APPENDIX G

COVER DESIGN CALCULATIONS

G.1 RADON CALCULATIONS

G.2 EROSIONAL STABILITY CALCULATIONS

BACKGROUND

This appendix presents modeling results for radon attenuation and required cover thicknesses for facilities containing impounded waste materials at the St. Anthony Mine (Site) following Site reclamation. Stantec performed the analyses in accordance with the long-term radon emanation guidelines specified in 10 CFR Part 40 Appendix A, Criterion 6 (NRC, 2017). An analyses summary of radon attenuation through the proposed covers and underlying waste rock materials is presented and incorporates the reclamation designs (e.g., pit backfill and pile regrading) for the facilities in question.

Cover systems were evaluated for Pit 1, Pit 2, Shale Piles 1 and 2 (combined), Pile 3, and Pile 4. Because Pits 1 and 2 will be backfilled with impacted soil and rock from various locations throughout the Site, a cover comprising non-impacted materials is required at each location to mitigate radon emanation from the waste. Piles 1 through 4 currently contain a large volume of impacted waste material which will remain in place and be regraded during reclamation, therefore requiring a non-impacted cover for radon attenuation and revegetation. The following sections describe the materials analyzed in the models, as well as the methods used to develop model input parameters.

DESCRIPTION OF MODEL AND INPUT VALUES

Cover thicknesses required to limit radon emanation from the disposal areas were evaluated using the NRC RADON model (NRC, 1989). The model utilizes the one-dimensional radon diffusion equation, which uses the physical and radiological characteristics of waste and cover materials to calculate radon emanation through the cover. Stantec used the model to calculate the cover thickness required to limit the radon emanation rate through the cover to no more than 20 picocuries per square meter per second (pCi/m^2-s), following the guidance presented in U.S. Nuclear Regulatory Commission (NRC) publications NUREG/CR-3533 and Regulatory Guide 3.64 (NRC 1984, 1989). The rate of emanation standard is applied to the average emanation over the entire disposal area surface. Stantec also used the model to evaluate radon emanation for pre-determined cover thicknesses estimated during the material balance analysis for the Site.

The model input parameters are based on engineering experience with similar projects, results of waste and potential borrow material testing conducted in 2018 (DB Stephens, 2018), and soil analytical testing for radionuclides conducted in 2007, 2018, and 2019 (summarized in Appendix B). The input parameters and values in the model are outlined for all cover systems below.

Thickness of Cover and Waste Materials

Cover thicknesses were selected based on the results of the 2018 Revegetation Plan (Cedar Creek, 2018) and on the volume of available non-impacted waste material. For materials included in the cover designs as the topmost layer for revegetation (West Borrow, Lobo Tract, and North Topsoil), Cedar Creek recommended minimum cover thicknesses of 24 inches to ensure suitable planting media for revegetation during Site reclamation. Additional non-impacted material from the Pit 1 highwall excavation and South Topsoil pile will be used as cover for radon mitigation in Pit 1 and Pit 2, respectively, beneath the top revegetation layer.

The Pit 1 cover design includes 24 inches of material from the North Topsoil pile and the West Borrow area (selected due to their proximity to the pit) overlying an approximately 5-foot-thick layer of material excavated from the pit highwall. Although the topmost layer of cover comprises material from both the North Topsoil pile and West Borrow area, it was modeled as a single, 24-inch layer with input properties based on laboratory results for both materials. Waste material beneath the Pit 1 cover comprises an approximately 16-foot-thick layer of material (“Pit 1 Infill”) excavated from higher elevations within the pit and placed as backfill at the base of the pit.

The Pit 2 cover design comprises a 24-inch layer of West Borrow material overlying approximately eight feet of non-impacted cover material from the South Topsoil pile adjacent to the pit. Although the Pit 2 backfill profile includes materials (besides cover) from 8 distinct site facilities placed in lifts of varying thicknesses, only the uppermost layer was considered in the models. As documented in NRC Regulatory Guide 3.64, a tailings/waste thickness greater than 100 to 200 cm is effectively equivalent to an infinitely thick radon source and may be represented in RADON using a thickness of 500 cm. Therefore, the Surface Excavation layer, comprising material excavated from intermediate areas throughout the Site and placed as the final layer of waste beneath the cover, was the only waste layer included in the model as the actual placed thickness is greater than 500 cm.

Stantec selected cover thicknesses of 24 inches for Piles 1 through 4 based on Cedar Creek recommendations and used the RADON model to evaluate the corresponding radon emanation. Covers for the combined Shale Piles (1 and 2) and Pile 3 consist of a single 24-inch layer of borrow soil from the West Borrow Area placed atop the regraded waste in each pile. Material for the Pile 4 cover includes a combination of material from the West Borrow and Lobo Tract borrow areas combined into a 24-inch soil cover over the Pile 4 waste. Since the re-graded piles do not contain material transported from other site facilities, Stantec evaluated a single layer of waste material in each model and assumed homogenous soil properties throughout the waste profile. Similar to Pit 2, the depths of waste material (i.e., waste pile thicknesses) are considerably greater than 200 cm. Stantec assumed a thickness of 500 cm in the models to represent an infinite radon source for each pile's waste material.

Radium Activity Concentration

Radium-226 activity concentration input values are estimated based on the results of the 2007, 2018, and 2019 analytical testing. Guidance in Regulatory Guide 3.64 (NRC, 1989) states that radium activity in the cover soils may be neglected for cover design purposes provided cover soils are obtained from background materials not associated with ore formations or other radium-enriched materials. Results for borrow areas and topsoil piles (including Lobo Tract, North Topsoil, South Topsoil, and West Borrow) indicated Ra-226 concentrations less than 1 picocurie per gram (pCi/g), with a maximum value of 1.5 pCi/g. Therefore, each of these materials was assigned a concentration of 1 pCi/g in the RADON models.

Input values for Piles 1 through 4 and the Pit 1 Infill were estimated as the 75th percentile of the values measured during analytical testing for samples collected from each area. The activity of the Pit 1 Highwall Excavation was calculated using a weighted average of the activities for clean topsoil/alluvium and Piles 1 and 2 based on a visual approximation of the proportion of each material in the excavation profile (60% shale, 40% topsoil/alluvium). Thus, a weight of 0.6 was assigned to an activity of 7.7 pCi/g and a weight of 0.4 was assigned to an activity of 1.0 pCi/g, resulting in an average value of 5.0 pCi/g. The Surface Excavation material was conservatively assigned an activity of 117 pCi/g, which is equal to the 75th percentile activity level of the West Disturbance Area (WDA) near Pit 1, to represent the highest likely activity level of Surface Excavation material removed from the ground near the WDA. Table 1 summarizes the Ra-226 concentrations for the materials.

Table 1: Radium Activity Concentrations

Material	75th Percentile Ra-226 Activity Concentration (pCi/g)
West Borrow/North Topsoil	1.0
West Borrow/Lobo Tract Mix	1.0
South Topsoil	1.0
Pit 1 Highwall Excavation	5.0*
Piles 1+2	7.7
Pile 3	20.6
Pile 4	20.5
Pit 1 Infill	51.2
Surface Excavation	117.0

*Calculated as the weighted average of topsoil and Piles 1+2 activities

Radon Emanation Coefficient

The radon emanation coefficient in each model for the cover and waste layers was 0.35. This is the conservative default value used in the RADON model (NRC, 1989) and was used due to insufficient site-specific data.

Density and Porosity

The densities of the waste rock and cover materials are based on laboratory testing results (DB Stephens, 2018). Placed densities were assumed to be 90 percent of the Standard Proctor (SP) maximum compaction density, which was measured for each material type during laboratory testing.

Porosities were calculated based on the placed densities using the following relationship:

$$n = 1 - \frac{\rho_d}{G_s}$$

where n is the porosity, ρ_d is the compacted dry density, and G_s is the specific gravity (assumed 2.65 for all materials).

Table 2 summarizes the values for the material layers evaluated; these values are discussed in greater detail below. Attachment H.1.1 includes the estimation of densities and porosities for all materials.

Table 2: Density and Porosity Values

Material	Degree of Compaction (%)	Placed Density (pcf)	Placed Density (g/cm^3)	Porosity
Piles 1+2	90% SP	102.3	1.64	0.38
Pile 3	90% SP	112.3	1.80	0.32
Pile 4	90% SP	114.8	1.84	0.31
South Topsoil	90% SP	108.0	1.73	0.35
West Borrow/North Topsoil	90% SP	105.5	1.69	0.36
West Borrow/Lobo Tract Mix	90% SP	104.2	1.67	0.37
Pit 1 Highwall Excavation	90% SP	103.6	1.66	0.37
Pit 1 Infill	90% SP	112.3	1.80	0.32
Surface Excavation (Pile 3 properties)	90% SP	112.3	1.80	0.32
Surface Excavation (native properties)	90% SP	104.2	1.67	0.37

SP = Standard Proctor compaction

Laboratory data for density and porosity were available for all waste materials except the Pit 1 Highwall Excavation, Pit 1 Infill, and Surface Excavation, which were not included in the 2018 geotechnical investigation. As previously discussed, material excavated from the Pit 1 highwall was assumed to consist of 60% shale and 40% topsoil/alluvium based on the excavation profile through the highwall. The placed density of this material in the pit was calculated as 90% of the weighted average of Proctor results for the shale piles (0.6 weight) and the North Topsoil/West Borrow areas (0.4 weight). Since testing data was not available for the Pit 1 Infill, Stantec assigned the density calculated from the Pile 3 laboratory results to this material. Based on visually observed similarities in the physical appearance and composition of the Pit 1 Infill and Pile 3 materials, Stantec assumed they were excavated from the same source zone during mining activities and therefore have similar geotechnical properties. Surface Excavation materials, sourced from numerous areas throughout the Site, were evaluated using both native soil density (average of West Borrow, North Topsoil, and Lobo Tract) and Pile 3 density in two separate model runs. Stantec then compared radon emanation results for each case to evaluate the effect (if any) of the selected density on the radon emanation. Compacted densities for Piles 1 through 4 and the South Topsoil pile were calculated directly from Proctor testing results for samples collected from each pile during the 2018 investigation.

Due to limited available data for the West Borrow area and North Topsoil pile, laboratory results from the two areas were combined into a single dataset for estimating cover densities at each of the covered facilities. Furthermore, materials from the two locations were assumed to be similar based on laboratory results (e.g., nearly identical SP compaction densities as well as similar porosities and in-situ moisture contents), visual classification, and the proximity of the West Borrow area to the apparent location of origin of the North Topsoil material within the Pit 1 overburden. Therefore, as previously discussed, the Pit 1 cover was modeled as a single layer with soil properties representative of both materials. The same method was implemented for the Pit 2, Piles 1+2, and Pile 3 covers; although these covers consist only of West Borrow material, the North Topsoil datapoint was included in the parameter calculations due to the aforementioned similarities between the materials.

Stantec estimated the Pile 4 cover properties by evaluating the cover material as a combination of West Borrow and Lobo Tract materials. Because the two materials will be placed either as separate layers within the cover or as a mixture placed in a single layer, Stantec calculated the average density of laboratory results from both the West Borrow/North Topsoil and Lobo Tract datasets.

Long-term Moisture Content

Per NRC Regulatory Guide 3.64 (NRC, 1989), 6 percent by weight represents the lower bound for moisture in western soils and is typically used as a conservative default value for the long-term water content of the cover. However, where possible, Stantec estimated actual moisture contents using laboratory testing results for each material type. Stantec calculated average moisture contents for the covers based on the combined laboratory results for all materials included within each particular cover design.

Stantec compared the average in-situ moisture contents of the cover materials with the NRC-recommended value of 6 percent. Since the laboratory values for the West Borrow/North Topsoil and West Borrow/Lobo Tract mix cover materials were less than 6 percent, the average moisture contents were used in the models. Average moisture contents for the Pit 1 Highwall Excavation and South Topsoil materials (used as cover layers in Pit 1 and Pit 2, respectively) were greater than 6 percent; therefore, Stantec assumed default long-term moisture contents of 6 percent for each of these materials in the models. Actual lab values were used for the waste materials, since cover thickness calculations are less sensitive to changes in the moisture content of the waste compared to that of the cover and use of the default value may be overly conservative (NRC, 1989). Moisture contents for cover materials (excluding the Pit 1 Highwall Excavation and South Topsoil pile) were 5.2 percent, whereas results for waste materials were higher and ranged from 7.4 to 9.4 percent. Attachment H.1.1 includes the average water contents for the materials, and Table 3 summarizes the results.

To obtain a more conservative estimate of long-term moisture conditions, Stantec excluded testing results for Lobo Tract samples containing relatively high percentages of clay compared to the majority of samples from the area. Moisture contents measured for these samples were greater than those measured for samples that generally were more representative of materials found within the borrow area (e.g., 12-14 percent vs. 4-8 percent). One sample also was excluded from the West Borrow moisture calculation due to its depth of recovery (30 ft) and relatively high moisture content (9.3 percent) compared to other West Borrow samples. These conditions likely were not representative of long-term moisture conditions due to potential isolation at depth from climatological influences.

Table 3: Estimated Long-Term Moisture Contents

Material	Gravimetric Moisture Content (%)
Piles 1+2	9.4
Pile 3	8.3
Pile 4	9.3
South Topsoil	6.0*
West Borrow/North Topsoil	5.2
West Borrow/Lobo Tract Mix	5.2
Pit 1 Highwall Excavation	6.0*
Pit 1 Infill	8.3
Surface Excavation (Pile 3 Properties)	8.3
Surface Excavation (Borrow/Native Properties)	5.2

*Indicates NRC default moisture content was assumed

Diffusion Coefficient

The radon diffusion coefficient used in the RADON model can either be calculated based on an empirical relationship that depends on porosity and the degree of saturation or input directly in the model using values measured from laboratory testing. Due to limited laboratory test data, Stantec calculated diffusion coefficients using the following relationship presented in NRC (1989):

$$D = 0.07\exp\left[-4(m - mn^2 + m^5)\right]$$

where D is the diffusion coefficient, m is the moisture saturation fraction (ratio of volumetric water content to porosity), and n is the porosity. Table 4 summarizes the calculated diffusion coefficients.

Table 4: Estimated Radon Diffusion Coefficients

Material	Diffusion Coefficient (cm^2/s)
Piles 1+2	0.0168
Pile 3	0.0122
Pile 4	0.0074
South Topsoil	0.0241
West Borrow/North Topsoil	0.0302
West Borrow/Lobo Tract Mix	0.0310
Pit 1 Highwall Excavation	0.0277
Pit 1 Infill	0.0122
Surface Excavation (Pile 3 Properties)	0.0122
Surface Excavation (Borrow/Native Properties)	0.0310

MODEL RESULTS

The radon emanation modeling results show that the designed cover systems (presented in Table 5) will reduce radon emanation to values less than 20 pCi/m^2-s averaged over the entire area of the tailings impoundments, which is the regulatory criterion (NRC, 2017). Furthermore, the results for the Pit 2 cover indicate that radon attenuation is the same whether Pile 3 properties or borrow/native soil properties are assumed for the Surface Excavation material. Attachment H.1.2 provides a complete table of model input parameters and results, and Attachment H.1.3 shows the RADON model output files.

Table 5: Summary of Results

Facility	Cover Material	Cover Thickness (ft)	Cover Thickness (cm)	Surface Ra-226 Emanation ($pCi/m^2/s$)
Pit 1	North Topsoil & West Borrow, Pit 1 Highwall Excavation	2.0	61.0	15.2
Pit 2	West Borrow, South Topsoil (Pile 3 Properties Assumed)	2.0	61.0	11.4
	West Borrow, South Topsoil (Borrow/Native Properties Assumed)	2.0	61.0	11.4
Piles 1+2	West Borrow	2.0	61.0	6.2
Pile 3	West Borrow	2.0	61.0	15.8
Pile 4	West Borrow & Lobo Tract	2.0	61.0	13.5

REFERENCES

Cedar Creek Associates, Inc. (Cedar Creek), 2018. St. Anthony Mine: 2018 Revegetation Plan Update. December.

Daniel B. Stephens & Associates, Inc. (DB Stephens), 2018. Laboratory Report for Stantec: St. Anthony Geotech Investigation. July 2.

U.S. Nuclear Regulatory Commission (NRC), 2017. Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content, 10 CFR Part 40 Appendix A. August 29.

U.S. Nuclear Regulatory Commission (NRC), 1984. Radon Attenuation Handbook for Uranium Mill Tailings Cover Design, NUREG/CR-3533.

U.S. Nuclear Regulatory Commission (NRC), 1989. Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers, Regulatory Guide 3.64.

ATTACHMENT G.1.1

MATERIAL PARAMETERS ESTIMATION TABLES

Pit 1												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow & North Topsoil (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.69	0.36	8.8	24.1	0.2	0.0302	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
2	Highwall Excavation	P1-1 (15'B)	N/A	1.82	6.0	1.66	0.37	10.0	26.8	0.3	0.0277	5.0
		P1-1A (30'A)										
		P1-2 (50'A)										
		P2-1 (5'A)										
		P2-1 (25'B)										
		TN-2 (20'A)		1.89								
		BW-1 (30'A)		1.87								
		BW-2 (10'A)										
		BW-3 (5'A)										
3	Pit 1 Infill (Pile 3 properties, except Ra-226 activity)	P3-1 (5'A)	7.3	2.00	8.3	1.80	0.32	14.95	46.4	0.46	0.0122	51.2
		P3-1 (15'A)	9.4									
		P3-2 (10'A)	6.6									
		P3-2 (20'A)	11.3									
		P3-3 (20'A)	8.1									
		P3-3 (40'A)	14.7									
		P3-4 (10'A)	9.3									
		P3-4 (30'A)	6.0									
		P3-4 (40'A)	7.1									
		P3-5 (10'A)	8.3									
		P3-6 (5'A)	4.8									
		P3-6 (20'A)	9.3									
		P3-6 (50'A)	6.0									

*TN = North Topsoil, BW = West Borrow, P1 = Pile 1, P2 = Pile 2, P3 = Pile 3

Pit 2 - Pile 3 properties for surface excavation												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.69	0.36	8.8	24.1	0.241	0.0302	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
2	South Topsoil (Subsoil)	TS-1 (5'A)	N/A	1.92	6.0	1.73	0.35	10.4	30.0	0.300	0.0241	1.0
		TS-2 (15'A)										
		TS-3 (10'A)										
		TS-4 (10'A)										
3	Surface Excavation (Pile 3 properties, except Ra-226 activity)	P3-1 (5'A)	7.3	2.00	8.3	1.80	0.32	14.95	46.4	0.46	0.0122	117.0
		P3-1 (15'A)	9.4									
		P3-2 (10'A)	6.6									
		P3-2 (20'A)	11.3									
		P3-3 (20'A)	8.1									
		P3-3 (40'A)	14.7									
		P3-4 (10'A)	9.3									
		P3-4 (30'A)	6.0									
		P3-4 (40'A)	7.1									
		P3-5 (10'A)	8.3									
		P3-6 (5'A)	4.8									
		P3-6 (20'A)	9.3									
		P3-6 (50'A)	6.0									

*TN = North Topsoil, BW = West Borrow, TS = South Topsoil Pile, P3 = Pile 3

Pit 2 - borrow area properties for surface excavation												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.69	0.36	8.8	24.1	0.241	0.0302	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
2	South Topsoil (Cover)	TS-1 (5'A)	N/A	1.92	6.0	1.73	0.35	10.4	30.0	0.300	0.0241	1.0
		TS-2 (15'A)										
		TS-3 (10'A)										
		TS-4 (10'A)										
3	Surface Excavation (Borrow/Native material properties)	TN-2 (20'A)	6.0	1.89	5.2	1.67	0.37	8.65	23.5	0.23	0.0310	117.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
		L1-1 (10'A)	6.3	1.81								
		L1-2 (20'B)										
		L1-3 (5'A)	4.2									
		L1-4 (5'B)	7.5									
		L2-1 (5'B)	4.1									
		L2-1 (15'A)	5.0									
		L2-3 (5'A)	3.8									
		L2-5 (5'B)										
		L2-6 (10'B)										

*TN = North Topsoil, BW = West Borrow, TS = South Topsoil Pile, P3 = Pile 3, L1 = Lobo Tract (West), L2 = Lobo Tract (East)

Piles 1 & 2												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.69	0.36	8.8	24.1	0.241	0.0302	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
2	Piles 1+2 (Waste)	P1-1 (15'B)	10.0	1.82	9.4	1.64	0.38	15.4	40.4	0.404	0.0168	7.7
		P1-1A (30'A)	3.9									
		P1-2 (50'A)	4.3									
		P2-1 (5'A)	13.2									
		P2-1 (25'B)	15.4									

*TN = North Topsoil, BW = West Borrow, P1 = Pile 1, P2 = Pile 2

Pile 3												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.69	0.36	8.8	24.1	0.241	0.0302	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
2	Pile 3 (Waste)	P3-1 (5'A)	7.3	2.00	8.3	1.80	0.32	15.0	46.4	0.464	0.0122	20.6
		P3-1 (15'A)	9.4									
		P3-2 (10'A)	6.6									
		P3-2 (20'A)	11.3									
		P3-3 (20'A)	8.1									
		P3-3 (40'A)	14.7									
		P3-4 (10'A)	9.3									
		P3-4 (30'A)	6.0									
		P3-4 (40'A)	7.1									
		P3-5 (10'A)	8.3									
		P3-6 (5'A)	4.8									
		P3-6 (20'A)	9.3									
		P3-6 (50'A)	6.0									

*TN = North Topsoil, BW = West Borrow, P3 = Pile 3

Pile 4												
		Lab Results			RADON Program Input Parameters							
Layer #	Material	Data Sample ID*	Moisture Content (%, g/g)	$\rho_{d,max}$ (g/cm^3)	Avg Moisture Content (%, g/g)	ρ_d (90% SP) (g/cm^3)	Porosity	VWC (%)	Saturation (%)	Moisture Saturation (cc/cc)	Diffusion Coeff. (NRC)	Ra-226 Activity (pCi/g)
1	West Borrow & Lobo Tract Combination (Cover)	TN-2 (20'A)	6.0	1.89	5.2	1.67	0.37	8.7	23.5	0.23	0.0310	1.0
		BW-1 (30'A)		1.87								
		BW-2 (10'A)	5.9									
		BW-3 (5'A)	3.8									
		L1-1 (10'A)	6.3	1.81								
		L1-2 (20'B)										
		L1-3 (5'A)	4.2									
		L1-4 (5'B)	7.5									
		L2-1 (5'B)	4.1									
		L2-1 (15'A)	5.0									
		L2-3 (5'A)	3.8									
		L2-5 (5'B)										
		L2-6 (10'B)										
2	Pile 4 (Waste)	P4-5 (20'A)	7.3	2.05	9.3	1.84	0.31	17.0	55.8	0.56	0.0074	20.5
		P4-6 (10'A)	10.0									
		P4-7 (5'A)	9.8									
		P4-7 (25'B)	6.2									
		P4-8 (15'B)	13.0									

*TN = North Topsoil, BW = West Borrow, L1 = Lobo Tract (West), L2 = Lobo Tract (East), P4 = Pile 4

ATTACHMENT G.1.2

MATERIAL PARAMETERS AND RESULTS TABLE

Facility	Layer No.	Material	Porosity	ρ_d (g/cm^3)	Ra-226 Activity (pCi/g)	Emanation Coefficient[(1)]	Moisture Content (%, g/g)	Diffusion Coefficient[(2)]	Layer Thickness (cm)	Layer Thickness (ft)	Radon Emanation (pCi/m^2/s)
Pit 1	1	West Borrow/North Topsoil	0.36	1.69	1	0.35	5.2	0.0302	61.0	**2.00**	**15.2**
	2	Pit 1 Highwall Excavation	0.37	1.66	5.0	0.35	6.0	0.0277	152.4	5.00	
	3	Pit 1 Infill	0.32	1.80	51.2	0.35	8.3	0.0122	500	16.40	
Pit 2	1	West Borrow	0.36	1.69	1	0.35	5.2	0.0302	61.0	**2.00**	**11.4**
	2	South Topsoil	0.35	1.73	1	0.35	6.0	0.0241	243.8	8.00	
	3	Surface Excavation (Pile 3 Properties)	0.32	1.80	117	0.35	8.3	0.0122	500	16.40	
Pit 2	1	West Borrow	0.36	1.69	1	0.35	5.2	0.0302	61.0	**2.00**	**11.4**
	2	South Topsoil	0.35	1.73	1	0.35	6.0	0.0241	243.8	8.00	
	3	Surface Excavation (Native Properties)	0.37	1.67	117	0.35	5.2	0.0310	500	16.40	
Shale Piles 1 & 2	1	West Borrow	0.36	1.69	1	0.35	5.2	0.0302	61.0	**2.00**	**6.2**
	2	Piles 1+ 2	0.38	1.64	7.7	0.35	9.4	0.0168	500	16.40	
Pile 3	1	West Borrow	0.36	1.69	1	0.35	5.2	0.0302	61.0	**2.00**	**15.8**
	2	Pile 3	0.32	1.80	20.6	0.35	8.3	0.0122	500	16.40	
Pile 4	1	West Borrow/Lobo Tract Mix	0.37	1.67	1	0.35	5.2	0.0310	61.0	**2.00**	**13.5**
	2	Pile 4	0.31	1.84	20.5	0.35	9.3	0.0074	500	16.40	

(1) NRC Regulatory Guide 3.64 default value of 0.35 was used for all materials

(2) Diffusion coefficients calculated based on correlation function presented in NRC Regulatory Guide 3.64

ATTACHMENT G.1.3

RADON MODEL OUTPUTS

Pit1_2ftcover_emanation_default_hw_moisture
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U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pit1_2ftcover_emanation_default_hw_moisture

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	3	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Pit 1 Infill

THICKNESS	500	cm
POROSITY	.32	
MEASURED MASS DENSITY	1.8	g cm^-3
MEASURED RADIUM ACTIVITY	51.2	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	2.117D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	8.300000000000001	%
MOISTURE SATURATION FRACTION	.467	
MEASURED DIFFUSION COEFFICIENT	.0122	cm^2 s^-1

LAYER 2 Pit 1 Highwall Excavation

Pit1_2ftcover_emanation_default_hw_moisture

THICKNESS	152.4	cm
POROSITY	.37	
MEASURED MASS DENSITY	1.66	g cm^-3
MEASURED RADIUM ACTIVITY	5	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	1.649D-05	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.269	
MEASURED DIFFUSION COEFFICIENT	.0277	cm^2 s^-1

LAYER 3 Cover (West Borrow North Topsoil)

THICKNESS	61	cm
POROSITY	.36	
MEASURED MASS DENSITY	1.69	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.450D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.244	
MEASURED DIFFUSION COEFFICIENT	.0302	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
3	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.220D-02	3.200D-01	2.117D-04	4.669D-01	1.800
2	1.524D+02	2.770D-02	3.700D-01	1.649D-05	2.692D-01	1.660
3	6.100D+01	3.020D-02	3.600D-01	3.450D-06	2.441D-01	1.690

BARE SOURCE FLUX FROM LAYER 1: 5.163D+01 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

Pit1_2ftcover_emanation_default_hw_moisture

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	3.425D+01	3.393D+04
2	1.524D+02	1.646D+01	8.510D+03
3	6.100D+01	1.524D+01	0.000D+00

Pit2_native_waste_properties_default_ts_moisture
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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pit2_native_waste_properties_default_ts_moisture

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	3	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Surface Excavation

THICKNESS	500	cm
POROSITY	.37	
MEASURED MASS DENSITY	1.67	g cm^-3
MEASURED RADIUM ACTIVITY	117	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.881D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.235	
MEASURED DIFFUSION COEFFICIENT	.031	cm^2 s^-1

LAYER 2 South Topsoil

Pit2_native_waste_properties_default_ts_moisture

THICKNESS	243.8	cm
POROSITY	.35	
MEASURED MASS DENSITY	1.73	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.633D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.297	
MEASURED DIFFUSION COEFFICIENT	.0241	cm^2 s^-1

LAYER 3 Cover (West Borrow)

THICKNESS	61	cm
POROSITY	.36	
MEASURED MASS DENSITY	1.69	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.450D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.244	
MEASURED DIFFUSION COEFFICIENT	.0302	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
3	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	3.100D-02	3.700D-01	3.881D-04	2.347D-01	1.670
2	2.438D+02	2.410D-02	3.500D-01	3.633D-06	2.966D-01	1.730
3	6.100D+01	3.020D-02	3.600D-01	3.450D-06	2.441D-01	1.690

BARE SOURCE FLUX FROM LAYER 1: 1.744D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

Pit2_native_waste_properties_default_ts_moisture

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	7.661D+01	1.036D+05
2	2.438D+02	1.215D+01	6.169D+03
3	6.100D+01	1.143D+01	0.000D+00

Pit2_pile3_waste_properties_default_ts_moisture
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U.S. Nuclear Regulatory Commission Office of Research

RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pit2_pile3_waste_properties_default_ts_moisture

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	3	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Surface Excavation

THICKNESS	500	cm
POROSITY	.32	
MEASURED MASS DENSITY	1.8	g cm^-3
MEASURED RADIUM ACTIVITY	117	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	4.837D-04	pCi cm^-3 s^-1
WEIGHT % MOISTURE	8.300000000000001	%
MOISTURE SATURATION FRACTION	.467	
MEASURED DIFFUSION COEFFICIENT	.0122	cm^2 s^-1

LAYER 2 South Topsoil

Pit2_pile3_waste_properties_default_ts_moisture

THICKNESS	243.8	cm
POROSITY	.35	
MEASURED MASS DENSITY	1.73	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.633D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	6	%
MOISTURE SATURATION FRACTION	.297	
MEASURED DIFFUSION COEFFICIENT	.0241	cm^2 s^-1

LAYER 3 Cover (West Borrow)

THICKNESS	61	cm
POROSITY	.36	
MEASURED MASS DENSITY	1.69	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.450D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.244	
MEASURED DIFFUSION COEFFICIENT	.0302	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
3	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.220D-02	3.200D-01	4.837D-04	4.669D-01	1.800
2	2.438D+02	2.410D-02	3.500D-01	3.633D-06	2.966D-01	1.730
3	6.100D+01	3.020D-02	3.600D-01	3.450D-06	2.441D-01	1.690

BARE SOURCE FLUX FROM LAYER 1: 1.180D+02 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

Pit2_pile3_waste_properties_default_ts_moisture

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	7.616D+01	8.162D+04
2	2.438D+02	1.208D+01	6.137D+03
3	6.100D+01	1.137D+01	0.000D+00

Pile_1+2_2ftcover_emanation

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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pile_1+2_2ftcover_emanation

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	2	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Shale pile waste rock

THICKNESS	500	cm
POROSITY	.38	
MEASURED MASS DENSITY	1.64	g cm^-3
MEASURED RADIUM ACTIVITY	7.7	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	2.443D-05	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.4	%
MOISTURE SATURATION FRACTION	.406	
MEASURED DIFFUSION COEFFICIENT	.0168	cm^2 s^-1

LAYER 2 West Borrow cover

Pile_1+2_2ftcover_emanation

THICKNESS	61	cm
POROSITY	.36	
MEASURED MASS DENSITY	1.69	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.450D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.244	
MEASURED DIFFUSION COEFFICIENT	.0302	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
2	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.680D-02	3.800D-01	2.443D-05	4.057D-01	1.640
2	6.100D+01	3.020D-02	3.600D-01	3.450D-06	2.441D-01	1.690

BARE SOURCE FLUX FROM LAYER 1: 8.301D+00 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	6.222D+00	2.912D+03
2	6.100D+01	6.194D+00	0.000D+00

Pile_3_2ftcover_emanation

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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pile_3_2ftcover_emanation

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	2	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Pile 3 waste rock

THICKNESS	500	cm
POROSITY	.32	
MEASURED MASS DENSITY	1.8	g cm^-3
MEASURED RADIUM ACTIVITY	20.6	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	8.517D-05	pCi cm^-3 s^-1
WEIGHT % MOISTURE	8.300000000000001	%
MOISTURE SATURATION FRACTION	.467	
MEASURED DIFFUSION COEFFICIENT	.0122	cm^2 s^-1

LAYER 2 West Borrow cover

Pile_3_2ftcover_emanation

THICKNESS	61	cm
POROSITY	.36	
MEASURED MASS DENSITY	1.69	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.450D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.244	
MEASURED DIFFUSION COEFFICIENT	.0302	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
2	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	1.220D-02	3.200D-01	8.517D-05	4.669D-01	1.800
2	6.100D+01	3.020D-02	3.600D-01	3.450D-06	2.441D-01	1.690

BARE SOURCE FLUX FROM LAYER 1: 2.077D+01 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.708D+01	7.209D+03
2	6.100D+01	1.578D+01	0.000D+00

Pile_4_2ftcover_emanation

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RADON FLUX, CONCENTRATION AND TAILINGS COVER THICKNESS
ARE CALCULATED FOR MULTIPLE LAYERS

OUTPUT FILE: Pile_4_2ftcover_emanation

DESCRIPTION:

CONSTANTS

RADON DECAY CONSTANT	.0000021	s^-1
RADON WATER/AIR PARTITION COEFFICIENT	.26	
DEFAULT SPECIFIC GRAVITY OF COVER & TAILINGS	2.65	

GENERAL INPUT PARAMETERS

LAYERS OF COVER AND TAILINGS	2	
DEFAULT RADON FLUX LIMIT	20	pCi m^-2 s^-1
LAYER THICKNESS NOT OPTIMIZED		
DEFAULT SURFACE RADON CONCENTRATION	0	pCi l^-1
RADON FLUX INTO LAYER 1	0	pCi m^-2 s^-1
SURFACE FLUX PRECISION	.001	pCi m^-2 s^-1

LAYER INPUT PARAMETERS

LAYER 1 Pile 4 waste

THICKNESS	500	cm
POROSITY	.31	
MEASURED MASS DENSITY	1.84	g cm^-3
MEASURED RADIUM ACTIVITY	20.5	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	8.943D-05	pCi cm^-3 s^-1
WEIGHT % MOISTURE	9.300000000000001	%
MOISTURE SATURATION FRACTION	.552	
MEASURED DIFFUSION COEFFICIENT	.0074	cm^2 s^-1

LAYER 2 Cover (West Borrow Lobo Tract Mix)

Pile_4_2ftcover_emanation

THICKNESS	61	cm
POROSITY	.37	
MEASURED MASS DENSITY	1.67	g cm^-3
MEASURED RADIUM ACTIVITY	1	pCi/g^-1
DEFAULT LAYER EMANATION COEFFICIENT	.35	
CALCULATED SOURCE TERM CONCENTRATION	3.317D-06	pCi cm^-3 s^-1
WEIGHT % MOISTURE	5.2	%
MOISTURE SATURATION FRACTION	.235	
MEASURED DIFFUSION COEFFICIENT	.031	cm^2 s^-1

DATA SENT TO THE FILE `RNDATA' ON DRIVE A:

N	F01	CN1	ICOST	CRITJ	ACC
2	0.000D+00	0.000D+00	0	2.000D+01	1.000D-03

LAYER	DX	D	P	Q	XMS	RHO
1	5.000D+02	7.400D-03	3.100D-01	8.943D-05	5.520D-01	1.840
2	6.100D+01	3.100D-02	3.700D-01	3.317D-06	2.347D-01	1.670

BARE SOURCE FLUX FROM LAYER 1: 1.646D+01 pCi m^-2 s^-1

RESULTS OF THE RADON DIFFUSION CALCULATIONS

LAYER	THICKNESS (cm)	EXIT FLUX (pCi m^-2 s^-1)	EXIT CONC. (pCi l^-1)
1	5.000D+02	1.444D+01	5.207D+03
2	6.100D+01	1.349D+01	0.000D+00