RADIOACTIVE RELEASES IN THE ENVIRONMENT: IMPACT AND ASSESSMENT

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order to estimate doses but later, measurement data will become available that will enable improved estimates to be made.

Doses from inhalation can usually be estimated in a straightforward manner from a knowledge of the average radionuclide concentration in air over the period of interest, CA (Bq m^{-3}), the breathing rate (m^3 per unit time) and the dose coefficients for inhalation for the radionuclides present.

Measured concentrations of radionuclides in particulate form in air can be obtained by passing large volumes of air through an air filter using a high-volume air sampler. Typically, these will trap particulate material of size greater than around 0.5 μm and will filter around 10 m^3 of air per minute. They will not trap radionuclides that are in the form of gases, such as ^{85}Kr, or, in many situations, isotopes of iodine, although the latter can be trapped in activated carbon filters. Returning to particulate material, the results from an air sampler will enable an estimate to be made of the average concentration in air over the period that the air sampler was operated. If the air sampler is operating during an accidental release of radionuclides, multiplication of this average value by the estimated release duration will give the *time-integrated air concentration* (Bq s m^{-3}). This is an important intermediate quantity in calculating doses from accidental releases to atmosphere. Doses from intakes of radionuclides by inhalation can be estimated by multiplying the time-integrated air concentration by the breathing rate (m^3 s^{-1}) to give the intake of radionuclide and then by the appropriate dose coefficient to yield the dose as follows:

$$\text{Dose} = \text{Time-integrated air concentration (Bq s m}^{-3}) \times \text{breathing rate (m}^3\ \text{s}^{-1}) \times \text{dose coefficient (Sv Bq}^{-1}) \qquad (16.5)$$

This simple calculation assumes that only one radionuclide is present. If there is a mixture of different radionuclides, radiochemical analysis or gamma-spectrometry will have to be performed on the filter in order to establish the amounts of the different radionuclides present. The calculation would have to be performed for each radionuclide separately and the results then summed.

Radionuclides present as particulate material in the atmosphere will deposit on the ground and give rise to doses from, for example, soil-associated pathways (see Section 16.3.1). Two mechanisms cause particulate material to deposit, i.e. impaction on the underlying surface, termed *dry deposition*, and the action of rain, termed *wet deposition*.

Deposits of radionuclides on the ground can be estimated from the time-integrated air concentration by multiplication by a deposition velocity appropriate for that form of material. The *deposition velocity* is defined as the ratio of the amount of material deposited on the surface per unit area per unit time, to the concentration in air per unit volume at the surface. Typical deposition velocities for dry deposition of micron-sized particulates are around 10^{-3} m s^{-1}. An appropriate deposition velocity for reactive gases, such as iodine, would be 10^{-2} m s^{-1}. Iodine in an organic form has a lower deposition velocity of around 10^{-5} m s^{-1}. Noble gases do not deposit on the ground and therefore have a deposition velocity of zero.

Thus, the calculation becomes: