

# Plutonium

Page 17 of the PSR-LA Appeal makes two incorrect statement about plutonium.

Plutonium is NOT *“one of the most toxic substances on earth.”* This is a favorite myth perpetuated by the anti-nuclear crowd. Google “most toxic substances on earth” and you will find carbon monoxide and asbestos listed, as well as more esoteric biological and toxic poisons. But you will not find plutonium listed. Plutonium is certainly hazardous if inhaled into the lungs, and to a lesser extent, if ingested. But if it is in a sealed container and stays outside the body, plutonium radioisotopes are relatively harmless, being principally alpha emitters and low energy gammas emitters that is easily shielded. The radiotoxicity of Pu-239, if inhaled, is certainly, one of the more radiotoxic alpha emitters, though is comparable to more common naturally occurring alpha emitting radionuclides. The following presents airborne concentrations (in  $\mu\text{Ci/mL}$ ) that if inhaled over the course of one year would give a total lifetime dose of 50 millirem, together with background threshold values in soil (in  $\text{pCi/g}$ ). Common naturally occurring uranium-238 and thorium-232 have concentrations in soil at least 100 times higher than plutonium-239 from fallout yet have comparable airborne (inhalation) limits.

<b>Radionuclide</b>	<b>Airborne (Inhalation) Limit (<math>\mu\text{Ci/mL}</math>)</b>	<b>Background Threshold Value in Soil (<math>\text{pCi/g}</math>)</b>
Plutonium-239	$2 \times 10^{-14}$	0.0142
Uranium-238	$6 \times 10^{-14}$	1.68
Thorium-232	$4 \times 10^{-15}$	2.95
Radium-226	$9 \times 10^{-13}$	1.88

The following table tests the assertion that *“a few millionths of an ounce [of plutonium], if inhaled, will cause lung cancer with a virtual 100% statistical certainty.”* This statement is shown to be incorrect. The excess lifetime cancer incidence risk (ELCR) is actually 0.18%. Using the same calculation, naturally occurring uranium-238 would have an ELCR of 0.059%, one third that of plutonium-239. Naturally occurring thorium-232 would have an ELCR of 0.89%, more than 4 ½ times that of plutonium-239.

Test of Hirsch's claim that few millionth's of an ounce of Pu-239 will cause 100% likelihood of cancer			Test for naturally occurring alpha emitters		
	Pu-238		U-238	Th-232	Ra-226
Breathing rate of reference man	2.0E+04	mL per minute	2.0E+04	2.0E+04	2.0E+04
	60	minutes per hour	60	60	60
	8,760	hours per year	8,760	8,760	8,760
Breathing rate of reference man	1.05E+10	mL per year	1.05E+10	1.05E+10	1.05E+10
<b>Derived Airborne Concentration (DAC) for the public (10CFR20, Appendix B)</b>	<b>2.0E-14</b>	<b>µCi per mL</b>	<b>6.0E-14</b>	<b>4.0E-15</b>	<b>9.0E-13</b>
Annual inhaled activity at DAC	2.1E-04	µCi	6.3E-04	4.2E-05	9.5E-03
<b>Specific activity</b>	<b>6.2E+04</b>	<b>µCi per gram</b>	<b>6.2E+04</b>	<b>6.2E+04</b>	<b>6.2E+04</b>
Annual inhaled mass at DAC	3.4E-09	gram	1.0E-08	6.8E-10	1.5E-07
	0.0353	ounce per gram	0.0353	0.0353	0.0353
Annual inhaled mass at DAC	9.6E-08	ounce	2.9E-07	1.9E-08	4.3E-06
Total lifetime dose at DAC	50	mrem	50	50	50
Hirsch's "few millionths of ounce"	3.0E-06	ounce	3.0E-06	3.0E-06	3.0E-06
Total lifetime dose at Hirsch's 3E-6 oz	1,560	mrem	520	7,802	35
BEIR VII radiation cancer incidence risk	1.1E-06	ELCR per mrem	1.1E-06	1.1E-06	1.1E-06
Excess lifetime cancer incidence risk (ELCR) at Hirsch's 3E-6 oz	<b>1.8E-03</b>	ELCR	<b>5.9E-04</b>	<b>8.9E-03</b>	<b>4.0E-05</b>
	<b>0.18%</b>		<b>0.059%</b>	<b>0.89%</b>	<b>0.0040%</b>