

APPENDIX D

TCEQ VERIFICATION CALCULATION

**RAECOM MODEL FOR ESTIMATING THE RADON
EMANATION RATE THROUGH THE WCS BYPRODUCT
FACILITY COVER SYSTEM**

Uranium Mill Tailings Cover Calculator


(last updated 2 Jul 2004)

Requires Netscape 3.0, Internet Explorer 3.0 or higher. JavaScript must be enabled.

For educational purposes only. No warranty.

Determine the radon flux through a multi-layer soil cover of an uranium mill tailings pile and/or optimize the cover for a given flux.



(For calculating radon flux from bare and/or water covered tailings, see the [Uranium Mill Tailings Radon Flux Calculator](#))

Select activity unit first, then enter the parameters and click the "Calculate" button below. **HELP** 

Layer 1 is the tailings layer.

Numbers can be entered in exponential notation: $5 \cdot 10^{-6} = 5e-6$

Activity unit: pCi Bq

Input Data							
Layer Data HELP 							
Layer No.	Thickness [m]	Ra-226 Activity Conc. [pCi/g]	Rn-222 Emanation Fraction	Porosity	Moisture Cont. [dry wt_%]	Fraction Passing #200 Mesh (75 μ m *)	Rn-222 Eff. Diff.Coeff (*) [m ² /s]
1	21.33	84660	0.3	0.3	12		
2	.457	0	0	0.29	12		
3	.914	0	0	0.29	12		
4	2.44	0	0	0.475	12		
5	1.22	0	0	.417	3		
6	1.52	0	0	0.397	3		
7	.762	0	0	.398	10		
8	2.54E-2	0	0	.417	3		
Options HELP 							
<input type="text" value="0"/>	Entrance Radon flux to Layer 1 [pCi/m ² s]						
<input type="text" value="0"/>	Surface Radon conc. at top of system [pCi/L]						
<input type="text" value="0"/>	Layer No. to be optimized *)						

0	Surface flux constraint for optimization [pCi/m ² s]
0.01	Surface flux convergence criterion (fraction)
48.3	Annual Precipitation [cm] (Note: This is for the Amarillo Region which is 19 in/yr versus16 inches for Andrew's area to account for potentially wetter climate in the future.)
198.12	Annual Lake Evaporation [cm]
45.72	Depth to Water Table [m]
*) optional	

RESULTS

----- Input Parameters -----

Number of Layers: 8

Radon Flux into Layer 1: 0 pCi/m²s

Surface Radon Concentration: 0 pCi/L

Bare Source Flux (Jo) from Layer 1: 28371 pCi/m²s

Specific Bare Source Flux from Layer 1: 0.335 pCi/m²s per pCi_Ra-226/g

Layer No.	Thickness [m]	Ra-226 [pCi/g]	Emanation Fract	Porosity	Moisture [dry wt %]	Diff Coeff [m ² /s]
1	21.33	84660	0.3	0.3	12	166.3E-9
2	0.457	0	0	0.29	12	108.9E-9
3	0.914	0	0	0.29	12	108.9E-9
4	2.44	0	0	0.475	12	2.255E-6
5	1.22	0	0	0.417	3	4.814E-6
6	1.52	0	0	0.397	3	4.624E-6
7	0.762	0	0	0.398	10	1.691E-6
8	0.025	0	0	0.417	3	4.814E-6

----- Results of Radon Diffusion Calculation -----

Layer	Thickness	Exit Flux	Exit Conc.	MIC
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No.	[m]	[pCi/m2s]	[pCi/L]	
1	21.33	12004	92.29E6	0.441
2	0.457	1615.	11.63E6	0.413
3	0.914	54.36	29.43E3	0.413
4	2.44	6.275	3.894E3	0.735
5	1.22	2.658	2.278E3	0.916
6	1.52	0.786	947.7E0	0.909
7	0.762	0.566	5.450E0	0.698
8	0.025	0.566	0E0	0.916

Total cover radon retention: 100.0%

Exit Flux is less than 20 pCi/m2s which meets the Texas Regulatory requirement as set forth in 25 TAC §289.260 and 40 CFR 192.