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

September 9, 1988 SAB-RAC-88-042

OFFICE OF
THE ADMINISTRATOR

Honorable Lee M. Thomas
Administrator
U. S. Environmental Protection Agency
401 M Street SW
Washington, DC 20460

Dear Mr. Thomas:

The Dose and Risk Subcommittee of the Science Advisory Board's Radiation Advisory Committee has completed its review of the Office of Radiation Programs' Radon Risk Estimates. This review was requested on May 25, 1988 by the Director of the Office of Radiation Programs and was conducted on June 20, 1988, at an open meeting in Washington, DC, at which Dr. Douglas Chambers of SENES Consultants and Dr. Leonard Hamilton of the Brookhaven National Laboratory presented oral and written comments on behalf of the public. Because the Office of Radiation Programs is considering using its new estimate as part of the technical basis for the revised radionuclides NESHAP, the Science Advisory Board was asked to respond as early as possible.

The Office of Radiation Programs' proposed risk estimate, based upon an adjusted BEIR-IV model, consists of a range of 120-750 fatal lung cancers per million working level months of radon exposure with a central estimate of 300. The Environmental Protection Agency's current central value is 460 fatal lung cancers per million working level months of radon exposure with a range of 230-920. For radon exposure, risk to the lung is considered the only relevant cancer risk.

Three important technical consensus reports on radon risks are of potential use to the Agency: (1) the 1987 International Commission on Radiological Protection's Report entitled "Lung Cancer Risks from Indoor Exposures to Radon Daughters" (ICRP 50); (2) the 1988 report of the National Academy of Sciences' Committee on the Biological Effects of Ionizing Radiation Report entitled "Health Risks of Radon and other Internally Deposited Alpha-emitters" (BEIR-IV); and (3) the 1984 report of the National Council on Radiation Protection and Measurements' Report 78 entitled "Evaluation of Occupational and Environmental Exposures to Radon and Radon Daughters in the United States" (NCRP 78). None of these reports is clearly pre-eminent; each has its strengths and limitations. These limitations reflect the uncertain state of our knowledge in particular areas and the

consequent legitimate basis for differences in the interpretation of the limited data available. Of the three reports cited, ICRP 50 and BEIR-IV appear to have the greater utility for the Agency. Both use the relative risk projection model and generally their projections are quite similar. Their models differ in certain ways, however; for example, BEIR-IV, in its projections diminishes the excess relative risk with time since exposure, whereas ICRP 50 uses a constant excess relative risk.

The Dose and Risk Subcommittee does not recommend that the Agency attempt to develop still another model for radon and radon daughter risk estimation and projection; there is not time nor sufficient personnel to do it better than existing technical consensus groups have done before the radionuclides NESHAP is scheduled to be published in final form. Moreover, such a model would not have the weight of authority of the consensus documents since it could not be scrutinized carefully by the scientific community. Instead the Agency should use the ICRP 50 and BEIR-IV reports to determine the range of risk estimates that exists, to identify the ambiguities in the data on which the risk estimates rest, to determine the consequences of the projecting of these risks to a lifetime, and to understand the uncertainties of the models. The ICRP 50 and BEIR-IV projection values could be averaged to provide a central estimate except where there are good reasons to prefer one result to the other. One such case may be risks to children as the BEIR-IV report is primarily concerned with a working population, whereas the ICRP 50 report attempted to address risks to the general population whose susceptibility to cancer may differ by age at exposure. The Subcommittee suggests that the risk estimate used in the projection of the lifetime risks with the BEIR-IV model be the BEIR estimate based on the internal rather than the external comparisons, but strongly urges that the description of the projections be tempered by a discussion of the limitations of the epidemiological data.

The National Council on Radiation Protection Report on radon and radon daughter products differs from the ICRP and BEIR-IV in a number of ways. Specifically these are: (a) NCRP 78 uses an absolute model for risk projection; (b) NCRP 78 projects the same risks for males and females, for different age at exposure groups, and for smokers and nonsmokers; (c) NCRP presumes no expression of the increased risk until after the age of 40, and (d) NCRP 78 assumes that a loss half-time (20 years) exists for the stem cells in the lung transformed by exposure to alpha irradiation, so that the cancer risk diminishes with time since exposure. Nevertheless, it should be noted that the NCRP 78 model, for non-smokers, leads to conclusions within the range resulting from the ICRP 50 and BEIR-IV models.

Generally speaking, the ICRP 50 and BEIR-IV models will lower the level of risk understood to be associated with radon

exposure somewhat below the levels estimated by the Agency in 1985. No additional major technical assessments of radon and radon daughter risks are currently underway that would contribute to the Agency's understanding of these risks in the next two years or so, but several studies are in progress or have been recently published that will provide the basis for an improved evaluation later. Such studies include an update on the Ontario miners, further work with the Czechoslovakian miners, experimental studies of radon as a cancer promoter, and the National Cancer Institute sponsored studies of radon exposure and lung cancer.

Besides recommending that the Agency rely on the ICRP 50 and BEIR-IV reports, the Subcommittee offers comments on certain aspects of the modelling of risk.

The Subcommittee supports the relative risk model used by ICRP 50 and BEIR-IV because the experience in Japan clearly shows that for survivors aged 20 and older at the time of exposure, the excess relative risk of cancer changes very little with time since exposure. For those under age 20 at the time of exposure, neither the absolute nor the relative risk model works very well. The atomic bomb survivors were exposed primarily to external, low-LET radiation at a high dose rate, not radon or its daughters; but because the survivors represent the only well-studied large general population exposed to radiation, the experience in Japan for predicting population risks is compelling.

The Subcommittee endorses the use of a linear model for low-dose extrapolation of risks from radon exposure although it is not possible to determine statistically whether the linear, linear-quadratic, or quadratic dose-response model best fits the available human population studies. The Ontario and Colorado miner data sets have a linear-quadratic quality to them; however, controlled experiments in animals exposed to high-LET radiation indicate linearity in the low-dose range, and the Subcommittee places greater reliance in these latter findings, for the present, given the limitations in the human studies.

The Subcommittee believes that risks established for mining populations can be transferred to a general population including the young, females, and nonsmokers since the levels of exposure are similar, at least in some instances. Although the dose to the lung is determined by the unattached fraction of the daughters of radon, and this fraction appears somewhat higher in homes than in mines (which implies a slightly higher dose in rad or gray in the former than the latter environment), the lower breathing rate, on average, in the home would offset this effect. Accordingly, the Subcommittee believes the current state of knowledge is such that the risks established for miners provide an acceptable basis to predict risks for the general population.

With regard to age, the Subcommittee recommends that where there is a specific need to predict risks from radon and radon daughters in a young population, such as risks of radon in schools, the Agency should rely on the ICRP 50 rather than the BEIR-IV report because children may be more susceptible.

The Subcommittee finds the data on the interrelationship of smoking and radon exposure to be complex but recommends that under these circumstances the Agency treat the interrelationship as multiplicative at the present time. If the effects of smoking and exposure are additive, this will have the effect of overestimating the risk, but given the uncertainties in their relationship, this would seem the conservative course at present.

In summary, the Subcommittee endorses the range of risk estimates proposed by the Office of Radiation Programs. It does recommend that the Agency not attempt to develop still another model for radon and radon daughter risk estimation and projection, but urges the use of the existing technical consensus reports described above.

The Subcommittee looks forward to the opportunity to review the Background Information Document on which the final regulations will be based.

We appreciate the opportunity to share our views with you and look forward to a written response from the Agency.

Sincerely,

Norton Nelson
Chairman, Executive Committee
Science Advisory Board

William J. Schull
Chairman, Radiation Advisory Committee,
and Dose and Risk Subcommittee

Attachment: Roster

cc: R. Guimond
J. Cotruvo