Physicists say there's an urgent need for nuclear detectives

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A terrorist nuclear explosion devastates Manhattan, but no group takes credit. The pressure on the U.S. president to retaliate is intense. Acting on sketchy information, the president orders an attack, but it turns out to be the wrong terrorists, in the wrong country. Things go downhill from there.

To avoid that and other nightmare scenarios, a group of 12 scientists with extensive nuclear expertise, headed by Stanford physicist Michael May, is urging an international push to improve the science of nuclear forensics.

May is a research professor emeritus and former co-director the Center for International Security and Cooperation. He also is the former director of the U.S. nuclear weapons design laboratory in Livermore, Calif. Other members have experience in nuclear intelligence and defense research. One member, Jay Davis, was a United Nations inspector in Iraq.

They say there is an urgent need for more nuclear detectives, armed with science PhDs and instilled with the instincts of an investigator. And those detectives will need training, advanced equipment and stronger ties to intelligence agencies, political leaders and law enforcement.

With the right mobile equipment, nuclear detectives could sift through the debris and the radioactive cloud of an attack in this country or elsewhere and quickly glean crucial information, the scientists argue in a 60-page report to be discussed Feb. 16 at the annual meeting of the American Association for the Advancement of Science (AAAS) in Boston.

The report, Nuclear Forensics: Role, State of the Art, Program Needs, was written by a joint working group of the AAAS and the American Physical Society.

Using radiochemistry techniques and access to proposed international databases that include actual samples of uranium and plutonium from around the world, the nuclear investigators might be able to tell the president—and the world—where the bomb fuel came from, or at least rule out some suspects.

“Nuclear forensics can make a difference,” May said in an interview.

But the U.S. capacity for such investigations has deteriorated since the end of the Cold War, when the capabilities were well supported at the nuclear weapons laboratories. “Presently available trained personnel are highly skilled, but there are not enough of them to deal with an emergency and they are not being replaced,” according to May. “A program to refill the pipeline of trained personnel should be undertaken.”

There’s also a need for development of new equipment, both in the lab and on the street, which could provide a faster analysis during a crisis. The authors also recommend more coordination between scientists and law enforcement; even simple steps such as trading phone numbers could prove crucial. “You really want the top decision makers to know where to get information,” May said.

The remnants of an atomic explosion carry a host of clues, even at the microscopic level, including crystal structures and impurities.

Uranium, for example, varies in isotopic composition and impurities according to where it was mined and how it was processed. Weapons-grade plutonium can be exposed during its production to different neutron fluxes and energies, depending on the particular reactor used. It is also possible to establish the length of time plutonium spent in the reactor.

In some cases, it may be possible for scientists at Lawrence Livermore National Laboratory or Los

Alamos National Laboratory to use their experience, intelligence data and software codes to reverse-engineer a nuclear bomb from its debris and learn telltale details of the design of the explosive.

These clues would not be the equivalent of fingerprints or DNA, May said, but would in most cases allow officials to at least rule out or in broad classes of possible sources.

Tracing bomb material to its source may be only the beginning of an investigation, rather than the end, as the authors acknowledge. Discovering that a terrorist explosive was made of uranium stolen from a specific site in Russia, for example, does not identify the terrorists, but it does provide a starting point, especially if there is suspicion that the bomb makers had inside help.

In their report, the scientists recommend that atomic sleuthing be applied also to radioactive materials seized by law enforcement agencies or border guards. Tracking the substances back to their source might prevent or deter attacks, they said. The authors note that the International Atomic Energy Agency's Illicit Trafficking Database contains 1,080 confirmed events involving illicit trafficking in nuclear and other radioactive materials between 1993 and 2006.

Convincing the nuclear states to share database information about their own uranium and plutonium may be difficult, May said. He suggests that the International Atomic Energy Agency, which has databases of its own, could play an important role.

Source: Stanford University