

QUESTION 13

You are the Radiation Protection Manager at an isotope separation facility. Upon your arrival at the plant this morning, you are informed that a pipe had ruptured 30 minutes prior to your arrival, emitting a dense aerosol mist. A worker successfully stopped the spill after 20 minutes, and has just exited the area. The worker was dressed in anti-contamination clothing, a full-face respirator, and was wearing a lapel air sampler for the duration of the entry.

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- Waste Stream
 - $^{137}\text{Cs} - 0.5 \text{ Ci L}^{-1}$
 - $^{90}\text{Sr} - 0.02 \text{ Ci L}^{-1}$
- Lapel air sampling rate: 4 L min^{-1} for 20 minutes
- Total volume of spilled material = 500 L
- Diameter of spill area = 10 m
- Breathing rate of worker: 20 L min^{-1}
- Protection Factor (PF) of respirator: 50
- Analysis of lapel sample
 - $^{137}\text{Cs} - 9 \times 10^7 \text{ dpm}$
 - $^{90}\text{Sr} - 2 \times 10^6 \text{ dpm}$
- G for $^{137}\text{Cs} = 0.33 \text{ R m}^2 \text{ hr}^{-1} \text{ Ci}^{-1}$
- ALI for class D $^{137}\text{Cs} = 200 \mu\text{Ci}$
- ALI for class Y $^{90}\text{Sr} = 4 \mu\text{Ci}$
- Assume that a gamma exposure of 1R delivers a dose equivalent of 1 rem
- Particle terminal setting velocity: $\frac{d_1^2 r_1 g}{18h} = \frac{d_2^2 r_2 g}{18h}$,
 where $g = 9.8 \text{ m s}^{-2}$ and h is the viscosity of air.

STATE ALL ASSUMPTIONS**POINTS**

- 30** A. Determine the external deep dose equivalent from ^{137}Cs photons to the worker. Assume that the worker was standing at the center of the spill for the 20 minutes and the dosimetric point of interest is 0.8 meters above the spill. Neglect any effects of self-shielding. **Show all calculations.**
- 40** B. Calculate the airborne radioactivity concentration of ^{90}Sr as measured by the lapel air sampler and the Committed Effective Dose Equivalent to the worker from the ^{90}Sr intake. **Show all calculations.**

- 30** C.
1. What do the letters AMAD stand for?
 2. Briefly describe the dosimetric significance of AMAD.
 3. If the spherical droplets have a specific gravity of 2.56 and a diameter of 5 μm , what is their AMAD? **Show all calculations.**