QUESTION 7

You are the health physicist for a new research accelerator facility that has both primary and secondary beam areas, and your field measurements show that the average ambient fluxes, (per cm^2 per sec), in the control room are 3000 3-MeV photons, 500 thermal neutrons, and 800 fast neutrons. The control room is used by 10 people who on the average work 40 hours per week, 50 weeks per year in the control room. A 5-m by 20-m concrete shielding wall between the control room and the accelerator room is 2-m-thick. The accelerator operates constantly for 40 hours per week and is designed for a 20 year operating lifetime.

GIVEN

Conversion between particle fluence and effective dose,

Neutron Energy	Sv per n/cm^2
Thermal	2.3×10^{-12}
Fast	1.2×10^{-10}

Photon Energy, MeV	Sv per photon/cm^2
1	3.27×10^{-12}
3	8.2×10^{-12}
5	1.2×10^{-11}

and dose attenuation coefficients.

Particle	E, cm^{-1}
Thermal neutrons	0.25
Fast neutrons	0.08
3-MeV Gammas	0.08

Concrete cost: $500 per cubic meter
ALARA: $2000 cost per person-rem saving

POINTS

20 A Calculate the annual collective effective dose in the control room. **Show all work**

30 B Calculate the concrete shielding wall thickness required to reduce the effective dose rate in the control room from 100 mrem/hr to 1 mrem/hr. (Assume dose buildup factor = 1). **Show all work.**

20 C Assume a collective dose rate of 1000 person-rem/yr in the control room with the existing shielding wall. Is it cost-effective to increase the shielding wall thickness to reduce this to 1 person-rem per year? **Show all work.**

30 D List six events/conditions that could lead to unusual exposures either in the primary or in the secondary beam areas (provide explanation to support each event/condition). (5 points for each answer). **Number your responses. Only the first six will be graded.**