

The quixotic quest for zero radiation dose

BY TED ROCKWELL

HERE IS RISING scientific opposition to the relentless regulatory insistence on ever-lower permissible radiation levels. Reaching far below natural background level, to levels below even the variations in natural background, the National Council on Radiation Protection and Measurements (NCRP) recently issued the draft report of Subcommittee 1-6, *Evaluation of the Linear Nonthreshold Dose-Model Response*, for public comment. Along with BEIR-VI, *Health Effects of Exposure to Radon*, issued in final form in February 1999 by the Committee on Health Risks of Exposure to Radon of the Board on Radiation Effects Research, National Research Council, this report reaffirms the long-standing position that radiation policy should be based on the premise that detrimental health effects from radiation decrease linearly with radiation dose down to zero dose (the linear, no-threshold [LNT] hypothesis).

The inescapable corollary of the LNT, that a single gamma ray can initiate a lethal cancer, supports most of the extreme antinuclear scenarios and political arguments. In addition, these reports justify "collective dose," which claims that when thousands of people each receive a harmless dose (say from the transport of waste and spent fuel casks), then a calculable number of them will die.

Each of these reports represents a several-year effort by a com-

One who was there provides a look at the 108th Meeting of the NRC's Advisory Committee on Nuclear Waste, where a number of important questions were raised concerning a recent NCRP report.

And so the NRC's Advisory Committee on Nuclear Waste (ACNW) meeting on March 23-25 at the NRC's Rockville, Md., office, to review and receive public comment on the NCRP SC 1-6 report, was an important occasion. The ACNW is to be commended for providing this forum and for raising a number of important questions during the session.

After welcoming remarks by ACNW Chairman John Garrick, NRC Commissioner Greta Joy Dicus opened the session. She clearly stated the NRC's position that cost, in the broadest sense, must be a consideration in setting radiation standards, and that the NRC should provide the amount of radiation protection demanded by the public—and no more. (Later in the session, James Muckerheide, founding president of Radiation, Science & Health, Inc. [RSH], an international organization of independent radiation health effects scientists and public policy experts, argued that the public demands were driven by fear of radiation created by the government's repeated public predictions of deaths from trivial amounts of radioactivity, based on the LNT.)

The case for the LNT was presented by Arthur Upton, chairman of SC 1-6. Marvin Frazier, of the Department of Energy's Office of Biological and Environmental Research, described the new DOE low-level radiation research program, and Charles Land, Radiation Epidemiology Branch, National Cancer Institute, wrapped up the first morning with a mathematical analysis purporting to show that epidemiology cannot produce any useful information in the low-level radiation range.

In the afternoon, presentations on the LNT were made by Evan Douple, director of the National Academy of Sciences' Board on Radiation Effects Research (which appoints the BEIR committees); Edward Calabrese, of the University of Massachusetts, director of the Northeast Regional Environmental Public Health Center, and publisher of the *BELLE Newsletter on Biological Effects of Low Level Exposures*; Charles Meinhold, vice chairman of the International Commission on Radiological Protection and president of the National Council on Radiation Protection and Measurements; and Keith Dinger, president, of the Health Physics Society. Ralph Andersen, of the Nuclear Energy Institute, had been scheduled for this presentation period, but withdrew.

Myron Pollycove, visiting medical fellow with the NRC and chairman of RSH, had been scheduled as a member of the discussion panel to follow the individual speakers, but was pulled from that panel at the last moment, leaving no one on the two-day program who was ready to present the case against the LNT except for Calabrese, who described his work on building a hormesis data base. Pollycove objected to that situation. After Andersen withdrew as a presenter, Pollycove was scheduled in his place. Pollycove, who remained off the panel, was allowed 10 minutes of Andersen's 30-minute time slot—the coffee break was extended to make up the difference. Each of the preceding talks was 45 minutes long, with two exceptions: Upton was allotted one hour, and Meinhold was given 30 minutes.

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mittee of a dozen or so senior scientists and administrators. In addition, a BEIR-VII Committee is about to begin another three-year task that is expected to defer the current challenge, and to justify yet again the use of the LNT. These committees argue that they are merely advisory, but in fact, when the Nuclear Regulatory Commission or the Environmental Protection Agency issue rules or regulations for public comment, they insist they are not free to deviate from the basic radiation doctrine set out by these "advisory groups." Thus, these advisory reports do in practice have the force of unpealable law.

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The panel was then heard from. In addition to the individual speakers previously mentioned, the panel included Jerry Puskin, of the EPA, and NEI's Ralph Andersen. Alex Flint, of the Senate Appropriations Committee staff, and Pete Lyons, of Sen. Pete Domenici's staff, were scheduled but did not appear.

As vice president of RSH, I had requested time for a presentation,

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and had been promised 15 minutes before the panel discussion. This was postponed to the very end of the day, when I was told I would have five minutes. Requesting the promised 15 minutes, I was held to 10. Muckerheide noted that the session on low-level radiation was scheduled to continue until noon the next day, with many questions for the speakers and discussion from the floor. He was told that since Muckerheide and Polycove had talked with the Committee in 1996, no further input from them was needed. I suggested that the Committee would not want to be in the position of refusing more scientific input. It was then agreed that anyone who wished to speak would be given a chance.

The next morning, March 24, the speakers and the panelists had been excused and the public attendance had thinned considerably.

Ray Johnson, president-elect of the Health Physics Society, gave a brief but explicit statement supporting the HPS position that quantitative control of radiation levels below 5 rem per year was not scientifically justified.

Ted Quinn, American Nuclear Society president, was in town for congressional briefings, and used the opportunity to state that ANS considered the question of low-level radiation health effects a matter of utmost importance. He stressed that requirements to reduce radiation to levels far below where any damage has been observed is costing the American public enormously and that this endangers the nuclear enterprise. This matter needs recognition of the short- and long-term needs of the nation and world in establishing safe and prudent limits, Quinn said, based on the data available today. In the long term, he added, new scientific approaches in the study of molecular science, currently funded by the DOE, should provide a stronger scientific basis for the limits on workers and the general public, but this effort is expected to take a number of years.

ANS is just completing a public policy statement on the effects of low-level radiation, Quinn said, and will forward it to the ACNW when it is approved. He noted the critical role of the ACNW in influencing regulatory policy, and urged the committee to seize this opportunity to ensure that science is not misused to deprive the world of life-saving nuclear technologies.

An active participant in both days' sessions was Dana Powers, chair of the statutory Advisory Committee on Reactor Safeguards. He was quick to pick up on the significance of some of the critical points made, and asked some insightful questions. For example, to illustrate the insignificance of some radioactivity levels being treated as hazards, Muckerheide noted that if existing radioactivity at Hanford were discharged to the Columbia River, it would be millions of times below Hanford releases during operations, and billions to trillions of times below natural radioactivity carried in the river. Powers quickly added that he had personally made the calculation, and that Muckerheide's statement was indeed correct.

I believe that the issues facing the committee are simple to state.

PERSPECTIVE

The scientific basis for current policy is weak to nonexistent. To quote its proponents (the National Council on Radiation Protection and Measurements, in a November 1995 report, NCRP-121):

Few experimental studies, and essentially *no human data*, can be said to prove or *even to provide direct support* for the concept of collective dose with its implicit uncertainties of nonthreshold linearity and dose-rate independence with respect to risk. The *best* that can be said is that *most* studies do not provide quantitative data that, with statistical significance, contradict the concept of collective dose. Ultimately, confidence in the linear no-threshold dose-response relationship at low doses is based on our understanding of the basic mechanisms involved. . . . It is *conceptually possible*, but with a *vanishingly small probability*, that any of these effects *could* result from the passage of a single charged particle, causing damage to DNA that *could* be expressed as a mutation or small deletion. It is a result of this type of reasoning that a linear non-threshold dose-response relationship *cannot be excluded*. It is this *presumption*, based on *biophysical concepts*, which provides a basis for the use of collective dose in radiation protection activities. [emphasis added]

If this is the best that can be said in defense of the LNT hypothesis, then research yielding contradictory evidence should be recognized, encouraged, and given very careful attention.

Many senior radiation specialists, including some of the most respected international leaders in the field, have testified and presented papers over the years showing that there is an enormous body of data refuting the LNT hypothesis and the notion of "collective dose" that form the foundation on which radiation protection policy has been based for 50 years. This refutatory evidence is based on laboratory work at the molecular, cellular, organ, and whole animal level, including clinical and epidemiological data on humans. This evidence shows that low-level radiation is not harmful, and in fact is likely to be beneficial and perhaps even essential to life.

Three separable scientific principles are entwined here. The first two are fundamental principles not dependent on any theory of radiation effects:

- 1) No hazard can be controlled in the presence of a variable background of the same nature that is several orders of magnitude larger than the signal to be controlled.
- 2) Hundreds of billions of dollars should not be spent to protect against conditions that cause no observable detrimental effects, even at much higher levels. Extrapolating damage from high doses over several orders of magnitude to predict similar damage at low doses is not scientifically defensible.
- 3) The notion of "collective dose" has no supporting theory or data and should be dropped. It serves no useful purpose, and generates baseless fear.

These three scientific and common-sense objections to current policy are rapidly gaining support. Roger Clarke, a staunch LNT advocate, chairman of the International Commission on Radiological Protection (ICRP) and former head of the British National Radiological Protection Board, recently proposed eliminating all use of collective dose. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) is also inclining in that direction, urged on by Zbigniew Jaworowski, past president and current member of UNSCEAR, and others. This is a good first step. It would eliminate the most egregious flaw in the policy, but it would not face up to the fundamental scientific and institutional weaknesses. For example:

- 1) Clarke would retain the LNT for radiation protection, writing wistfully, "[P]erhaps there is no need to destroy the credibility of the profession in arguments for or against a threshold." Clarke's proposal shows "Fatal Risk" as 10^{-3} for 30 000 mSv (3 rem), and feels obliged to go to a risk of 10^{-6} (30 mSv or 3 mrem) for a "trivial risk to the individual." And we are still left with the "one gamma ray will kill you" objection, which we can only rebut with a mumbled statement about improbability. If a 10^{-6} risk of death could reasonably be reduced, there will always be pressure to do so.

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2) The DOE low-level radiation research program is aimed at ultimately revealing the details of how radiation interacts with living organisms. But that is a 10-year program (to start), and we should not wait to take action. Biological theory, supported by a wide range of data, shows that radiation acts as nearly all agents do: It stimulates the body's defenses in the low range and overwhelms those defenses in the high range. The number of DNA molecules damaged by radiation, at any level, is unimportant, since there is millions of times more DNA damage by normal metabolism. So when the body's defenses are stimulated, this enormous amount of metabolically endangered DNA is reduced. There are actually *fewer* mutated molecules after low-level irradiation, not more. Thus, the risk of cancer is *reduced*, not increased (as the LNT would predict). This is confirmed in many epidemiological and biological studies.

3) This situation has long defied resolution—primarily because it has never really been seriously examined and considered by the close-knit group of individuals funded by the radiation protection agencies who lead these advisory groups and write these important reports. Muckerheide noted at the meeting that although Meinhold spoke as vice chair of ICRP, he is also NCRP president, and "new" members are elected by the old members following assignments on various committees. Warren Sinclair chairs ICRP Committee 1 (on LNT), and is president emeritus of NCRP, and, in my opinion, is the de facto force behind NCRP and BRER (which appoints the BEIR committees). While he chaired BRER, Sinclair also continued to be deeply involved with NCRP. The choice of which scientists were and were not invited to this hearing, to LNT conferences at Seville and the Wingspread Conference, and to ICRP and NCRP meetings, etc., further reinforces this concern.

Carl Paperiello, director of the NRC's Office of Nuclear Material Safety and Safeguards, had warned the ACNW at its December 1997 meeting: "I've never seen any of the various NCRP, ICRP, or any of these organizations seriously look at the data. It gets tossed off . . . when I look at these various committees they're self-perpetuating, there's interactions between members that sit on one and sit on the

other . . . you don't really have the independence."

The ACNW itself had expressed concern in its July 1996 letter to the Commission, referring to failures to consider existing relevant data. They stated, regarding NCRP SCI-6:

We recommend that the need for special attention be conveyed to the NCRP regarding its study. Such attention should include: 1) Assurance that the study includes scientists other than those who are "recognized experts" with a reputation built on the LNT; 2) An evaluation of the data by an entity with an expertise in statistics or information science but no prior position on LNT . . . ; 3) Consideration of essentially all studies that could relate to the LNT. We will follow the [NCRP] program . . . and will report to the Commission on the study and its implication.

The Commissioners duly forwarded this warning to the NRC's Office of Regulatory Research, to submit it to NCRP. But NCRP ignored this warning. Since the NRC had ordered and paid for the report, if the NRC raises no objections, it becomes a party to the flaws.

In this situation, credibility must be restored to the process. Asked at the meeting what individual or organization would be considered credible to review this situation, Pollycove and Muckerheide replied that it would have to be someone not publicly committed through the years to the current, inflexible policy, and not benefiting professionally from that policy. The first objective is that the NRC review the NCRP draft report with respect to specific concerns and input already received, and request substantive input from the scientists who have criticized the LNT on the consideration of the data. ANS board member Kim Kearfott, acting as a consultant to the ACNW and in attendance at the meeting, suggested that the Surgeon General might provide the needed credibility. I added that if questions arose in settling this question, the NRC Inspector General or an appropriate congressional committee might have to assure that the evaluation of the data, and appropriate inquiries on charges that data have been suppressed, were conducted properly.

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