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ENVIRONMENTAL EFFECTS OF RADIATION EMERGENCIES

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RADIONUCLIDES

There are two main classes of radionuclides in nuclear reactors, fission products and those that are neutron-induced. The latter include transuranics (eg, plutonium-239, americium-241) produced from fuel and elements such as iron-55 formed by the interaction of neutrons and reactor materials (see Table 1).[1,2] Given the half-life in days of each isotope (column 2), the 100-year environmental commitment (column 3) is the integral of the radioactivity present for 100 years, assuming the worst possible event: that the entire inventory is released. The ingestion dose-conversion factor (column 4 from ICRP-30)[2] is the effective dose-equivalent commitment if one were to consume one curie of the radionuclide, assuming that <u>all</u> the material is ingested or inhaled. The final column, a hazard index in rems, does not include the fraction of a nuclide actually released--a crucial factor--or any consideration for nuclide transport, dispersion, or uptake. However, note that cesium-137 has the highest hazard index.

In considering the physical, chemical, and biological characteristics of radionuclides released during radiation emergencies, cesium, much like sodium, is distributed uniformly throughout the body. Strontium, and plutonium seek bone; iodine seeks the thyroid. Environmental impact depends on: (1) size of release, half-life of the isotope, and physical and chemical form (whether an aerosol, particulate, or solubilized); (2) manner of transport; (3) type of radiation (alpha, beta, or gamma); and (4) for internal exposures, the dose-conversion from the amount of activity ingested or inhaled to the actual dose delivered to the various organs.

HISTORIC REACTOR EMERGENCIES

Several emergencies have been discussed in these proceedings (see Table 2 for activities of various isotopes released during the Three Mile Island accident).[3] The relatively small numbers of the isotopes reflect the absence of health effects other than emotional stress in that locality. In contrast, figures for the Chernobyl release (see Table 3) are some million times larger.[4] A major concern was the thyroid-seeking iodine-131: 7.3 megacuries were released, which was 20% of the activity of this isotope in the core at the time of the explosion. A total of 1.5 megacuries of cesium-137 and cesium-134 also was released into the environment. The Soviets calculated a population dose of 210 million person-rem from the ingestion of cesium in food in the next century. Many other risk estimates have been based on this calculation.

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