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How Dangerous is the Plutonium from the Japanese Nuclear Plant?

By Washington's Blog
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Theme: Environment
In-depth Report: Nuclear War

MSNBC reports that plutonium has been found in soil around the Fukushima plant:

> The Tokyo Electric Power Co., which operates the plant, said it found three radioactive isotopes of plutonium — plutonium 238, 239 and 240 — in five locations outside the plant in soil tests on March 21-22.

NHK tv notes that a giant crane fell over and probably crushed spent fuel rods at in Fukushima reactor number 3, which contain a plutonium-uranium mix.

CNN points out:

> Plutonium can be a serious health hazard if inhaled or ingested, but external exposure poses little health risk, according to the U.S. Environmental Protection Agency.

As the Argonne National Laboratory notes:

> Essentially all the plutonium on earth has been created within the past six decades by human activities involving fissionable materials.
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> Atmospheric testing of nuclear weapons, which ceased worldwide by 1980, generated most environmental plutonium. About 10,000 kg were released to the atmosphere during these tests.
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> Average plutonium levels in surface soil from fallout range from about 0.01 to 0.1 picocurie per gram (pCi/g).
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> Accidents and other releases from weapons production facilities have caused greater localized contamination.

So like radioactive cesium and iodide – which I discussed yesterday – plutonium doesn't exist in nature in any significant quantity, and so "background radiation" is a meaningless concept.

Plutonium stays radioactive for a long time. Pu-238 has an 88-year half-life, Pu-239 has a 24,000-year half-life, and Pu-240 has a 6,500-year half life.

As I noted yesterday, “internal emitters” (radioactive substances which get inside our bodies) are more dangerous than “external emitters”. Plutonium is not that dangerous as an external emitter, but deadly as an internal emitter.

As Argone National Labs notes:

> When plutonium is inhaled, a significant fraction can move from the lungs through the blood to other organs, depending on the solubility of the compound. Little plutonium (about 0.05%) is absorbed from the gastrointestinal tract after ingestion, and little is absorbed through the skin following dermal contact. After leaving the intestine or lung, about 10% clears the body. The rest of what enters the bloodstream deposits about equally in the liver and skeleton where it remains for long periods of time, with biological retention halflives of about 20 and 50 years, respectively, per simplified models that do not reflect intermediate redistribution. The amount deposited in the liver and skeleton depends on the age of the individual, with fractional uptake in the liver increasing with age. Plutonium in the skeleton deposits on the cortical and trabecular surfaces of bones and slowly redistributes throughout the volume of mineral bone with time.
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> Plutonium generally poses a health hazard only if it is taken into the body because all isotopes except plutonium-241 decay by emitting an alpha particle, and the beta particle emitted by plutonium-241 is of low energy. Minimal gamma radiation is associated with these radioactive decays. However, there is an external gamma radiation hazard associated with plutonium-244 from it short-lived decay product neptunium-240m. Inhaling airborne plutonium is the primary concern for all isotopes, and cancer resulting from the ionizing radiation is the health effect of concern. The ingestion hazard associated with common forms of plutonium is much lower than the inhalation hazard because absorption into the body after ingestion is quite low. Laboratory studies with experimental animals have shown that exposure to high levels of plutonium can cause decreased life spans, diseases of the respiratory tract, and cancer. The target tissues in those animals were the lungs and associated lymph nodes, liver, and bones.

NPR claims:

> Although plutonium is a long-lived emitter of radiation, it is also quite heavy, so it is not likely to move very far downwind from its source.

However, plutonium from Chernobyl has been discovered in Sweden and Poland.

So plutonium might be heavier than other radioactive materials, but it is not so heavy that it can’t travel hundreds of miles in the right circumstances.

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