CBRNorthTrendPEm Resource

From: Rhonda Grantham [rgrantham@bbc.net]
Sent: Monday, March 17, 2008 11:01 AM
To: Cohen, Stephen
Subject: RE: Electronic Mildos Files
Attachments: MILDOSinputparameters9000gpmandNT.doc

Hi Steve,

I am attaching the MILDOS input parameters, is this what he wants??

Happy St. Paddy's Day to ya.

Rhonda

From: Stephen Cohen [mailto:SJC7@nrc.gov]
Sent: Monday, March 17, 2008 7:00 AM
To: rgrantham@bbc.net; Larry Teahon
Subject: Electronic Mildos Files

Hello:

Our HP doing the health physics review of the North Trend application wants to know if you can send the electronic MILDOS files, so he can run the code here. Thanks,

Steve

Hearing Identifier: CrowButte_NorthTrend_Public
Email Number: 2

Mail Envelope Properties (3AF7DEF82ADA8944AD8247B7ED7FD65131F49594B4)

Subject: RE: Electronic Mildos Files
Sent Date: 3/17/2008 11:01:29 AM
Received Date: 3/17/2008 11:01:29 AM
From: Rhonda Grantham

Created By: rgrantham@bbc.net

Recipients:
"Cohen, Stephen" <Stephen.Cohen@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

Files	**Size**	**Date & Time**
MESSAGE	574	3/17/2008 11:01:29 AM
MILDOSinputparameters9000gpmandNT.doc	138304	

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

ATTACHMENT 7.3(A)

Table 7-3(A)- 1: Site Specific Information
Crow Butte Project

NORTH TREND SATELLITE

PARAMETER	VALUE
Average ore quality, U_3O_8, in ore body	0.27 percent
Ore radon activity, assuming equilibrium with U-238	761 pCi/g
Operating days per year (plant factor)	365 days
Dimensions of ore body	
Area per year to be mined	20 acres
Average thickness of body	5 ft
Average screened interval	15.1 ft
Average production flow rate (Satellite Facility)	4500 gpm
Average production flow rate (Main Facility)	9000 gpm
Formation porosity	29 percent
Process recovery	95 percent
Leaching efficiency	60 percent
Rock density	1.89 g/cm^3
Restoration flow rate (Satellite Facility)	500 gpm
Restoration flow rate (Main Facility)	1000 gpm
Restoration Residence time	35 days
Production cell parameters	
Residence time	7 days
Type of cell pattern	variable
Average cell area	10,000 ft^2
Average cell flow rate	121 lpm
Source stack description (Main)	
Stack height	15.9 m
Stack diameter	0.30 m
Stack velocity	11 m/sec
Source stack description (Satellite)	
Stack height	10 m
Stack diameter	0.2
Stack velocity	10 m/sec

ft/ft^2 = feet/square feet
g/cm^3 = grams per cubic centimeter
gpm = gallons per minute
lpm = liters per minute
m = meter
m2/sce = meters squared per second
pCi/g = picoCuries per gram

Table 7-3(A)- 2: Source Coordinates
North Trend Satellite

Source	East (km)	North (km)	Rn-222 (Curies)
1. Plant Vent	0.00	0.00	4603
2. Satellite Plant Vent	-5.30	9.60	342
3. MU-2-4 (restoration)	-0.30	0.16	350
4. MU-5	0.0	0.74	454
5. MU-6&8	1.92	-1.20	908
6. MU 7&9	0.00	-0.74	908
7. North Trend Well field	-5.30	9.60	1320

Sources 2 and 7 are from the proposed North Trend Satellite Facility operating at 4500 gpm using upflow IX columns and 500 gpm restoration flow using downflow IX and reverse osmosis. Resin from the North Trend Satellite is transferred to the Crow Butte processing facility for elution and precipitation.

All other sources are from the existing Crow Butte processing facility operating at 5000 gpm production flow using downflow IX columns, 4000 gpm production flow using pressurized upflow IX colums, and a 1000 gpm restoration flow using downflow IX and reverse osmosis.

Table 7-3(A)- 3: Individual Receptor Location Data

Location	X (km)	Y (km)	Distance (km)
1. R1	-1.21	-0.44	1.29
2. R2	-1.95	1.95	2.76
3. R3	-1.89	2.71	3.30
4. R4	-3.34	2.80	4.36
5. R5	-3.57	3.99	5.35
6. CRAWFORD	-4.39	4.45	6.25
7. R7	-1.99	3.96	4.43
8. R8	-1.99	3.60	4.11
9. R9	-1.57	3.23	3.59
10. R10	-1.16	2.80	3.03
11. R11	-1.78	2.77	3.29
12. R12	-0.30	2.35	2.35
13. R13	0.03	1.49	1.49
14. R14	0.51	0.98	1.10
15. R15	0.52	0.34	0.62
16. R16	1.31	0.30	1.34
17. R17	1.31	-0.34	1.35
18. EHLERS	0.73	-0.06	0.73
19. GIBBONS	0.73	0.73	1.03
20. STETSON	-0.46	1.22	1.30
21. KNODE	-1.89	2.68	3.28
22. BROTT	-1.37	1.34	1.92
23. SP 1	0.73	0.15	0.75
24. SP 2	0.67	0.58	0.89
25. SP 3	0.67	0.91	1.13
26. McDOWELL	-2.16	4.36	4.87
27. TAGGART	-1.89	4.45	4.83
28. FRANEY	-0.98	4.76	4.86
29. BUNCH	1.01	4.27	4.39
30. DYER	-2.44	0.55	2.50
31. NT-1	-3.97	11.33	12.01
32. NT-2	-4.12	8.93	9.83
33. NT-3	-4.75	7.87	9.19
34. NT-4	-5.82	6.69	8.87
35. NT-5	-4.61	6.76	8.18
36. NT-6	-7.20	11.65	13.70
37. NT-7	-8.25	9.86	12.86
38. NT-8	-0.44	2.76	2.79

TABLE 7-3(A)-4
Calculation Of Annual Radon Emissions
Crow Butte Resources Project Main Processing Site
5,000 gpm Upflow/4,000 gpm Pressurized Down flow

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1) To calculate radon release from leaching assuming that U-238 is in equilibrium with all its decay products:

$Ci/m^3 = 761\ pCi/g\ ore \times 1.89\ g/cm^3 \times 0.2 \times 0.71/0.29 \times 10^6 = 7.04 \times 10^{-4}\ Ci/m^3$

Where: 0.2 = Emanating Power
0.71 = 1-Porosity
0.29 = Porosity

Total radon in solution for 9,000 gpm is then:

$7.04 \times 10^{-4}\ Ci/m^3 \times 34069\ lpm \times (0.72) \times 365\ d/yr \times 1.44 = 9077\ Ci/yr$

Where: 34069 = liters per minute production
0.72 $=1-e^{-(\lambda t)}$
λ= Rn-222 decay constant (0.182 d^{-1})
t= production residence time (7 d)
1.44 = constant

2) Total radon in solution from restoration is given by:
$7.04 \times 10^{-4}\ Ci/m^3 \times 3785\ lpm \times 365\ d/yr \times (0.99) \times 1.44 = 1387\ Ci/yr$

Where: 3785 = Restoration flow in liter per minute
0.99 $=1-e^{-(\lambda t)}$

λ= Rn-222 decay constant (0.182 d^{-1})

t= restoration residence time (25 d)

1.44 = Constant

The total radon in solution for this proposed operation is then:

Production	9,077
Restoration	1,387
	10,462 Ci/yr

3) Actual Radon Release to the Environment

With 5,000 gpm being processed by upflow ion exchange columns, it is expected that all of the radon will be released to the environment and that 25% of the radon will be released in the well field and 75% will be released in the plant vent. The source term for the 5,000 gpm flow is 5,043 Ci/yr and the 25% released in the well field will be 1,261 Ci/yr and the 75% released in the plant will be 3,782 Ci/yr.

The 4,000 gpm of flow being processed by pressurized downflow ion exchange columns will release only a small fraction of the contained radon to the environment. Only about 10% of the contained radon will be released during regeneration and venting. It is also expected that 25% of the radon will be released in the well field. The source term for 4,000 gpm will be 4,034 Ci/yr and the 25% released in the well field will be 1,009 Ci/yr and the 10% of the remaining radon (3,026 Ci) will be 303 Ci/yr.

During restoration 1,000 gpm of recovered water will be processed by pressurized downflow ion exchange (IX) columns. After IX treatment, 400 gpm will be treated by reverse osmosis (RO). Only a small fraction of the contained radon will be released during ion exchange and virtually all of the contained radon will be released during RO treatment. The actual release of the source term of 1,387Ci of radon/yr will be as follows:

- 25% of the 1,387 Ci will be released in the well field-347 Ci/yr

- 10% of the radon in the 600 gpm to be treated by pressurized IX (Note: All of the radon in the 400 gpm to be treated by IX-RO will be released) will be released.

The calculation follows for the IX treatment:
(1387 Ci/yr – 347 Ci/yr (well field loss))x 600gpm/1000gpm x 0.10 = 62 Ci/yr

The calculation follows for the IX-RO treatment:
(1387 Ci/yr – 347 Ci/yr (well field loss))x 400gpm/1000gpm = 416 Ci/yr

A summary of the actual radon releases follows:

	Ci/yr Released	
5,000 gpm upflow		
Plant Vent	3782	
Well field	1260	
4,000 gpm Pressurized downflow		
Plant Vent	303	
Well field	1008	
1,000 gpm		
Restoration	825	
TOTAL RADON RELEASE*		7,178 Ci/yr

Table 7-3(A)- 5: Calculation of Annual Radon Emissions
Crow Butte Project - North Trend Satellite Area

1) To calculate radon release from leaching, assuming that U-238 is in equilibrium with all its decay products:

$Ci/m^3 = (761\ pCi/g\ ore) \times (1.89\ g/cm^3) \times 0.2 \times (0.71/0.29) \times 10^{-6} = 7.04 \times 10^{-4}\ Ci/m^3$

Where:	0.2	=	Emanating Power
	0.71	=	1 - Porosity
	0.29	=	Porosity
	1.89	=	Rock Density

The yearly release is then:

$7.04 \times 10^{-4}\ Ci/m^3 \times 17034\ lpm \times (0.72) \times 365\ d/yr \times 1.44 = 4538\ Ci/yr$

Where:	17034	=	liters per minute (Production Rate)
	$\in$	=	$1-e^{-(\lambda t)}$
	$\in$	=	$1-e^{-(0.1812)(7d)}$
	$\in$	=	$1-e^{-(0.28)}$
	$\in$	=	0.72
	1.44	=	constant
	365	=	operating time

2) The radon release from start-up is given by:

$7.04 \times 10^{-4}\ Ci/m^3 \times 20\ acres \times 4074\ m^2/acre \times 1.52\ m \times 0.29 = 25\ Ci/yr$

Where:	4074	=	m^2/acre
	1.52	=	Thickness of ore body in meters
	0.29	=	Porosity

The total release of radon from the start-up solution and production lixiviant solution is:

Start-up solution	25 Ci/yr
Production	4538 Ci/yr
	4563 Ci/yr

3) The radon release from restoration is given by:

$7.04 \times 10^{-4}\ Ci/m^3 \times 1893\ lpm \times 365\ d/yr \times (0.99) \times 1.44 = 693\ Ci/yr$
$+ 25\ (start\text{-}up) = 719\ Ci/yr$

Where:	1893	=	Restoration flow in liters per minute
	$\in$	=	$1-e^{-(\lambda t)}$
	35	=	Restoration Residence time (t) in days
	$\in$	=	$1-e^{-(0.181)(35)}$

$\in$	=	0.99
1.44	=	constant

The total release from this in-situ satellite mining operation is then:

Production (includes start-up)	4563
Restoration (Includes Start-up)	719
	5282 Ci/yr

4) Actual Radon Release to the Environment

The 4500 gpm of production flow at the North Trend Satellite being processed by pressurized downflow ion exchange columns will release only a small fraction of the contained radon to the environment. Approximately 10 percent of the contained radon will be released during resin transfer and venting. It is also expected that 25 percent of the radon will be released in the well field. This releases is:

Well field Release = 4563 x 0.25 = 1140 Ci/yr

The remainder of the radon will go to the process plant where a conservative estimate of 10 percent of the radon is released via the plant vent. The estimated radon released is:

4563 Ci/yr - 1140 Ci/yr (well field) = 3423 Ci/yr
3423 Ci/yr x 0.1 (plant loss) = 342 Ci/yr released from plant vent

The radon released during production is 1140 Ci/yr from the well field and 342 Ci/yr from the plant vent for a total estimated release of 1482 Ci/yr.

During restoration, 500 gpm of recovered water will be processed by pressurized downflow ion exchange (IX) columns. After IX treatment, 200 gpm will be treated by reverse osmosis (RO). Only a small fraction of the contained radon will be released during ion exchange. The estimated release of the source term of 719 Ci of radon/yr (including start-up) is as follows:

- 25 percent of the 719 Ci/yr will be released in the Well field = 180 Ci/yr
- Assuming annual release from startup, production, and restoration, the total well field release rate is approximately 1140 Ci/yr +180 Ci/yr =1320 Ci/yr

Table 7-3(A)- 4: Miscellaneous Data

Fraction of year during which cattle graze locally	Est. 67percent
Fraction of cattle feed obtained by grazing	Est. 90 percent
Fraction of stored cattle feed grown locally	Est. 10 percent
Acreage required to graze 1 animal unit (450 kg) for one month (AUM)	3.5 ha
Length of growing season	4 mo/yr
Fraction of locally produced vegetables consumed locally	Est. 100 percent
Fraction of locally produced meat consumed locally	Est. 10 percent
Fraction of locally produced milk consumed locally	Est. 100 percent

Estimates based on personal communication with the Sioux County, Nebraska Agricultural Extension Educator located in Harrison, Nebraska (Ms. Jenny Nixon).

AUM = animal units per month
ha = hectares
kg = kilogram
mo/yr = months per year