May 31, 2005

Walston Chubb
4953 Cline Hollow Road
Apt. 244
Murrysville, PA 15668-1591

Dear Mr. Chubb:

I am writing to you in response to several recent letters you sent to the U.S. Nuclear Regulatory Commission (NRC) regarding health effects associated with exposure to ionizing radiation. Senator Rick Santorum also forwarded one of your letters to us. A copy of our response to Senator Santorum is enclosed.

I would like to provide additional information on some of the concerns that you raised in these letters regarding the NRC's standards associated with radiation exposure. Because radiation affects different people in different ways, it is impossible to indicate the precise dose needed to prove fatal. It depends on the health of the individual before exposure and the medical care he or she receives after exposure. Please note that the time frame, in which the radiation dose is delivered, is in many cases unimportant. However, if the radiation exposure is protracted over several weeks or months, larger radiation doses are needed to induce the same biological effect because radiation-induced damage is repaired during the longer term exposure.

An exposure to 1,000 rads (10 Gy) of radiation over a period of several seconds, minutes, hours or days will result in certain death within 1 to 2 months, although the amount of energy deposited in the body is not very great. For example, 1,000 rads (10 Gy) of radiation would increase a person's body temperature by approximately 0.002 °C (0.036 °F), meaning that the energy deposited would be analogous to sipping 6 ml (0.2 oz) of hot coffee! Smaller exposures would deposit proportionately smaller amounts of energy.

Why then do we regulate radiation exposure as we do? The answer lies in how the radiation energy is deposited in the body. When an x-ray, for example, passes through the body, it deposits energy along a track in a non-uniform manner. That is, the track comprises numerous clusters (or localized deposits) of approximately 100 eV of energy. If a 100 eV cluster were deposited in a sphere that is 3 nm (about 1 ten-millionth of an inch) in diameter, it would increase the temperature (locally) from 37°C (98.6°F) to approximately 80°C (176°F). Consequently, it is the distribution of energy (rather than the total amount of energy) that is important. If a cluster is deposited next to a chromosome, damage can occur. Fortunately, most radiation-induced chromosomal damage can be repaired, but some cannot. Damage that is incorrectly repaired (or not repaired) may result in a mutation in the chromosome or death of the cell. As a regulatory agency, it is our responsibility to protect against this type of damage, as well as the immediate effects due to higher doses.

Finally, health effects like the symptoms associated with acute radiation sickness that occur after a large radiation exposure may be observed within several hours after exposure depending on the total amount of radiation received. The dose response for acute radiation sickness is not linear and there is a dose threshold that must be exceeded before symptoms are observed. Once this threshold is exceeded, the severity of the symptoms increase with total exposure. Conversely, the dose response for radiation-induced carcinogenesis is believed to increase in a linear, no threshold manner and the severity of the disease is independent of total dose received. Although these two types of injury are not directly comparable, they are used by the NRC to develop regulatory standards and are intended to protect all workers and members of the public from exposure to ionizing radiation.

I hope that this additional information is helpful.

Sincerely,

/RA/ Cheryl A. Trottier

Cheryl A. Trottier, Chief
Radiation Protection, Environmental Risk,
and Waste Management Branch
Division of Systems Analysis and Regulatory
Effectiveness
Office of Nuclear Regulatory Research

Enclosure: As stated

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