CESIUM 173

8. REGULATIONS AND ADVISORIES

The international, national, and state regulations and guidelines regarding stable cesium in air, water, and other media are summarized in Table 8-1. The regulations regarding radioactive cesium are summarized in Table 8-2.

No MRLs were derived for inhalation or oral exposure to stable or radioactive cesium. Two MRLs, derived by the Agency for Toxic Substances and Disease Registry (1999) for external exposure to ionizing radiation, are applicable to external exposure to radioisotopes of cesium. An MRL of 400 mrem (4.0 mSv) was derived for acute-duration external exposure (14 days or less), based on cognitive learning deficit in children who had been exposed to ionizing radiation at critical stages of fetal development (gestation weeks 8–15) during the atomic bombing of Hiroshima and Nagasaki (Schull et al. 1988). An MRL of 100 mrem/year (1.0 mSv/year) above background was derived for chronic-duration external exposure (365 days or more), based on the BEIR V (1990) report that the average annual effective ionizing radiation dose to the U.S. population is 360 mrem/year (3.6 mSv/year), a dose not expected to produce adverse health effects.

The EPA has not derived reference concentrations (RfCs) or reference doses (RfDs) for stable or radioactive cesium (IRIS 2002). The IRIS database does not provide cancer assessments for radio-isotopes of cesium. This function is the responsibility of the EPA Office of Radiation and Indoor Air (ORIA). All radionuclides, including radioisotopes of cesium, are classified as known human (Group A) carcinogens. This classification is based on results of epidemiological studies of Japanese atomic bomb survivors, underground uranium miners, radium dial painters, and patients subjected to a variety of radiation treatments, as well as results of laboratory animal research and mammalian tissue culture studies. ORIA has published cancer slope factors (mortality and morbidity cancer risk estimates) for all known radionuclides, by various exposure routes (inhalation, drinking water ingestion, food ingestion, soil ingestion, immersion in a cloud, and external exposure from contaminated soil) for five age groups and 14 radiogenic cancer sites (EPA 2000). Slope factors for ¹³⁷Cs and ¹³⁴Cs are listed in Table 8-2.

Table 8-1. Regulations and Guidelines Applicable to Cesium

Agency	Description	Information	Reference
INTERNATIONAL	•		
Guidelines:			14.00.0000
IARC		No data	IARC 2000
NATIONAL Regulations and			
Guidelines:			
a. Air			
ACGIH	TLV (8-hour TWA for a 40-hour workweek)		ACGIH 2000, 2001
	Cesium hydroxide (based on upper respiratory tract, skin, and eye irritation)	2 mg/m ³	
EPA	,	No data	
NIOSH	REL (10-hour TWA for a 40-hour workweek		NIOSH 1992, 2000
	Cesium hydroxide (based on skin, eye, and respiratory irritation)	2 mg/m ³	
OSHA	,	No data	
b. Water		No data	
c. Food		No data	
d. Other STATE		No data No data	
OTAIL		NO data	

ACGIH = American Conference of Governmental Industrial Hygienists; EPA = Environmental Protection Agency; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; OSHA = Occupational Safety and Health Administration; REL = recommended exposure limit; TLV = threshold limit value; TWA = time weighted average

Table 8-2. Regulations and Guidelines Applicable to Radioactive Cesium

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NTERNATIONAL Guidelines: IARC 14RC 2000	Agency	Description	Information	Reference
IARC NATIONAL Regulations and Guidelines: a. Air ACGIH		NAL		
NATIONAL Regulations and delines:				
Regulations and Guidelines: a. Air			No data	IARC 2000
a. Air ACGIH ACGIH ACGIH BPA Detection limits for man-made beta particle and photon emitters NIOSH NRC Effluent concentrations—air 134°Cs 137°Cs 2x10-10 μCi/mL NRC 1999a 10 CFR 20 App B		and Outstalling an		
ACGIH EPA Detection limits for man-made beta particle and photon emitters NIOSH NRC Effluent concentrations—air 134 Cs 137 Cs C. Food FDA Derived intervention level® (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs 137 Cs 137 Cs 138 Cs 137 Cs 138 Cs 137 Cs 138 Cs 139 Cs 139 Cs 138 Cs 139 Cs 143 Cs 143 Cs 150 C	•	nd Guidelines:		
EPA Detection limits for man-made beta particle and photon emitters NIOSH 2000 N				4.0.0111.0000
Photon emitters No data A0 CFR 141.25 NIOSH NRC Effluent concentrations—air 134°Cs 2x10°10 μCi/mL 10 CFR 20 App B 138′CS 2x10°10 μCi/mL NRC 1999a 10 CFR 20 App B NRC Effluent concentrations—water NRC 1999a 10 CFR 20 App B 138′CS 131°Cs 1210°8 μCi/ml PDA 1998 C. Food FDA Derived intervention level® (DIL; Bq/kg food) in accidentally-contaminated human food 138′CS 139°CS 1360 C. Other EPA Concentration levels for environmental compliance 134°CS 139′CS 1.9x10°14° Ci/m³ 40 CFR 61 App E FDA 1999a A0 CFR 61 App E 138°CS 1.9x10°14° Ci/m³ EPA 2002 FDA 1999a				
NRC Effluent concentrations—air 134 Cs 137 Cs 2x10 ⁻¹⁰ μCi/mL NRC 1999a 10 CFR 20 App B NRC 1999a	EPA		·	40 CFR 141.25
134 Cs 137 Cs 2x10 ⁻¹⁰ μCi/mL 10 CFR 20 App B	NIOSH		No data	NIOSH 2000
b. Water NRC Effluent concentrations—water 134°Cs 9x10*7 μCi/mL b. Water NRC Effluent concentrations—water 134°Cs 9x10*7 μCi/ml 137°Cs 137°Cs 1x10*6 μCi/ml c. Food FDA Derived intervention level³ (DIL; Bq/kg food) in accidentally-contaminated human food 134°Cs 930 1360 d. Other EPA Concentration levels for environmental compliance 134°Cs 137°Cs 19x10*14 Ci/m³ 129°Cs 10x10*14 Ci/m³ 129°Cs 10x10*14 Ci/m³ 129°Cs 129°Cs 10x10*14 Ci/m³ 129°Cs 129°Cs 10x10*14 Ci/m³ 129°Cs 12	NRC			
b. Water NRC Effluent concentrations—water				10 CFR 20 App B
NRC Effluent concentrations—water 134 Cs 9x10-7 μCi/ml 137 Cs 1x10-6 μCi/ml C. Food FDA Derived intervention level³ (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs 930 1360 d. Other EPA Concentration levels for environmental compliance 134 Cs 0.7x10-14 Ci/m³ 137 Cs 1.9x10-14 Ci/m³ Carcinogenicity—slope factors⁵ Lifetime risk per pCi—ingestion Water 134 Cs 4.22x10-11 137 Cs 3.04x10-11 Food 134 Cs 5.14x10-11 137 Cs 3.74x10-11 Soil 136 Soil 137 Cs 5.81x10-11 137 Cs 4.33x10-11 Lifetime risk per pCi—inhalation 134 Cs 4.33x10-11 Lifetime risk per pCi—inhalation 134 Cs 4.33x10-11 Lifetime risk per pCi—inhalation 134 Cs 1.65x10-11		¹³⁷ Cs	2x10 ⁻¹⁰ µCi/mL	
134 Cs 137 Cs 1x10-6 μCi/ml 137 Cs 1x10-6 μCi/ml EDA 1998 FDA Derived intervention level ⁸ (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs 930 137 Cs 1360 d. Other EPA Concentration levels for environmental compliance 134 Cs 137 Cs 1.9x10-14 Ci/m³ Carcinogenicity—slope factors ^b EPA 2002 Lifetime risk per pCi—ingestion Water 134 Cs 4.22x10-11 137 Cs 3.04x10-11 Food 133 Cs 5.14x10-11 Soil 137 Cs 5.81x10-11 Soil 134 Cs 5.81x10-11 134 Cs 4.33x10-11 Lifetime risk per pCi—inhalation 134 Cs 1.65x10-11 Lifetime risk per pCi—inhalation 134 Cs 1.65x10-11	b. Water			
c. Food FDA 1998 FDA Derived intervention level ^a (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs 930 137 Cs 1360 d. Other EPA Concentration levels for environmental compliance 134 Cs 0.7x10 ⁻¹⁴ Ci/m³ 137 Cs 1.9x10 ⁻¹⁴ Ci/m³ Carcinogenicity–slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water 134 Cs 4.22x10 ⁻¹¹ 137 Cs 3.04x10 ⁻¹¹ Food Food Food Soil 134 Cs 5.14x10 ⁻¹¹ 137 Cs 5.81x10 ⁻¹¹ 134 Cs 5.81x10 ⁻¹¹ 137 Cs 5.81x10 ⁻¹¹ 134 Cs 1.37 Cs 1.8x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.85x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.85x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.85x10 ⁻¹¹	NRC		_	10 CFR 20 App B
C. Food FDA Derived intervention level ^a (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs 137 Cs 1360 d. Other EPA Concentration levels for environmental compliance 134 Cs 137 Cs 10.7x10 ⁻¹⁴ Ci/m ³ 10.7x10 ⁻¹⁴ Ci/m ³ Carcinogenicity—slope factors ^b Carcinogenicity—slope factors ^b Lifetime risk per pCi—ingestion Water 134 Cs 137 Cs 1.9x10 ⁻¹⁴ Ci/m ³ EPA 2002 EPA 2002 EPA 2002 EPA 2002 Lifetime risk per pCi—ingestion Water 134 Cs 137 Cs 3.04x10 ⁻¹¹ Food 134 Cs 137 Cs 3.74x10 ⁻¹¹ Soil 134 Cs 137 Cs 3.74x10 ⁻¹¹ Soil 134 Cs 137 Cs 4.33x10 ⁻¹¹ Lifetime risk per pCi—inhalation 134 Cs 1.65x10 ⁻¹¹			•	
FDA Derived intervention level³ (DIL; Bq/kg food) in accidentally-contaminated human food 134 Cs		¹³⁷ Cs	1x10 ⁻⁶ µCi/ml	
accidentally-contaminated human food 134 Cs 137 Cs 1360 d. Other EPA Concentration levels for environmental compliance 134 Cs 137 Cs 1.9x10 ⁻¹⁴ Ci/m³ 1.9x10 ⁻¹⁴ Ci/m³ Carcinogenicity—slope factors ^b 1.9x10 ⁻¹⁴ Ci/m³ Carcinogenicity—slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water 134 Cs 137 Cs 3.04x10 ⁻¹¹ Food 134 Cs 137 Cs 3.74x10 ⁻¹¹ Soil Soil 134 Cs 137 Cs 3.74x10 ⁻¹¹ Soil 134 Cs 137 Cs 4.33x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.65x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.65x10 ⁻¹¹	c. Food			FDA 1998
d. Other EPA	FDA	accidentally-contaminated human food		
d. Other EPA			930	
EPA Concentration levels for environmental compliance 40 CFR 61 App E 134 Cs		¹³⁷ Cs	1360	
compliance 40 CFR 61 App E 134 Cs 0.7x10 ⁻¹⁴ Ci/m³ 1.9x10 ⁻¹⁴ Ci/m³ Carcinogenicity–slope factors ^b 1.9x10 ⁻¹⁴ Ci/m³ Carcinogenicity–slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water 134 Cs 4.22x10 ⁻¹¹ 137 Cs 3.04x10 ⁻¹¹ Food 134 Cs 5.14x10 ⁻¹¹ 5oil 137 Cs 3.74x10 ⁻¹¹ Soil 134 Cs 5.81x10 ⁻¹¹ Soil 137 Cs 4.33x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134 Cs 1.65x10 ⁻¹¹	d. Other			
134Cs 0.7x10 ⁻¹⁴ Ci/m ³ 1.9x10 ⁻¹⁴ Ci/m ³ Carcinogenicity–slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water 134Cs 4.22x10 ⁻¹¹ 137Cs 3.04x10 ⁻¹¹ Food 134Cs 5.14x10 ⁻¹¹ 5oil 134Cs 5.81x10 ⁻¹¹ Soil 134Cs 5.81x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134Cs 1.65x10 ⁻¹¹ Lifetime risk per pCi–inhalation	EPA			
137Cs 1.9x10 ⁻¹⁴ Ci/m ³ Carcinogenicity–slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water 134Cs 4.22x10 ⁻¹¹ 137Cs 3.04x10 ⁻¹¹ Food 134Cs 5.14x10 ⁻¹¹ 3.7Cs 3.74x10 ⁻¹¹ Soil 134Cs 5.81x10 ⁻¹¹ Soil 137Cs 4.33x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134Cs 1.65x10 ⁻¹¹			44 2	40 CFR 61 App E
Carcinogenicity–slope factors ^b EPA 2002 Lifetime risk per pCi–ingestion Water				
Lifetime risk per pCi–ingestion Water 134Cs			1.9x10 ⁻¹⁴ Ci/m ³	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				EPA 2002
$^{134}\text{Cs} \qquad \qquad 4.22 \times 10^{-11} \\ ^{137}\text{Cs} \qquad \qquad 3.04 \times 10^{-11} \\ \text{Food} \\ ^{134}\text{Cs} \qquad \qquad 5.14 \times 10^{-11} \\ ^{137}\text{Cs} \qquad \qquad 3.74 \times 10^{-11} \\ \text{Soil} \\ ^{134}\text{Cs} \qquad \qquad 5.81 \times 10^{-11} \\ ^{137}\text{Cs} \qquad \qquad 4.33 \times 10^{-11} \\ \text{Lifetime risk per pCiinhalation} \\ ^{134}\text{Cs} \qquad \qquad 1.65 \times 10^{-11} \\ \\ $		• • •		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$				
Food $^{134}\text{Cs} \qquad 5.14\text{x}10^{-11}$ $^{137}\text{Cs} \qquad 3.74\text{x}10^{-11}$ Soil $^{134}\text{Cs} \qquad 5.81\text{x}10^{-11}$ $^{137}\text{Cs} \qquad 5.81\text{x}10^{-11}$ Lifetime risk per pCi–inhalation $^{134}\text{Cs} \qquad 1.65\text{x}10^{-11}$		¹³⁴ Cs		
$^{134}\text{Cs} \qquad \qquad 5.14 \times 10^{-11} \\ ^{137}\text{Cs} \qquad \qquad 3.74 \times 10^{-11} \\ \text{Soil} \\ ^{134}\text{Cs} \qquad \qquad 5.81 \times 10^{-11} \\ ^{137}\text{Cs} \qquad \qquad 4.33 \times 10^{-11} \\ \text{Lifetime risk per pCiinhalation} \\ ^{134}\text{Cs} \qquad \qquad 1.65 \times 10^{-11} \\ \\$		^{13/} Cs	3.04x10 ⁻¹¹	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		Food		
Soil ^{134}Cs 5.81×10^{-11} 4.33×10^{-11} Lifetime risk per pCi–inhalation ^{134}Cs 1.65×10^{-11}		¹³⁴ Cs		
134Cs 5.81x10 ⁻¹¹ 137Cs 4.33x10 ⁻¹¹ Lifetime risk per pCi–inhalation 134Cs 1.65x10 ⁻¹¹		¹³⁷ Cs	3.74x10 ⁻¹¹	
Lifetime risk per pCi–inhalation 134 Cs 4.33x10 ⁻¹¹ 1.65x10 ⁻¹¹		Soil		
Lifetime risk per pCi–inhalation 1.65x10 ⁻¹¹		¹³⁴ Cs		
¹³⁴ Cs 1.65x10 ⁻¹¹		¹³⁷ Cs	4.33x10 ⁻¹¹	
		Lifetime risk per pCi-inhalation		
¹³⁷ Cs 1.19x10 ⁻¹¹				
		¹³⁷ Cs	1.19x10 ⁻¹¹	

Table 8-2. Regulations and Guidelines Applicable to Radioactive Cesium

Agency	Description	Information		Reference	
NATIONAL (cont.)					
	External exposure-risk/year per pCi/g soil			EPA 2002	
	¹³⁴ Cs	7.10x10 ⁻⁶			
	¹³⁷ Cs 5.32x10 ⁻¹⁰				
	¹³⁷ Cs (plus disintegration products)	2.55x10 ⁻⁶			
NRC	Occupational inhalation exposure			NRC 1999a	
	ALIs			10 CFR 20 App B	
	¹³⁴ Cs	100 μCi 200 μCi			
	¹³⁷ Cs				
	DACs				
	¹³⁴ Cs	4x10 ⁻⁸ μCi/mL 6x10 ⁻⁸ μCi/mL 10 μCi 10 μCi			
	¹³⁷ Cs				
	Quantities of licensed material requiring labeling			NRC 1999b	
	¹³⁴ Cs			10 CFR App C	
	¹³⁷ Cs				
<u>STATE</u>					
a. Air					
Michigan	Gross beta particle activity			MI Dept Environ	
	¹³⁴ Cs	15 pCi/L		Quality 2000	
b. Water		No data			
c. Food		No data			
d. Other					
Louisiana	Quantity required for consideration of need for		Quantity	LA Dept Environ	
	emergency plan for responding to a release	fraction		Quality 2000	
	¹³⁴ Cs		2,000 Ci		
	¹³⁷ Cs	0.01	3,000 Ci		

^aThe FDA-recommended Derived Intervention Level (DIL) for radionuclides of cesium, is defined as the DIL for the most sensitive age group (adults) that was calculated from the most limiting Protective Action Goal (PAG; 5 mSv committed effective whole body dose equivalent).

ACGIH = American Conference of Governmental Industrial Hygienists; ALI = annual limitations on intake; CFR = Code of Federal Regulations; DAC = derived air concentrations; EPA = Environmental Protection Agency; FDA = Food and Drug Administration; IARC = International Agency for Research on Cancer; NIOSH = National Institute for Occupational Safety and Health; NRC = Nuclear Regulatory Commission; OSHA = Occupational Safety and Health Administration

^bEPA classifies all radionuclides as Group A (known human) carcinogens. Radionuclide risk coefficients, or slope factors, are calculated by EPA's Office of Radiation and Indoor Air (ORIA) to assist HEAST users with risk-related evaluations and decision-making at various stages of the remediation process. Ingestion and inhalation slope factors are central estimates in a linear model of the age-averaged, lifetime attributable radiation cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested, expressed as risk/picocurie (pCi). Ingestion values are tabulated separately for ingestion of tap water, dietary intakes (food), and incidental soil ingestion. External exposure slope factors are central estimates of the lifetime attributable radiation cancer incidence risk for each year of exposure to external radiation from photon-emitting radionuclides distributed uniformly in a thick layer of soil, and are expressed as risk/year per pCi/gram of soil.