RADIATION: THE MYTH OF THE MILLIREM

Natural and Man-Made Radiation
The Nuclear Age generates and processes massive amounts of radioactive material and waste. Processing uranium for use as nuclear fuel for generating electricity, in nuclear weapons and other nuclear applications, has exposed millions of workers and ordinary people worldwide to radiation. Fission in nuclear reactors and the detonation of nuclear weapons result in the generation of new sources of radioactivity. All life on Earth is exposed to and impacted by natural sources of ionizing radiation. Radiation exposures are increasing due to planned and accidental releases of man-made radioactivity.

Ionizing radiation is the emission of energetic particles (alpha, beta, neutron) or rays (gamma and x-rays) from a radioactive isotope--also called a radionuclide. These emissions may knock off an electron in its target, thus resulting in ionization. When something absorbs the energy of the ray or the particle, irradiation occurs. When a living being absorbs it, that individual has received a "dose" of radiation.

Curies, Rads, and Rems
The pioneers of the Nuclear Age invented units for measuring radioactivity. The measure of radio - active decay--the **curie** (named for Madame Marie Curie)--is the count, per second, of radioactive emissions, also called "disintegrations." One curie is that amount of a radioactive material that gives off 37 billion radioactive particles or rays per second. This unit is a fixed standard, and concentrations in curies (or fractions of a curie) per gram or per liter, and per second or per minute, can be verified with proper instrumentation.

Translating the curie amount into a potential **dose** to a living organism is far from precise. Unlike the curie, which has a clear definition, the units for estimating impacts of radiation on living tissues--rads, rems and millirems--are based on models and assumptions. Estimates of the biological impacts of exposure to specific types of radiation have been based on animal experiments and on a limited number of human experiments. Some estimates of dose are based on data collected from the survivors of the Hiroshima and Nagasaki bombs, even when the given situation is different.

The **Rad** is used to measure the energy absorbed by tissue that is exposed to radioactivity. In Europe the unit for 100 Rads is called a Gray.

The **Rem** combines the amount of radiation exposure (Rad) with its alleged impact on health. The estimated damage or "biological effectiveness" of the radiation is based on models. In Europe the unit for 100 Rems is called a Sievert. The prefix, "milli," denotes one-thousandth of a unit. For example: one rem equals 1,000 millirems.

The Rem (the unit of radiation dose) is not based upon a standard unit that can be verified. One must know the duration of exposure, amount and type of radioactivity involved, the size of the body that absorbed it, and what that radiation event did to the particular body in question. Even under very controlled conditions, it is virtually impossible to derive each of these data points with certainty. In uncontrolled conditions, such as accidental releases and doses to the "general population," as we are known, it is even less possible to gather this information accurately.

The Standard Man

Emblematic of the arbitrary nature of dose assessment is the invention of the Standard Man**:** a fictional or contrived individual whose physical characteristics have been defined by officials who set radiation standards. Sadly, the nuclear pioneers who were charged with overseeing a work force of not-so-standard men did not take variability into account. Nor did they assess the differing impacts on women, fetuses, infants, children and elders. The work of the late Dr. Alice Stewart confirms that many groups of human beings are not comparable to the Standard Man.

When a radioactive release happens, and the dose to those impacted is estimated or "reconstructed," the characteristics of the Standard Man and the standardized assumptions about the impact of radiation on the Standard Man are used as the basis for the estimated dose. The many differences between real people and

the Standard Man are not considered when estimating the official dose to individual members of the public.

Radiation Effects on Real People

Exposure to radiation increases the risk of damage to tissues, cells, DNA and other vital molecules--potentially causing programmed cell death (apoptosis), genetic mutations, cancers, leukemias, birth defects, and reproductive, immune, cardiovascular, and endocrine system disorders. The varying impacts on health of each of the hundreds of different nuclides to which people may be exposed are simply not known.

Since scientists do not truly know the specific impacts a given radionuclide may have on the organs and tissues of a specific person, the translation of the amount of radioactivity to which that person has been exposed (in curies or fractions of a curie) into a radiation dose (in rems or millirems) is basically speculation. That is, determining the quality and the quantity of a radiation dose is far from an exact science.

The late Dr. Donnell Boardman, a physician with many years of medical observation of nuclear workers, explained that no two radiation exposures are ever the same, even to the same individual. Ongoing research about the biochemical and physical impacts of ionizing radiation on living cells by British scientists Eric Wright and Carmel Mothersill, and others, confirms Dr. Boardman's observation. A single alpha particle, acting on a single cell, may damage that cell to the same degree as if a thousand x-rays had hit it. That is, one radiation particle can cause great damage to a single cell**;** that damage can even lead to a person's death, while registering a dose to the total body of zero!

"Permissible" Does NOT Mean Safe

Since the beginning of the Atomic Age, radiation standards have been set by governments based on advice from commissions composed of representatives of industries, governmental agencies, academic institutions and the medical profession involved in nuclear technologies. The standards so devised are lenient enough to allow the nuclear industry to continue exposing its workers and the public to levels of radiation decreed to be "permissible," and to continue contaminating our air, water, and soil. Permissible does not mean safe, but merely expedient.

In the U.S. the "protection" standards are usually written in rems and millirems. Since dose in rems or millirems cannot be verified, our "legal protection standards" for workers and the public cannot be verified. These standards must be taken for exactly what they are**: a myth**. Unfortunately, the radiation and its likely impacts on health are real.

The US Nuclear Regulatory Commission (NRC) has provided ample evidence of the non-verifiability of the millirem in how it has revised its radiation standards. Although in 1991 the NRC announced that it had lowered its maximum annual radiation dose for a worker and a member of the public, it actually increased the permissible levels of concentration --- in air and water --- of some radionuclides inside the workplace and in releases to our environment.

Please Don't Tell Us What You Don't Know

The "mythical millirem" has given a false legitimacy to official pronouncements about risk from exposure to radiation. Whether promoting the deregulation of radioactive waste for use in consumer products, or reporting on Chernobyl, Three Mile Island and other nuclear accidents**,** the nuclear industry minimizes the dangers of radiation and does not admit to the many uncertainties about monitoring and calculating the amounts of radioactivity to which workers and the public may be exposed, or its impact on our health.

A prominent health physicist admitted after an accident at the Tokaimura nuclear fuel factory in Japan in 1999, "The local government took external measurements where there was no possibility of measurement, nor were they measuring for the appropriate type of radiation **. . . .** We as a profession need to stop taking actions solely to pacify a population, when there is absolutely no benefit, and more importantly, no scientific merit."

It is time to reject the term, millirem. We should request instead that official statements about nuclear accidents, materials and facilities include data given in curies of specific radionuclides, and that authorities make it clear that the health consequences of any resulting exposure cannot be standardized or accurately predicted. Therefore any claim of "no damage to the public" has no credible basis except as one more convenient myth. --*Mary Fox Olson & Kay Drey, November 2003*

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