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The *Four* Principles of External Radiation Protection: Time, Distance, Shielding and Decay

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Dear Editors:

EXTERNAL radiation protection dogma has traditionally emphasized only three principles: *time*, *distance* and *shielding*. At a constant dose rate, dose is directly proportional to time; limiting time limits dose. For a point source, dose rate is inversely proportional to the square of distance; maximizing distance minimizes dose. The relationship of dose rate to kind and thickness of shielding is fairly complex, but can be close to an exponentially decreasing function of shield thickness for monoenergetic photons; increasing shield thickness decreases dose.

In spite of the fact that the fourth principle is often applied, it is not often discussed. The fourth principle of external radiation protection is: "Go away from the radioactivity, and come back after it has decayed," or *decay* for short. Decay is the principle used at Three Mile Island (stay out of containment until the short-lived activity is reduced to manageable levels). Decay is the principle used in managing short-lived radioactive waste,

such as patient excreta or ^{99m}Tc waste. Decay is one of the most important principles in radiation protection after a nuclear attack (i.e. stay in the shelter until fallout radiation levels have decayed to non-life-threatening levels).

Some have said, "Decay is the same thing as time," presumably because time appears in the formulas $A(t) = A_0e^{-\lambda t}$ (for a single radionuclide) or $X'(t) = X'(1\text{ h})t^{-1.2}$ (for fission products from a nuclear weapon, $1 < t < 4500$ h). But it's not at all the same kind of time as *limiting* exposure time—it's *maximizing* decay time!

It's time we updated our dogma to "time, distance, shielding and decay."

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