

QUESTION 5

You are a health physicist working at a nuclear power station. You are assigned the task of calculating potential dose rates from systems scheduled for maintenance during an upcoming outage to enable pre-staging of temporary shielding materials.

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- The sample coupon originally weighed 5 grams
- The sample was 100% ^{59}Co
- The dimensions of the sample are 1 cm x 3 cm x 0.2 cm
- The ^{59}Co (n, γ) ^{60}Co thermal neutron activation cross section is 37 barns
- Average thermal neutron fluence rate in the reactor is $1 \times 10^{10} \text{ n cm}^{-2} \text{ sec}^{-1}$
- Average fast neutron fluence rate is $4 \times 10^{10} \text{ n cm}^{-2} \text{ sec}^{-1}$
- ^{60}Co has a half-life of 5.27 years
- The specific gamma-ray exposure constant, Γ , for ^{60}Co is $1.3 \text{ R m}^2 \text{ Ci}^{-1} \text{ hr}^{-1}$

POINTS**STATE ALL ASSUMPTIONS**

- 20** A. Nine months ago, a sample coupon was removed from the reactor vessel. Plant records indicate that the sample had been in the reactor since initial start-up for a length of 22 effective full power years. What is the activity in the sample coupon currently? **State all assumptions and show all calculations.**
- 10** B. Assume that the activity of the coupon is 0.75 Ci. What is the exposure rate, in R hr^{-1} , that can be expected at a point 3 meters from the coupon? **State all assumptions and show all calculations.**
- 20** C. A worker will have to stand at a point 'X' that is 2.5 m away from the mid-point of a 0.5-cm diameter sample line that is 10 m long (See below). The interior of the line is uniformly contaminated with 4 Ci of ^{60}Co . What is the exposure rate at the point 'X', where the worker is standing? Neglect self-shielding in the pipe. **State all assumptions and show all calculations.**

