

QUESTION 13

You are the health physicist at a power reactor facility that uses continuous air monitors (CAMs) to measure airborne, beta-emitting particles near work activities that present some potential of generating airborne activity. The monitor uses a fixed-filter sample and a pancake-type GM detector contained inside a lead shield. The monitor reads out in counts per minute (cpm) and uses a strip chart to record data for historical purposes.

A maintenance job is to be performed within a contaminated area. Prior to performing work in the area, the filter paper on the monitor is replaced and the monitor is moved into place and turned on at 0800.

GIVEN

- Monitor flow rate: $1 \text{ ft}^3 \text{ min}^{-1}$
- Filter collection efficiency: 90%
- Counting efficiency: 0.30 c d^{-1} per beta disintegration
- Detector background (with fresh filter paper): 70 c min^{-1}
- DACs are based on ICRP 26 methodologies
- Radon progeny $T_{1/2}$ (effective) = 30 minutes

Isotope	DAC ($\mu\text{Ci}/\text{cm}^3$)	Inhalation ALI (μCi)
Co-60	1×10^{-8}	30
I-131	2×10^{-8} (Thyroid)	50
Cs-137	6×10^{-8}	200

POINTS

- 30** A. Particulate radon daughters are known to be present in the room at a beta concentration of $3 \times 10^{-10} \mu\text{Ci cm}^{-3}$ with an effective half-life of approximately 27 minutes. At 0900 hours, what count rate should be observed on the monitor? **State all assumptions. Show all work.**
- 20** B. At 0900 hours, work begins in the room where the air monitor is located. At 0945, the air in the room suddenly becomes contaminated. Over the next 10 minutes, the strip chart recorder shows that the count rate has increased by $40,000 \text{ c min}^{-1}$. Based upon this information, what is the estimated airborne concentration in the room, assuming that the half-life of the measured activity is much greater than 10 minutes? **State all assumptions and show all work.**

- 20 C. The workers leave the room at 0955 and report the incident to the health physics office. You suspect that the workers were exposed to a mixture of ^{137}Cs and ^{60}Co . To confirm your suspicions, you send the workers to have a whole body count. What are four advantages of a whole body count in this specific case over urine bioassay? **Number your responses. Only the first four will be graded.**
- 10 D. A count of the filter on a gamma spectroscopy system shows that the airborne radioactivity is due to 25% ^{60}Co , and the remainder due to ^{137}Cs . What is the potential Committed Effective Dose Equivalent (CEDE) for each hour of exposure if the air concentration is measured to be $2 \times 10^{-6} \mu\text{Ci cm}^{-3}$? **Show all work.**
- 20 E. Gamma spectroscopy screening of an air sample shows that ^{131}I and ^{137}Cs are present. The worker is exposed for 4 hours to the contaminated atmosphere, and inhales 2 ALI of ^{131}I and 0.5 ALI of ^{137}Cs . What are the Committed Effective Dose Equivalent and the Committed Dose Equivalent to the thyroid from this exposure? **Show all work.**