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Iodine-131

■ **General:** Its name is from the Greek word "iôeides," meaning "violet colored," after the violet color of iodine in a gas form. As a solid it is shiny, black and non-metallic. In its non-radioactive form occurs on land and in sea in sodium and potassium compounds, and is necessary for proper functioning of the thyroid.

■ **Half-life:** 8.04 days.

■ **Atomic number:** 53.

■ **Decay mode:** beta radiation.

■ **Sources:** Fission product created in nuclear reactors and in nuclear weapons explosions.

■ **Release of iodine-131 per kiloton of fission explosive power:** 125,000 curies.

■ **National Cancer Institute estimate of iodine-131 releases from the Nevada Tests:** 150 million curies.

■ **Organ most affected:** thyroid.

■ **Main pathway:** milk.

■ **Other pathways:** ingestion of other dairy products, vegetables, fruits, and eggs; inhalation; and external irradiation.

■ **Direct physical effects:** radioactive iodine damages or destroys thyroid cells.

■ **Health effects:** Increased risk of thyroid tumors, notably in children. Likely increase of thyroid cancer risk in children exposed before the age of 15 years. Children under five at highest risk. Females have more than twice the risk of males. Linked to other thyroid disorders, such as autoimmune hypothyroidism, autoimmune thyroiditis, hyperthyroidism incident to Grave's disease, and thyroid nodules.

■ **NCI estimate of thyroid dose from Nevada Tests averaged over entire country:** 2 rad.

■ **NCI estimate of thyroid dose to children aged 3 months to five years in high fallout areas:** 27 to 112 rad.

■ **Official iodine-131 release estimate from Chernobyl:** 7.3 million curies—decay-corrected to ten days after the start of the accident.

■ **Iodine-131 inventory in the Chernobyl reactor on April 26, 1986, the day the accident started:** approximately 83 million curies.

■ **IEER's rough estimate of actual releases from Chernobyl over the course of the ten-day fire:** 10 to 15 million curies (assuming the official estimate of a 20% release fraction is correct).

Chronology of External Radiation Exposure Standards

1931–34	US Advisory Committee on X-Ray and Radium Protection (precursor to the National Council on Radiation Protection and Measurements) adopts X-ray "tolerance dose" of 0.1 roentgen *per day.*
1940–41	US Advisory Committee proposes, but does not implement, lowering the X-ray tolerance dose to 0.02 roentgen *per day.*
1942	U. of Chicago Metallurgical Laboratory adopts a "maximum permissible exposure" standard of 0.1 roentgen *per day.* Becomes standard for entire Manhattan Project.
1954	Atomic Energy Commission adopts National Bureau of Standards recommended dose limit of 5 rem *per year.* Sets additional limits for internal exposures at 15 rem per year for most organs.
1959	Dose limit for workers remains 5 rem per year. AEC also adopts dose limits for the public equal to one-tenth of those allowed for workers: 0.5 rem for external exposure; and 1.5 rem for most organs for internal exposure.
late 1980s –1990	Department of Energy adopts dose limit for the public of 100 millirem (0.1 rem) per year; dose limit for workers remains 5 rem per year. A new model for calculation of internal doses to workers is adopted, the "*committed effective dose equivalent.*" (See main article.)
1991	International Committee for Radiological Protection recommends worker dose limit be reduced to 2 rem per year. Recommendation is not adopted by DOE.

NOTE: For external radiation sources, roentgen and rem are considered to be equivalent.

Sources: 1931–34, 1940–41, and 1942: Barton Hacker, *The Dragon's Tail*, (Berkeley: University of California Press, 1987), Appendix A, pp. 163–64; 1954: US Atomic Energy Commission, AEC Manual, TN-000-22, Chapter 0522, Vol. 0000, Part 0500, AEC-0522-01, BMBP, (US AEC, Feb. 26, 1954), 0522-01.h; and National Bureau of Standards (NBS) *Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissile Concentrations in Air and Water*, Handbook 52, (Washington: US Dept. of Commerce, March 20, 1953); 1959: NBS, *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure*, Handbook 69, (Washington: US Dept. of Commerce, June 5, 1959), pp.4-6; late 1980s–1990: US Dept. of Energy, Office of Environmental Safety and Health, *Order: DOE 5400.5*, (US DOE, February 8, 1990), II.1a; 1991: International Commission on Radiological Protection, *1990 Recommendations of the International Commission on Radiological Protection*, ICRP Publication 60. Annals of the ICRP, Vol. 21, No. 1–3, (Oxford, New York: Pergamon Press, 1991), p. 72. parg. (S25).

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Worker Radiation Dose Records Deeply Flawed

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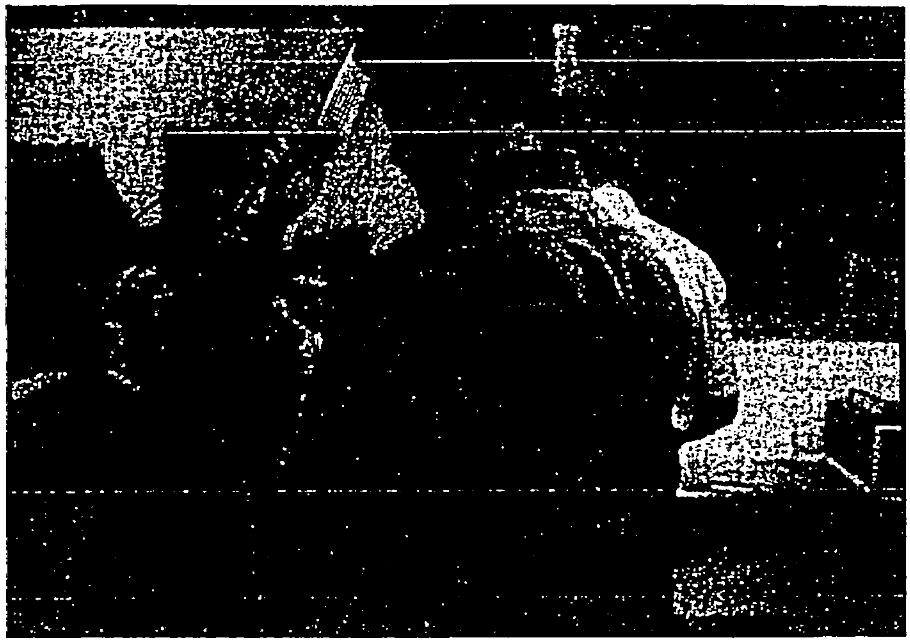

ROBERT DEL TREDICI

A worker at the Plutonium Finishing Plant at Hanford, Washington receives a whole-body survey to detect potential radioactive contamination.

As part of its responsibility for the production and testing of nuclear weapons, the Department of Energy (DOE) and its predecessor agencies (the Atomic Energy Commission, 1947–1974; and the Energy Research and Development Administration, 1974–1977) have been responsible for ensuring that workers were not exposed to more than the allowable amounts of radiation. The DOE has also been responsible to adhere to what is called the "ALARA" principle—the idea that radiation exposures should be kept "As Low As Reasonably Achievable" with available technology.

The goal of setting radiation dose limits and following the ALARA guideline is to protect worker health by limiting exposure. But if exposure is not properly measured, radiation exposure regulations cannot be enforced. nor can guidelines be followed. Health monitoring personnel may not be aware of instances when workers are overexposed. Diseases that workers may be at greater risk of contracting may go undetected, harming them and their families. Health studies based on worker dose data would produce misleading results because dose records would be incomplete and knowledge of doses would be inaccurate.

From the beginning of the nuclear era until 1989, *radiation doses from radioactive materials inhaled or ingested by workers were not calculated or included in worker dose records*. This was revealed by DOE in a background paper sent to IEER on April 7, 1997.[1] DOE and its predecessor agencies did make measurements of internal exposure to radioactive materials, though often sporadic (see below), mainly by taking urine samples. After the mid-to-late 1960s, there was also selective use of more sophisticated counters that

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Editorial

Identify Groups of Workers at Risk

As noted in the accompanying article, the Department of Energy has stated that it did not calculate internal doses for workers, and therefore did not integrate them into dose records until 1989. This single fact means that historical worker dose records for 500,000 to 600,000 DOE workers are open to question and that a large number of them—those belonging to workers at risk of internal exposure—are flawed.

The DOE was not actually required to do such integration of internal and external doses, as we note in the article. Still, in the 1950s it was possible to crudely calculate internal worker doses and enter them into worker dose records (though such estimates would often have underestimated exposures). Relatively precise estimates were possible after the mid-1960s by matching up urine data with direct measurements of lung burdens, as IEER did in the case brought against

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