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21 Oct. 1990



Comments on EPA's 1990 Citizen's Guide to Radon

Overall, I believe that this Guide, like its 1986 forerunner, is a serious over-reaction to the potential health hazards of radiation exposure to the general public due to radon in homes. The present draft, however, is even more extreme and unjustified than the extant version. The proposed changes in the recommendations for citizens (in terms of the need to act and action levels), and how they may affect these recommendations (in terms of testing and the interpretation of risk) are profound. The accompanying Technical Support Document offers little to change my view that the Guide is based more on a public relations effort than on scientific merit.

These comments mainly address three dominant shortcomings of the Guide: i) the overall advocacy tone and alarmist nature of the document; ii) the absence of any consideration given to the large uncertainties involved with the proposed recommendations; and iii) the treatment of comparative risk with medical chest x-rays. Inasmuch as I believe that the Guide is so seriously flawed in terms of the underlying philosophy and public policy impacts that I have not provided a detailed line-by-line summary of the many statements in the Guide that I believe are misleading by both omission and commission), technically incorrect, or without a scientific basis.

i. overall tone

The writing style and overall tone of the language in the Guide hardly seems appropriate for a Government publication, particularly for one that is presumably based on scientific findings of public health risk. Instead of being a dispassionate presentation of facts in a health advisory and what citizens may do about it, the Guide reads like an advocacy document or promotional advertisement. I find the entire presentation of radon introduced as "an intruder invading your neighborhood" to be intellectually insulting (as I suspect many citizens will as well). If EPA really believes that the Guide must be written for 3rd or 4th grade reading comprehension, do they really also believe that citizens will understand the risk tables and be able to make informed decisions? The very flavor of the Guide's language reads like and seems more suitable as an advertisement for home burglary alarm systems. I happen to have more faith in the intelligence of that segment of the general population that may be concerned with radon in their homes, and believe that they may also wonder why this issue is being presented in such a hyped and alarmist fashion.

ii. neglect of uncertainties

As a result of the nearly complete absence of any consideration for the large uncertainties involved, readers of this Guide will, of necessity, be seriously misled.

The Guide is quite definitive in making absolute statements about quite questionable facts, e.g., "radon is the second leading cause of lung cancer", "no level of radon is considered absolutely safe", "you can get test results that are accurate and reliable", etc.

Regrettably, the Guide is not equally forthright in giving the following information:

1. Your test results have an associated measurement uncertainty although none of the measurement vendors provide this information nor does EPA encourage it. The results should not be considered to be more reliable than plus or minus 25%. Therefore, to try to distinguish between a result of 4.5 pCi/L and 3.5 pCi/L is stupid. More importantly, remember that any decision that you choose to make based on this single, short-term measurement result has this underlying uncertainty and unreliability.
2. The radon concentration in your house is highly variable changing from hour to hour, day to day, season to season. A single, short-term, screening measurement result (even if perfectly accurate, which is impossible) may differ from an annual average by very large percentages -- see the attached table. You can not improve the accuracy of the temporal variation by increasing the number of screening measurements made at the same time since this will only result in increased precision for the measurement result at that time and not improve the accuracy in the annual average. [N.B. The answer to Question #9 in the Guide which contradicts this is clearly wrong.] Again, any decision you make based on your test results should be made with cognizance of this additional large uncertainty.
3. Differences in your lifestyle and home conditions for even identical annual average radon concentrations can result in very different lung doses and therefore pose a very different magnitude of the hazard. This occurs because the dose arises from the deposition of radon daughters [which are not once mentioned in the Guide, I suppose for simplicity] which in turn depends on a large number of very complex aerosol factors. Again, you should be aware that your underlying risk is dependent on these uncertainties.

4. In addition to all of the above uncertainties, the risk estimates provided in this Guide are in themselves very uncertain and based on a large number of sometimes untenable assumptions. The estimates were obtained exclusively from rather scant data on lung cancers in miners. There are large uncertainties in the miner data, large uncertainties used in the models used to obtain the risk estimates, and large uncertainties associated with differences between miners and the general public. [There is a nice summary of all of these uncertainties in Dept. of Energy report DOE/ER-0448P (March, 1990).]

The proposed changes in the health advisory recommendations to citizens presented in this draft Guide are substantial. The 1986 Guide at least suggested that there were associated uncertainties by giving ranges (e.g., in the range of about 4 to 20 pCi/L) for various action levels. This is now replaced by a single absolute 4 pCi/L fiducial mark for taking action, and a somewhat veiled suggestion (in the risk tables only) that you may want to take remedial action even at levels down to 2 pCi/L. All of this is proposed without any significant new epidemiological data or changes in our understanding of the radon risk. The unaware citizen can only be ~~lead~~ ^{led} to believe that these risks are understood much better than in fact they are. Even aside from these changes, to suggest to citizens that they make important and costly decisions on whether to remediate their house based on a single, short-term, screening measurement is irresponsible considering the large uncertainties in both the measurements and temporal variations alone. ←

As I stated above, the measurements can not be considered to be more reliable than 25% or so, and the temporal variations are even larger. The EPA evaluation on the reliability of short-term measurements and the relationship to annual averages in the Technical Support Document seemed to be very convoluted and disjoint, and at variance with all of my instincts as well as with the impressions and experience of nearly everyone I ever spoke with about radon measurements. For comparison purposes, I extracted from some Princeton Univ. data, some estimates on the reliability of short-term measurements (see the attached table). ↗

I found, for example, that the probability that a single short-term measurement will be within 25% of the annual average was only 10 to 15% for measurements taken in the summer only. These results were obtained at about 40 pCi/L and the variation could be expected to be even greater at 4 pCi/L. I do not know how to reconcile these results with the supporting analysis presented by EPA. The EPA testing strategy and the basis for decision-making may be much more suspect if the uncertainties for false-positive are larger than suggested by EPA.

The bottom line, of course, is whether it is good public policy to recommend actions that will result in a vast expenditure of citizen's money when such decisions are based on such uncertainties. I personally doubt it. If even a fraction of this money were spent by citizens in more beneficial ways, such as by enrolling in smoking prevention clinics, there would be a much more beneficial impact on public health.

iii. comparative risk treatment

I believe that equating and comparing the lung cancer risk from radon exposure to that from medical diagnostic chest x-rays is poor science and worse public policy. I am sure that EPA has heard and read all the past arguments for this "apples and oranges comparison" in terms of the distinctions between external low-LET exposures from x-rays and internally-deposited high-LET exposure from radon daughters, the comparative population differences, etc., and the large number of assumptions (with the attendant large uncertainties) needed to make this comparison. These arguments by others more versed in the subject than I have obviously had little impact, so I will instead focus more on the public policy implications. I find the rationale for using x-rays for a risk comparison as curious. I doubt that the general public has a very good understanding of any radiation exposure risk. Was it chosen because surveys have found that the public does have very great fears of radiation exposure of any kind, and very large misconceptions about the actual risks involved? More importantly, this Guide if anything can only reinforce these misconceptions about the use of beneficial radiation exposures. I believe consideration should be given to the net health impact that may result if this Guide has the effect of reducing x-ray examinations by the public. It might be useful for EPA to address this specific issue with the FDA Center for Devices and Radiological Health to obtain their opinion on this important policy issue.

Probability that Short-Term Measurement
Will Predict Annual Average To Within 25% at 40pCi/L*

DURATION OF SINGLE SHORT TERM MEASUREMENT

SEASON	1 day	2 day	4 day	7 day
FALL	35%	35%	35%	35%
WINTER	45%	50%	60%	70%
EARLY SPRING	65%	75%	80%	85%
LATE SPRING	60%	65%	65%	70%
SUMMER	15%	15%	15%	10%
AVERAGE OF 4 SEASONAL SHORT-TERM MEASUREMENTS	75%	80%	90%	95%

* Extracted from data obtained by Princeton University from measurements in their research house studies (Robert H. Socolow, unpublished, 1990).