Nuclear Disaster

Radioactive Materials Derived from Nuclear Accidents

	H-3 Tritium	Sr-90 Strontium-90	I-131 Iodine-131	Cs-134 Cesium-134	Cs-137 Cesium-137	Pu-239 Plutonium-239
Types of radiation	β	β	β, γ	β, γ	β, γ	α, γ
Biological half-life	10 days *1 *2	50 years *3	80 days *2	70-100 days *4	70-100 days *3	Liver: 20 years *4
Physical half-life	12.3 years	29 years	8 days	2.1 years	30 years	24,000 years
Effective half-life (calculated from biological half-life and physical half-life)	10 days	18 years	7 days	64-88 days	70-99 days	20 years
Organs and tissues where radioactive materials accumulate	Whole body	Bones	Thyroid	Whole body	Whole body	Liver and bones

Effective half-life: The time required for the amount of radioactive materials in the body to reduce to half through biological excretion (biological half-life) and the physical decay (physical half-life) of the radioactive materials; The values are cited from the "Emergency Exposure Medical Text" (Iryo-Kagaku Sha).
Effective half-lives are calculated based on values for organs and tissues where radioactive materials accumulate as indicated in the table of biological half-lives.
*1: Tritium water; *2: ICRP Publication 78; *3: JAEA Technical Manual (November 2011); *4: Assumed to be the same as Cesium-137; *5: ICRP Publication 48

Four types of radioactive materials, Iodine-131, Cesium-134, Cesium-137, and Strontium-90, are the major concerns in relation to health and environmental effects of radioactive materials released into the environment due to the accident at Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi NPS. While various other materials were also released, they are known to have shorter half-lives than these four types or have been released in negligible amounts.

Iodine-131 has a short half-life of about 8 days, but once it enters the body, 10-30% will accumulate in the thyroid. If this happens, the thyroid will continue to be locally exposed to β-particles and γ-rays for a while.

Two types of radioactive cesium, Cesium-134 and Cesium-137, are the major causes of contamination due to nuclear plant accidents. Cesium-137 has a long half-life of 30 years and continues to contaminate the environment for a long time. Since radioactive cesium has similar chemical properties to potassium, it will be distributed throughout the body, like potassium. The biological half-lives of cesium and iodine vary depending on the age of the person, and are known to become shorter, the younger the person is.

Strontium-90 has a long half-life, and once it enters the body, it accumulates in bones because of its chemical properties similar to calcium. Since it does not emit γ-rays, it is not as easy as in the case of Cesium-134 and Cesium-137 to detect where and how much it exists in the body. In a nuclear plant accident, Strontium-90 is also produced as a result of nuclear fission, though smaller in quantity than Cesium-134 and Cesium-137. Plutonium-239 and the like derived from the accident at TEPCO's Fukushima Daiichi NPS have also been detected, but detected amounts are almost equal to the results of the measurement conducted all over Japan before the accident.
(Related to p.30 of Vol. 1, "Products in Nuclear Reactors")

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