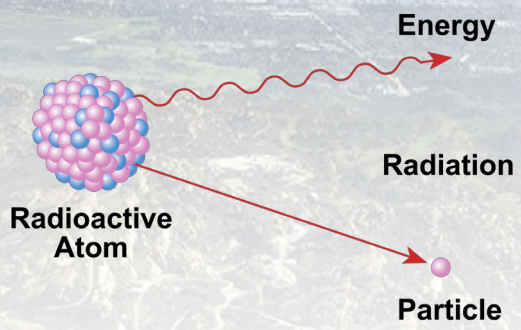
Toward Cleanup at Santa Susana

Environmental Impact Statement for Remediation of Area IV of the Santa Susana Field Laboratory

Radiation Basics

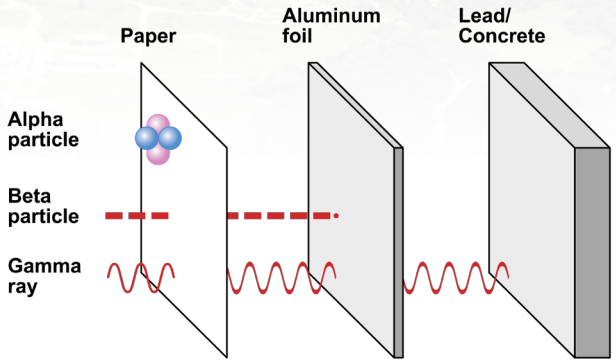


What is radiation? Radiation is energy emitted from unstable (radioactive) atoms in the form of atomic particles or electromagnetic waves. This type of radiation is also known as ionizing radiation because it can produce charged particles (ions) in matter.

What is radioactivity? Radioactivity is produced by the process of radioactive atoms trying to become stable. Radiation is emitted in the process. In the United States, radioactivity is measured in units of curies. Smaller fractions of the curie are the millicurie (1/1,000 curie), the microcurie (1/1,000,000 curie), and the picocurie (1/1,000,000 microcurie).

What is radioactive material? Radioactive material is any material containing unstable atoms that emit radiation.

What are the four basic types of ionizing radiation?



Alpha particles—Alpha particles consist of two protons and two neutrons. They can travel only a few centimeters in air and can be stopped easily by a sheet of paper or by the skin's surface.

Beta particles—Beta particles are smaller and lighter than alpha particles and have the mass of a single electron. A high-energy beta particle can travel a few meters in the air. Beta particles can pass through a sheet of paper, but may be stopped by a thin sheet of aluminum foil or glass.

Gamma rays—Gamma rays (and x-rays), unlike alpha or beta particles, are waves of pure energy. Gamma radiation is very penetrating and can travel several hundred feet in air. Gamma radiation requires a thick wall of concrete, lead, or steel to stop it.

Neutrons—A neutron is an atomic particle that has about one-quarter the weight of an alpha particle. Like gamma radiation, it can easily travel several hundred feet in air. Neutron radiation is most effectively stopped by materials with high hydrogen content, such as water or plastic.

What are the sources of radiation?

Natural sources of radiation—(1) Cosmic radiation from the sun and outer space; (2) natural radioactive elements in the earth's crust; (3) natural radioactive elements in the human body; and (4) radon gas from the radioactive decay of uranium naturally present in the soil.

Manmade sources of radiation—Medical radiation (x-rays, medical isotopes), consumer products (TVs, luminous dial watches, smoke detectors), nuclear technology (nuclear power plants, industrial x-ray machines), and fallout from past worldwide nuclear weapons tests or accidents (Chernobyl).

What is radiation dose? Radiation dose is the amount of energy of ionizing radiation absorbed per unit mass of any material. The basic unit in the United States for measuring radiation dose is the rad (radiation absorbed dose). To show biological risk and the probability of harmful effect, the rad is converted to rem (radiation equivalent to man). The rem reflects tissue dose and takes into account the type of radiation absorbed and the likelihood of damage from the different types of radiation. Because exposures are normally in fractions of a rem, the commonly used unit of exposure is the millirem (mrem). One thousand millirem equals one rem.

Average Annual Radiation Dose from Natural and Manmade Sources

Globally, humans are exposed constantly to radiation from the solar system and the Earth's rocks and soil. This radiation contributes to the natural background radiation that always surrounds us. Manmade sources of radiation also exist, including medical and dental x-rays, household smoke detectors, and materials released from nuclear and coal-fired power plants. The attached table shows average annual radiation in the United States.

Source	Average Annual Dose (millirem)
Cosmic Radiation (from outer space)	
If your home is located at sea level your cosmic radiation dose is:	26
If you live above sea level your dose must be adjusted by the addition of the following amounts:	
Elevation up to 1,000 feet	2
Elevation 1,000 to 2,000 feet	5
Elevation 2,000 to 3,000 feet	9
Elevation 3,000 to 4,000 feet	15
Elevation 4,000 to 5,000 feet	21
Elevation 5,000 to 6,000 feet	29
Elevation 6,000 to 7,000 feet	40
Elevation 7,000 to 8,000 feet	53
Elevation above 8,000 feet	70
Terrestrial Radiation (from the ground)	
Terrestrial radiation varies by location; if you live in the:	
Gulf States or Atlantic Coast regions	23
Colorado plateau	90
Elsewhere in the United States	46
Internal Radiation (in your body)	
From food and water (e.g., potassium)	40
From air (radon)	200
Plutonium-powered pacemaker	100
Porcelain crowns or false teeth	0.07
Travel Related Sources	
For each 1000 miles traveled by jet:	1
Miscellaneous Sources	
Nuclear weapons test fallout (global)	1
Brick, stone, or concrete home construction	7
Luminous wrist watch	0.06
Watching television	1
Computer use	0.1
Home smoke detector	0.08
Each medical x-ray	40
Each nuclear medicine procedure	14
Living within 50 miles of a nuclear power plant	0.009
Living within 50 miles of a coal fired power plant	0.03

Note: The amount of radiation exposure is usually expressed in millirem. In the United States, the average person is exposed to an effective dose equivalent of approximately 360 millirem (whole-body exposure) per year from all sources (NCRP Report No. 93). These doses are based on the American Nuclear Society's brochure "Personal Radiation Dose Chart." The primary sources of information are the National Council on Radiation Protection and Measurements Reports No. 92, 95, and 100. Values in the table are general averages and do not provide data for precise individual dose calculations.

Source: U.S. EPA website at http://www.epa.gov/radiation/understand/calculate.html (January 2008).

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