Facts about cesium-137, iodine-131, strontium-90, and plutonium

*The following fact sheets were produced by the **Centers for Disease Control and Prevention (CDC**) and are available online with links to other important resources about radiation and health. Cesium-137, iodine-131, strontium-90, and plutonium are the principal radioisotopes of concern during the crisis at the Fukushima 1 Nuclear Power Plant in Japan, as a result of reactor explosions, fires, and releases of radioactive steam following the 8.9 Richter scale earthquake and tsunami on 11 March, 2011.*

Radioisotope Brief: Cesium-137 (Cs-137)

(http://www.bt.cdc.gov/radiation/isotopes/cesium.asp)

Half-life: 30.17 years

Mode of decay: Beta and gamma radiation

Chemical properties: Liquid at room temperature, but readily bonds with chlorides to form a powder.

What is it used for?

Cs-137 is used in small amounts for calibration of radiation-detection equipment, such as Geiger-Mueller counters. In larger amounts, Cs-137 is used in medical radiation therapy devices for treating cancer; in industrial gauges that detect the flow of liquid through pipes; and in other industrial devices to measure the thickness of materials, such as paper, photographic film, or sheets of metal.

Where does it come from?

Cs-137 is produced by nuclear fission for use in medical devices and gauges. Cs-137 also is one of the byproducts of nuclear fission processes in nuclear reactors and nuclear weapons testing. Small quantities of Cs-137 can be found in the environment from nuclear weapons tests that occurred in the 1950s and 1960s and from nuclear reactor accidents, such as the Chernobyl power plant accident in 1986, which distributed Cs-137 to many countries in Europe.

What form is it in?

Because it readily bonds with chlorides, Cs-137 usually occurs as a crystalline powder, rather than in its pure liquid form.

What does it look like?

Small amounts of Cs-137 are incorporated into Lucite disks, rods, and seeds. Larger Cs-137 sources are enclosed in lead containers (such as long tubes that are closed at each end) or small round metal containers. If the lead containers of Cs-137 are opened, the substance inside looks like a white powder and may glow. Cs-137 from nuclear accidents or atomic bomb explosions cannot be seen and will be present in dust and debris from fallout.

How can I be exposed to Cs-137?

Small amounts of Cs-137 are present in the environment from weapons testing in the 1950s and 1960s, so people are exposed to some Cs-137 every day. However, Cs-137 is dangerous in the large, concentrated amounts found in radiation therapy units and industrial gauges. The sources in these devices are designed to remain sealed and keep people from being exposed; however, if these canisters are intentionally or accidentally opened, the Cs-137 inside could be dispersed.

How can it hurt me?

External exposure to large amounts of Cs-137 can cause burns, acute radiation sickness, and even death. Exposure to Cs-137 can increase the risk for cancer because of exposure to high-energy gamma radiation. Internal exposure to Cs-137, through ingestion or inhalation, allows the radioactive material to be distributed in the soft tissues, especially muscle tissue, exposing these tissues to the beta particles and gamma radiation and increasing cancer risk.

Radioisotope Brief: Iodine-131 (I-131)

(http://emergency.cdc.gov/radiation/isotopes/iodine.asp)

Half-life: 8.06 days

Mode of decay: Beta particles and gamma radiation

Chemical properties: I-131 can change directly from a solid into a gas, skipping the liquid phase, in a process called sublimation. I-131 dissolves easily in water or alcohol. I-131 readily combines with other elements and does not stay in its pure form once released into the environment.

What is it used for?

I-131 is used in medicine to diagnose and treat cancers of the thyroid gland.

Where does it come from?

I-131 is produced commercially for medical and industrial uses through nuclear fission. It also is a byproduct of nuclear fission processes in nuclear reactors and weapons testing.

What form is it in?

In medicine, I-131 is supplied in capsules or liquid of a specific activity designed to be swallowed by patients. As a product of nuclear fission, it is a dark purple gas that can be inhaled, or absorbed through the skin. I-131 in fallout from nuclear weapons or reactor accidents can occur in particle form, which can be ingested in food or water.

What does it look like?

Pure I-131 is a non-metallic, purplish-black crystalline solid. However, because it readily binds with other elements, I-131 usually is found as a compound rather than in its pure form. For medical purposes, the I-131 capsules contain small granules of I-131 sodium iodide that are designed to be swallowed by patients. Liquid I-131 sodium iodide used to diagnose and treat thyroid disease is a clear liquid.

How can it hurt me?

External exposure to large amounts of I-131 can cause burns to the eyes and on the skin. Internal exposure can affect the thyroid gland, a small organ located in the neck near the Adam's apple. The thyroid gland uses iodine to produce thyroid hormones and cannot distinguish between radioactive iodine and stable (nonradioactive) iodine. If I-131 were released into the atmosphere, people could ingest it in food products or water, or breathe it in. In addition, if dairy animals consume grass contaminated with I-131, the radioactive iodine will be incorporated into their milk. Consequently, people can receive internal exposure from drinking the milk or eating dairy products made from contaminated milk. Once inside the body, I-131 will be absorbed by the thyroid gland exposing it to radiation and potentially increasing the risk for thyroid cancer or other thyroid problems.

Radioisotope Brief: Strontium-90 (Sr-90)

(http://emergency.cdc.gov/radiation/isotopes/strontium.asp)

Half-life: 29.1 years

Mode of decay: Beta radiation

Chemical properties: Chemically reactive; can create halide, oxide, and sulfide compounds

What is it used for?

Because Sr-90 generates heat as it decays, it is used as a power source for space vehicles, remote weather stations, and navigational beacons. It also is used in industrial gauges and medically, in a controlled manner, to treat bone tumors.

Where does it come from?

Sr-90 is produced commercially through nuclear fission for use in medicine and industry. It also is found in the environment from nuclear testing that occurred in the 1950s and 1960s and in nuclear reactor waste and can contaminate reactor parts and fluids.

What form is it in?

Sr-90 is a soft metal. It can be present in dust from nuclear fission after detonation of nuclear weapons or a nuclear power plant accident.

What does it look like?

In its pure form, Sr-90 is a soft, shiny silver metal, but it quickly changes to yellow when exposed to air.

How can it hurt me?

Sr-90 can be inhaled, but ingestion in food and water is the greatest health concern. Once in the body, Sr-90 acts like calcium and is readily incorporated into bones and teeth, where it can cause cancers of the bone, bone marrow, and soft tissues around the bone.

Sr-90 decays to yttrium 90 (Y-90), which in turn decays by beta radiation so that wherever Sr-90 is present Y-90 is also present. Because of the beta radiation, Y-90 poses a risk of burns to the eyes and on the skin from external exposure.

Radioisotope Brief: Plutonium

(http://emergency.cdc.gov/radiation/isotopes/plutonium.asp)

Plutonium-238 (Pu-238)
Half-life: 87.7 years

Plutonium-239 (Pu-239)
Half-life: 24,110 years

Plutonium-240 (Pu-240)
Half-life: 6,564 years

Mode of decay: Alpha particles

Chemical properties: Solid under normal conditions, plutonium can form compounds with other elements.

What is it used for?

Plutonium-238 generates significant heat through its radioactive decay process, which makes it useful as a heat source for sensitive electrical components in satellites, as a well as a power source (for example, battery power) for satellites. Plutonium-239 is used to make nuclear weapons. Pu-239 and Pu-240 are byproducts of nuclear reactor operations and nuclear bomb explosions.

Where does it come from?

Plutonium is created from uranium in nuclear reactors. It is a by-product of nuclear weapons production and nuclear power operations.

What form is it in?

Plutonium is a solid material that is fashioned into rods for use in nuclear reactors and into ceramic ?buttons? for use in satellite systems.

What does it look like?

Plutonium is a silvery-gray metal that becomes yellowish when exposed to air. Most plutonium in the environment is in the form of microscopic particles that are the remnants of nuclear weapons testing and nuclear reactor accidents.

How can it hurt me?

Because it emits alpha particles, plutonium is most dangerous when inhaled. When plutonium particles are inhaled, they lodge in the lung tissue. The alpha particles can kill lung cells, which causes scarring of the lungs, leading to further lung disease and cancer. Plutonium can enter the blood stream from the lungs and travel to the kidneys, meaning that the blood and the kidneys will be exposed to alpha particles. Once plutonium circulates through the body, it concentrates in the bones, liver, and spleen, exposing these organs to alpha particles. Plutonium that is ingested from contaminated food or water does not pose a serious threat to humans because the stomach does not absorb plutonium easily and so it passes out of the body in the feces.