

Purpose: To estimate the annual dose from occupational exposures attributed to using a portal monitoring threshold (gamma) based on 4 Bq/cm² surface contamination as a screening tool in response to receipt of commercial shipments from Japan. See: *Use of Portal Monitor Gross Count Rate to Estimate Potential Surface Contamination on Cargo Containers*. Not intended to supplant regulation or standing policies on radiation protection.

Robert D Daniels rtd2@cdc.gov
 Research Health Physicist
 NIOSH
 Checked by: S. Hinnefeld

References:
 EPA (1993). External Exposure to Radionuclides in Air, Water, and Soil, Federal Guidance Report No. 12 EPA-402-R-93-081 (Oak Ridge National Laboratory, Oak Ridge, TN; U. S. Environmental Protection Agency, Washington, DC.)
 ANSI [1999]. Surface and Volume Radioactivity Standard of Clearance. ANSI/HPS N13.12-1999
 EPA [1988]. Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, Federal Guidance Report No. 11

The models below use methodology and assumptions from ANSI 13.12.

External dose

Federal Guidance Report No. 12

Nuclide	Sv per Bq s per m2									cont. level (Bq/m ²)	Decay corrected (Bq/m ²)	hours per year	Effective dose per year (mrem)	Fraction of occupational limit
	Gonad	Breast	Lung	Marrow	BSurface	Thyroid	Remainder	Effective	Skin					
I-131	3.94E-16	3.81E-16	3.58E-16	3.60E-16	5.90E-16	3.71E-16	3.49E-16	3.76E-16	6.43E-16	40000	1271.152672	2000	0.34	0.00
Cs-137	3.31E-19	3.47E-19	2.22E-19	1.97E-19	8.15E-19	2.51E-19	2.25E-19	2.85E-19	2.75E-16	40000	39541.44033	2000	0.01	0.00
Ba-137m	6.17E-16	5.90E-16	5.61E-16	5.70E-16	8.27E-16	5.87E-16	5.51E-16	5.86E-16	1.65E-15	40000	39541.44033	2000	16.68	0.17
													16.69	0.17
Sr-90	3.33E-19	3.50E-19	2.19E-19	1.93E-19	8.31E-19	2.49E-19	2.23E-19	2.84E-19	1.40E-16	40000	39527.69227	2000	0.01	0.00
Y-90	5.75E-18	5.72E-18	4.76E-18	4.57E-18	1.17E-17	5.02E-18	4.68E-18	5.32E-18	1.05E-14	40000	39527.69227	2000	0.15	0.00
SR-90/Y-90													0.16	0.00

Inhalation Dose

Federal Guidance Report 11 Table 2.1

Nuclide	Sv per Bq									cont. level (Bq/m ²)	Decay corrected (Bq/m ²)	RF	Bq/m ³	hours per year	Breathing rate (M ³ hr ⁻¹)	Uptake (Bq)	Effective dose per year (mrem)	Fraction of occupational limit (effective dose)
	Gonad	Breast	Lung	Marrow	BSurface	Thyroid	Remainder	Effective	Skin									
I-131	2.53E-11	7.88E-11	6.57E-10	6.26E-11	5.73E-11	2.92E-07	8.03E-11	8.89E-09		40000	1271.152672	1.00E-06	1.27E-03	2000	1.2	3.05E+00	0.00	0.00
Cs-137	8.76E-09	7.84E-09	8.82E-09	8.30E-09	7.94E-09	7.93E-09	9.12E-09	8.63E-09		40000	39541.44033	1.00E-06	3.95E-02	2000	1.2	9.49E+01	0.08	0.00
Sr-90 D	2.64E-09	2.64E-09	3.73E-09	3.36E-07	7.27E-07	2.64E-07	3.36E-07	6.47E-08		40000	39527.69227	1.00E-06	3.95E-02	2000	1.2	9.49E+01	0.61	0.01
Sr-90 Y	2.69E-10	2.69E-10	2.86E-06	3.28E-08	7.09E-08	2.69E-10	5.73E-09	3.51E-07		40000	39527.69227	1.00E-06	3.95E-02	2000	1.2	9.49E+01	3.33	0.03
Y-90 W								2.13E-09		40000	39527.69227	1.00E-06	3.95E-02	2000	1.2	9.49E+01	0.02	0.00
Y-90 Y								2.28E-09		40000	39527.69227	1.00E-06	3.95E-02	2000	1.2	9.49E+01	0.02	0.00

Ingestion Dose

Federal Guidance Report 11, Table 2.2

Nuclide	Sv per Bq									cont. level (Bq/m ²)	Decay corrected (Bq/m ²)	Effective Ingestion transfer Rate (m ² /hr)	RF	hours per year	Uptake (Bq)	Effective dose per year (mrem)	Fraction of occupational limit (effective dose)	
	Gonad	Breast	Lung	Marrow	BSurface	Thyroid	Remainder	Effective	Skin									
I-131	4.07E-11	1.21E-10	1.02E-10	9.44E-11	8.72E-11	4.76E-07	1.57E-10	1.44E-08		40000	1271.152672	1.00E-04		1	2000	2.54E+02	0.37	0.00
Cs-137	1.39E-08	1.24E-08	1.27E-08	1.32E-08	1.26E-08	1.26E-08	1.48E-08	1.35E-08		40000	39541.44033	1.00E-04		1	2000	7.91E+03	10.68	0.11
Sr-90 D	1.51E-09	1.51E-09	1.51E-09	1.94E-07	4.19E-07	1.51E-09	6.14E-09	3.85E-08		40000	39527.69227	1.00E-04		1	2000	7.91E+03	30.44	0.30
Sr-90 Y	5.04E-11	5.04E-11	5.04E-11	6.45E-09	1.39E-08	5.04E-11	6.07E-09	3.23E-09		40000	39527.69227	1.00E-04		1	2000	7.91E+03	2.55	0.03
Y-90							2.91E-09			40000	39527.69227	1.00E-04		1	2000	7.91E+03	2.30	0.02

Totals

Screening threshold (Bq/cm²) based on ANSI 13.12 Criterion (i.e. 1 mrem/yr)

Nuclide	Total Effective Dose Equivalent per year (mrem)	Fraction of occupational limit (effective dose)	Dose (mrem) at ANSI 13.12 screening level	NIOSH coefficient Bq/cm ² per mrem	ANSI coefficient Bq/cm ² per mrem	NIOSH coefficient mrem per Bq/cm ²
I-131	0.71	0.01	1.78	5.61	6	0.18
Cs-137	27.45	0.27	6.86	0.15	0.15	6.86
Sr-90 D	33.53	0.34	8.38	0.12	0.12	8.38
Sr-90 Y	8.36	0.08	2.09	0.48	NA	2.09

Half-life (y)	Lambda	fraction	Decay corrected
0.022027397	0.693147181	31.4675026	0.031778817
30	0.693147181	0.023104906	0.988536008
29.12	0.693147181	0.023803131	0.988192307

Key Limitations:

Actual worker geometries, stay times, and exposure controls are not known. Therefore, models crudely represent exposure scenarios and results may be highly imprecise. Radionuclides other than Cs-137, I-131, and SR-90/Y-90 were not considered.

