SUMMARY

2.10 Ionizing Radiation

What is radiation?

Radiation is energy that moves through space in the form of waves and particles. We are constantly exposed to radiation of all kinds, but the radiation of most concern is ionizing radiation.

What is ionizing radiation?

Ionizing refers to the ability of higher energy radiation to create electrically charged particles called ions in the material it penetrates, including human tissue.

What form of ionizing radiation is emitted by radioactive materials?

Radioactive materials emit ionizing radiation in the form of alpha and beta particles and X-rays and gamma rays. An alpha particle is essentially a helium nucleus with a positive charge of 2 (2 protons) and an atomic weight of 4 (2 protons and 2 neutrons). Beta particles are negative electrons. X-rays and gamma rays are waves of pure energy.

2.11 Identification of Atoms

What is nuclear radiation?

Because the ionizing radiation from radioactive materials comes from the nuclei of the radioactive atoms in the material, it is called "nuclear radiation." The individual radioactive atoms, which are identified by the number of protons and neutrons in their nuclei, are often called radioisotopes. The number of protons (i.e., the atomic number) determines what an atom is. For example, uranium has the highest naturally occurring atomic number, 92.

What makes an atom what it is?

2.12 Sources of Radioisotopes

Where do radioisotopes come from?

There are many naturally occurring radioisotopes in the world. With a few important exceptions, nearly all result from the uranium and thorium present when the Earth was formed. There are also many manmade radioisotopes, most created by the use of uranium in nuclear reactors.

2.13 Radioactive Decay and Half-Life

Radioactive materials become less active with time by radioactive decay. The decay of a radioisotope is measured in half-lives. The half-life of a radioisotope is the time it takes for a quantity of that radioisotope to lose half of its activity. Half-lives of radioisotopes range from a fraction of a second to more than a billion years. For example, radioisotopes in spent nuclear fuel will be hazardous for hundreds of thousands of years.

2.14 Sources of Exposure

What is the annual average individual radiation exposure? How much from natural sources? How much from other sources?

The annual average radiation exposure of an individual in the United States, from all sources, is estimated at 360 mrem. Of this, 82% comes from natural sources: outer space, the air we breathe, the earth around us, and the food we eat. Essentially, the rest results from medical X-rays, nuclear medicine, and consumer products. Nuclear power and miscellaneous sources contribute much less than 1 percent.

2.15 Radiation Protection

It is important to use caution in handling highly radioactive materials. The shielded casks used to store or transport spent nuclear fuel are examples of how we use shielding to protect workers, the public, and the environment from exposure to ionizing radiation.

Planning for the permanent disposal of our Nation's nuclear waste is a complex undertaking that presents numerous challenges in terms of radiation protection. The waste must be transported safely to the disposal site. At the disposal site, the waste must be handled safely and packaged properly. Finally, it must be permanently isolated from the public and the environment for long periods of time.