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INTERNATIONAL TECHNOLOGY CORPORATION

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Support Documentation: Annual Dose Calculations for Selected Scenarios at the SL-1 and BORAX-I Burial Grounds

Dear Jean:

IT is pleased to submit the attached documentation to support calculation of annual doses for selected scenarios at the SL-1 and BORAX-I burial grounds. A final letter report of the results of the calculations was transmitted to you on July 3, 1995. Frank Eidson (IT-Albuquerque) prepared the calc brief for the internal pathways, and Art Rood (LITCO) developed the calc brief for the external exposure pathway. These two calc briefs are included in this transmittal.

Occupational scenarios evaluated for SL-1 are current (external exposure dose based on soil sampling concentrations), and 30- and 100-year future (external exposure based on computer-modeled inventories). The current occupational scenario for BORAX-I (external exposure based on soil sampling data) was also evaluated. Residential intrusion for the 30-year future scenarios were evaluated for both sites.

Risk spreadsheets for the appropriate scenario and pathway in Appendices D and E of the SL-1/BORAX-1 Remedial Investigation/Feasibility Study (RI/FS) provided the starting point for the estimation of dose. Radionuclides posing a risk less than 1E-07 for a given pathway were screened from the evaluation (based on the professional judgement of IT and LITCO risk management staff). As a result of this approach, the inhalation of dust pathway for the SL-1 30- and 100-year future occupational scenarios were eliminated from consideration.

Consistent with the RI/FS, source terms for all pathways in the residential intrusion scenarios, and the external exposure pathway for the occupational scenarios were generated from the reactor histories using computer codes. An exception to this approach for the dose evaluation was the use of surface soil analytical results for the external exposure pathway in the current occupational scenario at both sites. The inhalation of dust and soil ingestion pathways for the occupational scenarios used the 95% upper confidence limit of surface soil analytical results.

To the extent possible, radioactive progeny were specifically included in the dose evaluations. For a given pathway, radionuclides without dose conversion factors were excluded from the spreadsheet. Dose conversion factors for the external exposure pathway were obtained from *Internal Dose Conversion Factors for 19 Target Organs and 9 Irradiation Times and External Dose-Rate Conversion Factors for 21 Target Organs for 259 Radionuclides Produced in Potential*

Fusion Reactor Material, S. Fetter, EGG-FSP-8036, March 1988, Idaho National Engineering Laboratory. Inhalation and ingestion 50-year committed dose conversion factors were calculated using tissue weighting factors from ICRP-60, in conjunction with the computer program DFINT, "A Code to Preview the Dosimetric Data of ICRP Publication 30, Parts 1-4," K. Eckerman, 1992, Health and Safety Research Division, Oak Ridge National Laboratory.

The formulas, source terms, and dose conversion factors used to estimate annual dose rates are presented in the attached spreadsheets. Results of the calculations are summarized in Tables 1 and 2.

Table 1. Annual dose rates for selected scenarios at the SL-1 burial ground.

Scenario	Pathway	Annual Dose Rate (mrem/yr)
30-Year Future Residential Intrusion	External Exposure	34,000
	Soil Ingestion	69
	Dust Inhalation	0.31
	Groundwater Ingestion	0.043
	Total (2 significant digits)	34,000
Current Occupational	External Exposure	650
	Soil Ingestion	2.8
	Dust Inhalation	0.021
	Total (2 significant digits)	650
30-Year Future Occupational	External Exposure	8,200
	Soil Ingestion	1.4
	Dust Inhalation	N/E[a]
	Total (2 significant digits)	8,200
100-Year Future Occupational	External Exposure	1,600
	Soil Ingestion	0.25
	Dust Inhalation	N/E[a]
	Total (2 significant digits)	1,600

a. N/E: Pathway not evaluated because no radionuclides posed a risk greater than 1E-07.

Table 2. Annual dose rates for selected scenarios at the BORAX-I burial ground.

Scenario	Pathway	Annual Dose Rate (mrem/yr)
30-Year Future Residential Intrusion	External Exposure	1,800
	Soil Ingestion	7.0
	Dust Inhalation	0.14
	Groundwater Ingestion	0.64
	Total (2 significant digits)	1,800
Current Occupational	External Exposure	1,300
	Soil Ingestion	1.2
	Dust Inhalation	0.093
	Total (2 significant digits)	1,300

If you have any questions, please call me at 505-662-1236.

Respectfully submitted,

IT CORPORATION

Richard Filemyr
Project Manager

attachments

cc: Doug Vetter, IT-Albuquerque
Larry Hull, IT-Idaho Falls
Central File 301679

Attachment 1

Calc Brief: Conversion of Radiation Intake to Dose

Calc Brief: Conversion of Radiation Intake to Dose

Purpose:

The purpose of this calculation is to convert the intake of radionuclides to dose. Intake is described here as internal deposition of radionuclides. The dose provided is the committed effective dose equivalent using tissue weighting factors in ICRP-60, calculated using 50-year committed dose conversion factors. The dose conversion factors for inhalation and ingestion are from the DFINT code, Keith F. Eckerman, Health and Safety Research Division, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, Tennessee, 37830-6383.

Approach for Internal Exposure:

Inhalation:

$$\text{Intake pCi} = (C \times IR \times EF \times ED)/(PEF \times CF)$$

where

Intake = contaminant intake, pCi

C = radionuclide concentration in soil (pCi/g) (decay previously calculated)

IR = inhalation rate, 20 m^3/day

EF = exposure frequency, 250 days/year

ED = exposure duration, 25 years

PEF = particulate emission factor, 1 x 10^8 m^3/kg

CF = conversion factor, 1 x 10^{-3} kg/g

Conversion of the intake using the radionuclide- and pathway-specific inhalation dose conversion factor (IDF):

IDF = 2.62 x 10^{-1} mrem/pCi for an assumed 1 μm AMAD particle

where the tissue weighting factors in ICRP-60 were assumed.

$H_{eff,\ 50}$ mrem = Intake pCi x IDF mrem/pCi

Example Calculation:

Using the exposure parameters defined above and given a soil contaminated with 1 pCi/g americium-241, intake from inhalation is calculated:

$$\text{Intake pCi} = (1 \text{ pCi/g} \times 20 \text{ m}^3\text{/day} \times 250 \text{ day/y} \times 25 \text{ y})/$$

$$(1 \times 10^6 \text{ m}^3\text{/kg} \times 10^{-3} \text{ kg/g}) = 1.25 \text{ pCi}$$

Converting the intake using the IDF for americium-241:

$$H_{eff,50} = \text{Intake pCi} \times \text{IDF mrem/pCi}$$

$$= 1.25 \text{ pCi} \times 2.62 \times 10^{-1} \text{ mrem/pCi} = 3.28 \times 10^{-1} \text{ mrem}$$

Ingestion:

The conversions of ingestion intakes by soil and drinking water ingestion are done in the same way as inhalation exposures. That is, the appropriate intake equation is used as shown in the spreadsheets (attached). Intake is in units of pCi. The appropriate dose conversion factor is used, which is in units of mrem/pCi and the $H_{eff,50}$ dose is calculated in mrem.

Dose Conversion Factors for SL-1 Radionuclides

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
Am-241	2.62×10^{-1}	2.14×10^{-3}
Sb-126	1.25×10^{-5}	1.19×10^{-5}
Sb-126m	3.70×10^{-8}	1.28×10^{-7}
Cs-134	4.75×10^{-5}	7.21×10^{-5}
Cs-137 + Ba-137m	3.17×10^{-5}	4.98×10^{-5}
Eu-152	1.71×10^{-4}	7.09×10^{-6}
Eu-154	2.16×10^{-4}	1.11×10^{-5}
Eu-155	2.81×10^{-5}	1.86×10^{-6}
Kr-85	No data in file	
Np-237 + D	See page 4	
Pu-238	2.32×10^{-1}	1.89×10^{-3}
Pu-239	2.40×10^{-1}	2.08×10^{-3}
Pu-240	2.54×10^{-1}	2.08×10^{-3}
Ra-226 + D	See U-234 + D	
Ra-228 + D	See Th-228 + D	
Sm-151	1.85×10^{-5}	5.01×10^{-7}
Sr-90 + D	See page 4	
Tc-99	8.94×10^{-6}	2.46×10^{-6}
Th-228 + D	See Th-232 + D	
Th-230	1.97×10^{-1}	2.87×10^{-4}
Th-232	8.17×10^{-1}	1.37×10^{-3}
Sn-126	1.00×10^{-4}	2.42×10^{-5}
H-3	6.40×10^{-8}	6.40×10^{-8}
U-234 + D	See page 6	
U-235 + D	See page 7	

Dose Conversion Factors for Np-237 + D

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
Np-237	2.88×10^{-1}	2.36×10^{-3}
Pa-233	1.01×10^{-5}	4.92×10^{-6}
U-233	1.35×10^{-1}	1.06×10^{-4}
Th-229	1.30	1.78×10^{-3}
Ra-225	7.64×10^{-3}	2.62×10^{-4}
Ac-225	8.07×10^{-3}	1.41×10^{-4}
Fr-221	No data in file	
At-217	No data in file	
Bi-213	1.42×10^{-5}	6.47×10^{-7}
Po-213	No data in file	
Tl-209	No data in file	
Pb-209	8.40×10^{-8}	1.97×10^{-7}
Bi-209	No data in file	

Dose Conversion Factors for Sr-90 + D

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
Sr-90	1.30×10^{-3}	1.15×10^{-4}
Y-90	9.94×10^{-6}	1.45×10^{-5}
Zr-90	No data in file	

Dose Conversion Factors for Th-232 + D

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
Th-232	8.17×10^{-1}	1.37×10^{-3}
Ra-228	4.29×10^{-3}	1.02×10^{-3}
Ac-228	1.85×10^{-4}	1.66×10^{-6}
Th-228	3.25×10^{-1}	2.43×10^{-4}
Ra-224	3.08×10^{-3}	2.74×10^{-4}
Rn-220	No data in file	
Po-216	No data in file	
Pb-212	1.35×10^{-4}	3.09×10^{-5}
At-216	No data in file	
Bi-212	1.75×10^{-5}	8.17×10^{-7}
Po-212	No data in file	
Tl-208	No data in file	
Pb-208	No data in file	

Dose Conversion Factors for U-234 + D

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
U-234	1.32×10^{-1}	1.04×10^{-4}
Th-230	1.97×10^{-1}	2.87×10^{-4}
Ra-226	8.02×10^{-3}	8.31×10^{-4}
Rn-222	No data in file	
Po-218	No data in file	
Pb-214	7.51×10^{-6}	5.70×10^{-7}
At-218	No data in file	
Bi-214	5.92×10^{-6}	3.97×10^{-7}
Po-214	No data in file	
Tl-210	No data in file	
Pb-210	7.52×10^{-3}	2.97×10^{-3}
Bi-210	1.92×10^{-4}	7.12×10^{-6}
Po-210	6.31×10^{-3}	7.93×10^{-4}
Tl-206	No data in file	
Pb-206	No data in file	

Dose Conversion Factors for U-235 + D

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
U-235	1.23×10^{-1}	1.01×10^{-4}
Th-231	9.46×10^{-7}	1.63×10^{-6}
Pa-231	6.39×10^{-1}	5.26×10^{-3}
Ac-227	3.98	8.36×10^{-3}
Th-227	1.60×10^{-2}	4.70×10^{-5}
Fr-223	6.21×10^{-6}	8.64×10^{-6}
Ra-223	7.69×10^{-3}	4.76×10^{-4}
Rn-219	No data in file	
Po-215	No data in file	
Pb-211	8.61×10^{-6}	6.08×10^{-7}
At-215	No data in file	
Bi-211	No data in file	
Po-211	No data in file	
Tl-207	No data in file	
Pb-207	Stable	

Dose Conversion Factors for BORAX-I Radionuclides

Radionuclide	Inhalation (mrem/pCi)	Ingestion (mrem/pCi)
Ac-227 + D	see SL-1 U-235 + D	
Cs-137 + D	see SL-1	
Kr-85	see SL-1	
Pb-210 + D	see SL-1 Ra-226 + D	
Ra-226 + D	see SL-1	
Sr-90 + D	see SL-1	
U-234 + D	see SL-1	
U-235 + D	see SL-1	
U-238 + D	see SL-1	

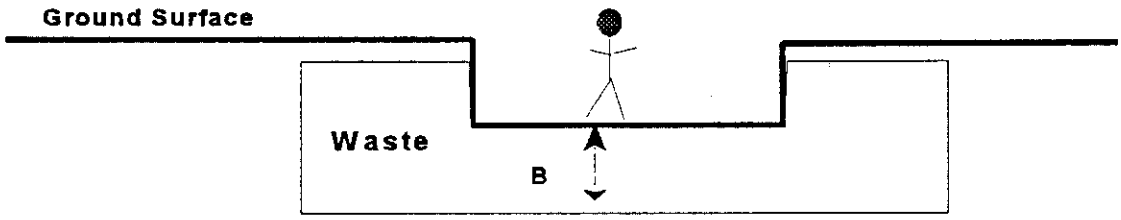
Attachment 2

Calc Brief: Dose Calculations for Intrusion Scenarios:
Dose Conversion Factors

Dose Calculations for Intrusion Scenarios:
Dose Conversion Factors

Arthur S. Rood
June 22, 1995, Revised September 19, 1995

1. Conceptual Model for the Intruder Scenario. Dose is only calculated from the waste underlying the receptor and not from the adjacent basement walls.



B = the thickness of the waste the intruder is exposed to.

Let C = the contaminated thickness where the source is considered to be planer rather than volumetric. This thickness is usually less than 1 cm

For B < 1 cm:

Convert the concentration in the surface soil intruder is exposed to a surface concentration by dividing by the thickness, B. Compute the effective dose equivalent using

$$EDE = C_{soil}\, DCF_{ext}\, ET\, EF$$

where C_{soil} = the soil concentration (Ci/m^2)
DCF_{ext} = the external dose rate conversion factor (rem m^3 Ci^{-1} s^{-1})
ET = exposure time per day (sec day^{-1})

EF = exposure frequency (day y^{-1})

For 1 m > B >1 cm:

Use the dose-rate conversion factors for a contaminated soil volume of the nearest appropriate thickness (rem m^3 Ci^{-1} s^{-1}) as reported in EPA Federal Guidance Document Number 12. Call Irma McKnight at (202) 233-9357 (EPA Washington Office) to order a copy of this document. The document reports dose-rate conversion factors for various contamination thicknesses ranging from 1cm to about a meter. For a conservative dose estimate, see below.

For B > 1 m

The dose-rate conversion factors in Federal Guidance Document 12 are recommended. However, if you need to perform some calculations now, I have included some dose conversion factors from the RESRAD manual (Yu et al., 1993) and from the Fusion Reactor Safety Program (Fetter, 1988). Fetter's dose-rate conversion factors (Table 1) assumes a soil bulk density of 1.6 g cm^{-3}. The RESRAD data reports dose-rate conversion factors for two soil densities; 1.0 and 1.8 g cm^{-3}. Both of these dose-rate conversion factors sets are considered conservative for performing calculations where B>1 cm and B<1 m; but not overly conservative as assuming the entire inventory was placed on the surface and the surface contamination dose-rate conversion factor (rem m^2 Ci^{-1} s^{-1}) was used to calculate EDE.

Sample Calculation:

Use Fetter's DCF's for Cs-137+D (including Ba-137m) source of 1.5 pCi/g. Other data includes:
soil density = 1.6 g cm^{-3}
ET = 54000 sec
EF = 350 d/y

EDE = (1.5 pCi g^{-1})(1.6 g cm^{-3})(10^6 cm^3 m^{-3})(6.62E-5 rem m^3 Ci^{-1} s^{-1}) (1 Ci)(10^{-12} pCi)(54000 s d^{-1})(350 d y^{-1}) = 0.003 rem y^{-1}.

Note on Table 1: For nuclides that have progeny listed to the right of the nuclide, you should use the dose-rate conversion factor listed in the column "Total EDE". following the last progeny member in the chain. The "+D" designation indicates progeny contributions are included in this dose conversion factor.

Table 1. Dose conversion factors from Fetter (1988).

Parent Nuclide	Progeny	EDE (rem-m**3/s-Ci)	Total EDE (rem-m**3/s-Ci)
Ac-227		4.89E-12	
	Th-227	1.03E-05	
	Ra-223	3.08E-05	
	Rn-219	no dcf	
	Po-215	no dcf	
	Pb-211	no dcf	
	Bi-211	no dcf	
	Ti-207	no dcf	4.11E-05
Am-241		1.05E-06	
Am-242m		2.03E-09	
Am-243		1.84E-06	
	Np-239	1.32E-05	1.84E-06
Cm-243		1.11E-05	
Cs-134		1.77E-04	
Cs-135		1.30E-10	
Cs-137+D		6.62E-05	
Eu-152		1.32E-04	
Eu-154		1.43E-04	
Eu-155		no dcf	
Fr-223		no dcf	
I-129		1.73E-07	
Kr-85		2.67E-07	
Nb-93m		7.43E-10	
Np-237		1.08E-06	
	Pa-233	2.07E-05	2.18E-05
Pa-231		2.99E-06	
Pa-234		no dcf	
Pd-107		7.36E-15	
Pm-147		0	
Pu-238		1.03E-09	
Pu-239		4.49E-09	
Pu-240		8.66E-10	
Pu-241		8.13E-11	
Sb-125		4.85E-05	
Sb-126		3.22E-04	
Sb-126m		1.82E-04	
Sm-151		5.51E-14	
Sn-121m		2.36E-08	
Sn-126		2.17E-06	
Sr-90		5.75E-09	
	Y-90	1.96E-07	2.02E-07
Tc-99		5.07E-10	
Te-125m		1.89E-07	
U-234		5.05E-09	
U-235		1.37E-05	
	Th-231	4.41E-07	1.41E-05
U-236		2.32E-09	
U-238		2.55E-07	
	Th-234	1.23E-06	
	Pa-234	no dcf	1.49E-06
Zr-93		0	

References:

Fetter, S., Internal Dose Conversion Factors for 19 Target Organs and 9 Irradiation Times and External Dose-Rate Conversion Factors for 21 Target Organs for 259 Radionuclides produced in Potential Fusion Reactor Material. EGG-FSP-8036 Idaho National Engineering Laboratory, Idaho Falls, Idaho, March, 1988.

Yu, C., et al., Manual for Implementing Residual Radioactive material Guidelines Using RESRAD, Version 5.0. ANL/EAD/LD-2 Argonne National Laboratory, Argonne, IL, September, 1993.

Attachment 3

Dose Calculation Spreadsheets

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose - External Exposure at SL-1

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration in surface soils (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (86400 sec/d) 86400
EF = exposure frequency (350 d/y) 350

COC	Soil Concentration (see note)	C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
Am-241	2.93E+00 pCi/g	4.39E+06	1.05E-06	1.4E-01
Cs-137+D	1.14E+04 pCi/g	1.71E+10	6.62E-05	3.4E+04
Eu-152	1.54E-01 pCi/g	2.31E+05	1.32E-04	9.2E-01
Eu-154	1.64E+00 pCi/g	2.45E+06	1.43E-04	1.1E+01
Kr-85	9.94E+01 pCi/g	1.49E+08	2.67E-07	1.2E+00
Np-237	2.14E-02 pCi/g	3.21E+04	1.08E-06	1.0E-03
Pa-233	2.14E-02 pCi/g	3.21E+04	2.07E-05	2.0E-02
Sb-126	2.49E-02 pCi/g	3.73E+04	3.22E-04	3.6E-01
Sb-126m	1.78E-01 pCi/g	2.67E+05	1.82E-04	1.5E+00
Sn-126	1.78E-01 pCi/g	2.67E+05	2.17E-06	1.8E-02
U-235	4.60E-01 pCi/g	6.90E+05	1.37E-05	2.9E-01
Th-231	4.60E-01 pCi/g	6.90E+05	4.41E-07	9.2E-03
Ac-227	3.60E-04 pCi/g	5.40E+02	4.89E-12	8.0E-11
Th-227	3.55E-04 pCi/g	5.33E+02	1.03E-05	1.7E-04
Ra-223	3.60E-04 pCi/g	5.40E+02	3.08E-05	5.0E-04
			Pathway Dose =	3.4E+04

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs.do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024
- "+D" indicates that the DCF accounts for daughter(s).

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose - Ingestion of Soil at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
IR = soil ingestion rate (100 mg/d) 100
EF = exposure frequency (350 d/y) 350
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
Am-241	2.93E+00 pCi/g	2.14E-03	1.03E+02 pCi	2.2E-01
Cs-137+D	1.14E+04 pCi/g	4.98E-05	3.99E+05 pCi	2.0E+01
Pu-238	5.30E+00 pCi/g	1.89E-03	1.86E+02 pCi	3.5E-01
Pu-239	1.04E+01 pCi/g	2.08E-03	3.63E+02 pCi	7.6E-01
Pu-240	1.56E+00 pCi/g	2.08E-03	5.45E+01 pCi	1.1E-01
Sm-151	4.13E+02 pCi/g	5.01E-07	1.45E+04 pCi	7.2E-03
Sr-90	1.05E+04 pCi/g	1.15E-04	3.69E+05 pCi	4.2E+01
Y-90	1.05E+04 pCi/g	1.45E-05	3.69E+05 pCi	5.3E+00
			Pathway Dose =	6.9E+01

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose - Inhalation of Fugitive Dust at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = (C x IR x EF x ED)/(PEF x CF)
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
IR = inhalation rate (20 m**3/d) 20
EF = exposure frequency (350 d/y) 350
ED = exposure duration (1 y) 1
PEF = site-specific particulate emission factor (width*5.8E10/area) (m**3/kg)
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = inhalation dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)	PEF (m**3/kg)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
Cs-137+D	9.04E+02 pCi/g	4E+08	3.17E-05	1.58E+01 pCi	5.0E-04
Pu-238	5.30E+00 pCi/g	4E+08	2.32E-01	9.28E-02 pCi	2.2E-02
Pu-239	1.04E+01 pCi/g	4E+08	2.40E-01	1.82E-01 pCi	4.4E-02
Sr-90	1.05E+04 pCi/g	4E+08	1.30E-03	1.84E+02 pCi	2.4E-01
Y-90	1.05E+04 pCi/g	4E+08	9.94E-06	1.84E+02 pCi	1.8E-03

Pathway Risk = 3.1E-01

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024
- "+D" indicates that the DCF accounts for daughter(s).

Future Residential Scenario Annual Dose - Groundwater Ingestion at SL-1 (calculated with GWSCREEN Track 2 Parameters).
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = estimated water concentration (from GWSCREEN in pCi/L)
IR = groundwater ingestion rate (2 L/d)
EF = exposure frequency (350 d/y)
ED = exposure duration (1 y)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Groundwater Concentration from GWSCREEN		Transit Time (years)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
H-3	1.78E-10 Ci/L	1.78E+02 pCi/L	1.8E+01	6.40E-08	1.25E+05 pCi	8.0E-03
Tc-99	2.06E-11 Ci/L	2.06E+01 pCi/L	2.6E+01	2.46E-06	1.44E+04 pCi	3.5E-02

Pathway Dose = 4.3E-02

Note: - Only radionuclides with risk >1E-7 in the BRA are evaluated for dose

Current Occupational Scenario Dose - External Exposure at SL-1
based on concentrations in surface soil

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration in surface soils (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (8 hr/d = 28800 sec/d) 28800
EF = exposure frequency (250 d/y) 250

COC	Soil Concentration (see note)	C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
Cs-137+D	9.04E+02 pCi/g	1.36E+09	6.62E-05	6.5E+02
Eu-154	2.68E+00 pCi/g	4.02E+06	1.43E-04	4.1E+00
			Pathway Dose =	6.5E+02

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentration of Cs-137 is the 95% upper confidence limit calculated from arithmetic mean of seven or fewer samples; Eu-154 is the estimated upper 95%iles (single sample result multiplied by 4).
- "+D" indicates that the DCF accounts for daughter(s).

Current Occupational Scenario Annual Dose -
Ingestion of Soil at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
IR = soil ingestion rate (50 mg/d) 50
EF = exposure frequency (250 d/y) 250
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)	DCF (mrem/pCi)	Intake		EDE (mrem/yr)
Cs-137+D	9.04E+02 pCi/g	4.98E-05	1.13E+04	pCi	5.6E-01
Sr-90	1.37E+03 pCi/g	1.15E-04	1.71E+04	pCi	2.0E+00
Y-90	1.37E+03 pCi/g	1.45E-05	1.71E+04	pCi	2.5E-01
			Pathway Dose =		2.8E+00

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentrations of Cs-137 and Sr-90 are 95% upper confidence limits calculated from arithmetic mean of seven or fewer samples
- Y-90 is assumed to be in secular equilibrium with the parent Sr-90
- "+D" indicates that the DCF accounts for daughter(s).

Current Occupational Scenario Annual Dose -
Inhalation of Fugitive Dust at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = (C x IR x EF x ED)/(PEF x CF)
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
IR = inhalation rate (20 m**3/d) 20
EF = exposure frequency (250 d/y) 250
ED = exposure duration (1 y) 1
PEF = site-specific particulate emission factor (width*5.8E10/area) (m**3/kg)
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = inhalation dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)	PEF (m**3/kg)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
Th-228	1.63E+00 pCi/g	1E+08	3.25E-01	6.41E-02 pCi	2.1E-02

Pathway Dose = 2.1E-02

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Concentration of Th-228 is the 95% upper confidence limit calculated from arithmetic mean of seven or fewer samples
- Soil sample analytical results do not report any Th-228 daughters

Future Occupational Scenario (30-yr, 2024) Annual Dose -
External Exposure at SL-1

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration in surface soils (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (8 hr/d = 28800 sec/d) 28800
EF = exposure frequency (250 d/y) 250

COC	Soil Concentration (see note)	C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
Cs-137+D	1.14E+04 pCi/g	1.71E+10	6.62E-05	8.2E+03
Eu-152	1.54E-01 pCi/g	2.31E+05	1.32E-04	2.2E-01
Eu-154	1.64E+00 pCi/g	2.45E+06	1.43E-04	2.5E+00
Kr-85	9.94E+01 pCi/g	1.49E+08	2.67E-07	2.9E-01
Sb-126	2.49E-02 pCi/g	3.73E+04	3.22E-04	8.7E-02
Sb-126m	1.78E-01 pCi/g	2.67E+05	1.82E-04	3.5E-01
U-235	4.60E-01 pCi/g	6.90E+05	1.37E-05	6.8E-02
Th-231	4.60E-01 pCi/g	6.90E+05	4.41E-07	2.2E-03
Ac-227	3.60E-04 pCi/g	5.40E+02	4.89E-12	1.9E-11
Th-227	3.55E-04 pCi/g	5.33E+02	1.03E-05	3.9E-05
Ra-223	3.60E-04 pCi/g	5.40E+02	3.08E-05	1.2E-04
			Pathway Dose =	8.2E+03

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024
- "+D" indicates that the DCF accounts for daughter(s).

Future Occupational Scenario (30-yr, 2024) Annual Dose - Ingestion of Soil at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = C x EXP(-0.693*t/T) x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
t = years until occupational scenario (30 y)
T = radionuclide-specific half-life (y)
IR = soil ingestion rate (50 mg/d) 50
EF = exposure frequency (250 d/y) 250
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Initial (1994) Soil Concentration (see note)	half-life (y)	Concentration in 2024 (pCi/g)	DCF (mrem/pCi)	Intake		EDE (mrem/yr)
Cs-137+D	9.04E+02 pCi/g	3.02E+01	4.54E+02	4.98E-05	5.68E+03	pCi	2.8E-01
Sr-90	1.37E+03 pCi/g	2.86E+01	6.62E+02	1.15E-04	8.27E+03	pCi	9.5E-01
Y-90	1.37E+03 pCi/g	7.32E-03	6.62E+02	1.45E-05	8.27E+03	pCi	1.2E-01

Pathway Dose = 1.4E+00

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentrations of Cs-137 and Sr-90 are 95% upper confidence limits calculated from arithmetic mean of seven or fewer samples
- Cs-137 and Sr-90 are decayed from 1994 to 2024 using EXP(-0.693*30/half life)
- Y-90 is assumed to be in secular equilibrium with the parent Sr-90 in 1994 and 2024
- "+D" indicates that the DCF accounts for daughter(s).

Future Occupational Scenario (100-yr, 2094) Annual Dose -
External Exposure at SL-1

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration in surface soils (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (8 hr/d = 28800 sec/d) 28800
EF = exposure frequency (250 d/y) 250

COC	Soil Concentration (see note)	C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
Cs-137+D	2.27E+03 pCi/g	3.40E+09	6.62E-05	1.6E+03
Eu-154	5.80E-03 pCi/g	8.71E+03	1.43E-04	9.0E-03
Sb-126	2.49E-02 pCi/g	3.73E+04	3.22E-04	8.7E-02
Sb-126m	1.78E-01 pCi/g	2.66E+05	1.82E-04	3.5E-01
U-235	4.60E-01 pCi/g	6.90E+05	1.37E-05	6.8E-02
Th-231	4.60E-01 pCi/g	6.90E+05	4.41E-07	2.2E-03
Ac-227	1.00E-03 pCi/g	1.50E+03	4.89E-12	5.3E-11
Th-227	9.91E-04 pCi/g	1.49E+03	1.03E-05	1.1E-04
Ra-223	1.01E-03 pCi/g	1.52E+03	3.08E-05	3.4E-04
			Pathway Dose =	1.6E+03

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2094
- "+D" indicates that the slope factor accounts for daughter(s).

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose - External Exposure at BORAX-I

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (86400 sec/d) 86400
EF = exposure frequency (350 d/y) 350

COC	Soil Concentration (see note)		C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
U-235	2.94E+01	pCi/g	4.41E+07	1.37E-05	1.8E+01
Th-231	2.94E+01	pCi/g	4.41E+07	4.41E-07	5.9E-01
Ac-227	2.29E-02	pCi/g	3.44E+04	4.89E-12	5.1E-09
Th-227	2.26E-02	pCi/g	3.39E+04	1.03E-05	1.1E-02
Ra-223	2.29E-02	pCi/g	3.44E+04	3.08E-05	3.2E-02
Cs-137+D	6.02E+02	pCi/g	9.03E+08	6.62E-05	1.8E+03
Kr-85	2.73E+00	pCi/g	4.10E+06	2.67E-07	3.3E-02
U-234	9.29E+02	pCi/g	1.39E+09	5.05E-09	2.1E-01
Ra-226	8.77E-03	pCi/g	1.32E+04	6.52E-07	2.6E-04
U-238	1.91E-01	pCi/g	2.86E+05	2.55E-07	2.2E-03
Th-234	1.91E-01	pCi/g	2.87E+05	1.23E-06	1.1E-02
				Pathway Dose =	1.8E+03

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024
- "+D" indicates that the DCF accounts for daughter(s).

Future Occupational Scenario (100-yr, 2094) Annual Dose - Ingestion of Soil at SL-1
(Based on dose conversion factors for 50-year committed dose)

Intake = C x EXP(-0.693*t/T) x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
t = years until occupational scenario (100 y)
T = radionuclide-specific half-life (y)
IR = soil ingestion rate (50 mg/d) 50
EF = exposure frequency (250 d/y) 250
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Initial (1994) Soil Concentration (see note)	half-life (y)	Concentration in 2094 (pCi/g)	DCF (mrem/pCi)	Intake		EDE (mrem/yr)
Cs-137+D	9.04E+02 pCi/g	3.02E+01	9.11E+01	4.98E-05	1.14E+03	pCi	5.7E-02
Sr-90	1.37E+03 pCi/g	2.86E+01	1.21E+02	1.15E-04	1.52E+03	pCi	1.7E-01
Y-90	1.37E+03 pCi/g	7.32E-03	1.21E+02	1.45E-05	1.52E+03	pCi	2.2E-02
					Pathway Dose =		2.5E-01

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentrations of Cs-137 and Sr-90 are 95% upper confidence limits calculated from arithmetic mean of seven or fewer samples
- Cs-137 and Sr-90 are decayed from 1994 to 2094 using EXP(-0.693*100/half life)
- Y-90 is assumed to be in secular equilibrium with the parent Sr-90 in 1994 and 2094
- "+D" indicates that the DCF accounts for daughter(s).

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose - Ingestion of Soil at BORAX-I
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration (pCi/g)
IR = soil ingestion rate (100 mg/d) 100
EF = exposure frequency (350 d/y) 350
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)		DCF (mrem/pCi)	Intake		EDE (mrem/yr)
Cs-137+D	6.02E+02	pCi/g	4.98E-05	2.11E+04	pCi	1.0E+00
Sr-90	5.39E+02	pCi/g	1.15E-04	1.89E+04	pCi	2.2E+00
Y-90	5.39E+02	pCi/g	1.45E-05	1.89E+04	pCi	2.7E-01
U-234	9.29E+02	pCi/g	1.04E-04	3.25E+04	pCi	3.4E+00
Th-230	5.83E-01	pCi/g	2.87E-04	2.04E+01	pCi	5.9E-03
Ra-226	8.77E-03	pCi/g	8.31E-04	3.07E-01	pCi	2.6E-04
Pb-214	8.77E-03	pCi/g	5.70E-07	3.07E-01	pCi	1.7E-07
Bi-214	8.77E-03	pCi/g	3.97E-07	3.07E-01	pCi	1.2E-07
Pb-210	4.01E-03	pCi/g	2.97E-03	1.40E-01	pCi	4.2E-04
Bi-210	4.01E-03	pCi/g	7.12E-06	1.40E-01	pCi	1.0E-06
Po-210	3.94E-03	pCi/g	7.93E-04	1.38E-01	pCi	1.1E-04
U-235	2.94E+01	pCi/g	1.01E-04	1.03E+03	pCi	1.0E-01
Th-231	2.94E+01	pCi/g	1.63E-06	1.03E+03	pCi	1.7E-03
Pa-231	3.83E-02	pCi/g	5.26E-03	1.34E+00	pCi	7.1E-03
Ac-227	2.29E-02	pCi/g	8.36E-03	8.02E-01	pCi	6.7E-03
Th-227	2.26E-02	pCi/g	4.70E-05	7.91E-01	pCi	3.7E-05
Fr-223	3.17E-04	pCi/g	8.64E-06	1.11E-02	pCi	9.6E-08
Ra-223	2.29E-02	pCi/g	4.76E-04	8.02E-01	pCi	3.8E-04
Pb-211	2.29E-02	pCi/g	6.08E-07	8.02E-01	pCi	4.9E-07

Pathway Dose = 7.0E+00

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024

Future Intrusive Residential Scenario (30-yr, 2024) Annual Dose -
Inhalation of Fugitive Dust at BORAX-I
(Based on dose conversion factors for 50-year committed dose)

Intake = (C x IR x EF x ED)/(PEF x CF)
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration (pCi/g)
IR = inhalation rate (20 m**3/d) 20
EF = exposure frequency (350 d/y) 350
ED = exposure duration (1 y) 1
PEF = site-specific particulate emission factor (width*5.8E10/area) (m**3/kg)
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = inhalation dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)		PEF (m**3/kg)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
U-234	9.29E+02	pCi/g	6E+09	1.32E-01	1.09E+00 pCi	1.4E-01
Th-230	5.83E-01	pCi/g	6E+09	1.97E-01	6.87E-04 pCi	1.4E-04
Ra-226	8.77E-03	pCi/g	6E+09	8.02E-03	1.03E-05 pCi	8.3E-08
Pb-214	8.77E-03	pCi/g	6E+09	7.51E-06	1.03E-05 pCi	7.8E-11
Bi-214	8.77E-03	pCi/g	6E+09	5.92E-06	1.03E-05 pCi	6.1E-11
Pb-210	4.01E-03	pCi/g	6E+09	7.52E-03	4.72E-06 pCi	3.6E-08
Bi-210	4.01E-03	pCi/g	6E+09	1.92E-04	4.72E-06 pCi	9.1E-10
Po-210	3.94E-03	pCi/g	6E+09	6.31E-03	4.64E-06 pCi	2.9E-08

Pathway Dose = 1.4E-01

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Subsurface soil concentrations are based on estimates of the contaminated soil volume and the activity of the buried contaminants for the year 2024

Future Residential Scenario Annual Dose - Groundwater Ingestion at BORAX-I (calculated with GWSCREEN Track 2 Parameters).
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED
EDE = Intake x DCF

where
Intake = estimated contaminant intake (pCi)
C = estimated water concentration (from GWSCREEN in pCi/L)
IR = groundwater ingestion rate (2 L/d)
EF = exposure frequency (350 d/y)
ED = exposure duration (1 y)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Groundwater Concentration from GWSCREEN		Transit Time (years)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
U-234	7.26E-12 Ci/L	7.26E+00 pCi/L	1.0E+04	1.04E-04	5.08E+03 pCi	5.3E-01
Th-230	4.04E-14 Ci/L	4.04E-02 pCi/L	1.0E+04	2.87E-04	2.83E+01 pCi	8.1E-03
Ra-226	3.18E-14 Ci/L	3.18E-02 pCi/L	1.0E+04	8.31E-04	2.23E+01 pCi	1.8E-02
Pb-214	3.18E-14 Ci/L	3.18E-02 pCi/L	1.0E+04	5.70E-07	2.23E+01 pCi	1.3E-05
Bi-214	3.18E-14 Ci/L	3.18E-02 pCi/L	1.0E+04	3.97E-07	2.23E+01 pCi	8.8E-06
Pb-210	3.16E-14 Ci/L	3.16E-02 pCi/L	1.0E+04	2.97E-03	2.21E+01 pCi	6.6E-02
Bi-210	3.16E-14 Ci/L	3.16E-02 pCi/L	1.0E+04	7.12E-06	2.21E+01 pCi	1.6E-04
Po-210	3.16E-14 Ci/L	3.16E-02 pCi/L	1.0E+04	7.93E-04	2.21E+01 pCi	1.8E-02

Pathway Dose = 6.4E-01

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Bold type indicates parent radionuclide
- Pb-214 and Bi-214 assumed in equilibrium with parent Ra-226; Bi-210 and Po-210 assumed in equilibrium with parent Pb-210

Current Occupational Scenario Annual Dose -
External Exposure at BORAX-I

EDE = C x DCF x ET x EF x 1E03 mrem/rem x 1E-12 Ci/pCi

where

EDE = effective dose equivalent (mrem/yr)
C = radionuclide concentration in surface soils (pCi/m**3)
DCF = dose conversion factor, radionuclide-specific (rem-m**3/sec-Ci)
ET = exposure time per day (8 hr/d = 28800 sec/d) 28800
EF = exposure frequency (250 d/y) 250

COC	Soil Concentration (see note)		C (pCi/m**3)	DCF (rem-m**3/sec-Ci)	EDE (mrem/yr)
U-235	6.86E+01	pCi/g	1.03E+08	1.37E-05	1.0E+01
Cs-137+D	1.82E+03	pCi/g	2.73E+09	6.62E-05	1.3E+03
				Pathway Dose =	1.3E+03

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentration of Cs-137 is 95% UCL using transformed data;
  U-235 is the 95% UCL using arithmetic mean (see Appendix F of RI/FS).
- Soil sample analytical results do not report any U-235 daughters
- "+D" indicates that the DCF accounts for daughter(s).

Current Occupational Scenario Annual Dose -
Ingestion of Soil at BORAX-I
(Based on dose conversion factors for 50-year committed dose)

Intake = C x IR x EF x ED x CF
EDE = Intake x DCF

where

Intake = estimated contaminant intake (pCi)
C = radionuclide concentration in surface soils (pCi/g)
IR = soil ingestion rate (50 mg/d) 50
EF = exposure frequency (250 d/y) 250
ED = exposure duration (1 y) 1
CF = conversion factor (1E-03 kg/g)
EDE = effective dose equivalent (mrem/yr)
DCF = ingestion dose conversion factor, radionuclide-specific (mrem/pCi)

COC	Soil Concentration (see note)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
Cs-137+D	1.82E+03 pCi/g	4.98E-05	2.27E+04 pCi	1.1E+00
U-235	6.86E+01 pCi/g	1.01E-04	8.58E+02 pCi	8.7E-02
			Pathway Dose =	1.2E+00

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
- Radionuclides without DCFs do not appear in the spreadsheet
- Concentration of Cs-137 is 95% UCL using transformed data;
  U-235 is the 95% UCL using arithmetic mean (see Appendix F of RI/FS).
- Soil sample analytical results do not report any U-235 daughters
- "+D" indicates that the DCF accounts for daughter(s).

Current Occupational Scenario Annual Dose -
Inhalation of Fugitive Dust at BORAX-I
(Based on dose conversion factors for 50-year committed dose)

Intake = (C x IR x EF x ED)/(PEF x CF)
EDE = Intake x DCF

where

Intake =	estimated contaminant intake (pCi)	
C =	radionuclide concentration in surface soils (pCi/g)	
IR =	inhalation rate (20 m**3/d)	20
EF =	exposure frequency (250 d/y)	250
ED =	exposure duration (1 y)	1
PEF =	site-specific particulate emission factor (width*5.8E10/area) (m**3/kg)	
CF =	conversion factor (1E-03 kg/g)	
EDE =	effective dose equivalent (mrem/yr)	
DCF =	inhalation dose conversion factor, radionuclide-specific (mrem/pCi)	

COC	Soil Concentration (see note)	PEF (m**3/kg)	DCF (mrem/pCi)	Intake	EDE (mrem/yr)
U-235	6.86E+01 pCi/g	5E+08	1.23E-01	7.57E-01 pCi	9.3E-02
				Pathway Dose =	9.3E-02

Notes:
- Only radionuclides with risk >1E-7 in the BRA are evaluated for dose
  U-235 is the 95% UCL using arithmetic mean (see Appendix F of RI/FS).
- Soil sample analytical results do not report any U-235 daughters