Table 2

Definitions of radiation units and ionizing radiation doses

The *curie*: measure of activity, i.e. of the rate at which radioactive material disintegrates. 1 curie = 37 billion disintegrations per second, approximately the radioactivity of one gram of radium 226.

The *becquerel*: means 1 disintegration per second. 1 curie = 3.7×10^{10} becquerels, and 1 becquerel = 27 picocuries (10^{-12} curies).

The *gray*: measures the "absorbed dose", i.e. the amount of energy divided by the mass of the material in which it is absorbed. 1 gray (Gy) means that 1 joule of energy is being absorbed by 1 kilogram of mass. The milligray (mGy) is more commonly used.

The *rad*: formerly used to express absorbed dose; now replaced by the gray (1 rad = 0.01 Gy).

The *sievert*: equal absorbed doses of different types of radiation have different likelihoods of producing biological injury. To account for this, the absorbed dose is multiplied by a quality factor for the particular type of radiation, resulting in a "dose equivalent" measured in sieverts (Sv). For beta or gamma radiation, or X-rays, which have a weaker ionization density than does alpha radiation, the quality factor is 1 (1 Sv = 1 Gy); for neutrons, it varies between 1 and 10; and for alpha radiation it is equal to 10 (1 Sv = 10 Gy). It should be noted that the average Canadian receives between 1 and 2 millisieverts (mSv) per year from natural radiation sources in the environment. Three chest X-rays result in a dose of about 1 mSv.

The *rem*: formerly used to express dose equivalent; now replaced by the sievert (1 rem = 0.01 Sv). The rem (*r*öntgen *e*quivalent *m*an) will continue to be used from time to time until conversion to the new unit (Sv) is complete.

Sources: Jean-Michel Bader *et al.*, "Tchernobyl: les réponses aux 11 questions que tout le monde se pose", *Science et Vie*, No. 825, June 1986, p. 26.
Atomic Energy Control Board, "Definitions", *Control*, Ottawa, 1986, p. 6.

receives an average annual dose of 160 millirems of radiation, two-thirds of which comes from natural background sources. To put this amount in perspective, it should be borne in mind that an acute radiation dose of 50 rems or more, over a 24-hour period, results in radiation sickness within one hour to several weeks. The chance of surviving a dose above 1,000 rems is virtually nil; 0 to 10% for a dose of from 600 to 1,000 rems, and 50% for a dose of 400 rems. With a dose of 200 rems or less, survival is almost certain. However, other consequences can occur, ranging from gastrointestinal and circulatory disorders to long-term effects like cancer, birth abnormalities, genetic defects and poor general health. Long-term effects can also result from chronic exposure to low-level radiation, and it is this type of exposure, rather than acute doses, that is the concern with radioactive waste disposal.[17]

In formulating the concept of deep geological disposal of nuclear fuel wastes (discussed starting on page 16 and in Chapter 3) certain minimum requirements must be incorporated relating to radiological health and safety, conventional health and safety, environmental protection, usage safeguards, and transportation. Work is in fact underway on formulating specific criteria for each of these areas.

[17] United States Congress, Office of Technology Assessment, *Managing the Nation's Commercial High-Level Radioactive Water*, Washington, 1985, p. 23.