-1, then stabilize in place existing residual solids (sludge, salts and sediments) at the bottom of the pond. The new liner system will be constructed on top of the stabilized pond solids.

This Technical Memorandum provides a conservative assessment of potential radiological doses to workers and the nearest member of the public during the 2019 relining of EP-1. This information will be used to inform the radiation protection measures and radiological monitoring to be employed for the project. These measures will be determined by the Radiation Safety Officer (RSO) and implemented under a Radiation Work Permit (RWP) to be developed in accordance with Standard Operating Procedure (SOP) 18 (Radiation Work Permits).

2. Potential Radiological Exposures

Based on descriptions provided in the EP-1 relining Work Plan (Stantec, 2018), the Site RSO has identified the following potential pathways for occupational and public exposures to radiation from 11.e(2) byproduct radionuclides contained residual solids at the bottom of EP-1:

1) Exposure to direct, external radiation from gamma-emitting radionuclides contained in the residual pond solids.
2) Inhalation of long-lived radionuclides in airborne particulates released to air from residual solids exposed at the active surface environment, a circumstance that could result from drying of the solids and environmental and/or mechanical disturbances that may occur during the construction process used to stabilize pond solids.
3) Inhalation of radon gas and its short-lived radon decay products once the water in EP-1 is removed and release of radon gas is no longer attenuated by pond water.
4) Accidental ingestion of radionuclides due to direct contact with residual solids or remotely impacted soils and transfer of associated contamination.

For occupational exposure pathways, inadvertent ingestion of radioactive material can be eliminated by following basic work rules regarding proper use of personal protective equipment (PPE), good industrial hygiene, restrictions on eating, drinking and use of tobacco products, and systematic radiological surveys for contamination on personnel and equipment. The ingestion pathway is thus not evaluated in the assessment of occupational dose, but is included in the assessment of public dose as such controls do not apply to potential public exposures. Given the above circumstances and potential exposure pathways for this work, the RESRAD-OFFSITE computer code (ANL, 2016) is an appropriate radiological fate and transport modeling program for evaluation of potential onsite doses to workers and offsite doses to the nearest member of the public.

3. Source Term

The layer of residual solids at the bottom of EP-1 has been estimated to be approximately 2.5 feet thick across a 20-acre area (CH2M, 2018). Previous sample analysis results for key radionuclides contained in residual pond solids are provided in Table 1. Source term concentrations for radiological dose modeling were conservatively assumed equal to the maximum values listed for each radionuclide in Table 1.

Table 1: Relevant media concentration data.

Sample	Location	Sample Date	U-nat (pCi/g)	Th-230 (pCi/g)	Ra-226 (pCi/g)
Salt Crust	EP1	6/14/2017	161	16.6	20.1
Sludge	W Coll Pond	9/24/2015	2566	0.5	-
Sludge	EP1	9/24/2015	-	-	32.5

4. RESRAD Modeling and Exposure Scenario Parameters

Radiological doses to a hypothetical maximally exposed EP-1 pond relining worker, and to the nearest member of the public, were modeled using the RESRAD-OFFSITE computer code (ANL, 2016) (hereafter referred to as "RESRAD" for brevity). Model parameters were conservatively estimated to provide an upper bound on potential exposures and doses. Aerial imagery and shapefiles of applicable Site areas and features were used to create a Site-specific receptor scenario layout as shown in Figure 1. The assumed

source term (contaminated zone with exposed pond solids) was conservatively represented by a rectangular area of approximately 28 acres, roughly centered on the center of the Contamination Zone depicted in Figure 1. The thickness of the source term was conservatively assumed to be 1 meter.

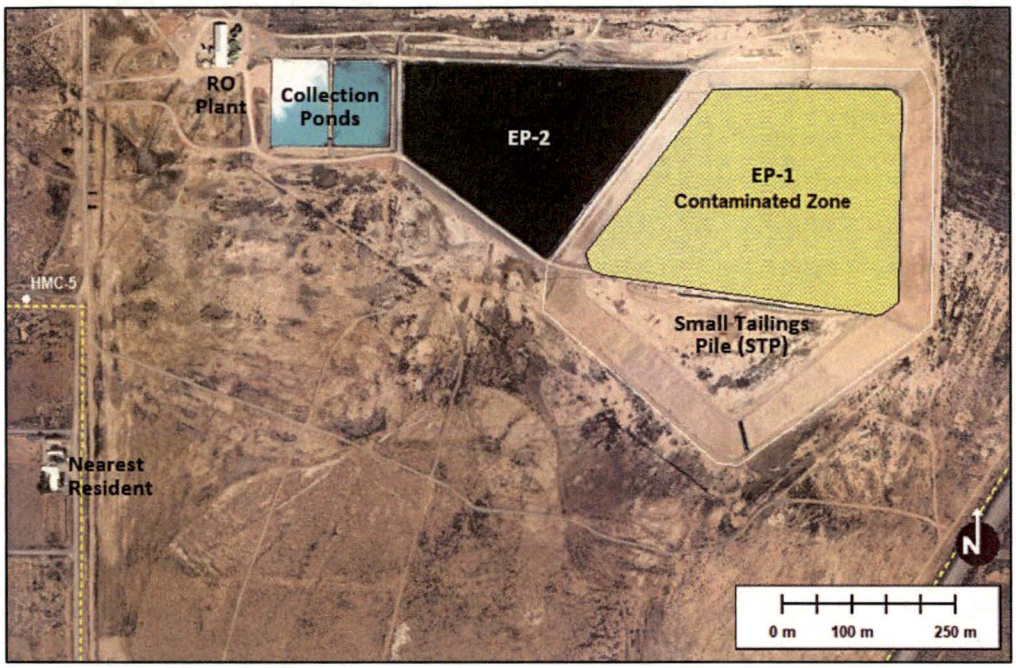

Figure 1: Site layout for RESRAD modeling of occupational and public dose estimation.

With respect to occupancy factors for receptor exposure scenarios, the duration of the EP-1 relining project was assumed to be six months. For occupational exposures, this amounts to 960 hours of outdoor exposure (equivalent to an annualized occupancy fraction of 0.11, assuming 40-hour workweeks), with the receptor positioned in the center of the Contaminated Zone. For the nearest resident, indoor and outdoor occupancy fractions were assumed equivalent to ½ of annualized RESRAD default values for a residential receptor scenario (i.e. 0.25 and 0.05 respectively).

Concentrations of the principle long-lived radionuclides in the Contaminated Zone source term were assumed to occur at the maximum values shown in Table 1. In accordance with relevant NRC guidance found in NUREG 1620, the concentration of Pb-210 was assumed equivalent to that of its Ra-226 decay series parent, and the apportioned activity concentrations for isotopic U-238, U-234 and U-235 contained in natural uranium (U-nat) were assumed equivalent to 48.9% for U-238 and U-234, and 2.2% for U-235.

Exposure pathways for the occupational receptor scenario were limited to 1) external gamma radiation, 2) inhalation of long-lived radionuclides in air particulates, and 3) inhalation of radon and its short-lived decay products (radon progeny). Again, inadvertent ingestion of contaminated solids can be prevented by following project work rules as defined in the RWP (e.g. proper PPE and good industrial hygiene). For the nearest resident receptor scenario, the soil ingestion pathway was also included (in addition to the three pathways identified above).

With respect to atmospheric transport, joint frequency distributions for atmospheric stability, wind speed and wind direction were based on Site-specific data generated in 2017 from the onsite meteorological monitoring station (Figure 2). All model parameter values not specified above were assumed equivalent to conservative default RESRAD values to support upper bound estimates on radiological doses for both onsite workers and for the nearest offsite member of the public during the EP-1 relining project.

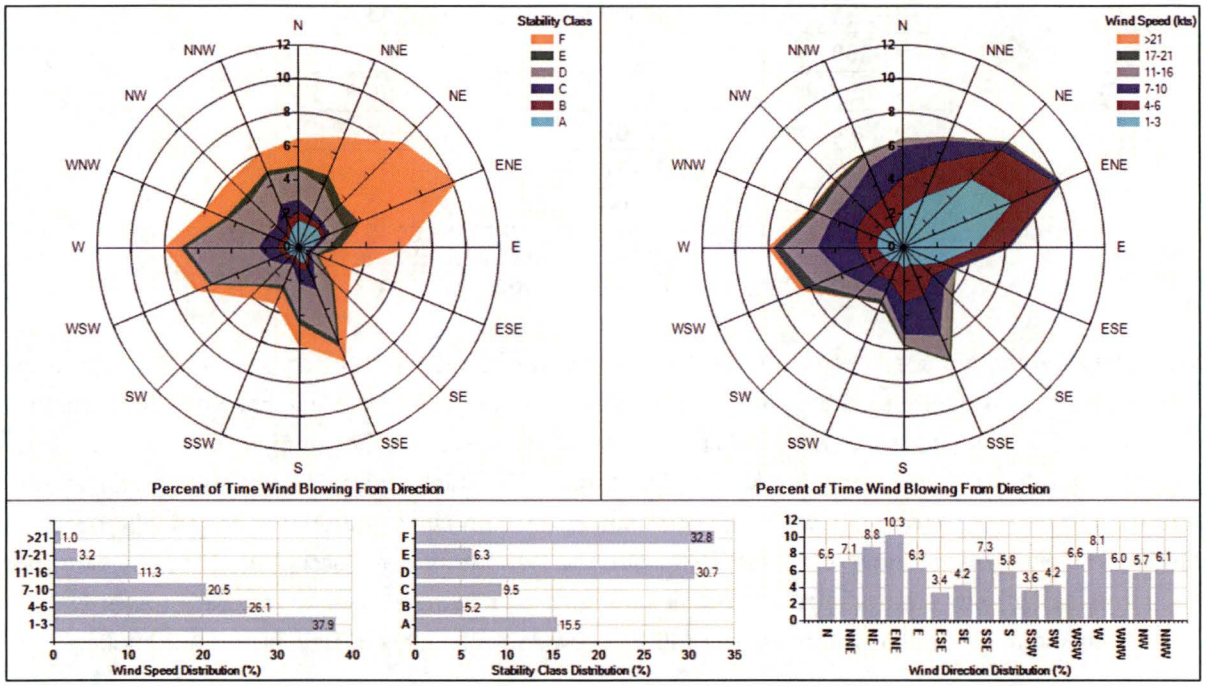

Figure 2: Atmospheric joint frequency distribution data used for RESRAD dose modeling.

5. RESRAD Modeling Results

For the modeled receptor scenarios, annualized doses incurred during EP-1 relining, estimated by radionuclide and exposure pathway, are provided in Table 2. The total modeled radiation dose for each receptor scenario is well below the 100 mrem/yr regulatory limit for members of the public as given in 10 CFR 20.1301. For occupational exposures, external dose from gamma radiation is dominated by Ra-226 and its progeny, yet significant contributions from U-238 are also expected (due to short-lived Pa-234 progeny). For the nearest offsite member of the public (nearest resident), radiological exposures are expected to be dominated by radon and its decay products, though the total annualized dose to the nearest resident is exceedingly small (< 1 mrem).

Table 2: Modeled occupational and public dose estimates.

Radionuclide / Pathway	Occupational Dose (mrem/yr)*	Public Dose (mrem/yr)*
Pb-210	4.5E-02	1.1E-04
Ra-226	3.7E+01	7.4E-01
Th-230	1.2E-01	8.0E-04
U-234	8.4E-01	4.8E-03
U-235	4.5E+00	1.9E-04
U-238	2.3E+01	4.1E-03
External	6.3E+01	1.2E-06
Inhalation	1.7E+00	1.0E-02
Radon	1.2E-01	7.4E-01
Ingestion	0.0E+00	8.3E-08
Total	**65**	**0.8**

*Modeled average for a 6-month exposure period

Uncertainties in the modeled doses in Table 2 are considerable, but extensive conservatism is built in to these estimates and they should provide a reasonable upper bound. A notable unknown is the potential for additional gamma emissions from tailings underlying the residual solids in EP-1 (once the water is removed), but generally speaking, workers are expected to be shielded inside of operating equipment when stabilizing the pond solids with clean soil cover, and the cover material will gradually provide additional shielding as the work progresses. Despite the low potential for occupational doses, external dosimeters along with breathing zone (BZ) air monitoring for workers are appropriate to verify this expectation and to ensure consistency with HMC's As Low As Reasonably Achievable (ALARA) policy.

6. Conclusions

The results of this assessment indicate that maximum occupational radiation doses to workers from working on the EP-1 relining project (estimated at 65 mrem/yr) are unlikely to be significant relative to 5,000 mrem/yr annual occupational dose limit specified in 10 CFR 20.1201. Expected doses to the maximally exposed member of the public (nearest resident) are expected to be negligible (0.8 mrem/yr), well below the 100 mrem/yr dose limit in 10 CFR 20.13.01 and within the variability in doses to the public from local background radiation. These dose estimates are conservative to provide a reasonable upper bound on potential exposures. This information will be used to inform the radiation protection monitoring and measures to be specified by the RSO in a RWP for the EP-1 relining project.

7. References

Argonne National Laboratory (ANL). 2016. RESRAD-OFFSITE for Windows. Version 3.2. June 28, 2016.

CH2M. 2018. Grants Reclamation Project Water Management Prefeasibility Study. Final Report. March 20.

Stantec. 2018. Grants Reclamation Project Design Work Plan for Re-lining EP-1. July 30, 2018.