Date: Wed, 23 Jun 2004 11:33:20 -0400

The Dirty Bomb Distraction

The biggest danger from radiological weapons is the misplaced panic that they would cause.

By Richard A. Muller
Technology for Presidents
June 23, 2004

Terrorists might attack the U.S. homeland again this summer, the Justice Department and the FBI warned last month. The same day, the Department of Energy announced a $450 million plan to counter terrorist nuclear weapons and dirty bombs. And shortly afterwards, the Justice Department released some details about Jose Padilla, the one-time street thug who had received extensive al Qaeda training and had hoped to explode a dirty bomb in the United States.

But according to the Justice Department announcement, al Qaeda had doubted that Padilla's proposal to build a dirty bomb was practical. They directed him instead to blow up two apartment buildings using natural gas. They apparently felt that such an action would have a greater chance of spreading death and destruction than would a radiological weapon.

Al Qaeda was right. Perhaps that should scare you. Al Qaeda appears to understand the limitations of these devices better than do many government leaders, newspapers, and even many scientists.

Our experience with radiological weapons -- the fancier name for dirty bombs -- is limited. They do not require a chain reaction like fission or fusion weapons, but instead use ordinary explosives to spread pre-existing radioactive material. Saddam Hussein reportedly tested such a weapon in 1987, but abandoned the effort when he saw how poorly it worked. In 1995,

Chechen rebels buried dynamite and a small amount of the radioactive isotope cesium-137 in Moscow's Ismailovsky park. They then told a TV station where to dig it up. Perhaps they recognized the truth: that the bomb's news value could be greater if it were discovered before it went off. For such weapons, the psychological impact can be greater than the limited harm they are likely to cause.

I don't mean to suggest that radioactive materials are harmless. Indeed, consider the story of scavengers in Goiania, Brazil, who found and dismantled an abandoned radiotherapy machine in 1987. The machine contained 1,400 curies of cesium-137. (A curie is the radioactivity of one gram of radium.) Two men, one woman, and one child died from acute radiation poisoning; 250 additional people were contaminated. Several of the 41 houses evacuated could not be cleaned adequately and were demolished.

Imagine now if that radiation weren't confined to a few houses, but were spread over the city by an explosion. Wouldn't fatalities be higher? The surprising answer is: No. If the radioactivity were dispersed in that way, larger area would have to be evacuated, yet in all probability no specific deaths could be attributed to the event.

To understand the details, let's walk through the design of a dirty bomb similar to what Padilla wanted to build. I'll assume the same amount of radioactive material as was in Goiania: 1,400 curies of cesium-137. Radiation damage is measured in units called rem, and if you stand one meter from that source, you'll absorb 450 rems in less than an hour. That's called LD50, for lethal dose 50 percent. Untreated, you'll have a 50 percent chance of dying in the next few months from that exposure.

To try do enhance the damage, let's use explosives to spread our 1,400 curies over a larger area, say a neighborhood one kilometer square. That will result in a radioactivity of 1.4 millicuries per square meter, and a careful calculation shows that residents will get a dose of 140 rems per year. But radiation illness is nonlinear. For extended exposures, the lethal dose increases by the fourth root of time, to approximately 1,250 rems for a one-year exposure and 2,500 rems for a 16-year exposure. So 140 rems per year is not enough to trigger radiation illness, even if you stayed there 24/7 for a decade. Radioactive contamination may be the one case for which the solution to pollution really is dilution.

There will be no dead bodies at the scene, unless someone is killed by the explosion itself. I suspect that's why al Qaeda instructed Jose Padilla to abandon the dirty bomb concept and try to plan a natural gas explosion instead.

But even a dirty bomb without casualties could spread nuclear panic, based on the danger of long-term cancer. For doses in the 100-rem range, results from historical exposures suggest the increased risk of cancer is about 0.04 percent per rem. That's a 6 percent increase in your chance of dying from cancer for each year you spend in the square kilometer. If the radioactivity were spread over a larger area, e.g., a 10- by 10-kilometer square, then the dose would be lower (12.6 rems per year) and so would the added risk of cancer: 0.06 percent per year of exposure. (I am assuming, conservatively, that risk is proportional to dose, even at low doses.

With such contamination, would I evacuate my home? Not if I were allowed to stay. To me, the increased risk-from the pre-existing average risk of cancer of about 20 percent per year to, say, 20.06 percent-is not significant.

But I wouldn't be given the choice. The exposure of 12.6 rems per year is 126 times more than the yearly limit allowed to the public. In fact, the Environmental Protection Agency decontamination standard is 0.025 rems per year, meaning that 98 percent of the radioactivity would have to be removed before I would be allowed to return to my home.

In the September 11 attacks, the terrorists took advantage of U.S. policy and prejudices. They knew they didn't need guns to take control because pilots had been instructed to cooperate with hijackers; nobody expected hijackers to turn planes into weapons. Similarly, a terrorist today might use a radiological weapon, not because of its actual damage, but in anticipation the out-of-scale panic and ensuing economic disruption that the weapon could trigger.

Could other radiological attacks be more potent than our hypothesized cesium-137 example? Electrical generators powered by the decay of radioisotopes, found in abandoned lighthouses in Russia, held 400,000 curies of strontium-90. But strontium-90 emits virtually no gamma rays; it is harmful only if you breathe it or ingest it. A cloud of aerosolized Sr-90 can kill-but it does not stay in the air for long. For the same reason, even a radiological bomb made using plutonium is unlikely to be dangerous. Anthrax would be deadlier, and much easier to obtain and transport. Nuclear waste storage facilities and nuclear reactors contain vastly more radioactivity, and the danger from them is substantial, if their radioactivity can be released.

If small dirty bombs threaten so little harm, why are they lumped in with true weapons of mass destruction? The reason is: it's the law, as written in the 1997 National Defense Authorization Act (Public Law 104-201) and other places, including California penal code 11417. Defining them this way was a mistake that could lead to misallocation of resources and a general

overreaction if such weapons were used. I hope, and expect, that most of the $450 million to be spent on the anti-nuclear initiative announced last month will be used to protect us from nuclear explosives and attacks on nuclear storage areas, and not specifically from radiological weapons.

If terrorists do attack this summer using a dirty bomb, the resulting death might come from automobile accidents as people flee. Dirty bombs are not weapons of mass destruction, but weapons of mass disruption. Their success depends on public and government overreaction. Beware not radioactivity but nuclear panic. The main thing we have to fear from a dirty bomb is fear itself.

Richard A. Muller, a 1982 MacArthur Fellow, is a physics professor at the University of California, Berkeley, where he teaches a course called "Physics for Future Presidents." Since 1972, he has been a Jason consultant on U.S. national security.