

Important Radionuclides and Their Sensitivity for Groundwater Pathway of a Hypothetical Near-Surface Disposal Facility

149

가

가

. 가 C-14 I-129가

가

U-235 U-238가

C-14 가 , I-129

가

Abstract

A radiological safety assessment was performed for a hypothetical near-surface radioactive waste repository as a simple screening calculation to identify important nuclides and to provide insights on the data needs for a successful demonstration of compliance. Individual effective doses were calculated for a highly conservative groundwater pathway scenario considering well drilling near the site boundary. Sensitivity of resulting ingestion dose to input parameter values was also analyzed using Monte Carlo sampling. Considering peak dose rate and assessment timescale, C-14 and I-129 were identified as important nuclides and U-235 and U-238 as potentially important nuclides. For C-14, the dose was most sensitive to Darcy velocity in aquifer. The distribution coefficient, which is typically a very sensitive parameter, showed high degree of sensitivity for I-129 release.

1.

가

가

가, 가

가(screening analysis)

가

가 가 , 가

가 가

가

(tiered approach)

5 가

가 가 1% 가

[1]. 가

가 가

가 가 가

가 가

2.

1 .

가 1 10 , 3가 .

(vault) 2 ,

20 (1(200) : 7 , 2() : 10 ,

3() : 3) .

2 m , 10 m .

20%

1 .

(unconsolidated)

3m 가

가 15 m 가 , 가 .

10 m/yr 가 .

200 m 가 .

2 3 .

3. 가

,

,

2 가

가 5 14

(, C- 14, Tc- 99,

I- 129 Pu- 239) ,

(dose conversion factor) U- 238 .

가 4 , 10

(repository averaging)

DUST [2]

(Ci/yr)

0 100 , 100 300 , 300 3

GWSCREEN [3]

가

GWSCREEN

3가

DUST

DUST GWSCREEN

가

1 2

3 5

4.

4.1

가

5

가

200 m

2 /day · man 가

[4],

가

DUST
GWSCREEN

2

mrem

C- 14 I- 129가

가

1,000 [5]

6

100

2,000

1

mrem

U- 235 U- 238

U- 235 U- 238

가

4.2

가

가

C- 14 I- 129

500

(normal),

(log - normal),

(uniform)

(triangular)

가

(rank

correlation coefficient)

Pearson

100%

(normalization)

6

C- 14

가

, I- 129

가

가

5.

가

가

가

가

가

, C- 14

I- 129가

가

가

6.

- 1) U.S. Nuclear Regulatory Commission, Branch Technical Position On A Performance Assessment Methodology For Low-Level Radioactive Waste Disposal Facilities, Draft for Public Comment, NUREG-1573 , May 1997.
- 2) Sullivan, T.M., "DUST - Disposal Unit Source Term: Data Input Guide." NUREG/CR-6041, BNL-NUREG-52375, 1993.
- 3) Rood, A. S., GWSCREEN: A Semi-Analytical Model for Assessment of the Groundwater Pathway from Surface or Buried Contamination: Theory and Users Manual Version 2.5, INEEL/ EXT-98-00750, Rev. 1, Feb. 1999.
- 4) IAEA, NSARS, Co-ordinated Research Program on the Safety Assessment of Near Surface Radioactive Waste Disposal Facilities, Specification for Test Case 2c, 1995.
- 5) 96-11 , .
, 1996.

1. (10)

	(m)
	266
	70
	8.7
(-)	2
	3

2. , (10)

	(years)	(Ci)
H- 3	1.24E+1	7.02E+2
C- 14	5.73E+3	4.54E+2
Co- 60	5.27E+0	4.68E+3
Ni- 59	7.50E+4	9.86E+1
Ni- 63	9.60E+1	2.57E+3
Sr- 90	2.91E+1	3.75E+1
Nb- 94	2.03E+4	2.71E+0
Tc- 99	2.13E+5	1.10E+0
I- 129	1.57E+7	3.39E- 1
Cs- 137	3.00E+1	1.65E+3
U- 235	7.04E+8	5.15E- 3
U- 238	4.47E+9	1.28E+0
Pu- 238	8.77E+1	3.46E+0
Pu- 239	2.41E+4	1.59E+0
Total		1.02E+4

3.

	(Distribution Coefficient, cm^3/g)							(Solubility, M)
	-						()	
			1	2	3			
H	0	0	0	0	0	0	0	-
C	5.0E+0	2.5E+3	2.5E+3	2.5E+3	2.0E+0	5.0E+0	1.0E+1	6.4E-2
Co	2.0E+2	2.0E+1	2.0E+1	2.0E+1	1.0E+1	1.5E+1	1.0E+3	1.2E-3
Ni	1.0E+2	2.0E+1	2.0E+1	2.0E+1	9.0E+0	4.0E+2	1.0E+3	-
Sr	1.0E+2	2.5E+0	2.5E+0	2.5E+0	8.0E+0	1.5E+1	2.0E+1	2.5E-1
Nb	2.0E+3	5.0E+2	5.0E+2	5.0E+2	0	0	1.0E+3	5.6E-8
Tc	5.0E+2	6.0E+2	5.0E+2	6.0E+2	5.0E-1	1.0E-1	1.0E+5	3.8E-8
I	1.0E+1	6.0E-1	6.0E-1	6.0E-1	5.0E+0	1.0E+0	5.0E+0	-
Cs	2.0E+2	2.5E-1	2.5E-1	2.5E-1	1.0E+2	3.0E+2	1.0E+2	-
U	1.0E+4	2.0E+3	2.0E+3	2.0E+3	-	-	1.0E+5	3.3E-7
Pu	2.0E+3	4.0E+4	4.0E+3	4.0E+4	-	-	5.0E+3	1.2E-9

4.

		(cm^2/sec)	(cm)	(kg/m^3)			
-		1.0E-6	10	2,000			
		1.6E-8	5	2,500			
	1	1.7E-8	5	2,500			
	2	7.9E-8	5	2,000			
	3	1.3E-7	10	1,800			
	(Water Content)		Van Genuchten Parameters		(m/yr)	(cm)	(kg/m^3)
			$\alpha (\text{cm}^{-1})$	n			
	0.21	0.3	0.035	3.0	4.42E-02	10	1,820
()	-	0.25	-	-	2.50E+2	5 10	2,522

5. (ingestion dose conversion factor)

			DCF
	(years)	(g/Mol)	(rem/Ci)
H- 3	12.4	3	63
C- 14	5730	14	2100
Co- 60	5.27	60	26000
Ni- 59	7.50E+04	59	200
Ni- 63	96	63	540
Sr- 90	29.1	90	3000
Nb- 94	20300	94	5100
Tc- 99	2.13E+05	99	1300
I- 129	1.57E+07	129	2.80E+05
Cs- 137	30	137	5.00E+04
U- 235	7.04E+08	235	2.51E+05
Pa- 231	3.28E+04	231	1.10E+07
Ac- 227	2.18E+01	227	1.46E+07
U- 238	4.47E+09	238	2.45E+05
U- 234	2.45E+05	234	2.60E+05
Th- 230	7.54E+04	230	5.30E+05
Ra- 226	1.60E+03	226	1.10E+06
Pb- 210	2.23E+01	210	6.71E+06
Pu- 238	87.7	238	3.80E+06
U- 234	2.45E+05	234	2.60E+05
Th- 230	7.54E+04	230	5.30E+05
Ra- 226	1.60E+03	226	1.10E+06
Pb- 210	2.23E+01	210	6.71E+06
Pu- 239	2.41E+04	239	4.30E+06
U- 235	7.04E+08	235	2.51E+05
Pa- 231	3.28E+04	231	1.10E+07
Ac- 227	2.18E+01	227	1.46E+07

(Note: Pu- 238 modelled as U- 234)

6. C- 14 I- 129

		PERC*	DEPTH*	AY*	U*	KDU*	KDA*	WI*
C- 14	(r)	0.224	-0.073	0.047	-0.626	-0.307	-0.202	-
	(%)	8.61	0.90	0.39	66.94	16.16	7.01	-
I- 129	(r)	0.309	-0.145	0.029	-0.221	-0.532	-0.035	0.234
	(%)	18.89	4.14	0.17	9.68	56.05	0.24	10.84

* : PERC :

DEPTH :

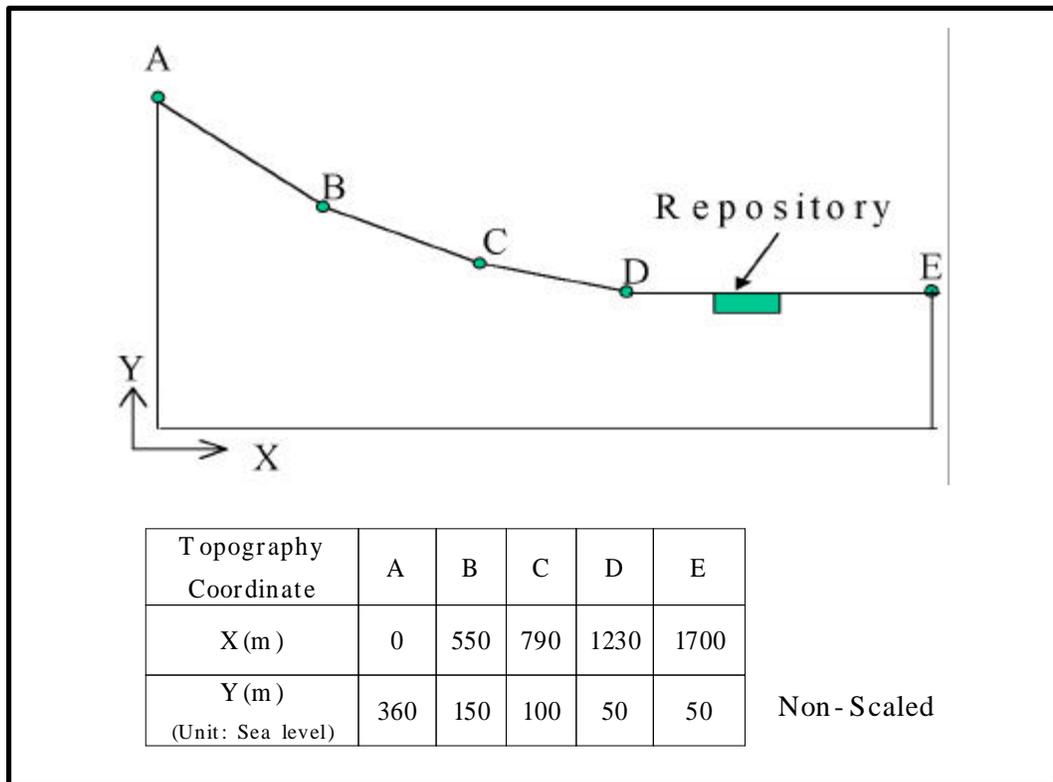
AY :

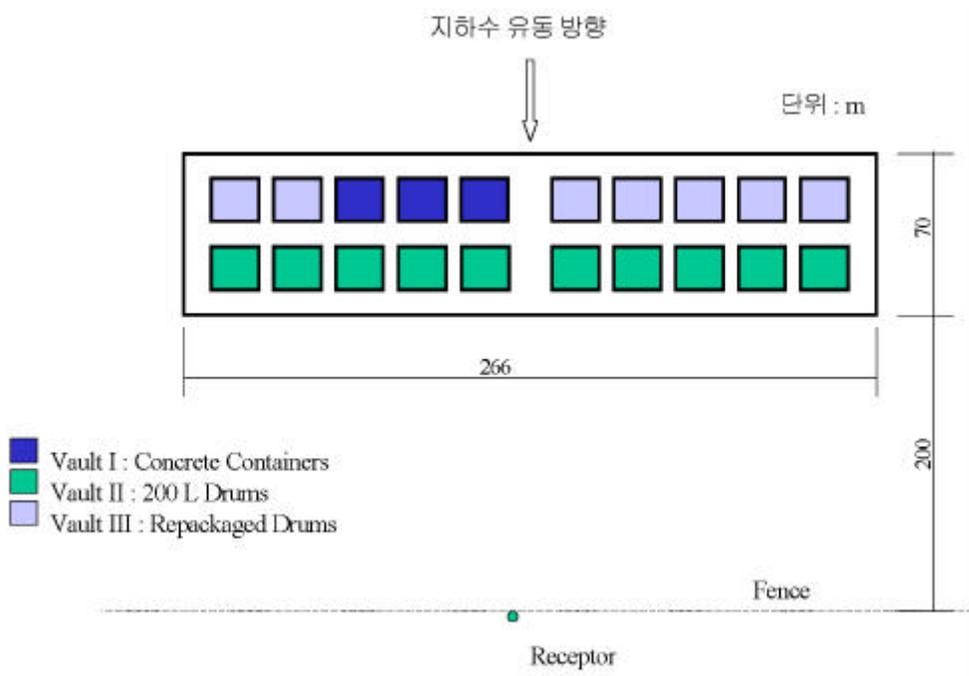
U :

KDU :

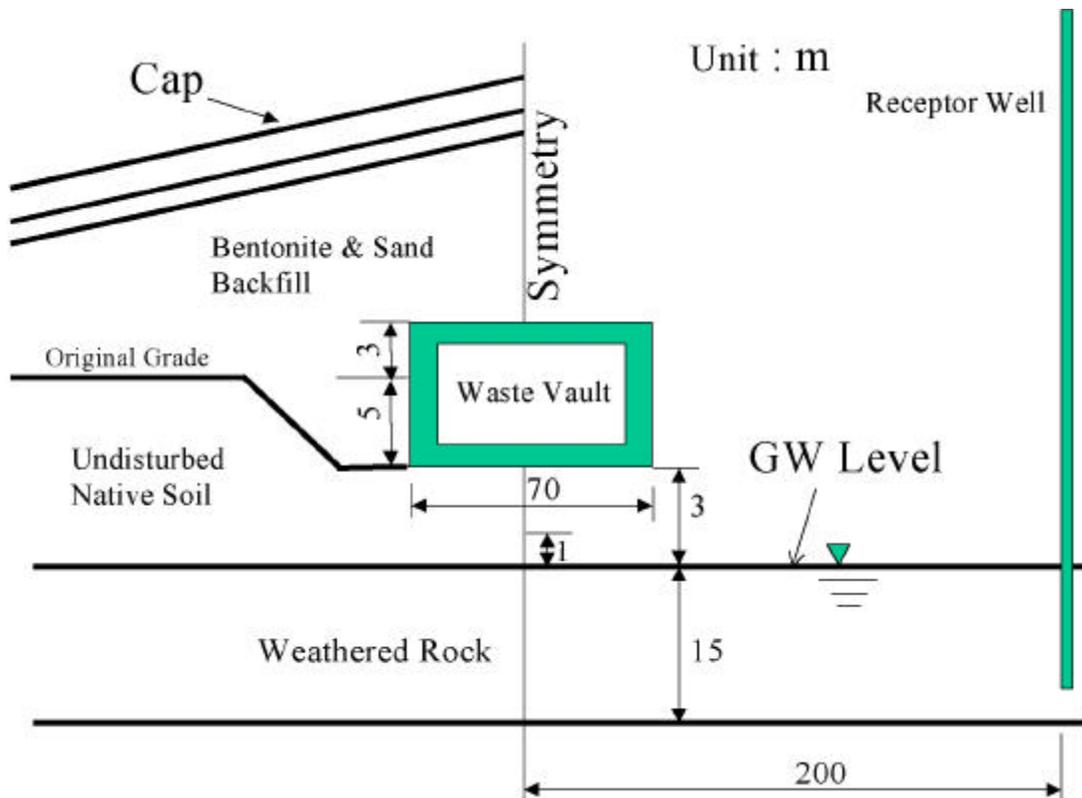
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WI :

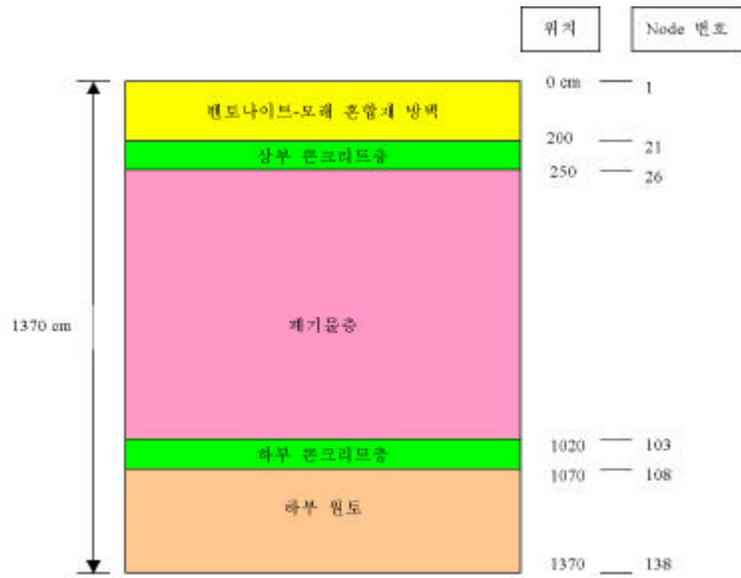




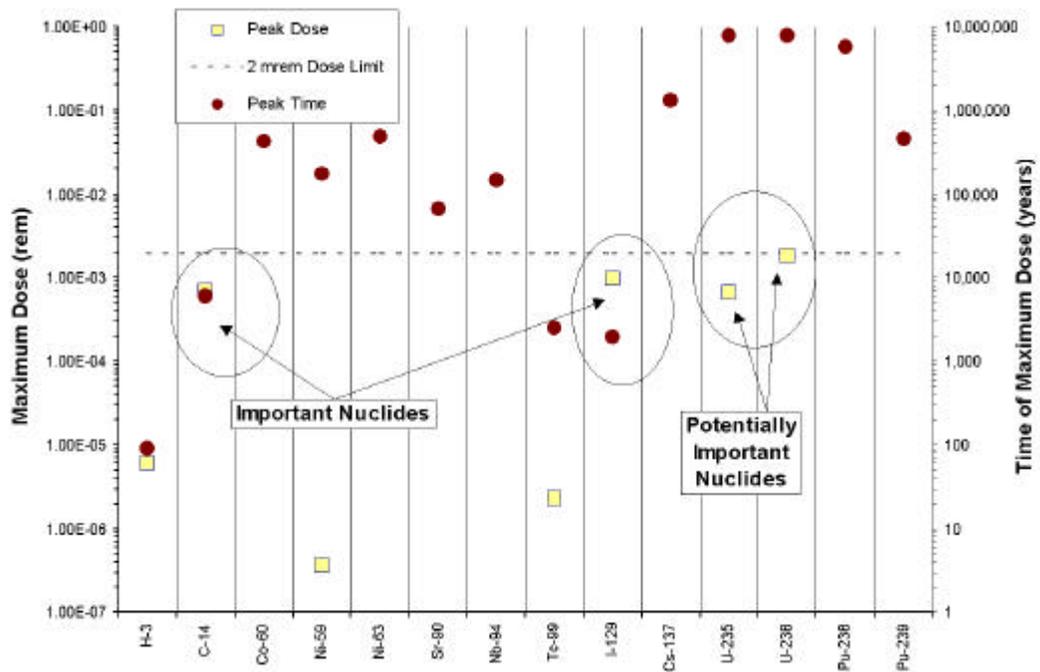
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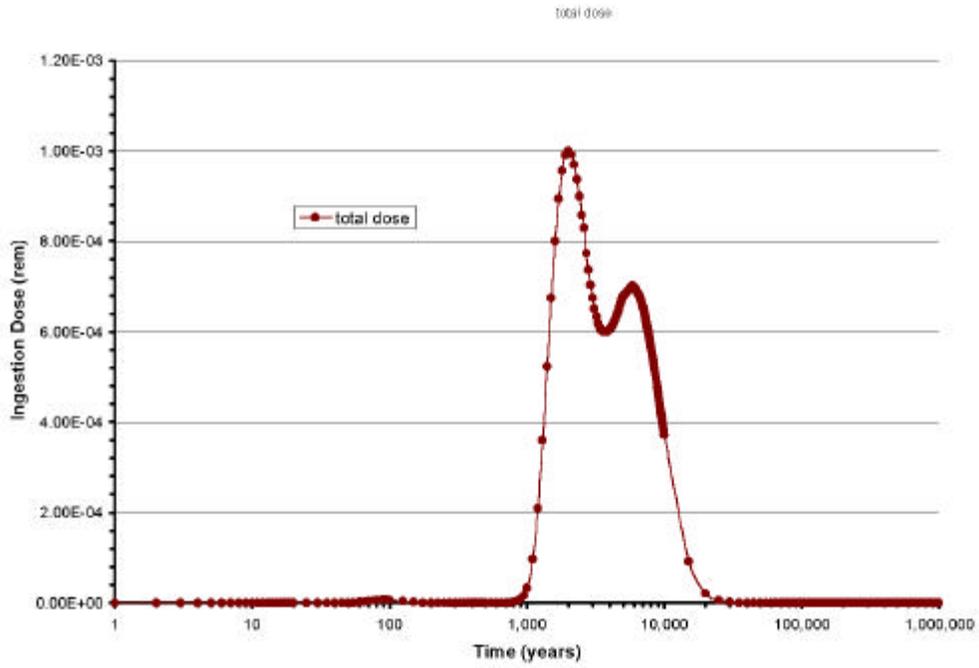
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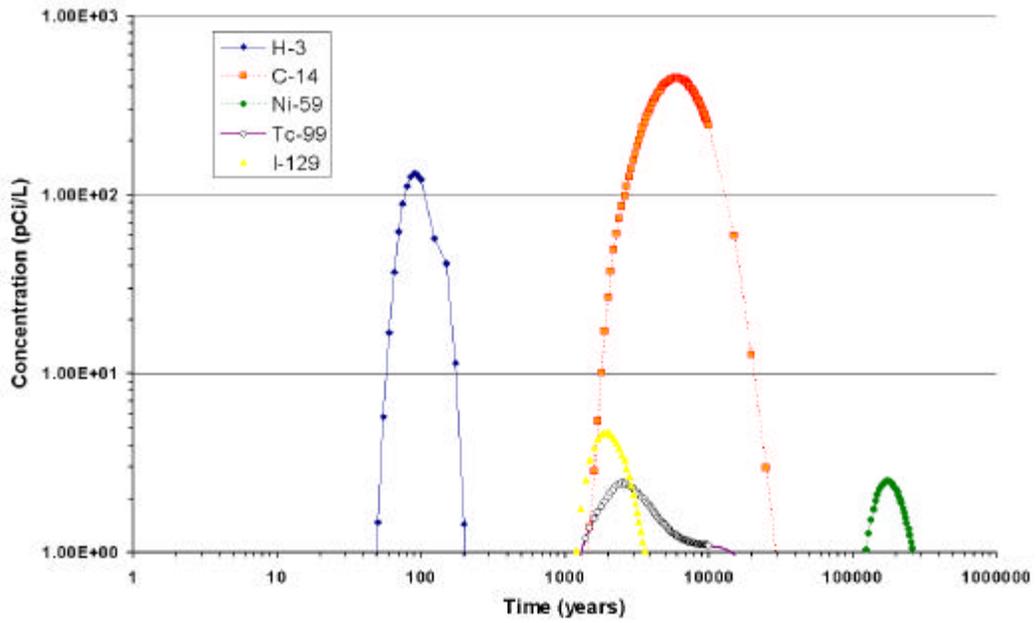
4. (10) DUST



5. 가



6.



7.