

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

Responses to Comments from the New Jersey Department of Environmental Protection (NJDEP)

(Note: Comments are condensed)

NJDEP Comment 1

There does not appear to be an absolute account of the location of the former monazite pile and there is no comprehensive map showing all post-remediation sampling data. The naming of the sampling points is confusing, and the same sample identification numbers were used at different locations.

Region I Response

The former monazite pile describes the land area at HMI where the pile of licensed source material was stored. The pile was formed in 1989, when HMI first submitted its application for an NRC license, after an inspection identified that source material was being concentrated in the process waste. The monazite material was placed in an area located southeast of the dry mill, and was surrounded by a fence and covered with tarps. The location of the pile remained unchanged until September 2001, when the fence was removed, and the material excavated and shipped for disposal offsite. The pile location was observed at least annually by NRC staff during inspections. Descriptions of the pile are included in inspection reports from 1990 - 2001. An NRC inspector observed the excavation, loading, and shipping of the material, as described in NRC Inspection Report 04008980/2001001 (ML023310240).

When the pile was shipped, RSI (the decommissioning contractor at the time) removed the material using large excavating equipment (front end loader). This left a visible, recessed land area in the location where the pile had been. ENERCON, the D&D contractor who replaced RSI, considered the entire depressed area of land as being the footprint of the former monazite pile, and performed a walkover survey of this area, logging with a GPS unit. The GPS survey map was provided to NRC in a report titled, "Removal of Fugitive, Licensable Soil, Heritage Mineral, Inc", dated June 26, 2003 (ML031960118). The map is drawn in units of feet, as was described to NJDEP in an email dated 10/31/05.

The NRC inspector assigned to HMI remained unchanged between 1998 - 2004. This inspector had observed the location of the pile when the material was still staged, observed the excavation and shipment of the material, and performed surveys of the footprint with ENERCON after the material was removed. This inspector reviewed the results of the soil samples and concurred with the location of the footprint as described by ENERCON in the 2003 map. Based on consistent NRC oversight of the HMI decommissioning activities and the fixed location of the pile, NRC staff is satisfied that the parameters of this licensed area are defined.

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The soil sample results used by NRC in the dose assessment constitute final condition surveys of the footprint. Fifteen samples were identified as representing the current condition of the footprint. Ten samples results were provided by ENERCON in the 2003 report referenced above. This sampling occurred after the first NRC confirmatory survey performed by ORISE in December 2001 had identified source material concentrations in excess of the release limits remaining within the footprint, and additional licensable source material remaining in soil pockets outside of the footprint. The December 2001 ORISE survey was conducted to verify the MARSSIM survey performed by RSI in 2001, which indicated that the monazite footprint met the release criteria. ORISE sampled soil locations that exhibited increased radiation levels as identified by a gamma walkover survey. In other words, the survey was biased-high. The sample locations were marked with flags, and numbered sequentially. In many cases, several samples were located in close proximity to each other. Before remediation of these locations was performed, HMI hired a new D&D contractor, ENERCON. ENERCON performed their own walkover survey so that they could determine the rough surface areas of the increased activity identified by the samples. Where ORISE had marked off specific point locations, ENERCON expanded the points into two-dimensional areas. In so doing, multiple samples locations flagged by ORISE that had been located in close proximity to one another, were now replaced by larger footprint locations that encompassed them. The footprint locations were designated by ENERCON descriptions, which did not correlate to the ORISE nomenclature, and ENERCON did not specify or note which ORISE samples became incorporated into which ENERCON footprints.

The footprints were excavated in June 2003, and sample results from the excavations were provided in the referenced 2003 report. Two of the excavated footprints were located within the footprint of the former monazite pile, and soil samples were obtained by ENERCON at the bottom of each footprint (Sample IDs 17-10 and 17-11). ENERCON also obtained soil samples of the undisturbed soil within the monazite pile footprint that surrounded each excavation, obtaining one from each cardinal point (17-10N, 17-10E, 17-10S, 17-10W, 17-11N, 17-11E, 17-11S, 17-11W).

The 2003 report indicated that ENERCON had remediated the remaining material in excess of the release criteria within the monazite footprint and had also remediated the pockets of licensable soil outside the footprint. A second NRC confirmatory survey was performed in April 2003 (ML040250070). This survey was performed using the same methods as the earlier ORISE survey, and encompassed the mill pads, monazite pile area, and land surrounding these areas. Soil samples were again obtained at locations identified as having elevated radiation levels by a gamma survey meter. Soil sample locations were marked with flags, and were numbered sequentially. Because this was a new survey, with new soil sample locations, the sample identifications do not correspond to the identifications from the first ORISE survey. Three soil samples from within the monazite pile footprint met the NRC release criteria. The results from these three samples were used in the staff dose assessment, because they represent final status of those locations within the footprint. Because the locations were identified from a gamma walkover survey, they are biased-high, and therefore are conservative. These samples were identified in the ORISE report as Sample Nos. 36, 37, and 38.

This second confirmatory survey identified two locations within the monazite pile footprint that exceeded the release criteria (Sample Nos 16/17 and 18/19 (samples in these locations were obtained at two depths at each location, resulting in two id numbers for each)), and identified additional locations outside the footprint that exceeded the licensable levels for source material. As they had done previously, ENERCON performed a walkover survey to identify the surface area footprints encompassing the elevated sample locations to identify the areas that required additional remediation. These footprints were identified with a new numbering system (1-8), although ENERCON credited ORISE with finding the elevated concentrations by naming the footprints ORISE 1 - ORISE 8. Although the footprints include the word "ORISE" in the names, the IDs do not correspond to the numbering system used by ORISE in the identification of the pin point sample locations. These footprints were excavated in December 2004, and NRC inspectors performed side by side samples of the excavations with ENERCON. The results of the two NRC samples (NRC-04-07 and NRC-04-08) (ML050960038) were included in the dose assessment.

We understand that the use of different names and numbering systems has led to confusion, and hope that this sequential description of the footprint remediation and sampling has helped.

NJDEP Comment 2

The NRC did not include the pockets of licensable source material identified outside the footprint in its dose assessment. Soil within this buffer area with elevated thorium and uranium that did not meet source material concentrations are allowed to remain even though they are above the NRC's cleanup level of 10 pCi/g. What is the NRC's rationale for believing that these areas were not contaminated by licensable activities? A dose assessment of the buffer area results in over 500 mrem/yr. Would residential restrictions be put in place for these areas?

Region I Response

The HMI site is impacted by both NRC-regulated material and state-regulated material. The NRC license issued to HMI in 1991 specified the extent of NRC jurisdiction at the site. This was addressed in a letter to NJDEP on 03/13/91 (ML010870190). NRC regulation of source material relates only to material exceeding the unimportant quantity concentration of 0.05% source material. At HMI, the only material that exceeded this amount was the material stored in the monazite pile. NRC required HMI dispose of that material and decontaminate the land area upon which the pile was stored. The regulated source material was created through the mechanical processing of HMI property sands. The point at which licensed material was separated from the remaining sands was identified at a particular stage within the wet mill process. This material continued through the remaining stages of wet mill processing and then was processed in the dry mill (all stages). NRC required decontamination of the portions of the mill buildings that were impacted by the licensed material. The mill buildings and the monazite pile contained the only material licensed by the NRC at the site.

The original minerals processing that occurred at HMI also concentrated the natural thorium and natural uranium present in the native sands. NRC samples taken at various stages of the processing operation indicated that the feed material (waste material from early processing operations) contained 0.018% source material (which correlates to up to 40 pci/g thorium). The leucoxene and zircon products obtained from the processing indicated source material concentrations of 0.014% and 0.035%, respectively (0.035% source material may contain over 78 pci/g thorium). These materials were transported around the site and stockpiled and regraded continuously, as described in a process description submitted by HMI in November 2002 (ML051990142). The monazite waste, however, was conveyed to the storage area as a slurry. NRC concurs with HMI that the elevated concentrations of source material identified around the mill buildings and the pile area are the result of regrading and transport of non-licensed sands from other stages of the processing operation.

The NRC confirmatory surveys performed by ORISE in 2001 and 2003 identified soil samples in these surrounding locations with source material concentrations in excess of the unimportant quantity of 0.05%. HMI contended that the samples were localized areas where non-licensed sands had been regraded and/or staged, and enough had built up to exceed the unimportant quantity concentration. NRC agreed that this was likely the case, and that the elevated samples were not from the monazite waste stream covered by the NRC license. Because of this, NRC did not amend the HMI license to add the material in these soil locations. However, because the concentration of source material in several locations exceeded the unimportant quantity exemption, they were deemed to be "licensable", and NRC staff determined that the locations should be remediated before terminating the license. NRC required HMI to decontaminate the licensable material (i.e. any soil locations with source material concentrations exceeding 0.05%) to meet the approved cleanup criteria, even though NRC concurred that these locations were contaminated with state-regulated material, as with the material in the blue and the gray areas.

Although the soils containing licensable material within this buffer zone were removed, state-regulated material remains in place both there and around the HMI site. Samples taken by ORISE (at the locations exhibiting dose rates above background) ranged from <0.001% to 0.047% concentration of source material. The average source material concentration from such samples is approximately 0.013%.

NRC did not include the soil sample results from the buffer zone in its dose assessment (neither the post-remediation results from the licensable material locations nor the as-left results indicating the presence of state-regulated material, as described above). The dose assessment only considered the dose to the average member of the impacted group from residual radioactivity within the portion of the HMI site licensed by the NRC. The NRC only licensed the source material within the monazite pile and the wet mill and dry mill equipment and buildings. Termination of the NRC license and release of the site for unrestricted use also only considers these locations. NRC agrees that there remains at the HMI site a significant dose impact from the state-regulated material remaining within the buffer zone and in the blue and gray areas. Although NRC staff have not performed a formal dose assessment within these areas, it is evident, if only through linear extrapolation, that the average dose in some locations exceeds 100 mrem/yr.

The unimportant quantity exemption in 10 CFR 40.13 allows any person to receive, possess, use, transfer, or deliver source material that is less than 0.05% by weight without an NRC license. The existence of elevated concentrations of source material, such as the state-regulated material remaining at HMI is possible in any location. This type of material was present at HMI before NRC-licensed material was created. Termination of the NRC license does not preclude or inhibit the state regulation of the site. HMI has communicated to NRC that it is required and intends to remediate the entire site to New Jersey cleanup criteria. In a letter to NRC dated June 30, 2004, they state, "Since HMI is currently is bound by the above-stated ACO (Administrative Consent Order) to 'investigate and cleanup' all contaminants at the site, including radionuclides, which will require it to satisfy New Jersey's 15 mrem/year standard to release the property for *unrestricted* use, including the planned construction of residential dwellings at the site. . . " (ML041910222). HMI has provided to NJDEP its proposed remediation plan for the state-regulated material (SENES Pathways Analysis and Remediation Planning for ASARCO/HMI Site, February 2002), which included "the 'Mill Vicinity' area where slightly elevated levels of naturally occurring radionuclides are present due to the use of overflow materials from the milling process for site grading" (ML041910222).

A news release issued by the NJDEP on September 4, 2003 announced a smart growth settlement between HMI and the state that constituted a conceptual agreement over the development of the HMI property. According to the release, the agreement limits any site development to the 1000 acres previously disturbed by mining. The release states "this area has radioactive sand and groundwater contamination that will require H. Hovnanian to perform all DEP-required remediation prior to the commencement of any new construction". (http://www.state.nj.us/dep/newsrel/releases/03_0122.htm). NRC termination of the HMI license acknowledges that the NRC-regulated material has been removed and the required portions of the site have been remediated to the cleanup criteria. NRC concedes to the state's authority for the regulation of the remaining material.

NJDEP Comment 3

The soil sample results seem to be questionable. ENECON underestimated the results for 7 out of 15 of the 'split' samples with the NRC. The laboratory used by ENERCON is not certified by the State of New Jersey so we cannot attest to the accuracy of these results. Ten of the fifteen sample results used in the NRC dose assessment were values provided by the laboratory used by ENERCON.

NEED: Lab sample analysis for the most recent samples

NEED: Details on sample prep and analysis from the lab used by ENERCON

NEED: Cross-Check details from the lab used by ENERCON

NJDEP Comment 4

Because of the questionable location of the footprint of the former monazite pile, we believe that a buffer zone should be included in determining whether to release this area for unrestricted use.

Region I Response

The Heritage Minerals site is unique in that there is federally-regulated and state-regulated contaminated soil in such close proximity and, in some cases, layered over each other. NRC has required HMI to remove the material authorized by its license, and this has been accomplished. The processing activities that resulted in HMI requiring an NRC license produced 1400 tons of licensed source material. As a result of the decommissioning activities performed to meet the NRC cleanup requirements in their approved License Termination Plan, HMI has disposed of 4246 tons of soil. The scope of cleanup performed by the licensee, together with the multiple rounds of surveys and sampling data, provide confirmation that all NRC-license material has been removed from the site. Likewise, all areas previously containing either licensed or licensable material have been remediated. The scope of decommissioning at this site required for the federally-regulated material is complete, pending Commission approval. As stated previously, decommissioning of the state-regulated material at the site is the stated, intended next step planned by the licensee, and is required by NJDEP regulations.

NJDEP Comment 5

We find that the dose assessment was performed properly using acceptable models. The results are above NJDEP's dose criterion of 15 mrem/yr and the NRC criterion of 25 mrem/yr. New Jersey cannot agree to an unrestricted release of the NRC licensed areas.

Region I Response

Although the NRC-licensed area at the Heritage site does not meet the 25 mrem/yr dose criterion of the License Termination Rule (LTR), as a former-SDMP site, it is grandfathered from this requirement. Heritage was required to comply with the decommissioning activities described in their approved Decommissioning Plan, which met the license termination criteria in effect at that time. The staff has concluded that Heritage has completed these activities. Under the Comprehensive Decommissioning Management Plan, Complex Sites such as Heritage are evaluated against the LTR when being considered for release for unrestricted use. A dose analysis is performed, and if the LTR is not met, Commission approval must be obtained prior to termination of the license and release of the site for unrestricted use. NRC staff is preparing a SECY paper requesting Commission approval to terminate the HMI license and release the site for unrestricted use. The NJDEP disagreement with the staff position has been noted in the SECY paper.

Responses to Comments from Heritage Minerals, Incorporated (HMI)
(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 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 incorporate based on a review of licensee documents, including the HMI Process History attached to te 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 incorporate based on a review of licensee documents, including the HMI Process History attached to te 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 40.13a exemption. Add the statement, “. . . and are, therefore, not considered licensable source material”.

Region I response:

This change is not necessary because the source material concentration of the Blue Area material is specified in this description. The fact that the Blue Area material did not exceed 0.05% source material concentration is evident from this information, making it unnecessary to add this statement.

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 (xi) states that NRC assumed groundwater was uncontaminated. NRC staff used default RESRAD values for food-transfer factors. The HMI dose assessment attached to the 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 that 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, however modifying this input will not significantly impact the NRC dose assessment. The RESRAD default value of 25% time spent outdoors is a conservative average value. The RESRAD Users Handbook states that a typical local or regional value should be considered for long-term evaluations. HMI has offered the value listed in the EPA EFH of 2 hours per day (8.33%) as a more realistic input. NRC agrees that this value would be appropriate to use. However, the EPA EFH, August 1997, (Table 1-2) also provides a recommended companion value for residential time indoors of 16.4 hours per day. The NRC dose assessment used the RESRAD default value for time indoors of 50% (12 hours per day). If the EPA source is used for the outdoor fraction, it also should be used for the indoor. The effect of modifying the input parameters to match both EPA values essentially cancel each other.

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 NRC assessment:

- 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. Modifying the HMI dose assessment to the NRC value would reduce the expected dose by approximately 0.56 mrem/year.

- b. Contaminated Zone Density (CZ Density)
HMI Value = 1.4 g/cm³
NRC Value = 1.5 g/cm³

HMI does not state how this value was determined. The densities of the saturated and unsaturated zones used by HMI were 1.5 g/cm³ (same as NRC). The NRC value was determined from licensee-supplied data and by the type of soil at the site. Modifying the HMI dose assessment to the NRC value would increase 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. Modifying the HMI dose assessment to the NRC value 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. Modifying the HMI dose assessment to the NRC value 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 used the RESRAD default value of 0.25. Modifying the HMI dose assessment to incorporate the EPA values for both Indoor and Outdoor Fraction 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. Modifying the HMI dose assessment to the NRC value would increase the expected dose by approximately 10.55 mrem/year.

In summary, NRC review of the HMI Comment 4 will result in no change to the NRC dose assessment. Although the HMI proposed value for outdoor fraction is valid, using it in conjunction with the EPA EFH value for indoor fraction negates any dose reduction, and does not significantly change the resultant dose. A summary of the input differences and resultant dose impacts is included in the tables below. The shaded Combination represents the impact to the HMI dose assessment described above (using EPA EFH Indoor and Outdoor fractions, in conjunction with the NRC CZ Thickness value of 1 m, and the NRC inputs for Th-232 concentration, CZ density, CZ porosity, and UZ thickness). With these inputs, the dose assessment results in 40.95 mrem/yr, which is just below the NRC-obtained value using the RESRAD default values for Indoor and Outdoor fractions.

	Variable	NRC Value	HMI Value	Impact on HMI DA using NRC value
	Starting 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

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