

U.S. Nuclear Regulatory Commission (NRC) Region I
Responses to Comments Received from Heritage Minerals, Inc. (HMI)
on Staff Dose Assessment
for Unrestricted Future Use Scenarios Following License Termination
of the HMI Site in Lakehurst, New Jersey

(Note: Comments are condensed)

HMI Comment 1

HMI provided numerous editorial comments on the Background section of the NRC Dose Assessment. Listed below is a summary of each comment and the Region I response:

a) NRC Dose Assessment, Page 2, Section 2.1, Paragraph 1:

Modify the description of the site boundaries. Change the statement, “. . . on the east by Route 37, and on the south by two residential areas and Pinewald Keswick Road.” to read, “. . . on the northeast by the Central Railroad tracks and privately-owned properties, and on the south by the State of New Jersey and corporate or privately-owned properties.”

Region I response:

This proposed change will be incorporated, based on further staff review of licensee documentation, including a map in the 1989 NRC site inspection (ADAMS ML010870128).

b) NRC Dose Assessment, Page 2, Section 2.1, Paragraph 2:

Modify the description of the site relationship to local streams, creeks, lakes, and marsh land. Change the statement, “. . . is also surrounded by” to read, “also adjoins some”.

Region I response:

This proposed change will be incorporated.

c) NRC Dose Assessment, Page 2, Section 2.2, Paragraph 1:

Modify the description of the wet mill processing. Change the statement, “hydraulic (wet) processing” to read, “hydraulic (wet) gravity processing”.

Modify the description of the product processed during the ASARCO operations. Change the statement, “such as ilmenite (Fe, TiO₂) and zircon (ZrO) from the sand” to read, “such as ilmenite from the sand.”

Modify the description of the wet process. Change the statement “This integrated process was called the ‘Wet Mill’ to read “This integrated wet gravity process was conducted in the ‘Wet Mill’.”

Region I response:

The proposed changes will be made, based on review of licensee documents, including the HMI Process History attached to the letter dated November 22, 2002 (ADAMS ML051990142).

d) NRC Dose Assessment, Page 3, Section 2.2, Paragraph 2:

Replace the entire paragraph describing the handling of material immediately after processing in the Wet Mill. Change the paragraph:

“The Wet Mill tailings (mostly silica sand and water) were stored in a pile of roughly one million tons, referred to as the ASARCO wet mill tailings. The separated heavy fraction (e.g., fraction with concentrated heavy minerals) was de-watered and stockpiled for further processing at a rate of about 45 MT (50 tons) per hour. The heavy fractions were then washed to remove the fine clay material coating the heavy minerals particles. The excess wash water and suspended clay were decanted into holding tanks. The unusable clay-laden water was pumped to a series of large-area settling ponds located on the north side of the Wet Mill.”

To read:

“The wet mill tailings (mostly silica sand water (sic)) are normally returned to the moving dredge pond as backfill. However, to enlarge the original dredge pond for adequate space for the dredging and operating equipment, the original one million tons of tailings (referred to as the ASARCO wet mill tailings) were stored at the dredge construction site located to the west of the old Central Railroad tracks.

“Based on its history, the radionuclide concentration of these mine tailings is below the natural background concentration of the area and, hence, not licensable source material since all of the heavy mineral fraction that contained monazite has been removed.

“The heavy mineral fraction followed a different path downward through the spirals and was de-watered and stockpiled outside the Wet Mill for further for further processing at the rate of about forty-five (45) metric tons per hour.

“The excess wash water containing the suspended clay washed from the heavy mineral fraction was processed through the Wet Mill holding tanks (sumps) to a series of large area settling ponds located to the north of the Wet Mill and identified as the ‘Blue Area’.”

Region I response:

The proposed changes will be made, with the exception of the last proposed paragraph. NRC will incorporate the first three proposed paragraphs and will modify the last to read:

“The excess wash water containing the suspended clay washed from the heavy mineral fraction was *processed by decanting using* the Wet Mill holding tanks (sumps) *and pumped* to a series of large area settling ponds located to the north of the Wet Mill and identified as the ‘Blue Area’.”

This language aligns with the descriptions contained in licensee documents, including the Revised Mine Tailings Radiological Assessment Plan, attached to the letter dated May 9, 1997 (ADAMS ML052000375). This document also verifies the other proposed changes.

e) NRC Dose Assessment, Page 3, Section 2.2, Paragraph 3:

Modify the description of the mineral composition of the stockpiled heavy fraction from the Wet Mill. Change the statement, "The stockpiled heavy fraction contained monazite (Fe, Ce, U, Th, PO₄), . . ." to read ". . . contained monazite (Fe, Ce, U, Th, PO₄ and ZrSiO₄)".

Modify the description of the heavy mineral concentrate. Change the statement, "The heavy mineral concentrate was allowed to drain and was transferred. . ." to read, "The drained heavy mineral concentrate was transferred. . .".

Region I Response:

The proposed changes will be incorporated based on a review of licensee documents, including the HMI Process History, attached to the letter dated November 22, 2002 (ADAMS ML051990142).

f) NRC Dose Assessment, Page 4, Section 2.2, Paragraph 10

Modify the description of the fate of the zircon circuit product. Change the statement, ". . . was returned to the Dry Mill titanium circuit. . . which yielded market-grade leucoxene" to read, ". . . was market-grade zircon containing 350 ppm Th + U."

Region I Response:

The proposed change will be incorporated based on a review of licensee documents, including the HMI Process History, attached to the letter dated November 22, 2002 (ADAMS ML051990142), and the 1989 NRC site inspection (ADAMS ML010870128).

g) NRC Dose Assessment, Page 4, Section 2.2, Paragraph 11

Modify the description of the Blue Area material to clarify that it was determined to meet the 10 CFR 40.13(a) exemption. Add the statement, ". . . and are, therefore, not considered licensable source material".

Region I response:

The description was modified to clarify that the Blue Area material is not licensable material. The language used is similar to that used in an earlier description of the Gray Area (Page 3, Section 2.2, Paragraph 8).

h) NRC Dose Assessment, Page 5, Section 2.3, Paragraph 2:

Modify the description of the groundwater and surface water investigation performed in 1997 to specify that no significant radionuclide transport or elevated concentrations in the surface water or aquifer system at the site are occurring. Change the statement, “(The) investigation was conducted to confirm. . .” to read, “(The) investigation confirmed. . .”

Region I response:

The proposed change will be made based on a review of licensee documents, including the SENES Pathways Analysis for the HMI site, attached to the letter dated June 30, 2004 (ADAMS ML041910222).

HMI Comment 2

Use of the ‘Resident Farmer’ scenario is misleading and unnecessary since HMI intends to develop the site for residential land use and the land use patterns and demography of Manchester Township are not compatible with the scenario. The assumption that the groundwater pathway will result in increased radiation exposure is unreasonable based on the results of the 1997 groundwater analysis and the 2003 Pathways Analysis of the site.

Region I response

The NRC staff performed its dose assessment of the HMI site using the ‘Suburban Resident’ scenario, which comports with the future use intentions that have been stated by HMI and with the available demographic data for the local area. The staff also modeled the site using the ‘Resident Farmer’ scenario, and included the result of this analysis in the report. Resident Farmer is the default land-use scenario used by NRC staff for sites that have been impacted by soil contamination. Previous requests to the Commission for release of former-SDMP sites have included staff dose assessment results using this scenario. To provide the Commission with a common basis by which to compare the HMI site to other former-SDMP sites, this analysis was included. The staff dose assessment specifies that the expected and most likely land-use scenario is suburban resident, and the staff’s request for license termination will also clarify this point. However, as there are no known land-use restrictions against farming in place or planned for the site, the possibility of a farming scenario cannot be omitted.

NRC agrees that the groundwater at the HMI site is uncontaminated. The assumptions used in the soil analysis are listed in Section 6 of the dose assessment. Surface Soil Assumption (xii) states that NRC assumed groundwater was uncontaminated. NRC staff used default RESRAD values for food-transfer factors. The HMI-performed dose assessment that you provided with your comments used the same default values.

HMI Comment 3

HMI provided numerous comments on the NRC Dose Assessment. Listed below is a summary of the comments that were in disagreement with the staff assessment followed by the Region I response:

a) HMI Dose Assessment Comment 1

HMI selected the thickness of the contaminated zone as 0.15 meters (6 inches). Because of the excavation of the monazite pile and the additional remediation of soil pockets within the pile footprint, all soils were excavated to meet the NRC cleanup criteria. Given that the pile had consisted of 1400 tons of monazite and over 4000 tons were removed, it is unreasonable to assume a contaminated zone of 1 meter. Post-remediation samples showed remaining concentrations of source material at or slightly above background. The RESRAD Users manual discusses allowance for variations and non-homogeneity of sample concentrations by assuming a contaminated zone thickness layer of 0.15 meters. We believe this is an appropriate selection.

Region I response:

NRC concurs that the former monazite pile at the HMI site has been excavated and removed and that samples from the remaining soil indicate that the NRC cleanup criteria has been met. The RESRAD Users Manual, Section 2.1.1, *Geometry of the Contaminated Zone*, defines a contaminated zone as, "a belowground region within which radionuclides are present in above-background concentrations". Additionally, the RESRAD Data Collection Handbook (available at the RESRAD website, <http://web.ead.anl.gov/resrad/documents/>), Section 39, 'Thickness of Contaminated Zone', defines this parameter as "the distance between the uppermost and lowermost soil samples that have radionuclide concentrations clearly above background."

HMI survey documents indicate that residual contamination above natural background concentrations (although below the required cleanup standards) remains present at depths up to 1 meter (39 inches). Soil samples 36-38 from the Sept. 2003 ORISE survey, which are three of the values used in the NRC dose assessment, provide one such reference. The results from the December 2004 / January 2005 ENERCON samples (Table 1 of the March 2005 license termination request) (ML051010170), which are from the bottoms of excavations, also support the assumption that permissible levels of residual contamination exists below the top 15 centimeters (6 inches) of soil. The February 2003 SENES report, 'Pathways Analysis and Site-Specific Options for the ASARCO/HMI Site', Table 4.4, provides downhole gamma survey data for the mill vicinity that indicates the average depth of soils contaminated above background is 2.8 feet. Given that the background value used by SENES is twice that used by ENERCON, the NRC value of 1 m is not unreasonable.

Conversely, HMI provided no site-specific data to support that remaining soils within the monazite pile area do not exceed background levels below 0.15 m. The discussion referenced by HMI on Page 3-8 of the RESRAD Users Manual pertains to a method of comparing average radionuclide concentrations within a non-uniformly contaminated area with the soil guidelines for unrestricted release. The method describes breaking up a non-uniformly contaminated area into components and averaging the radionuclide concentrations measured within each component. The criterion is used "for any 100-m² area and 0.15-m-thick layer within the contaminated zone". This method does not provide a means by which licensees may merely assume that all radioactivity above background is contained within a 0.15m depth.

b) HMI Dose Assessment Comment 2

The NRC dose assessment uses an outdoor fraction value of 25% for both the resident farmer and the suburban resident scenario. This equates to 6 hours per day spent outdoors every day on the contaminated zone. HMI believes this is an unrealistically high number. A suburban resident's outdoor time will not be spent exclusively on or near the contaminated zone, and each property will include areas such as paved driveways or patios that will reduce potential gamma exposure from any underlying radionuclide contamination. The RESRAD Users Manual notes that the EPA Exposure Factor Handbook (EPA EFH) assumes that a suburban resident will spend an average of 2 hours per day outdoors compared to the default RESRAD assumption of 6 hours per day. We believe this is a more realistic assumption for the average time spent outdoors by a suburban resident.

Region I response:

NRC agrees with the HMI comment on the outdoor fraction of time. NRC has revised the outdoor fraction of time to be consistent with the definition of the critical group in NUREG/CR-5512, Volume 3, which is based, in part, on the values from the EPA Exposure Factors Handbook. As part of this parameter modification, the staff modified the indoor exposure time and the food intake rates to also be consistent with NUREG/CR-5512, Volume 3.

HMI Comment 4

HMI performed its own dose assessment of the site, which resulted in an expected dose of 23.5 mrem/year to the suburban resident. A copy of this dose assessment was attached to the comment letter.

Region I Response

NRC review of the HMI dose assessment identified seven input differences from the initial NRC assessment. Following, is a discussion of each difference, as well as the calculated impact on the HMI-supplied dose assessment of using the NRC value.

- a. Average thorium-232 concentration
HMI Value = 2.4 pCi/g
NRC value = 2.3 pCi/g

HMI states that the radionuclide concentrations were determined using the licensee's sample results. NRC used staff and licensee results, which likely accounts for the slight difference in this value. Using the NRC value in the HMI dose assessment reduces the expected dose by approximately 0.56 mrem/year.

- b. HMI Value = 1.4 g/cm^3
NRC Value = 1.5 g/cm^3

HMI does not state how this value was determined. The densities of the saturated and unsaturated zones used by HMI were 1.5 g/cm^3 (same as NRC). The NRC value was determined from licensee-supplied data and by the type of soil at the site. Using the NRC value in the HMI dose assessment increases the expected dose by approximately 0.54 mrem/year.

- c. Contaminated Zone Porosity (CZ Porosity)
HMI Value = 0.25
NRC Value = 0.4

HMI does not state how this value was determined. The total porosity of the saturated and unsaturated zones used by HMI was 0.4 (same as NRC). The NRC value is the RESRAD default. Using the NRC value in the HMI dose assessment M has no impact on the expected dose.

- d. Unsaturated Zone Thickness (UZ Thickness)
HMI Value = 2 m
NRC Value = 0.15 m

HMI does not state how this value was determined. The NRC value was determined from licensee-supplied data. Using the NRC value in the HMI dose assessment has no impact on the expected dose.

- e. Outdoor Fraction
HMI Value = 0.0833
NRC Value = 0.25

As described in HMI Comment 3b, the value for Outdoor Fraction used by HMI was obtained from the EPA Exposure Factors Handbook. NRC initially used the RESRAD default value of 0.25. Using the EPA values for both Indoor and Outdoor Fraction in the HMI dose assessment increases the expected dose by 8.54 mrem/yr.

- f. Contaminated Zone Thickness (CZ Thickness)
HMI Value = 0.15 m
NRC Value = 1 m

As described in HMI Comment 3a, the value for CZ Thickness used by HMI was based on a misinterpretation of a method for evaluating residual contamination within non-uniformly contaminated areas described in the RESRAD Users Manual. The NRC value was based on site-specific survey results. Using the NRC value in the HMI dose assessment increases the expected dose by approximately 10.55 mrem/year.

In summary, NRC review of the HMI Comment 4 will result in little change to the NRC dose assessment. Although the HMI-proposed value for outdoor fraction may be valid, use of the corresponding indoor time fraction from the EPA EFH will almost completely negate any dose reduction. The final NRC dose analysis has been modified to include both outdoor and indoor time fractions, consistent with the EPA EFH, and the resultant dose did not drastically change.

In addition, the staff performed deterministic runs to compare input differences and resultant impacts to the HMI dose assessment described above (however, it uses EPA EFH indoor and outdoor fractions rather than NUREG/CR-5512 values). A summary of the comparisons is included in the tables below. Table 1 considers each input difference separately. Table 2 lists the impact on the HMI dose assessment from combinations of input differences. The shaded combination row shows the impact of the most plausible combination of inputs proposed by HMI. In this run, the NRC values for Th-232 concentration, CZ density, CZ porosity, UZ thickness, and CZ thickness are used (HMI provided no basis for the values they used for these variables). Also, this run uses the HMI-proposed value for outdoor fraction, together with the corresponding EPA EFH value for indoor fraction. With these inputs, the dose assessment results in 40.95 mrem/yr, which is similar to the results in the initial NRC analysis.

Table 1 Summary of Individual Variable Differences and Impact on HMI Dose Assessment

	Variable	NRC Value	HMI Value	Impact on HMI DA using NRC value
	Initial Dose Result	43 mrem/y	23.52 mrem/yr	
1	Th-232 avg concentration	2.3	2.4	22.96 mrem/y
2	CZ Density	1.5	1.4	24.06 mrem/y
3	CZ Porosity	0.4	0.25	23.52 mrem/y
4	UZ Thickness	0.15	2	23.52 mrem/y
5	Indoor Fraction	0.6833@	0.5	30.12 mrem/y
6	CZ Thickness	1	0.15	34.07 mrem/y
7	Outdoor Fraction	0.25	0.0833	32.06 mrem/y

@ = EPA EFH Value

Table 2 Impact on HMI Dose Assessment From Combinations of the Above Variables

Combinations	Impact on HMI DA using NRC value
1,2,3,4,5	30.07 mrem/y
1,2,3,4,6	33.32 mrem/y
1,2,3,4,5,6	40.95 mrem/y
1,2,3,4,5,6,7	43.2 mrem y
5,7	30.12 mrem/yr