

Radiation Biology, Protection and Applications
(PHYS-450)

Solutions

Week 13

Problem 1:

Ingestion of ^{137}Cs eating reindeer meat

In reindeer meat, a concentration of 500 Bq/kg of ^{137}Cs has been measured. What committed effective dose does a person receive on eating 250 grams of this meat?

Solution:

The committed effective dose for an adult:

$$E = A_{\text{ing}} \cdot e_{\text{ing}}(50)$$

The ingested radioactivity:

$$A_{\text{ing}} = 500 \text{ Bq/kg} \cdot 0,25 \text{ kg} = 125 \text{ Bq}$$

The committed effective dose equivalent (CEDE) of ^{137}Cs for ingestion for an adult:

$$e_{\text{ing}}(50) = 1,30\text{e-}8 \text{ Sv/Bq (from "ORaP", Annexe 5 art. 139, al. 2, et 194, al. 3)}$$

Therefore, the committed effective dose is $E = 125 \text{ Bq} \cdot 1,30\text{e-}8 \text{ Sv/Bq} = \mathbf{1,6 \mu\text{Sv}}$

Problem 2:

Inhalation of ^{131}I

The measured concentration of ^{131}I in a laboratory is 55 Bq/m³. What committed effective dose a person receives during 15 minutes light activity in this laboratory?

Hint: During light work, a reference person inhales 20 liters (0.02 m³) of air per minute. This corresponds to 60 mins. $\cdot 0.02 \text{ m}^3/\text{min.} = 1.2 \text{ m}^3$ per hour. The volume of air inhaled in 15 mins. is then $V = 1.2 \text{ m}^3/\text{h} \cdot 0.25 \text{ h} = 0.3 \text{ m}^3$.

Solution:

The committed effective dose for an adult:

$$E = A_{\text{inh}} \cdot e_{\text{inh}}(50)$$

The inhaled activity of ^{131}I :

$$A_{\text{inh}} = 55 \text{ Bq/m}^3 \cdot 0.3 \text{ m}^3 = 16 \text{ Bq}$$

The committed effective dose equivalent (CEDE) of ^{131}I for inhalation for an adult:
 $e(50) = 7.4\text{e-}9 \text{ Sv/Bq}$ (from “ORaP”, Annexe 5 art. 139, al. 2, et 194, al. 3)

Therefore, the committed effective dose is $E = 16 \text{ Bq} \cdot 7.4\text{e-}9 \text{ Sv/Bq} = \mathbf{1,2 \mu Sv}$