



Risks of Exposure to Low-Level Ionizing Radiation

Humans are constantly exposed to low levels of ionizing radiation,¹ referred to as background radiation.² While the data are clear that high levels of radiation exposure lead to an increased risk of humans developing cancer, the data are inconclusive for lower levels of radiation exposure on the order of background radiation. Given the uncertainty associated with the effects of exposure to low levels of ionizing radiation, a sustained low-dose radiation research program coordinated with international efforts is warranted to enhance scientific and public understanding of the actual risks associated with radiation. Improving risk communication practices associated with radiation risk and developing a fuller understanding of the societal responses to radiation risk must be an important part of this program. Also, regulatory practices should be reviewed to ensure they are being applied appropriately and consistently.

The linear no-threshold (LNT) model, in which radiation harm is assumed to increase linearly with exposure and zero harm exists only at zero exposure, is integral to current radiation protection regulations involving low-level ionizing radiation exposures. However, the LNT model may not adequately describe the relationship between harm and exposure. As an example of LNT model limitations, the International Commission on Radiological Protection (ICRP) recommends that the LNT model *not* be used for estimating the health effects of trivial exposures received by large populations over long periods of time because such estimates are not reasonable.³ The LNT model has been a subject of vigorous debate and criticism as potentially overpredicting health effects. Because of limitations of the LNT model, long-term research in low-level ionizing radiation exposure is needed to determine whether these exposures result in any relevant health impacts and how such information should be used in risk-informed decision-making.

In addition to setting exposure limits for ionizing radiation, regulatory agencies and industry standard-setting organizations often pursue additional reductions in dose, consistent with the principle of “As Low As Reasonably Achievable,” or ALARA. ALARA is intended to be an optimization process in which the costs associated with any potential dose reduction are balanced against the benefits in a risk-informed decision-making process considering all appropriate factors. Unfortunately, current implementation of ALARA often results in a practice of dose minimization rather than a risk-informed optimization, which can lead to more harm than benefit.

Despite the long-term nature of low-level ionizing radiation research, government and industry should make near-term changes to their implementation and/or enforcement of radiation protection regulations and practices to better align them with the intended application of ALARA. Additionally, certain near-term actions can help facilitate improved communication regarding the opportunities and challenges associated with nuclear and radiological technologies among all stakeholders, including industry, scientists, policymakers, regulators, and the public.

It is the position of the American Nuclear Society that:

1. Regulatory bodies at all levels of government and all those responsible for implementing radiation protection programs must ensure that radiation protection is practiced in accordance with the intended application of ALARA as an optimization tool to appropriately consider risk.
2. A comprehensive review of all radiation protection regulations and practices should be undertaken by the National Research Council of the National Academies, the National Council on Radiation Protection and Measurements, or similarly qualified

organization, to ensure they are consistent with the optimization approach described above and harmonized appropriately.

3. Radiation risk communication research and outreach, and a robust social science research program, should be prioritized to help promote science-informed perspectives regarding the risks and benefits of nuclear and radiological technologies in all industries.
4. Congress should establish a long-term low-dose radiation research program to improve knowledge of human biological responses resulting from low-dose and low-dose-rate ionizing radiation exposures. This program should be robustly funded and integrated into a comprehensive global research and development program.

References

1. A form of radiation that includes alpha particles, beta particles, gamma rays, X-rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. Compared to nonionizing radiation, such as radio waves, microwaves, and visible, infrared, or ultraviolet light, ionizing radiation is considerably more energetic. When ionizing radiation passes through material such as air, water, or living tissue, it deposits enough energy to produce ions by breaking molecular bonds and displacing (or removing) electrons from atoms or molecules.
2. On average, Americans receive a radiation dose of about 0.62 rem (620 millirem) each year (about half from natural background radiation and half from manmade sources). Background exposure comes from radon in the air, with smaller amounts coming from cosmic rays and from the Earth itself. Manmade sources of radiation include medical, commercial, and industrial sources. See <https://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html>.
3. ICRP Publication 103, Chapter 4, paragraph (161); available for free at <http://icrp.org/page.asp?id=5>.



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