BEYOND NUCLEAR FACT SHEET

RADIATION BASICS

What is Radiation?

Radiation is energy that travels in waves or particles. Each type of radiation has different properties. *Non-ionizing* radiation can shake or move molecules. *Ionizing* radiation, the kind expelled from nuclear reactors, can actually break molecular bonds in our cells, causing unpredictable chemical reactions. Humans cannot see, feel, taste, smell or hear ionizing radiation. Unavoidable exposure to ionizing radiation comes from cosmic rays and some natural material like rocks or soil. Human exposure to natural radiation is responsible for a certain number of mutations and cancers. *Any* additional exposure above natural background radiation can result in otherwise preventable disease since there is no safe dose.

From Alpha to gamma

Alpha particles are high energy, large subatomic structures. They can't travel very far and can be stopped by a piece of paper or skin. However, alpha particles hit hard and can do a great deal of damage once inhaled, ingested or otherwise taken inside the body, as through a cut in the skin. They have the power to tear through cells in organs or blood, releasing their tremendous energy to surrounding tissue and leaving extensive damage in their wake. A single track of one alpha particle can deliver a large dose of radiation to a cell. Plutonium is an alpha emitter and is produced in nuclear reactors. Other alpha emitters include radon gas, uranium, and americium.

Beta particles are electrons. They are a fraction of the size of alpha particles, can travel farther and are more penetrating. Betas pose a risk both outside and inside the body, depending on their energy level. External exposure can result in beta penetration through the surface to the most sensitive layers of skin. Inhalation or ingestion of a beta-emitting radionuclide poses the greatest risk. Externally, a half-inch of plexi-glass or water shielding can generally stop a beta. Strontium-90 and tritium are two beta-emitting radionuclides created by nuclear power reactors.

Gamma rays are the most penetrating type of radiation and can be stopped only by thick lead blocking their path**.** Cesium-137, Iodine-131and Iodine-129 are gamma emitters released from nuclear reactors.

Bioaccumulation

With man's increased uses of radioactive material, more radionuclides have been and continue to be released to the environment. Once released, they can circulate through the biosphere, ending up in drinking water, vegetables, grass, meat, etc. As we eat these contaminated foods, we incorporate radionuclides into our bodies. The higher an animal eats on the food chain, the higher the concentration of radionuclides. This is bioaccumulation and can be especially harmful to humans since many of us eat at the top of the food chain.

Measuring radiation

A **becquerel** (Bq) is a unit that measures radioactive decay per second. The higher the becquerel, the more radioactive.

The **gray (Gy)** is a unit of absorbed dose. It represents the amount of any type of ionizing radiation actually deposited in any kind of material.

The **sievert (Sv)** is used to express *effective* dose, a measure of the potential for biological damage from some amount of radiation. The sievert measurement is derived using formulas based on certain assumptions, therefore, it is not an actual measure and does not fully represent the range of damage, especially for sensitive groups, like women and children.

No safe dose

Radiation damage and protection levels are based on "Reference Man," a healthy, white male in the prime of life, and mostly ignore the more vulnerable fetus, growing infant and child, the aged, those in poor health, and women who are, according to the National Academy of Sciences 37- 50% more vulnerable than adult men to the harmful effects of ionizing radiation. These levels, therefore, do not take into account the far greater vulnerability of women and children, especially pregnant women and unborn children. Further, a panel from the U.S. National Academy of Sciences (NAS) charged to investigate the dangers of low-energy, low-dose ionizing radiation has concluded, "that it is unlikely that a threshold exists for the induction of cancers... (BIER VII, 2005)

Therefore, saying that there can be a "safe" level of radiation exposure is simply wrong. There is no guarantee that even the smallest doses of radiation will not cause harm.

How Radiation Harms

Ionizing radiation travels through our living tissue with much more energy than either natural chemical, or biological functions. This extra energy tears mercilessly at the very fabric of what makes us recognizably human—our genetic material. Elderly and people with immune disorders are more susceptible to ionizing radiation. Women are more susceptible to this damage then men and children more susceptible than adults. Children and the unborn are especially susceptible because of their rapid and abundant cell division during growth. Female children are the most susceptible.

Cancers linked to ionizing radiation exposure include most blood cancers (leukemia, lymphoma) lung cancer, and many solid tumors of various organs. Heart ailments are also associated with radiation exposure.

Additionally, evidence exists that radiation is permanently and unpredictably mutating the gene pool and contributing to its gradual weakening. The New Scientist quotes a report that calls genetic or chromosomal instabilities caused by radiation exposure a "plausible mechanism" for explaining illnesses other than cancer, including "developmental deficiencies in the fetus, hereditary disease, accelerated aging and such non-specific effects as loss of immune competence."

A living being's genetic material is the library that houses the instructions for many important aspects of that being and his or her offspring including the ability to defend against a myriad of diseases. If we allow ionizing radiation to tamper with our genes, it could cause irreversible damage, not just to this generation through cancer, but to future generations through gene mutations and ensuing disease.