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ENVIRONMENTAL SCIENCES DIVISION

Interdepartmental letterhead

Mail Station L 453

Ext. 23840

September 13, 1984

To: Fred Hatch

From: Lynn Anspaugh

Subject: Risk of Developing Lung Cancer Following a Dose of 0.45 rad

At your request, I have examined what the probability might be of developing lung cancer following a dose of 0.45 rad. The most recent consideration of this problem has been done by Rall, et al., (Ref. 1) in order to derive probability of causation for individuals who have already developed cancer.

For lung cancer, Rall, et al., have adopted a nonthreshold linear-quadratic dose-response model to aid them in calculating basic risk coefficients from the radioepidemiological studies done on people who received high doses of radiation. Their tabulated risk coefficient for lung cancer for men exposed at ages of 20 to 34 years is 0.116 excess cancers per 100,000 persons per year per rad for low doses of low-LET radiation (Table VI-1 on p. 97). This number is based upon follow-up of individuals over the period of 10 to 30 years post exposure and accounts for a presumed latent period of 10 years. Thus, if we assume an individual is exposed at the age of 20 years and we want to calculate the risk of developing lung cancer over the next 50 years, the result is

$$\frac{0.116}{100{,}000 \text{ persons}\bullet\text{yr}\bullet\text{rad}} \times 0.45 \text{ rad} \times (50-10) \text{ yrs} = 2\times10^{-5}$$

This approach differs somewhat from that taken by the National Research Council's Committee on the Biological Effects of Ionizing Radiation (BEIR) in the BEIR-III report (Ref. 2). They used a nonthreshold linear dose-response model to calculate a risk coefficient and derived a value of 2.45 excess cases per million persons per year per rad for males aged 20 to 34 years at exposure 11 to 30 years after exposure. The risk calculated from this is then

$$\frac{2.45}{1{,}000{,}000 \text{ persons}\bullet\text{yr}\bullet\text{rad}} \times 0.45 \text{ rad} \times (50-10) \text{ yr} = 4\times10^{-5}$$

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In my opinion, these risk calculations are subject to a great deal of uncertainty. The true risk might be zero as radiation has not been demonstrated as a carcinogenic agent at such low doses (Refs. 2 and 3). The true risk might also be substantially higher as data for follow up periods beyond 30 years are considered. My understanding from Mort Mendelsohn is that the rate of occurrence of excess cancers attributable to radiation is increasing as the Japanese A-bomb survivor population ages beyond the 30-year follow-up point.

I would conclude that a reasonable estimate of the excess risk of lung cancer from 0.45 rad is between $1x10^{-5}$ and $1x10^{-4}$.

Presently, I have no knowledge of the benefits of the proposed study wherein members of the Armed Forces might receive such doses. However, I do want to call your attention to another area of risk to LLNL. At the present time, the University is being sued by many (hundreds?) of "atomic veterans" who allege injury from doses smaller than 0.45 rad. They, and the "downwind people", allege that they were "human guinea pigs" and the US Congress has supported this allegation (e.g., Ref. 4). The atomic veterans and the downwind people allege, of course, that their doses were much higher (without validity, in my opinion); and you can be sure that the new "guinea pigs" will also allege in years subsequent that their doses were much higher than 0.45 rad.

As several of these "atomic veteran" cases are now in litigation and the Veterans Administration has already provided compensation for harm alleged to be due to radiation doses of less than one rad, I think the conduct of such a study on humans would be ill advised. It is clear that, at the present time, a veteran cannot sue the US government for injury alleged to have resulted from such exposure and his recourse would be to sue the University of California.

If such studies are carried out, I suggest that heroic measures be made to document the dose received by every individual and that a committee of qualified persons review such calculations and plans before anyone is exposed.

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References

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2. Committee on the Biological Effects of Ionizing Radiations, The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980, National Academy Press, Washington, DC (1980).

3. High Background Radiation Research Group, China, "Health Survey in High Background Radiation Areas in China," Science 209, 877-880 (1980).

4. Committee on Interstate and Foreign Commerce, US House of Representatives, The Forgotten Guiena Pigs, US Government Printing Office, Washington, DC, Committee Print 96-IFC53 (1980).

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