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OVERVIEW OF TRITIUM: CHARACTERISTICS, SOURCES, AND PROBLEMS

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Abstract -- Tritium has certain characteristics that present unique challenges for dosimetry and health-risk assessment. For example, in the gas form, tritium can diffuse through almost any container, including those made of steel, aluminum, and plastics. In the oxide form, tritium can generally not be detected by commonly used survey instruments. In the environment, tritium can be taken up by all hydrogen-containing molecules, distributing widely on a global scale. Tritium can be incorporated into humans through respiration, ingestion, and diffusion through skin. Its harmful effects are observed only when it is incorporated into the body. Several sources contribute to the inventory of tritium in our environment. These are 1) cosmic ray interaction with atmospheric molecules; 2) nuclear reactions in the earth's crust; 3) nuclear testing in the atmosphere during the 1950s and 1960s; 4) continuous release of tritium from nuclear power plants and tritium production facilities under normal operation; 5) incidental releases from these facilities; and 6) consumer products. An important future source will be nuclear fusion facilities expected to be developed for the purpose of electricity generation. The principal health physics problems associated with tritium are 1) the determination of the parameters for risk estimation with further reduction of their uncertainties (e.g., relative biological effectiveness and dose-rate dependency); 2) risk estimation from complex exposures to tritium in gas form, tritium in oxide form, tritium surface contamination, and other tritium-contaminated forms, with or without other ionizing radiations and/or nonionizing radiations; 3) the dose contributions of elemental tritium in the lung and from its oxidized tritium in the gastrointestinal tract; 4) prevention of tritium (in oxide form) intake and enhancement of tritium (oxide form) excretion from the human body; 5) precise health effects information for low-level tritium exposure; and 6) public acceptance of tritium leakage and waste disposal from reactors and fuel reprocessing plants.