



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
WASHINGTON, D.C. 20460

EPA-SAB-LTR-91-001

January 22, 1991

OFFICE OF  
THE ADMINISTRATOR

Honorable William K. Reilly  
Administrator  
U.S. Environmental Protection Agency  
401 M Street, SW  
Washington, DC 20460

Re: Letter Report on Radon Risk Estimates for General  
Population and Smokers, Non-Smokers, and Children

Dear Mr. Reilly:

The Radiation Advisory Committee of the Science Advisory Board has reviewed the February 15, 1990 draft document "Estimation of Risks from Indoor Radon Exposure." In his memorandum of February 17, 1990, the Director of the Office of Radiation Programs requested that the Science Advisory Board, "assess whether the scientific radon risk assessment information is appropriately summarized." Dr. Puskin of the Office of Radiation Programs briefed the Committee on the specifics of the risk estimates on February 18 and was available to discuss the document with the Committee at its public meeting May 17-18, 1990.

This document, prepared by Office of Radiation Programs staff, addresses risk to the general population as well as to the sub-populations of smokers, non-smokers and children. For estimating the risk of radon exposure to the general population, the Office of Radiation Programs essentially followed the earlier (June 1988) recommendation of the Radiation Advisory Committee that the average of the projection values from the National Academy of Sciences' model developed by the Board on the Effects of Ionizing Radiation (BEIR IV) and the International Commission on Radiological Protection's ICRP 50 Model be used (cf, letter to Honorable Lee M. Thomas of September 9, 1988; SAB-RAC-88-042). Since there has been no new scientific data reported since 1988, the Committee sees no reason to alter that recommendation.

The BEIR IV model in its projection assumes a decreased excess relative risk with time since exposure, a decreased risk with age of the individual, and a minimum latency period of 5 years.

The ICRP 50 model uses a constant excess relative risk but assigns a three-fold higher risk for exposure to children and young adults below the age of 20 years. Although there is admittedly limited evidence, the ICRP felt it prudent to assign a higher risk coefficient to children and young adults than to more mature individuals. The ICRP 50 model uses a minimum latency period of 10 years.

Both the BEIR V and ICRP 50 models are relative risk projection models based on data from studies of underground mining populations. Despite their differences, the two models project quite similar estimates of cancer fatalities for a lifetime exposure to a given concentration of radon.

The Office of Radiation Programs has introduced minor modifications to the two models: In the case of the ICRP 50 model ORP applied the same risk coefficient to adult members of the general population as had been determined for the mining populations from which the risk projection model was derived; the original ICRP 50 had reduced this risk coefficient by 20% when applied to the general population. In the BEIR IV model, the Office of Radiation Programs corrected the risk coefficient for the average background radon level. The results of these two modifications of the models are to increase the lifetime risk estimate by the former, and decrease the risk estimate by the latter; the average value of the two estimates remains essentially the same, however.

The Committee does not object to the modifications that the Office of Radiation Programs has introduced to the models. That the BEIR IV did not adjust for the average background level of radon might be viewed as a minor shortcoming of that model. The Office of Radiation Programs adjustment of the risk coefficient in the ICRP 50 model is based on the opinion that ICRP's 20% lowering of the risk coefficient to miners when applied to the general population is not warranted. In this regard, the Office of Radiation Programs is following the recommendation of the BEIR IV report. The conversion of exposure to dose for the two populations is fraught with great uncertainties and some of the known modifying factors are likely to cancel each other.

Overall, the lifetime risk projections for any of the models fall within the uncertainty range for those of the others and, as already pointed out, the "fine-tuning" of the models done by the Office of Radiation Programs did not change the average value of the estimates.

The average life-time risk projection value for the general public derived and used by the Office of Radiation Programs is 360 excess lung cancers per  $10^6$  person-working level months (WLM). For an average U.S. residential exposure of 0.25 WLM per year and for a population of 240 million, this translates to 21,600 deaths per year of 14% of all lung cancer deaths in the U.S.A. The Committee finds this value acceptable and as good as can be achieved at the present time. It would be highly desirable, however, to present this risk estimate with an uncertainty range, such as the range from the ICRP report as described in Section F of the document being reviewed.

There is an important relationship in lung cancer causation between cigarette smoking and exposure to radon. In order to establish a perspective on the combined risk of exposure to radon and smoking, the Office of Radiation Programs should qualify the overall population risk from exposure to radon in terms of smoking and indicate the comparative risks to smokers and non-smokers. The Office of Radiation Programs should provide advice that there is an increased risk of lung cancer from continuing exposure to elevated concentrations of indoor radon, and also that this risk is greatly increased by smoking because of the near-multiplicative interaction between radon exposure and smoking. Such advice would allow smokers to recognize that their overall risk may be greatly reduced by the combination of cessation of smoking and radon reduction.

In regard to the assumed greater risk for radon exposure in children, direct evidence is lacking. However, follow-up data on atomic bomb survivors in Japan indicate that individuals exposed as children may be a higher relative risk for radiation-induced cancer. In addition, dosimetric modeling suggests that for a given exposure to radon and radon daughters, children will receive a higher radiation dose to the bronchial epithelium than do adults.

One final comment is offered in regard to the present Office of Radiation Programs' estimate for risk from radon exposure. The Office of Radiation Programs should continue to review its risk estimate as new information is gained. The Committee understands that the Office of Radiation Programs has commissioned a National Academy of Sciences/National Research Council study of whether any correction should be required when using epidemiological data from underground uranium and iron miners for the estimation of radon risk to the general U.S. population. When the results of the National Academy of Sciences/National Research Council study become available, they should be reviewed, as changes in the current risk assessment may be warranted.

In conclusion, the Committee believes the Office of Radiation Programs has adequately treated the available information on lung cancer risk from radon and arrived at an estimate for lifetime risk for the general population which is as good as can be achieved at the present time. The Committee believes the Office of Radiation Programs should qualify the overall population risk from exposure to radon in terms of smoking and indicate the comparative risks to smokers and non-smokers. The Committee also believes it is prudent to assign a higher risk coefficient to children and young adults than to more mature individuals even if supportive evidence is limited in regard to this point. The Office of Radiation Programs should continue to review its risk estimate and risk assessment methodology as additional data and technical consensus documents become available.

We appreciate the opportunity to present our advice concerning this radon document and would appreciate receiving a written response which addresses our recommendations.

Sincerely,



Raymond C. Loehr, Chairman  
Executive Committee  
Science Advisory Board



Oddvar F. Nygaard, Chairman  
Radiation Advisory Committee  
Science Advisory Board

cc: ORP

ADDENDUM TO LETTER REPORT NUMBER: EPA-SAB-LTR-91-001

Re: Letter Report on Radon Risk Estimates for General Population and Smokers, Non-Smokers, and Children

The review by the Radiation Advisory Committee of the "Radon Risk Estimates for the General Population and Smoker, Non-smokers and Children" was conducted during the Spring of 1990. The letter report was essentially completed on May 18 and represents the committee's recommendations based on material available to it at that time. Although the Committee does not want to alter its endorsement of the Agency's risk estimates, it wishes, at this time, to expand on its comment in regard to the 3-fold greater risk of lung cancer, assigned to individuals exposed as children of young adults below the age of 20 years, since this current risk estimate derives from the SAB 1988 recommendation that the Agency should average the risks projected by the two radon risk models proposed by the BEIR IV committee and the ICRP-50 report, but use the ICRP-50 model for exposures to children and young adults. As already pointed out, the only supportive evidence for a higher relative risk for children derives from studies of Japanese atomic bomb survivors exposed to external gamma and neutron radiation. In a recent case control study of Chinese tin miners, Lubin et al. (Cancer Res. 50, 174-180, 1990) report that there is no evidence for a higher risk to workers who were first exposed to radon under the age of 13 years. This study, although not statistically significant by itself, is apparently the first report of lung cancer in individuals exposed to radon at an early age. Additionally, the recently published (1990) BEIR V report, the consensus report of the National Research Council's committee on the Biological Effects of Ionizing Radiation, states (p. 273) that "The Committee's analysis of respiratory cancer in A-bomb survivors showed little effect of age at exposure....." which greatly weakens the rationale for the higher risk to children, referred to above.

Another area of uncertainty is the conversion of radon exposure to lung dose, the relationship of this conversion in underground miners vs. the general population, and whether children receive the same dose as do adults from a given radon exposure. The National Research Council under contract to EPA has recently completed a review of this particular issue, and the report should be available to the Agency by the end of December (1990).

In the opinion of the Radiation Advisory Committee, the review by the National Research Council might be a significant document for the assessment of radon risk to the general US population, including children, and the committee emphatically recommends that the Agency give high priority to reviewing this report with a view to whether its conclusions warrant a re-assessment of the currently recommended risk coefficients to the general population based on radon exposures.