EPA Divided Over Radon Risk in Drinking Water

Conflicting data on radiation risks lead to split in agency outlook

In October, the EPA's appropriations bill for FY 1994 contained an amendment from Senator Bob Kerrey (D-NE) that will force the agency to examine its forthcoming standards on radon in drinking water with a magnifying glass. When Sen. Kerrey discovered the projected cost of cleaning water from some high-radon wells in Nebraska, he decided that the cost to clean high-radon water across the country would be too high, and added an amendment to the appropriations bill that forbid the agency to release a standard for drinking water radon for another year.

A Long-Brewing Controversy

The amendment gives the EPA some time that it needed anyway. Bringing the story of perhaps the most well-publicized contemporary radiation risk to a new nadir, factions in the EPA had already come to blows over radon's health hazards in drinking water. The controversy arose when U.S. Senators Frank Lautenberg (D-NJ) and John Chaffee (R-RI) last year asked the EPA to produce a report, due July 31, 1993, on waterborn radon risks and to finalize regulations; a 1986 reauthorization of the Safe Drinking Water act had given the agency three years to propose radon standards for drinking water, but the agency never implemented its proposal. As *Newsline* went to press, the EPA's report to Congress had just returned from the Office of Management and Budget (OMB) with comments that the EPA will incorporate in the proposal; the agency could still not give a date for the report's completion.

The sluggishness of response is a symptom of an enormous indeterminacy raging within the radon assessment community over the precise danger of the naturally occurring gas in the water supply. The answer can make the difference in whether the nation will spend about $300 million or more to clean up those supplies to save an estimated 107 lives per year. One problem, as some observers have pointed out, is that the EPA's final response may involve politics as much as science.

Ingested Radon

There are two major concerns for the effects of radon in drinking water: from the radon that leaves the water—as during a bath or shower—and travels into the ambient air, then is inhaled; and from ingested radon (Fig. 1). A draft report drawn up by EPA's Office of Water and released last July revealed that it was strongly influenced by a study by Jack Correia and colleagues at Massachusetts General Hospital. This team measured the amount of radon's safe sister element, xenon, that diffused through human tissue upon ingestion. Douglas Crawford-Brown, PhD, a radiation biophysicist at University of North Carolina, Chapel Hill, then

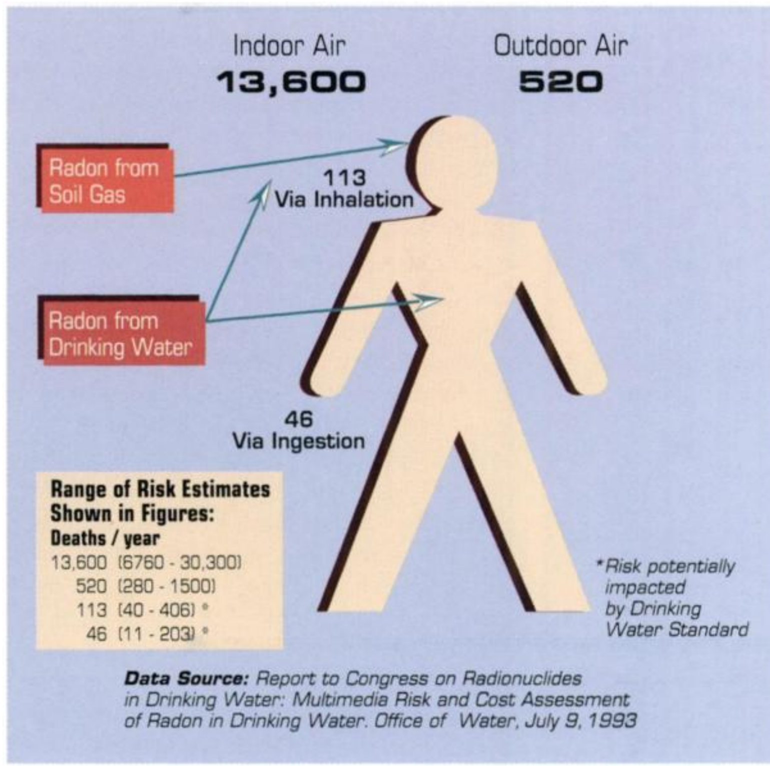

Figure 1. EPA's estimate of risks, in death per year, of radon from indoor and outdoor air, and from soil gas and drinking water. Drinking water risk is supposedly from both inhalation and ingestion of radon.

used the Correia data to develop a mathematical model of radon diffusion in tissues. Dr. Crawford-Brown said, "My model fit Correia's data and is consistant with the general theory of how radon moves through the body." Through the ingestion pathway, he found, there was a risk comparable to inhalation. The Office of Water based its risk assessment on this finding.

As Dr. Crawford-Brown pointed out, the problem is "I showed that the assumptions made about the ingestion pathway have not yet been tested by experimental data. A lot of critics picked up on

"Critics and I have argued that there's no evidence that radon is coming out of water into the stomach wall," said Dr. Crawford-Brown

this, and they overplayed it, though there are a couple of things I'm concerned about." Correia's data can predict how much xenon is present in water in the stomach; Dr. Crawford-Brown made an assumption about how radon moves into the stomach lining. "Critics and I have argued that there's no evidence that radon is coming out of water into the stomach wall before the water moves on to the intestine," he said. "My *assumption* is that it does diffuse through the stomach wall—but if it does not, then the estimate of risk may be too high by a factor of 5-10."

What happens in the stomach is significant because at that point in the gastrointestinal tract the radon is still at its highest concentration. In the small intestine, Dr. Crawford-Brown pointed out, radon could be absorbed into the rest of the body, but by then its concentration is low. The difficulty is not so much surface-to-volume ratio, which is higher in the small intestine, but how much radon moves into the wall and then into the body. According to this study, radon would tend to build up in the stomach wall, diffusing much more slowly into the body and thus exposing the stomach wall to greater amounts of radiation.

Disagreements Within EPA

Using his model, Dr. Crawford-Brown predicted that 300 pCi/liter of drinking water would lead to a risk coefficient of one cancer per 10,000 persons per lifetime. 300 pCi/liter is the maximum contamination level (MCL) that the EPA has proposed. Jennifer Orme-Zalvaleta, chief of drinking water health assessment in the EPA's Office of Science and Technology within the Water Office, granted that there is uncertainty in her group's assumptions about how much radon is volatilized into the air and how much of it and its progeny is absorbed into the body. But, stating that the overall uncertainty for radon risk was about one order of magnitude (approximately Dr. Crawford-Brown's estimate), she asserted that this "would indicate it is fairly reliable. We're using human data." She noted that the EPA's science advisory board (SAB) "applauded our efforts. The committee that reviewed it was complimentary. Only some members of the executive committee questioned it—but they were not integrally involved" in the project.

According to William Raub, PhD, EPA science advisor (who says he acts as an "interface" between EPA policy-makers and the SAB, which is a group outside the EPA itself), the SAB's response to the report was more complex. He and the SAB had been concerned with the uncertainty analysis in a draft of the report issued a year ago, and called for more stringent analysis for the next draft. The problem was that the model was nonlinear, yielding varying conclusions depending on the assumptions. For the second draft, "the staff did a superb Monte Carlo analysis, and the SAB applauded this," Dr. Raub said. "But the SAB were very critical when the staff didn't apply this analysis in making their policy."

To the EPA scientists, Dr. Raub expressed concern over what he felt was a great uncertainty in the risk assessment and over the inconclusive epidemiological evidence of whether ingested or inhaled radon presents a risk to nonsmokers. He suggested that the standard for water be set so that the radon that enters the air from outgassing (assuming that 1% of the radon in the water does so) is at the same level as radon in the ambient air, which would correspond to a drinking water MCL of about 1,500-2,000 pCi/liter. Before the EPA's report went to the OMB, the SAB noted the lack of conclusive epidemiological evidence or animal studies linking cancer to radon ingested from drinking water, which thus may mean there is no cancer risk.

The different factions argue not so much about whether there is an uncertainty of risk—that much they agree on—but how far to err on the side of uncertainty. Those supporting the stringent standard even acknowledge the problem of the extreme cost involved if it is implemented. "This is why we don't have a final reply," said Ms. Orme-Zavaleta. The only way the agency can enforce standards for radon in drinking water is through the Safe Drinking Water Act, for which the EPA was to issue final regulations on radionuclide content last October. A lawsuit on these regulations led to a court-ordered agreement on a issue date; unable to meet that date, the agency had to return to court to request a later date. These delays, Ms. Orme-Zalvaleta noted, were due to the EPA's need to assess the costs and benefits of implementing the stringent standard. The EPA's estimate for cost per life saved is $3.2 million.

If even those within the EPA favoring the drinking water standard are questioning its cost-benefit, interested parties outside the agency have responded vehemently. "We sent comments to the EPA arguing against [the drinking water standard]—it's too restrictive," said William Condon, spokesperson in the Bureau of radiation, New York Department of Health. "It's similar to the California standard—too much money for the health hazard. California's cost alone would exceed the EPA's cost estimate for the whole nation." Extrapolating from California's cost for its program to the rest of the nation for the EPA's, "The cost would be astronomical," Mr. Condon said. In general, New York standards follow the EPA's.

Radon in the Air

Assessing the risk of radon outgassing into the ambient air and contributing to lung cancer has a whole different set of problems and controversies. There are two basic questions at issue: how much radon outgasses from water into the ambient air; and what level of radon in the air poses a risk of lung cancer. The second question encompasses the history of radon risk assessment, and its answers—mired in politics, institutional stubbornness, and scientific indeterminacy—vary according to who is speaking. Even the estimates of how much radon outgasses from water varies from 1 in 10,000 pCi/L to 1 in 20,000 or greater. Depending on which numbers one chooses for radon outgassing and for radon cancer risk, one can arrive at vastly varying numbers for an MCL for the gas in drinking water. The EPA estimates 1 in 10,000 pCi/L volatilizes.

To complicate matters, a different EPA office (Air and Radiation) handles atmospheric radon—which the EPA cannot regulate because radon is naturally occurring and no law requires that the agency clean up natural "pollutants." Instead, the EPA sets guidelines for homeowners. Thus, some observers have pointed out, by regulating what boils down to ambient air radon levels—even if it derives from drinking water—the Office of Water is reaching beyond its jurisdiction.

Moreover, the Office of Water's proposal for a 300 pCi/liter standard, when multiplied by the 1 in 10,000 pCi/liter that volatilize, means that the standard for outgassing radon is 0.03 pCi/liter of air, much below the 0.2 pCi/liter MCL that the EPA recommends for ambient radon.

The Politics of Radon Risk

But even the 4.0 pCi/liter for EPA action guide level for mitigation of radon is far too low for many scientists and others who argue that the science has come a long way since the EPA first set its standards. Naomi Harley, MD, a research professor in the Dept. of Enviornmental Medicine, New York University Medical Center, noted that, in the international context, 4 pCi/liter is low; for example, the Canadian standard is 20. The NCRP recommends 8 pCi/liter. Dr. Harley feels that the EPA is sticking with 4 for historical reasons. The agency had first derived the number in the 1970's when studying radon emanating from phosphate mines in Florida. The EPA may fear, she noted, that if it increases the number to 8 pCi/liter, it may face lawsuits from companies that have spent money keeping within the 4 pCi/liter level.

But some researchers believe it may be to the advantage not only in terms of monetary cost to companies and homeowners, but in terms of health to *increase* the MCL. Bernard L. Cohen, PhD, professor of physics, University of Pittsburgh, has questioned the whole current approach to setting radon standards. Specifically, he criticizes the linear-no threshold hypothesis of radiation carcinogenesis, which assumes that there is no threshold dose level for carcinogenesis and that one may extrapolate linearly from the high doses measured in uranium miners and atomic bomb victims to the low doses experienced in most homes exposed to radon. By doing an ecological study of 1,601 U.S. counties, he demonstrated that the linear-no threshold hypothesis overestimates the risk of lung cancer from radon (Fig. 2).

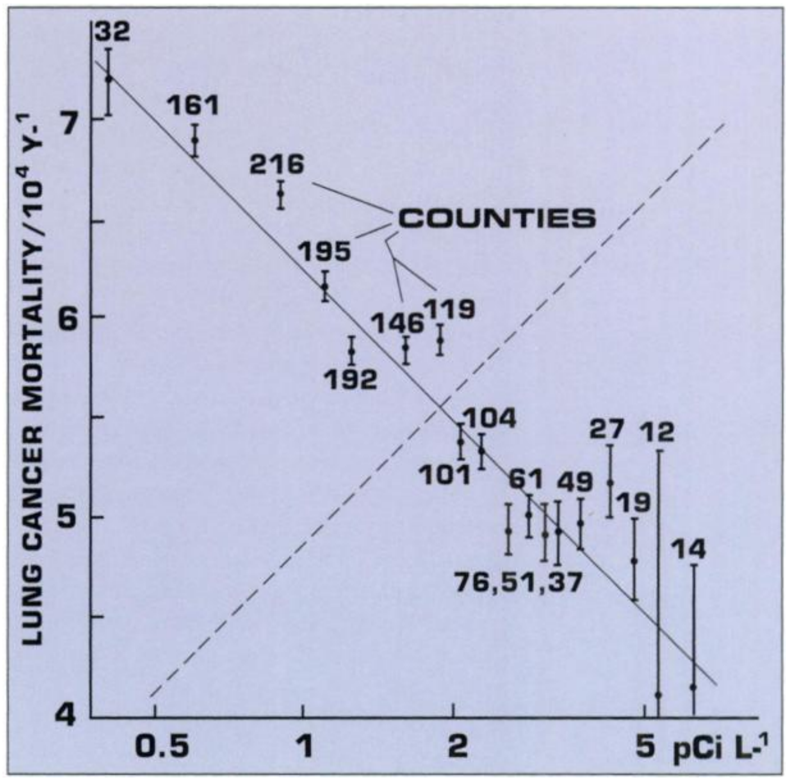

Figure 2. Lung cancer mortality rates of males in the 1,160 US Counties representing 90% of the population, with 5% error bars . Dashed line represents linear–no threshold hypothesis.

DATA FROM BERNARD L. COHEN.

Nancy Chiu, toxicologist in the EPA's Office of Water, criticized the ecological studies of the sort Dr. Cohen did, because it is "difficult to correlate the exposure level of the individual you're monitoring" with a particular cancer risk. Furthermore, she said, people move around the country, so it's difficult to draw conclusions from data about a particular county. Dr. Cohen countered these and other criticisms by correcting for such problems and accounting for the "ecological fallacy," in his paper, "How Dangerous Is Low Level Radiation?" (presented at the Royal Society of Canada Symposium on Risk Management, Ottawa, Ontario, October 18-19, 1993).

Researchers and policy makers, both in and out of the EPA, are obviously far from consensus on a matter that could cost up to $10 billion per year (in some estimates) to theoretically save about 100 lives—if there is any risk at all. Curiously, after doing his mathematical model on radon ingestion, Dr. Crawford-Brown has proceeded to study issues in the philosophy of science, on such questions as what level of evidence we have when we make decisions about theory and policy, why do we begin to debate certain topics, etc. If his line of inquiry is any example, a regulation calling for a radon MCL of 300 pCi/liter in drinking water may lead to widespread meditation on the relation of science and policy.

Lantz Miller

NBTF HOPEFULS SCRAMBLE FOR DOE GRANT

A national year-round isotope supply moves closer.

THE DOE'S OCTOBER 14, 1993 ANnouncement inviting grant applications for project definition studies for a National Biomedical Tracer Facility (NBTF) was a step toward materializing what the nuclear medicine community has advocated for years. DOE anticipates that it will award $300,000 to up to five applications for NBTF project definition studies. The announcement was also the starting bell for a competition among groups that have expressed interest in hosting such a prestigious and potentially profitable facility. But some critics say the DOE's plan to make biomedical isotope provision a commercially viable private enterprise is not the most cost-effective way to provide those isotopes.

The call for applications, appearing in the *Federal Register*, Vol. 58, No. 197 (Thursday, October 14, 1993, pp. 53197-53198), stated a four-pronged goal for the project definition study: to define the NBTF's design, cost estimate, and construction schedule; to address the facility's radioactive waste management; to develop a business plan for its commercial operation—including reimbursement to the federal government for construction; and to determine whether an NBTF would satisfy demands for radioisotopes—and whether it could be completely operated by a private enterprise. Though the request for proposal (RFP) states that the NBTF may be either a new facility or modification of an existing one, the emphasis on private enterprise leaves the RFP unclear as to whether it allows applications from federal labs which may already have some of the necessary infrastructure.

"We are very interested in an NBTF being sited at Los Alamos or institutions we're associated with," said Eugene Peterson, PhD, director of isotope production at the Los Alamos National Laboratory in New Mexico. But he pointed out that, through indications in the wording that favor the private sector, the RFP seems to make it difficult for national labs to apply. "If you don't take advantage of what is available at national institutes, it will be difficult to do this [project] within costs that could be allocated," he said, citing the complexities of operating an accelerator facility, the mire of regulations, and waste handling and disposal. "It seems to me that taking advantage of institutions that have the infrastructure would be only to the cost advantage," he said. "Still, we'll look into how we can participate within the requirements outlined in the RFP."

Other groups, though not national labs, are already setting up joint ventures between government (usually state or local) and the private sector. The University of North Texas (UNT, Denton, TX) is collaborating with a for-profit company, North Texas Research and Development Corp. (NTRD, Denton, TX) on a facility that this partnership will outline in a grant application. Raleigh Schaffer, PhD, associate vice president for research and dean, UNT Graduate School, explained that NTRD will raise money for work on radionuclide production, and UNT, using government funds, will handle research and education. This set-up takes advantage of the expertise of both sectors involved. Dr. Schaffer felt that certain other advantages to the plan would add to its suitability for the NBTF: the north Texas location's centrality to the rest of the country and proximity to an international airport; a 25-year history of accelerator tech-