Radiation Safety

Download, read, and understand the material at `http://physics.csuchico.edu/ayars/427/handouts/tipler_radiation_safety.pdf`, then answer the following questions:

1. In 1989, Stanley Pons and Martin Fleischman claimed to have achieved fusion in an electrochemical cell at room temperature. They claimed a power output of 4 W from deuterium-deuterium fusion in their electrodes. The two most likely reactions are

$$^2\mathrm{H} + {}^2\mathrm{H} \longrightarrow {}^3\mathrm{He} + n + 3.27 \text{ MeV}$$

$$^2\mathrm{H} + {}^2\mathrm{H} \longrightarrow {}^3\mathrm{H} + {}^1\mathrm{H} + 4.03 \text{ MeV}$$

   With 50% of the reactions going by each branch.

   (a) How many neutrons per second would we expect to be emitted in the generation of 4 W by this method?

   (b) If 10% of these neutrons were absorbed by an 80-kg researcher standing near the apparatus, and each neutron carries an average energy of 0.5 MeV with an RBE of 4, what is the researcher's dose in rems per hour?

   (c) How long would it take for the researcher to receive the LD50 dose of 500 rems?

2. There is a fairly "hot" ^{137}Cs source in a lead container in the lab.

   (a) Using a calibrated Geiger counter, determine the activity of the source. Consider distance and detector size in your calculation, and don't leave the container open longer than necessary.

   (b) If you were standing close enough to this source to absorb 10% of the radiation emitted, how long before you reached some relevant NRC dose limit, and what would that limit be?

   (c) Does use of this source in the lab present a health risk? Explain.

3. Repeat problem 2 for our 10 μCi ^{22}Na source. Again, clearly explain under what circumstances this source would present a health risk.