Dirty Bomb Explosion

What is a dirty bomb?

A dirty bomb is a type of radiological dispersal device (RDD) that combines available radioactive material (Cesium-137, Strontium-90, Cobalt-60, Americium-241, Plutonium-239, Polonium-210) with conventional explosives, such as trinitrotoluene (TNT). The explosion of hot, expanding gas propels radioactive material over an area beyond where the explosion has had immediate impact. It is important to distinguish between nuclear bombs and dirty bombs, which are vastly different in their levels of destruction and lethality. While nuclear bombs' highly radioactive material spreads tens to hundreds of square miles, dirty bomb explosions would likely spread a small amount of radiation only a few blocks or miles from the explosion. A dirty bomb has never been detonated.

What are its potential impacts and hazards?

"A Weapon of Mass *Disruption*"

The hazards of a dirty bomb do depend on the strength and intensity of the explosive and the amount of radiation contained in the dirty bomb. Immediately, dirty bombs would not contain enough radioactive material to cause significant illness or death; rather, its immediate lethal power would lay in the impact of the explosive itself and the panic it causes. As such, dirty bombs are often referred to as weapons of mass disruption rather than weapons of mass destruction.

The effects of a dirty bomb would be injuries sustained by those near the point of explosion, possible contamination of the city or neighborhood where the explosion occurred, and ensuing fear, confusion and mental distress. Longer term concerns include contamination of city buildings and the economic and social consequences of residents fleeing the city. Depending upon its size, a dirty bomb could contaminate large parts of cities, wreaking havoc by making neighborhoods uninhabitable until clean-up is feasible. Some residents located near to the explosion may have measurable internal contamination via inhalation and primary/secondary ingestions, which will require treatment; the sum of cumulative exposures from contamination in food/water supplies may also result in an increased lifetime cancer risk proportionate to dose. However, for responders in neighboring suburban and rural areas, a major point of concern is likely to be the worried well, who panic when learning that a dirty bomb contains radiation. According to a nationally representative survey fielded by the National Opinion Research Center (NORC) at the University of Chicago, in the event of a dirty bomb explosion, 65 percent of urban residents expect that they would evacuate after learning from the media that a dirty bomb has exploded but without receiving any directive or information regarding the event from local government officials.

Narrative of Scenario Depicted in Mapping Tool

The following is adapted from one of the National Planning Scenarios developed by the Department of Homeland Security.

Shortly after 11am, a 3,000-pound truck containing 2,300 curies of ^{137}Cs (Cesium-137) detonates in the downtown business district. One building partially collapses and three others suffer significant damage. Although contaminated detonation aerosol rises approximately 100 feet into the air, due to the size of the explosion, the ^{137}Cs contamination is blown widely and the immediate site of explosion is not as radioactive as might be expected. Winds varying between 3 and 8 miles per hour carry ^{137}Cs over approximately thirty-six city blocks; this area includes the business district, residential row houses, crowded shopping areas and one high school.

Most of the buildings in this part of the city are made of concrete and brick and range in height from two to twenty stories. Complex wind patterns common in urban areas with tall buildings result in heavier contamination in several "hot spots". Also, negative indoor building pressure draws radioactive aerosols inside the buildings through cracks near windows and doors. In addition, material is spread more widely as foot and vehicular traffic post-deposition of aerosols bring materials elsewhere via hair and clothing.

Although the explosion was instantaneous, particle dispersion continues for a short period of time afterward as breezes navigate the complex urban environments before settling. City responders do not recognize the explosion as a dirty bomb until responding units arrive with gamma detection equipment and thus, 15 minutes pass before the radioactive components in the explosion are identified. Downwind aerosol dispersion causes local/regional disruption. As soon as the presence of radiation is known, officials realize that they need to make a recommendation to residents, particularly those downwind, about whether they should shelter-in-place or evacuate, but the plume has already passed and settled before they have been able to issue a directive that could be particularly helpful to city residents.

The first responders who do not recognize the radioactive contamination immediately after the explosion are contaminated while attempting to assist those injured and killed by the explosion. In total, there are 180 immediate fatalities and 270 injuries and 65 percent of city residents evacuate. After the initial word spreads that a dirty bomb is the cause of the explosion, large numbers of city residents scramble to pick up their children, spouses, or elderly parents and leave primarily by car. The dirty bomb has exploded during the school year and therefore, parents are frantic to obtain their children from local schools. Cabs and buses are fully occupied. By mid-afternoon, the main interstate and several major highways are blocked with heavy amounts of traffic. Suburban gas stations service a continuous stream of vehicles. Grocery stores in the outer suburbs and rural communities find their shelf supplies dwindling and hospitals are overwhelmed, largely by citizens concerned that they may have been exposed.

Given that Cesium-137 is water-soluble and reacts with numerous chemicals and materials, including concrete and stone, a 36-block area in the city is contaminated at varying levels. Some examples of the type of decontamination and cleanup that must take place include: filling

cracks in streets and sidewalks and repaving those which are especially contaminated; resurfacing roofs; and chemically treating exterior surfaces using methods such as vacuum blasting and scabbling. The process will be expensive and lengthy. Residents in contaminated areas of the city likely will not be able to return to their homes for at least several months, if not longer, and many may not be willing to return to the city and will settle elsewhere. Economic impacts will be severe as business within the city will be at a standstill until clean-up is complete; schools and businesses may relocate and the city itself could suffer long-term decline. Rural and suburban areas can expect to see a permanent population influx.

Planning Considerations

Recommendations for planning reception sites:

- Reception site staff can triage, facilitate movement, communicate with other reception points, provide acute medical care, distribute maps and provide directions, disseminate risk communication messages, provide the latest information on the disaster and weather, and store basic supplies. Take advantage of all potential uses and plan accordingly.
- Strategically locate alternate care sites and general reception sites away from hospitals and traffic choke points.
- Print brochures describing availability of resources in town and in nearby towns so that evacuees can determine where their needs might be best met.
- Ensure that reception sites staff/volunteers are prepared to cope with the mental health aspects of disasters and have critical incident stress management and psychological first aid ready and waiting.
- Be sure that the reception sites have sufficient bathrooms/porta-potties.
- Alternate care sites should be in facilities that have medical clinic space, bathrooms, showers and kitchens.

Recommendations related to length of stay issues:

- Ensure that plans are adaptable to various lengths of stay among evacuees.
- Establish a rapid assessment team to identify changing priorities as length of stay increases.
- Keep in mind that social service and mental health needs also increase as time passes.
- Many evacuees with chronic mental health problems likely will not seek help for awhile.

The above guidelines were adapted from the Western New York Public Health Alliance Advanced Practice Center's *Rural Preparedness Planning Guide: Planning for Population Surge Following Urban Disasters.* Visit the guide to learn more about planning tasks for before, after, and during events that might prompt unexpected surges in population. The following sections may also be particularly relevant in the face of chemical incidents:

- State and Federal Assistance
- Regional Coordination
- Addressing Resident Concerns

Additional Resources

Centers for Disease Control and Prevention. “Frequently Asked Questions (FAQ) About Dirty Bombs.” Link

Council on Foreign Relations. “Dirty Bombs.” Backgrounder, October 19, 2006. Link

Davis, Lynn E. 2003. *Individual Preparedness and Response to Chemical, Radiological, Nuclear and Biological Terrorist Attacks.* Rand Corporation.

FAS Public Interest Report. 2002. “Dirty Bombs: Response to a Treat.” *The Journal of the Federation of American Scientists* 55(2). Link

Nichols, Bill, Mimi Hall and Peter Eisler. 2002. “‘Dirty bomb’ threatens U.S. with near terror attack.” USA Today. June 11, 2002. Link

USA Today. “How a ‘Dirty’ Bomb Works.” Link

U.S. Nuclear Regulatory Commission. 2003. “Fact Sheet on Dirty Bombs.” Link

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