The Nuclear Threat and U.S. Preparedness: Radiation Monitoring

Arthur Levy

Despite decades of attempts at arms control, nuclear weapons continue to proliferate. The U.S. faces three types of radiation threats from terrorism or war: 1) a radiological dispersal device (RDD or "dirty bomb"), 2) an improvised nuclear device (IND), or 3) a strategic nuclear warhead carried by an advanced delivery system such as a ballistic missile. For example, North Korea recently launched a missile from a submarine.[1] Russia is reportedly building new underground nuclear command posts, modernizing its strategic nuclear forces, and adopting a new defense doctrine that calls for a nuclear response to a conventional threat.[2]

There are two type of portable radiation detectors. "Interdiction" or pre-detonation devices are highly sensitive. They are designed to find a nuclear device, such as a "dirty bomb," before it is detonated. Typical "interdiction" detectors can measure radiation levels of 0.1µR/hr to 100 mR/hr. Response or post-detonation detectors must respond to dangerous high levels of radiation, but they may not respond to the minuscule levels detected by interdiction devices. Some "response" detectors can measure radiation levels of 1µR/hr to 1,000 R/hr.

The U.S. currently relies almost exclusively on interdiction instruments. There has been little interest on the national, state, or local level in response instruments or developing a fixed radiation detection network. The most commonly cited reasons are the belief that "it won't happen here"; the assumption that the federal government will respond immediately to a radiologic event; and lack of funding for nuclear response. There is also the myth that even tiny doses of radiation are lethal and that the "unthinkable" event would not be survivable in the long run. Thus, preparedness would be futile.

In fact, the nuclear industry as well as national preparedness has been crippled by irrational fears and unrealistic limits on exposure.[3]

Interdiction devices are carried by police, firefighters, and federal agents. Some hospitals have portal radiation detectors, but turn them off because they report false alerts. In a terrorist event most portal detectors would saturate in low levels of radiation. Few, if any ambulance services carry and know how to use broad-range radiation detectors. Transporting patients with radiation on their clothing and in their hair can contaminate both the ambulance and emergency departments. Training for ER staff in nuclear terrorism is very limited. Few, if any, hospitals have fixed radiation monitoring equipment on the roof of the structure that measures radiation from the ground and clouds simultaneously. During a radiological event, staff would be overwhelmed with physical, radiation, and psychological trauma. The importance of accurately measuring radiation is usually confined to the Nuclear Medicine Department, which is woefully unprepared to deal with a mass casualty event.

Instruments for Interdiction

Extremely sensitive instruments are deployed for interdiction and isotope identification at a cost of from $2,000 to $20,000 each. Since their ability to detect unexploded nuclear material is limited to a range of about 50 feet, interdiction is by no means guaranteed. Though more than $100 million has been spent on such instruments, after a nuclear detonation most of these instruments would be nearly useless because they would be saturated or "overloaded" in high levels of radiation. Some may saturate at dose rates as low as 10 mR/hr. Although affordable instruments with a very broad dose range are now available, they are not widely deployed.

Radiological Dispersal Devices (RDDs)

An RDD can be made by placing radioactive material, most likely Cs-137 or Co-60, in or around some explosive material. Most, if not all casualties would be caused by the explosion itself rather than radiation exposure. The greatest health risk from radiation would be from ingestion of the radioactive substance. But the mere presence of radiation could cause panic, and the contamination could cause severe economic damage because of stringent clean-up standards. According to a report by the Congressional Research Service, a study of the economic impact of an attack on the ports of Los Angeles and Long Beach using two RDDs placed total U.S. losses at $8.5 billion for exports and $26 billion for imports.[4]

Delivery methods for radiological attacks include trucks, cars, backpacks, and even hobbyist drones. A radioactive drone recently landed on the Japanese prime minister's roof.[5]

Improvised Nuclear Devices (INDs)

An IND capable of fitting in a backpack could deliver an explosive yield similar to that of the bomb that leveled Hiroshima. Unlike the Hiroshima bomb, which was air-burst, a ground-burst IND would, in addition to the initial nuclear radiation, generate a radioactive plume covering up to 1,000 square miles. Radiation from an IND could exceed 1,000 R/hr. Fortunately, the radiation

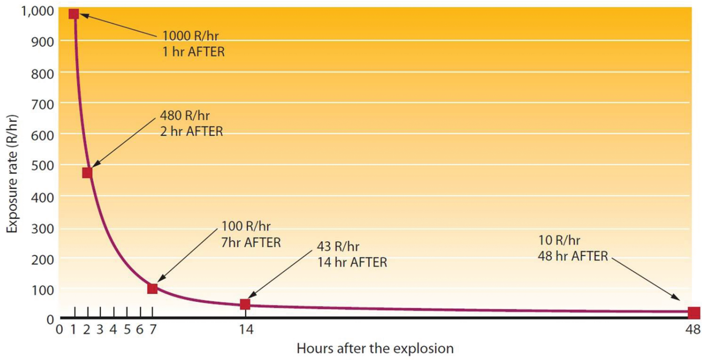

Figure 1. Radiation Decay Rate[6]

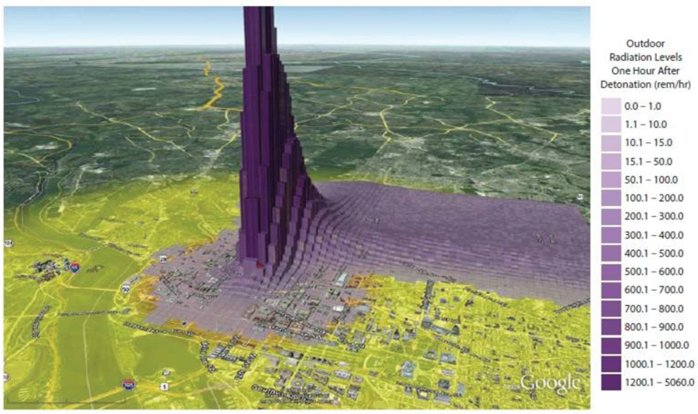

Figure 2. Exposure Rate after One Hour at Various Distances from Detonation[6]

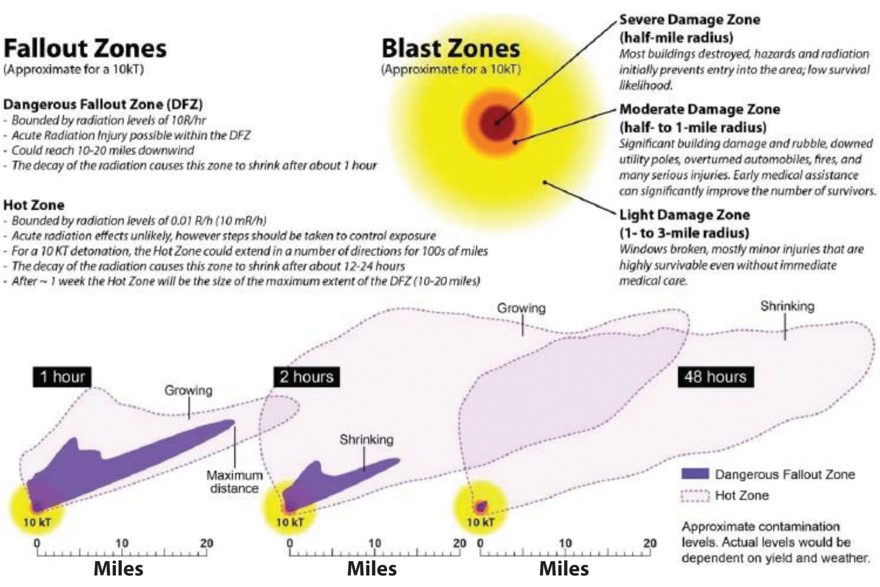

Figure 3. Approximate Blast and Fallout Zones for a 10 KT Nuclear Explosion.[6]

decays rapidly (see Figure 1).[6] The likely exposure rate one hour after detonation at various distances is diagrammed in Figure 2. The plume dynamics are diagrammed in Figure 3.

The direct effects of an IND explosion would be catastrophic in terms of lost lives and property. The blast from a 10 kiloton IND could level more than a city block, destroying everything in the immediate area and sending a shockwave shattering windows for many miles. The fallout from an IND-created blast, at ground level, sends dust and dirt into a large plume that is carried by the wind that could reach 90,000 feet. The blast could also create an electromagnetic pulse (EMP) disrupting radio communications, including cell phones and the power grid.

Many scenarios in books and preparedness training call for simultaneous, multiple IND detonations in many major cities.

Nevertheless, tens of thousands of lives could be saved by proper preparedness.[7] Tracking the plume would be essential for decisions on evacuation or sheltering in place.

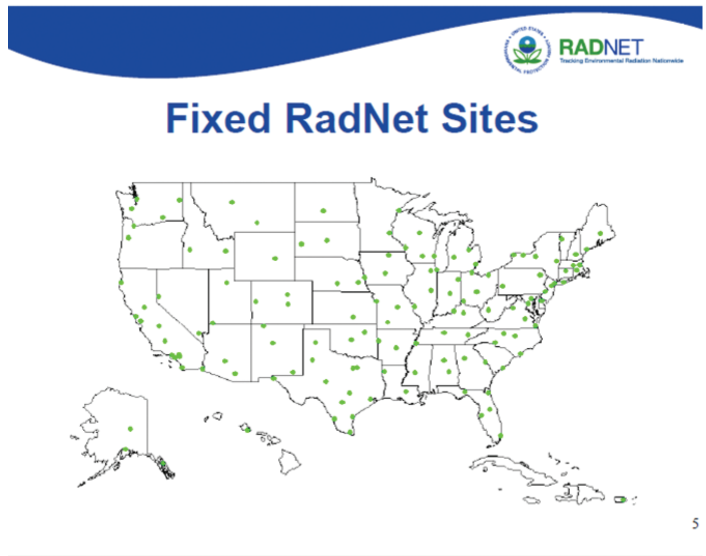

Figure 4. Fixed RadNet Sites.

RadNet

The Environmental Protection Agency's RadNet system (www.epa.gov/radnet) is intended to determine the large-scale national impact of a radiological incident, including exposure data for large areas of population and population dose estimation. It monitors air, precipitation, and drinking water. RadNet is specifically not intended to provide an early warning system for nuclear accidents or to provide a means to monitor in the immediate locality of an incident. There are 135 fixed stations in the U.S. (see Figure 4), manned by EPA volunteers, reporting once per hour by satellite telemetry and cellular data. There are also a few deployable stations the EPA can send.

The system is based on ERAMS (Environmental Ambient Radiation Monitoring Systems). The levels measured are near background, and the system would saturate at high levels. Moreover, the system works by filtering air, and fallout particles are airborne for only a short time.

RadResponder Network

The RadResponder Network (www.radresponder.net) is a product of collaboration between the Federal Emergency

Management Agency (FEMA), the Department of Energy (DOE) / National Nuclear Security Administration (NNSA), and the Environmental Protection Agency (EPA). It has more than 1,000 agencies and nearly 3,900 responders enrolled, but it requires trained properly equipped personal to enter a potentially high-radiation field to take measurements. RadResponder requires that individual measurements be entered on a smartphone or through a computer. A widespread network of automated radiation measurement stations that monitors critical infrastructure is lacking.

Automated Radiation Monitoring Stations

The Automated Radiation Monitoring Station (ARMS-2) (Figure 5) is based on the NukAlert-ER (Figure 6). Designed to be mounted on the roof of a building, it contains dual radiation detectors that constantly monitor "cloud shine" and "ground shine" at levels ranging from 1 μR/hr to 700 R/hr, with no saturation below 1,000 R/hr. The system has the capability to shut off the building's air intake through BACNet (Building Automation Control Network) to protect the building and its occupants from potentially deadly radiation. The ARMS can send email or text warnings to key personnel. Data from existing stations is being constantly transmitted by Internet, cellular, and WiFi (see http://www.viewpointsonics.com/naer/publicDeviceSummary.php). Also, the systems can feed real time data to the RadResponder Network. The cost of the unit is less than $10,000. Nevertheless, to date, government agencies have been reluctant to invest in preparing for a "low probability, high consequence" event involving radiation, even for monitoring critical infrastructure government buildings.

Figure 5. ARMS-2 Station

Figure 6. A NukAkert-ER™ (Extended Range) Radiation Monitor

Conclusion

The U.S. is a target for radiological and nuclear weapons. Technology is available that could preserve thousands or millions of lives by providing real-time radiation measurements that aid in warning the public of need for shelter or preventing panic. However, the technology currently deployed by government and local agencies may be unsuited to the threat.

Radiation detection equipment now widely deployed is designed to find pre-detonation nuclear devices, and may report unusable or dangerously misleading data as a result of insufficient monitoring, overly sensitive radiation detectors, and lack of trained responders, who may be required to operate in potentially dangerous areas. A national network of automated radiation measurement stations that report continuously is not currently in place.

Arthur Levy is a video and film producer, a former firefighter, and now director of government and commercial sales at Apogee Communications Group. Contact: ACG47@aol.com.

Disclosure: Apogee Communications Group markets and distributes the ARMS-2 system.

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