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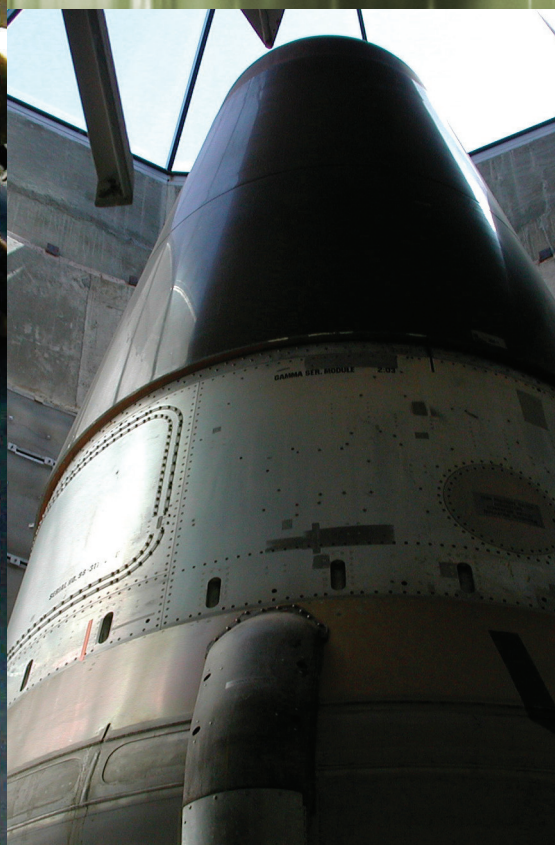
The U.S. AND Nuclear Terrorism

STILL DANGEROUSLY UNPREPARED



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AUGUST 2006

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Executive Summary and Recommendations

Five years after September 11, 2001, the United States remains dangerously unprepared to deal with the aftermath of a terrorist attack involving nuclear weapons, dirty bombs or explosions at nuclear power plants.

This summer America marks two somber anniversaries. On August 29, we were reminded of the death and destruction unleashed on the Gulf Coast by Hurricane Katrina. On September 11, Americans will pause to remember the anniversary of the worst terrorist attack in the history of our country.

As we mourn the victims of these disasters and contemplate the loss of life and property we must ask whether the United States is prepared to protect its citizens from even more devastating disasters.

In early 2001, a bipartisan task force established by the Department of Energy concluded, "The most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons useable material in Russia could be stolen and sold to terrorists or hostile nation states and used against American troops abroad or citizens at home."

Nuclear terrorism remains a very real threat. Since 1993 the International Atomic Energy Agency has documented 175 cases of nuclear trafficking, 18 of which involved highly enriched uranium or plutonium, the raw material for nuclear explosives.

To assess U.S. preparedness for nuclear terrorism, Physicians for Social Responsibility (PSR) evaluated the medical consequences of three hypothetical nuclear and radiological attack scenarios: a 12.5 kiloton nuclear weapon explosion in New York City, an attack on a nuclear power plant near Chicago, and a dirty bomb explosion in Washington, D.C. PSR then examined the steps that should be taken to try to minimize the deaths and injuries these events would cause.

FINDINGS

- Five years after September 11, 2001, the U.S. government still does not have a workable, public plan to respond to the medical needs of the huge numbers of people who would be injured in a nuclear terrorist attack. Thousands of American civilians injured by a nuclear terrorist attack might survive with careful preparedness planning.

- The government's ability to quickly and effectively evacuate communities or shelter populations downwind will be the single most important factor in minimizing casualties in each of these three scenarios. The United States still does not have a plan for deciding, in response to a specific attack and prevailing weather conditions, whether people should try to evacuate or shelter in place.

- There is no plan for communicating such a decision to the public, for carrying out an evacuation if needed or for supporting populations who

are asked to take shelter in their homes. The response to Hurricane Katrina suggests there is no clearly designated individual or group to make the decision to evacuate or shelter and no clearly defined criteria for making that decision. The failure to make such plans could lead to hundreds of thousands of preventable deaths in the event of a nuclear terrorist attack.

- Each of the nuclear terrorism scenarios generates a need for emergency medical care for hundreds to hundreds of thousands of victims. The U.S. does not have adequate plans for establishing field medical care, for mobilizing medical personnel or deploying additional medical supplies to the site of an attack.

- The 50 Disaster Medical Assistance Teams maintained by the Department of Homeland Security and deployed to the Gulf following Hurricane Katrina were overwhelmed quickly. The failure to develop plans to deploy adequate medical resources could prevent hundreds of thousands of Americans from receiving life saving medical care following a terrorist attack in which even more people are injured.

- The U.S. public health system, which would bear a large burden in responding to nuclear terrorism, is currently under-funded and under-staffed. New sources of funding and other resources are desperately needed to strengthen the existing public health system, so that the U.S. can better respond to a wide range of threats.

- Though an attack on the U.S. with a nuclear weapon or dirty bomb would be a unique disaster, advance planning can significantly reduce the resulting damage. Currently, there is no communication with the public on preparedness for nuclear terrorism and little evidence of serious consideration of potential scenarios by preparedness planners.

- One of the most critical elements of an effective disaster management plan is the identification of a central coordinating authority empowered to immediately step in to direct the response and rescue efforts. No such central coordinating authority has been designated.

- Clear communication with the public is equally critical. Without timely and understandable information from trusted sources the public cannot be expected to take appropriate or directed actions.

- Health care experts have proposed that hospitals in major urban areas not be the site of health care first response in a disaster because they could be quickly jammed with injured, anxious and contaminated victims compromising the ability to deliver care to existing patients. Rather, a system of disaster medical care centers should be prepared with pre-positioned supplies and equipment.

- A comprehensive plan for providing emergency and continuing patient care will be effective only if communities have adequate teams of health professionals available to them and access to essential medical equipment and supplies required for mass treatment. Decision-makers must work to develop creative solutions to this challenge.

- Even with extensive preparedness planning, a nuclear terrorist attack would create human casualties and economic destruction on a scale unprecedented in our national history. The U.S. response to this threat must include more vigorous effort to prevent terrorists from gaining the ability to commit such acts in the first place.

RECOMMENDATIONS

Physicians for Social Responsibility has a three point prescription to address these dangerous deficiencies in planning, organization, and communication. PSR recommends the Department of Homeland Security adopt the following measures:

Planning:

- Designate a central coordinating authority and a clear chain of command that would be activated in the event of a nuclear terrorist attack or natural disaster to direct the response and rescue efforts.
- Establish and communicate clear criteria to guide this authority in deciding whether to evacuate people or shelter them in place. Establish plans for carrying out any evacuations deemed appropriate and for supporting populations instructed to shelter in place.
- Include nuclear scenarios in most regular desk-top and field planning exercises and give the U.S. Weather Service capacity to map and broadcast radiation fallout plumes in real time.

Organization:

- Establish an adequate National Disaster Medical System with significantly increased numbers of Disaster Medical Assistance Teams and establish a mechanism for quickly mobilizing existing military medical teams and integrating volunteer health professionals.
- Pre-position radiation protection and monitoring equipment in areas felt to be high risk potential targets. Pre-position stockpiles of medical supplies that can be moved quickly to the affected areas in response to nuclear terrorism or natural disasters such as hurricanes or floods.
- Train and equip first responders so they can quickly identify a radiological emergency and perform their duties while also ensuring their own safety.
- Establish Disaster Medical Care Centers in high risk urban areas and mobile field hospitals that can be moved quickly to areas where existing medical facilities are overwhelmed.

Communication:

- Establish a plan for communicating evacuation or sheltering decisions to the public and educate the public in advance about these issues so that they will follow instructions in the chaotic aftermath of an attack.
- Ensure that the coordinating authority has access to real time information and can communicate the location and expected spread of radioactive fallout plumes.

A NOTE ON NUCLEAR TERRORISM PREVENTION

While there is much work to be done in the area of preparedness for a nuclear terrorist attack, PSR recognizes that even the best efforts in this area will not be enough to keep our communities safe. Given the potentially devastating consequences of a nuclear terrorist attack, prevention strategies centered on moving the U.S. and other nuclear weapons powers toward the elimination of nuclear weapons are key to our long-term safety.

At the same time, well-funded and rigorously enforced programs aimed at keeping nuclear weapons and materials out of the hands of terrorists, should be considered mainstays of prevention of nuclear terrorism. These should include securing the facilities that house this dangerous material and reducing and ultimately eliminating U.S. reliance on nuclear weapons and nuclear power.

Understanding Nuclear Terrorism

While the magnitude of death and destruction associated with a nuclear terrorist attack is difficult to comprehend, it is not difficult to envision how such an attack might occur. Today, much of the knowledge required to build a crude nuclear device is widely available in open literature and on the internet. The ability to put it all together requires little more than a basic understanding of nuclear physics and engineering. Access to nuclear weapons material is the greatest barrier for terrorist organizations.[1]

However, this barrier is not insurmountable, and more than 55 countries, including Russia and Pakistan, have poorly guarded military and civilian facilities which collectively store hundreds of tons of fissile material.[2] The International Atomic Energy Agency (IAEA), the organization charged with monitoring nuclear materials worldwide, has documented more than 175 cases of nuclear trafficking in the last decade, 18 of which involved highly enriched uranium or plutonium, essential ingredients to make a nuclear bomb.[3]

Moreover, terrorists may choose to use our own technology against us, as they did with jetliners on September 11. Nuclear power plants have previously been identified as the targets for terrorism, and their radioactive cores and waste storage facilities already are in place throughout the country.[4]

UNDERSTANDING CURRENT U.S. POLICY ON NUCLEAR TERRORISM PREPAREDNESS

The federal government has an absolute and clear responsibility to prepare for nuclear terrorist attacks. In 2005, the Department of Homeland Security (DHS) released its *National Preparedness Goal* (NPG) and a series of *National Planning Scenarios* (NPS) that analyze a variety of potential threats and responses, including those involving a nuclear terrorist attack. Despite repeated warnings by high-level government officials and independent experts about the likelihood of a nuclear terrorist attack, the DHS has not developed the comprehensive plans needed to respond to such an attack.[5] In fact, the bipartisan September 11 Commission's

1 Matthew Bunn, Anthony Wier, John P. Holdren, Controlling Nuclear Warheads and Materials: A Report Card and Action Plan; also see Linda Rothstein, Catherine Auer and Jonas Siegel, "Rethinking doomsday" Bulletin of the Atomic Scientists, November/December 2004.

2 Center for American Progress, "Agenda for Security: Controlling the Nuclear Threat" February 2005, page 7. Also see David Albright and Kimberly Kramer, "Fissile Material: Stockpiles Still Growing," Bulletin of the Atomic Scientists, November/December 2004.

3 International Atomic Energy Agency, "Calculating the new global nuclear terrorism threat," IAEA Press Release, November 1, 2001.

4 Ibid.

5 Sam Nunn, William Perry and Eugene Habiger, "Still Missing: A Nuclear Strategy," Washington Post, May 21, 2002.

final report, released on December 5, 2005, gave failing grades to the federal government's efforts to prevent or effectively respond to a large scale terrorist attack. The Commission gave an "F" to the government's efforts to prevent terrorists from acquiring weapons of mass distruction and warned that the United States is woefully unprepared to handle a terrorist attack involving nuclear weapons or material.[6]

The need to review existing infrastructure and to plan and prepare for disasters has been recognized at the highest levels of government for many years. Acknowledging this critical need for improvement in U.S. disaster planning and mitigation efforts, President Bush issued the Homeland Security Presidential Directive 8 (HSPD-8) in December 2003. The stated goal of the HSPD-8 was to establish

> *policies to strengthen the preparedness of the United States to prevent and respond to threatened or actual domestic terrorist attacks, major disasters, and other emergencies by requiring a national domestic all-hazards preparedness goal, establishing mechanisms for improved delivery of Federal preparedness assistance to State and local governments, and outlining actions to strengthen preparedness capabilities of Federal, State, and local entities.*[7]

However, almost three years after HSPD-8 was first issued, movement on disaster preparedness programs has been almost non-existent. To date, the only tangible progress has been the draft of a Department of Homeland Security (DHS) paper titled *National Preparedness Goal* (NPG), which only sets forth goals but has no clear plan or timeline for implementing them.[8]

While DHS has yet to develop a robust plan for disaster preparedness programs, it certainly recognizes the potential threats — including nuclear threats. DHS's own analysis, as reflected in its April 2005 "official use only" report titled *National Planning Scenarios* (NPS), detailed the devastating human, economic, and environmental impacts a nuclear bomb explosion or a terrorist attack with a dirty bomb would have on a U.S. city.[9] Although the NPS report does not describe the impact of a power plant core meltdown resulting from a terrorist attack, it does acknowledge that such an attack would cause significant damage.[10]

The NPS report underscores the urgency of planning for the aftermath of a possible nuclear terrorist attack. According to the report, a terrorist attack with a nuclear weapon or a dirty bomb would require immediate mobilization of federal, state and local authorities, as well as resources on a scale far greater than those required for responding to the terrorist attack on the World Trade Center or to Hurricane Katrina.

However, the intent and the rhetoric of the *NPS* or the *NPG* have not translated into a focused effort on the part of the government to demonstrably improve preparedness. Congressional and Government Accountability Office (GAO) inquiries into the federal government's response to Hurricane Katrina makes it clear that, despite the creation of the DHS and its drafting of the *National Preparedness Goal*, the federal government still has not settled the most basic preparedness questions.

A NUCLEAR EXPLOSION IN A MAJOR URBAN CENTER

The most catastrophic form of nuclear terrorism would be the detonation of a nuclear bomb in a

6 The 9-11 Commission, Final Report Card on the Government's Preparedness Efforts, December 2005, http://www.9-11pdp.org/press/2005-12-05_report.pdf

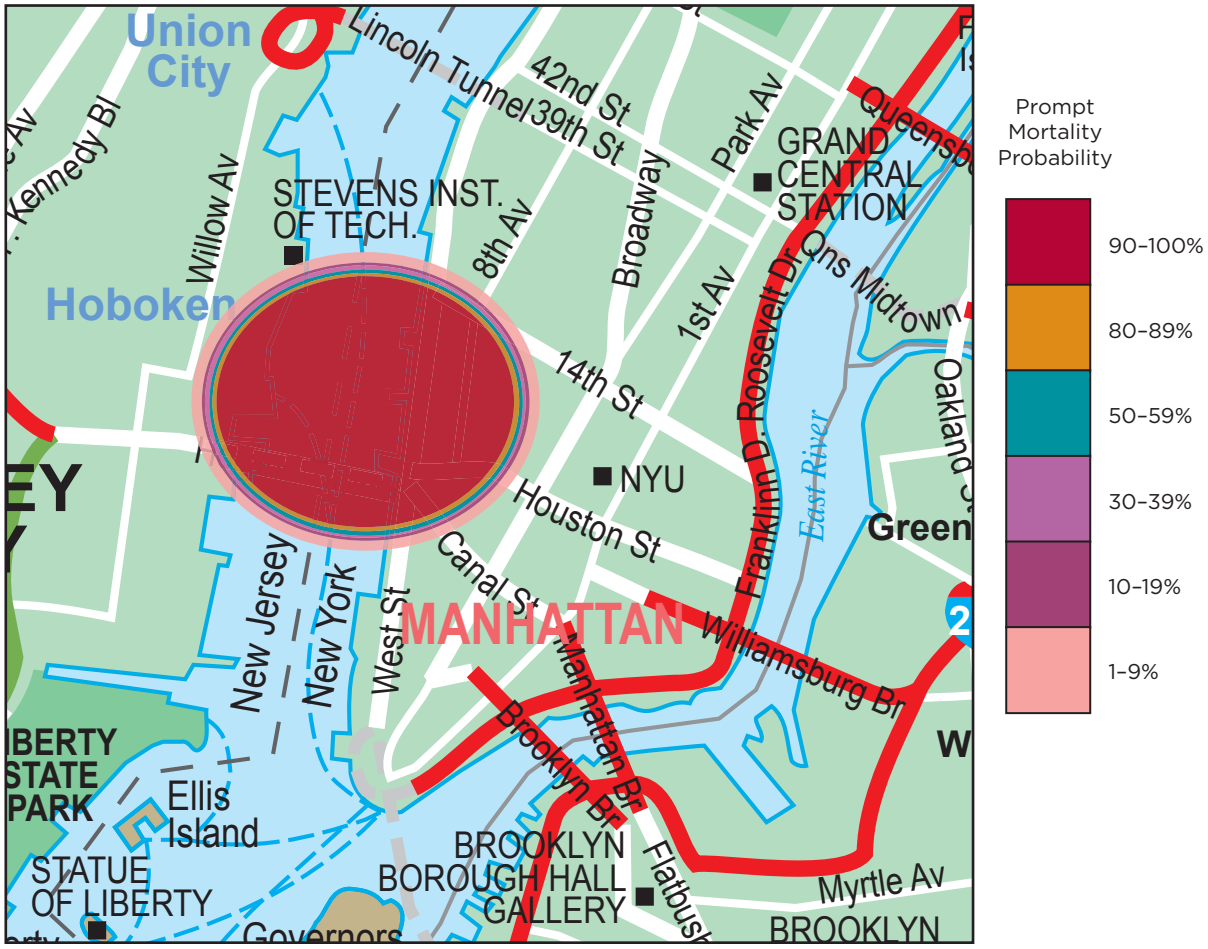
7 The White House, Homeland Security Presidential Directive/Hspd-8, December 17, 2003, http://www.whitehouse.gov/news/releases/2003/12/20031217-6.html

8 http://www.marc.org/emergency/meetings/rhscc-hspd8.pdf

9 DHS, National Planning Scenarios, see scenario # 1 and 11.

10 DHS, National Planning Scenarios, ii

Figure 1: Blast Radius and Prompt Mortality from a 12.5 kiloton Bomb Explosion in New York City



Source: Ira Helfand, Lachlan Farrow and Jaya Tiwari, "Nuclear Terrorism," *British Medical Journal*, Vol. 324, February 9, 2002, 356-359.

densely populated urban area. Terrorists could achieve this by acquiring an intact nuclear weapon or by obtaining highly enriched uranium (HEU) or plutonium (Pu) and building a bomb. This is not just a theoretical possibility, but represents a real danger. To make a simple nuclear bomb (like the one dropped on Hiroshima in August, 1945), less than 120 pounds of HEU would be needed; some more advanced designs using explosives would require as little as 75 pounds of HEU. HEU is highly dense material that is easily transported. For example, 125 pounds of HEU has the equivalent volume of eight soda cans. If terrorists succeeded in acquiring Pu, they would need an even smaller quantity of it than HEU to build a bomb. The plutonium weapon dropped on Nagasaki in August 1945 used approximately 13 pounds of Pu (the approximate size of a grapefruit). Many modern weapon designs require even less Pu.

Terrorists may be able to obtain HEU or Pu from a variety of sources, such as weapons laboratories in nuclear weapon states, civilian research centers, nuclear reactors, and fuel storage facilities. The global HEU stockpile is estimated to be between 1,300 and 2,100 metric tons. More than 100 tons — enough for 20,000 nuclear weapons — of surplus bomb grade Pu is currently stockpiled in unsafe facilities in Russia and remains vulnerable to theft or smuggling.

Even before the September 11 attacks, the likelihood that fissile material or even intact nuclear weapons would end up in the hands of a

non-state group was well recognized. A bipartisan Department of Energy task force warned in its 2001 report that, "The most urgent unmet national security threat to the United States today is the danger that weapons of mass destruction or weapons useable material in Russia could be stolen and sold to terrorists or hostile nation states and used against American troops abroad or citizens at home." In the less bureaucratic language of General Eugene Habiger, former head of the Department of Energy's nuclear anti-terror programs, "It is not a matter of if; it's a matter of when."

The consequences of a nuclear bomb explosion would be death and destruction unprecedented in U.S. history. Shortly after the September 11 attack, PSR published a study in the *British Medical Journal* (*BMJ*) that indicated that a 12.5 kiloton nuclear bomb detonated by terrorists at a dock in lower Manhattan would kill hundreds of thousands of people.[11] The scenario was developed using specialized software, the Hazard Prediction and Assessment Capability (HPAC) provided by the Defense Threat Reduction Agency and the Consequence Assessment Tool Set from FEMA. It contemplated a terrorist attack using a nuclear bomb smuggled by a cargo ship into New York City.

This is not an unlikely scenario. The Port of New York ranks as the largest port complex on the East Coast. With capacity to handle the highest container volume in North America, the Port of New York receives thousands of cargo shipments each day from around the world.[12] Given that less than five percent of cargo containers entering U.S. ports are ever screened, a determined terrorist group has numerous opportunities for transporting a concealed nuclear device.[13]

The *BMJ* case study found that the nuclear bomb blast would decimate much of lower Manhattan. The heat and blast from the explosion would kill an estimated 52,000 people immediately, while as many as 238,000 people would be exposed to direct radiation emanating from the blast. Of those exposed, a projected 44,000 individuals would suffer radiation sickness; and 10,000 of these individuals would receive lethal doses of radiation.

Figure 1 depicts the blast radius and the corresponding casualty rate resulting from a 12.5 kiloton bomb explosion in lower Manhattan.

After the explosion, the area surrounding New York City would experience "nuclear fallout," a phenomenon in which a cloud of radioactive debris is carried by prevailing winds, often traveling hundreds of miles. Depending on wind patterns and other weather conditions, portions of Long Island and other localities would be affected within 24-48 hours.

The *BMJ* case study predicted that another one and a half million people could be exposed to radioactive debris in the few days following a nuclear explosion. Unless the exposed population was evacuated or sheltered; this fallout could kill an additional 200,000 people, and cause several hundred thousand cases of acute radiation sickness.

In addition, care facilities would face a major disruption. The *BMJ* case study found that such an attack would destroy 1,000 acute care hospital beds, and another 8,700 acute care beds would need to be abandoned because they would lie in the area of heavy radioactive fallout.[14]

Figure 2 shows the distance the radioactive plume would travel and the corresponding exposures level for the affected population.

More recently, in a March 2005 report, the DHS analyzed a very similar hypothetical scenario detailing an attack in which terrorists explode a 10 kiloton bomb in downtown Washington, D.C., blocks from the White House.[15] In the DHS study, the immediate blast effects from the explosion would kill an estimated 15,000 people and wound 31,000. The report also predicts that there would be 190,000

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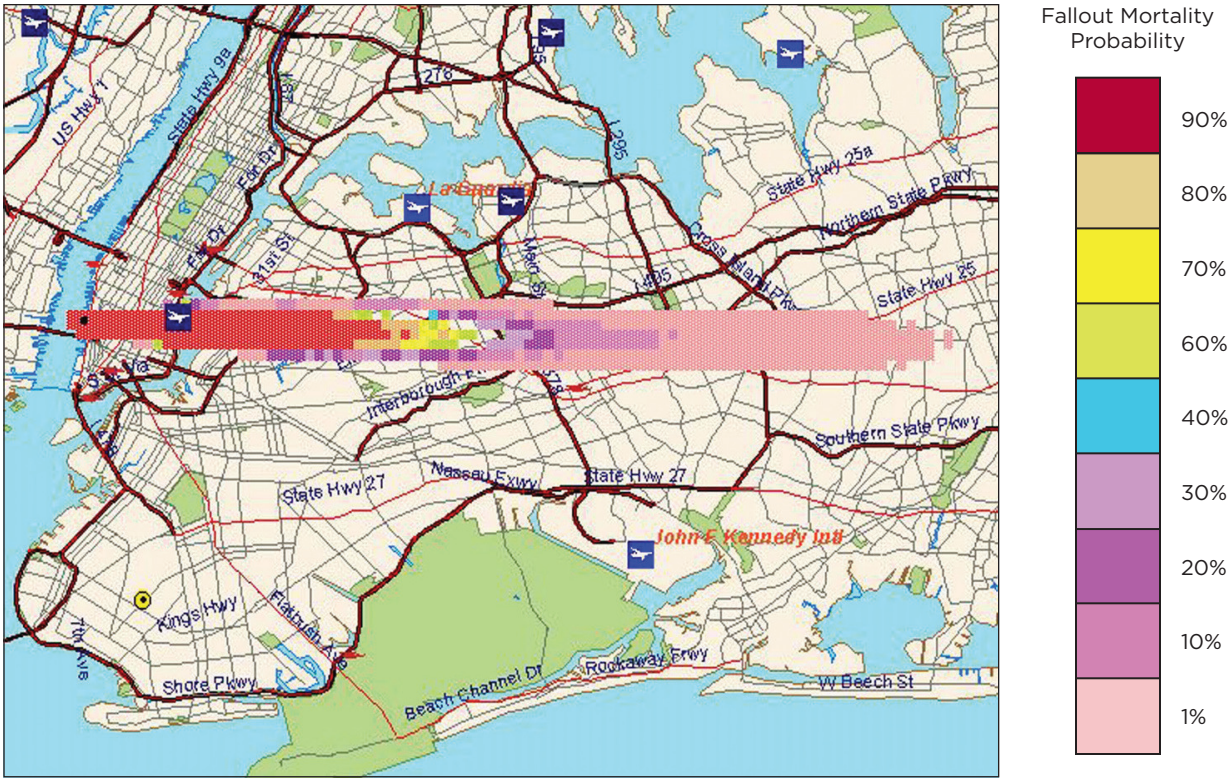
11 Ira Helfand, Lachlan Forrow, Jaya Tiwari, "Nuclear terrorism," British Medical Journal, February 9, 2002, 356.
12 The Port Authority of New York and New Jersey, Cargo Capabilities, available electronically at http://www.panynj.gov.
13 Michael E. O'Hanlon, "Cargo Security," Congressional Testimony: Senate Governmental Affairs Committee, March 20, 2003.
14 Ira Helfand, Lachlan Farrow, and Jaya Tiwari, "Nuclear Terrorism," British Medical Journal, Vol. 324, February 9, 2002, 356-359.
15 DHS, National Planning Scenarios, Scenario 1.

Figure 2. Radiation Exposure to Population and Fallout Mortality from a 12.5 kiloton Bomb Explosion in New York



Source: Ira Helfand, Lachlan Farrow, and Jaya Tiwari, "Nuclear Terrorism," *British Medical Journal*, Vol. 324, February 9, 2002, 356-359.

prompt, or immediate, deaths and 264,000 injuries from short term radiation exposure in an area 19 miles to the east from the explosion if the population is not adequately sheltered or evacuated. Additionally, the DHS study predicts that there would be chronic radiation exposure in an area 198 miles to the north and east of Washington, D.C., causing 49,000 cases of cancer, of which 25,000 would be fatal.[16] Figure 3 and 4 respectively show the blast radius and the corresponding casualties from a 10 kiloton bomb explosion in downtown Washington, D.C., the distance the radioactive plume would travel and the levels of radioactive exposure likely for the affected population.

AN ATTACK ON A NUCLEAR POWER PLANT

The United States is home to 104 nuclear power plants and 36 non-power research reactors licensed by the Nuclear Regulatory Commission (NRC).[17,18] These nuclear power plants generate eight percent of the energy consumed in the U.S.[19] An attack against one of these plants has long been considered a serious threat.

As early as 1982, the Argonne National Laboratory conducted a study detailing the likely damage that a commercial jet plane could inflict on the concrete containment walls protecting nuclear reactors. At that time, the concern was that an accidental airline crash could compromise

16 DHS, National Planning Scenarios, Scenario 1, Appendix 1-A, pp 1-15 to 1-17.
17 Nuclear Regulatory Commission, "Power Reactors," available electronically at www.nrc.gov/reactors/power.html
18 Nuclear Regulatory Commission, "Non-Power Reactors, " available electronically at www.nrc.gov/reactors/non-power.html
19 Amory Lovins, Energy Security Facts: Details and Documentation, Rocky Mountain Institute, June 2, 2003.

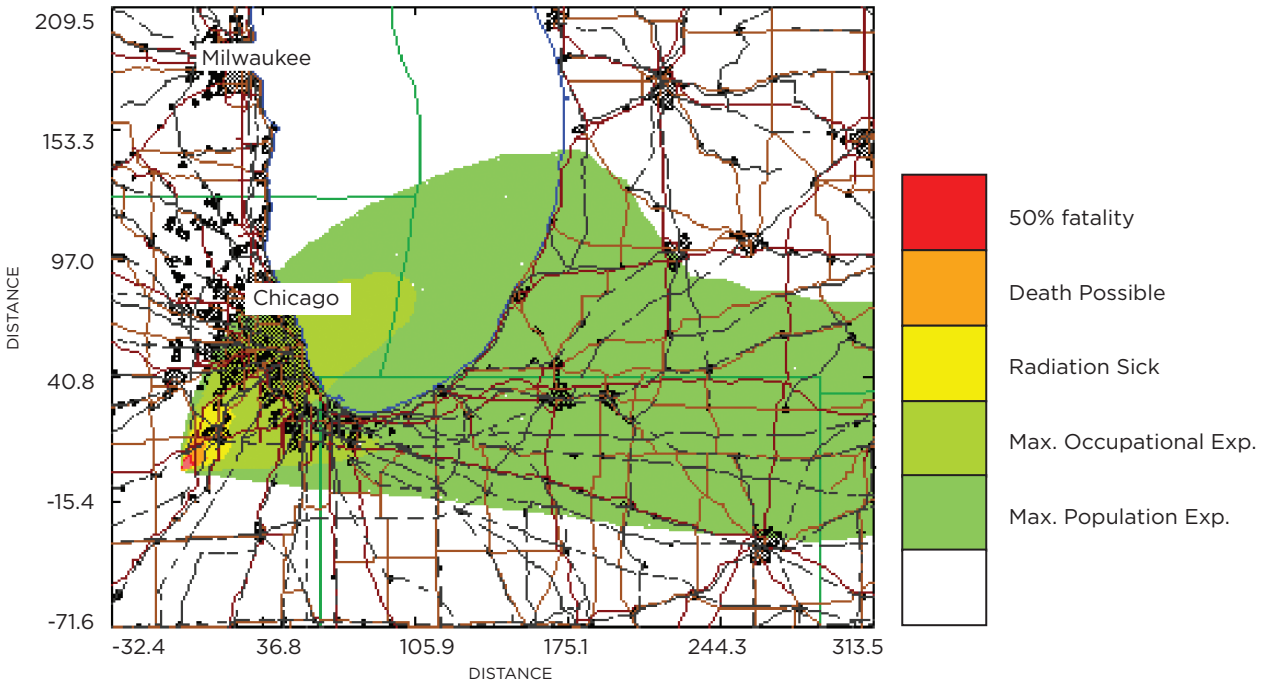
Figure 3. Prompt Blast Radius of a 10-kiloton Nuclear Detonation in the Central Business District of Washington, DC

Source: Department of Homeland Security, "National Planning Scenarios," Created for Use in National, Federal, State, and Local Homeland Security Preparedness Activities, Draft Report, April 2005, 1-15.

Figure 4. Countours for Acute (24-hour) Exposure Doses for a 10-kiloton Nuclear Detonation in Washington,DC

Source: Department of Homeland Security, "National Planning Scenarios," Created for Use in National, Federal, State, and Local Homeland Security Preparedness Activities, Draft Report, April 2005, 1-17.

Figure 5: Total Effective Radiation Exposure following Braidwood Nuclear Reactor Meltdown (distance in miles)



a nuclear power plant's primary containment wall and interior structure. The scenario showed that even if only one percent of a jetliner's fuel penetrated the containment and ignited after impact, this would create an explosion equivalent to 1,000 pounds of dynamite inside a reactor building. Such an explosion could create simultaneous failures in key safety measures leading to a loss of reactor coolant that cannot be mitigated and a meltdown of nuclear fuel.[20]

The PSR study considers the effects of a hypothetical attack against the Braidwood Nuclear Power plant[21] located 60 miles southwest of Chicago.[22] Overall, there are eleven operating reactors in Northern Illinois, making Chicago particularly susceptible to a terrorist threat against a nuclear plant. In this scenario, we imagine that a terrorist group hijacks a jet plane and crashes it into the plant.

Braidwood is a pressurized water reactor producing 2500 megawatts (MW) of electricity at full capacity. Pressurized water reactors, like most nuclear power plants, require huge amounts of water to cool the reactor and maintain continuous steam production to power the turbines. A catastrophic loss of coolant, from either a direct attack against the primary coolant system, or from a reactor vessel breach resulting from a commercial jetliner accident, would uncover the core of the reactor, causing it to melt and burn.

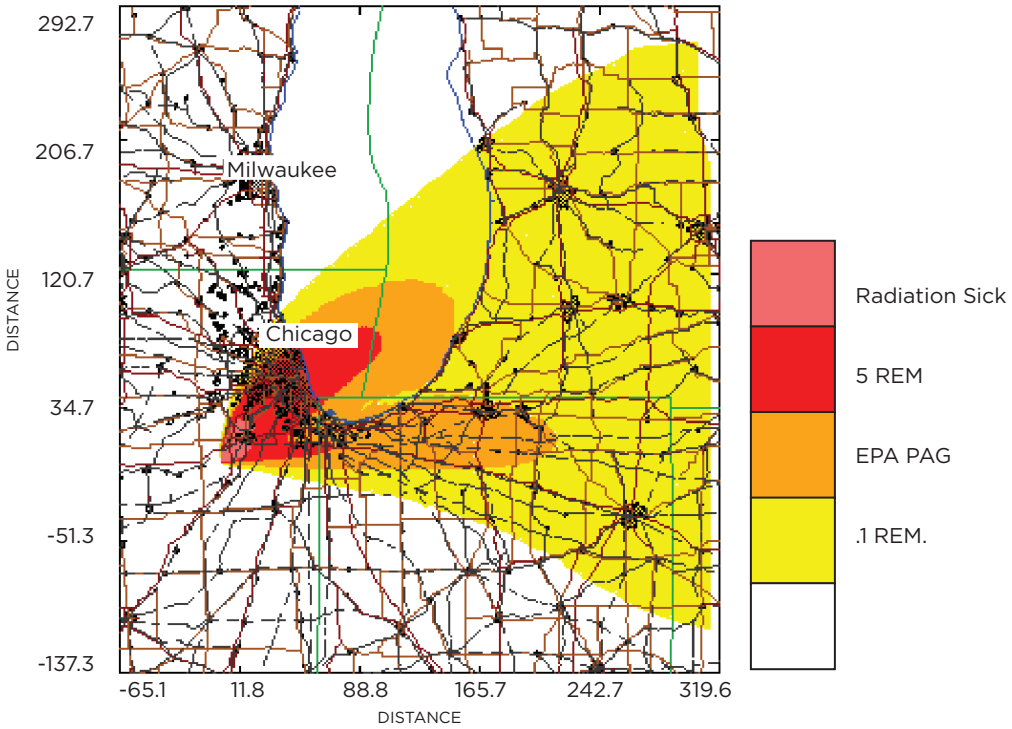
Exposure of the reactor core, a containment breach, would release the reactor's superheated

20 Dr. Ed Lyman, Security of the Nation's 103 Nuclear Reactors, Nuclear Control Institute and Committee to Bridge the Gap News Press Conference, September 25, 2001, transcript available electronically at http://www.nci.org.

21 The Braidwood power plant and its owner, the Exelon Corporation, were recently sued by Illinois Attorney General. The Braidwood unit was found to be leaking tritium that contaminated groundwater and tritium has been found in private wells of nearby property owners. See, Matthew L Wald, "Nuclear Reactors Found to Be Leaking Radioactive Water," The New York Times, March 17, 2006.

22 Similar to the BMJ Study, the scenario described here was created using specialized software called Hazard Prediction and Assessment Capability (HPAC) provided by the Defense Threat Reduction Agency and the Consequence Assessment Tool Set (CATS) from the FEMA.

Figure 6: Acute Radiation Exposure to Population following Braidwood Nuclear Plant Meltdown (distance in miles)



radioactive fuel into the air. It is important to note that nuclear power plant cores typically contain 20 to 40 times the amount of radioactive materials released in a small nuclear bomb explosion (as the one described in the first hypothetical scenario). In this power plant attack scenario, the Braidwood reactor is presumed to have suffered a catastrophic failure. The resulting plume of radioactive materials would extend north from the reactor itself to the northern edges of metropolitan Chicago, and east into Indiana and Michigan.

Figure 5 shows the distance the radioactive plume would travel.

The population would be exposed to different levels of radiation depending on the distance from the reactor, duration of exposure (for this simulation, it is assumed that the exposure would continue for one week), and the wind pattern.[23] It is estimated that more than 7.5 million people would be exposed to radiation (receiving greater than the maximum allowed annual population dose), of which 4.6 million would receive a dose equivalent of the maximum allowable occupational exposure for one year.[24] More than 200,000 would receive high enough doses to develop radiation sickness and 20,000 might receive a lethal dose (LD 50), according to our projections.

The acute exposure levels shown in Figure 6 below reveal the intensity of radioactivity, the risk to first responders, and the size of the area requiring evacuation. Radiation doses that are high enough to produce acute radiation sickness would affect an area encompassing parts of Kankakee, Will and Grundy counties. The area that would require evacuation or other protective measures is shown as the orange area in Figure 6 identified as EPA

23 These figures are for the total effective dose equivalent which is a combination of external radiation and radiation from internally consumed radioactive particles (primarily inhaled).

24 Population estimates are based on 1990 Census data. Actual numbers are likely to be significantly greater.

PAG (Environmental Protection Agency Population Action Guideline). As shown by the map, this includes the majority of the City of Chicago, extending east to Gary and South Bend, Indiana.

A similar study of a terrorist attack on the Indian Point nuclear power plant (located 35 miles north of New York City) showed an even higher death toll and greater destruction than illustrated in the scenario described above.[25] In this study, conducted by Dr. Edwin Lyman of the Union of Concerned Scientists (UCS), a meltdown at the Indian Point power plant could result in 44,000 people dying from radiation poisoning within a year and 518,000 cancer deaths over time.[26] In this scenario, millions of people in the greater New York City area would have to be permanently relocated because the resulting contamination would leave huge geographic areas uninhabitable for many years or decades. Economic losses from such an attack, according to the UCS study, could top $2 trillion.

THE NUMBER OF ACUTELY ILL PEOPLE in this scenario would overwhelm all available care facilities; about 113 hospitals would fall within the occupational exposure zone (including two Veterans Administration hospitals), affecting more than 32,000 potential beds. Nearly 20,000 physicians in five counties would receive greater exposure than occupational maximums for radiation exposure from the plume.

First responders, including firefighters, would also be injured. The 25 firefighters of Essex Fire Department would likely receive lethal doses, and the 67 firefighters of Braidwood and Herscher departments would suffer from radiation sickness and be unlikely to provide a sustained response to the emergency. Another 10,500 firefighters in 355 other departments would exceed occupational exposures from the plume itself and would be unavailable to respond within the highly contaminated area. Police departments also would be hard hit in Essex, Braidwood and Herscher, with an estimated 38 police officers there receiving potentially lethal doses of radiation.

A DIRTY BOMB EXPLOSION IN AN URBAN CENTER

Although often included in discussions of WMD, radioactive dispersal devices (RDDs, or dirty bombs) do not compare to nuclear weapons in terms of casualties or destruction. Dirty bombs are also easier to build than nuclear weapons since they do not require mastering complex physics processes, and they do not use bomb-grade plutonium and uranium, which are difficult to obtain.

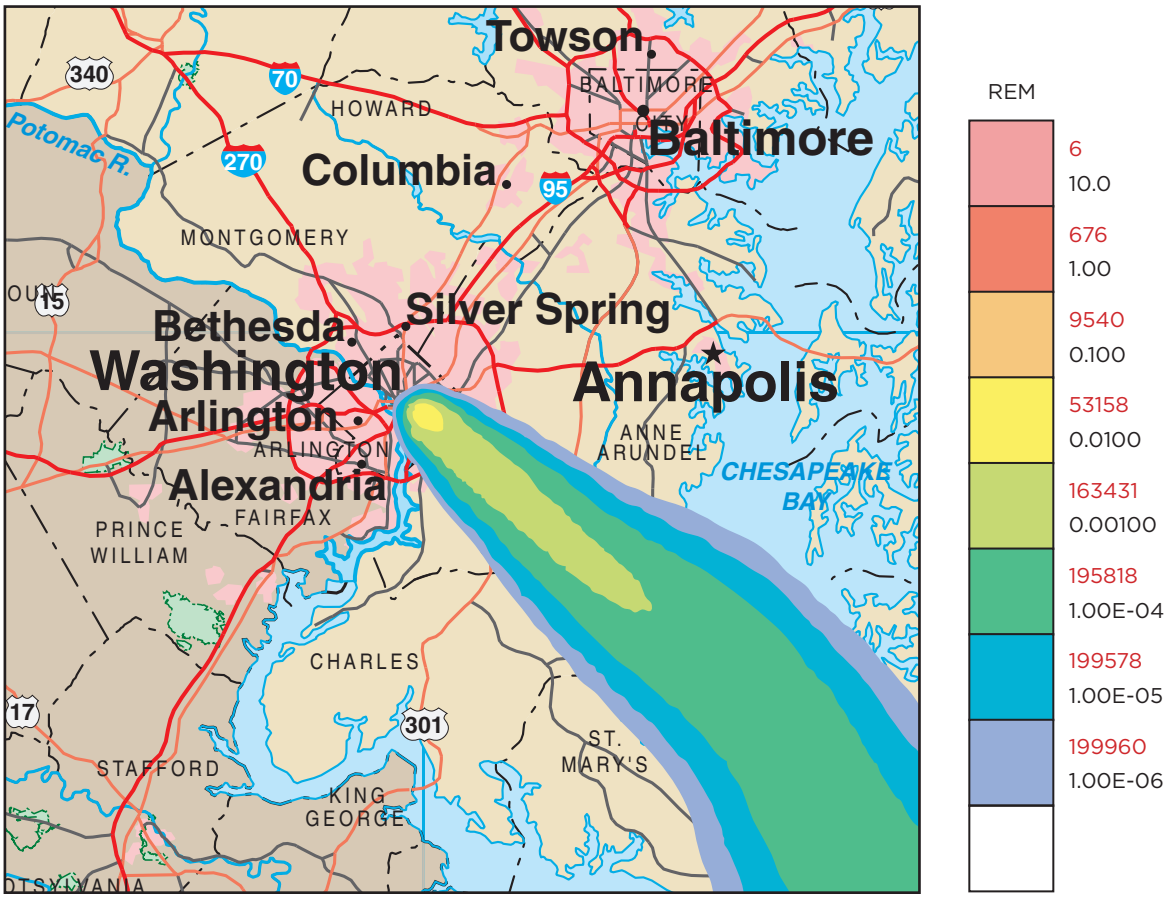
The conventional explosion which occurs in a dirty bomb can cause local injuries and death. However, the major danger is the air-borne dispersal of radioactive materials, as the pulse of heat and the blast aerosolizes the source of radioactive material and sprays it over a wide area.

A dirty bomb is a modified conventional weapon, likely made of either commercial or military explosive or an oil and fertilizer mixture, com-

25 All figures and details of Indian Point nuclear power plant core meltdown study cited hereinafter come from Edwin Lyman, Chernobyl on the Hudson? The Health and Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant (Washington, DC: Union of Concerned Scientists, September 2004); also see Mark Thompson and Bruce Crumley, "Are These Towers Safe? Why America's Nuclear Power Plants are Still so Vulnerable to Terrorist Attack–and How to Make them Safer," a special in depth investigation, Time, June 20, 2005, 34.

26 All figures and details of Indian Point nuclear power plant core meltdown study cited hereinafter come from Edwin Lyman, Chernobyl on the Hudson? The Health and Economic Impacts of a Terrorist Attack at the Indian Point Nuclear Plant (Washington, DC: Union of Concerned Scientists, September 2004); also see Mark Thompson and Bruce Crumley, "Are These Towers Safe? Why America's Nuclear Power Plants are Still so Vulnerable to Terrorist Attack–and How to Make them Safer," a special in depth investigation, Time, June 20, 2005, 34.

Figure 7: Dirty Bomb Blast Effect and Radiation Doses to Population in Washington, DC



bined with some form of radioactive material.[27] They are fairly simple to engineer, as they only require readily accessible materials, such as radium or certain cesium isotopes that are used in a variety of medical diagnostics and treatments. Other sources of radioactive material include food or seed irradiation equipment, portable power supplies, and highly radioactive fission products from nuclear power plant waste.[28,29]

Dirty bomb simulations can vary significantly based on the size of the conventional explosive and the source of the radioactive contamination. The following scenario describes the effects of a dirty bomb attack in downtown Washington, D.C.

In this scenario, a terrorist group explodes a moderate size dirty bomb, containing 2000 curies of cesium-137 (Cs-137), in the vicinity of the 15th and H streets, Northwest, D.C (around the corner from the White House). This scenario assumes that only 10 pounds of TNT is used as the explosive and that the bomb could be concealed in a car or another vehicle. The time of the explo-

27 Michael A. Levi and Henry C. Kelly, "Weapons of Mass Disruption" Scientific American, November, 2002.

28 Council on Foreign Relations, "Terrorism: Q&A," Fact Sheet, available electronically at http://www.terrorismanswers.com/weapons/dirtybomb.html

29 Department of Energy, Nuclear Regulatory Commission, Radiological Dispersal Devices: An Initial Study to Identify Radioactive Materials of Greatest Concern and Approaches to Their Tracking, Tagging, and Disposition, Report prepared by the DOE/NRC Interagency Working Group on Radiological Dispersal Devices for the NRC and Secretary of Energy, May 7, 2003, available electronically at http://www.nti.org/e_research/official_docs/doe/DOE052003.pdf

sion is around noon, when the city would be most crowded.

The explosion and local winds would spread radioactive particles over many miles, heavily contaminating the area in the immediate vicinity of the explosion.

Figure 7 shows the blast radius and the corresponding contamination from this dirty bomb explosion.

The scenario also predicts that the fallout would spread across the National Mall area, affecting many of the federal government buildings in the vicinity; depending on weather and wind conditions, fallout would travel over the Anacostia River in Maryland and toward Andrews Air Force Base.

In most scenarios, including the one described above, the conventional explosion would cause the vast majority of acute injuries and deaths. These would likely number in the tens to hundreds. However, the radiation would be spread over a large area and would require substantial effort to decontaminate. Whether one uses the Nuclear Regulatory Commission cutoff of 25 mrem per year, or the EPA maximum of 15 mrem per year, the area required to be decontaminated would include the White House, the National Mall, the House of Representatives office buildings, as well as Fort McNair and the Navy Yard.[30]

The use of a large amount of radioactive material, or material such as nuclear waste (in the form of a spent fuel rod), could significantly increase the adverse health effects from the radiation exposure. Also, the larger the explosive capacity of the bomb, the farther the radioactive contamination would spread. The area in the immediate vicinity of the blast might require long-term evacuation, as the cesium can chemically bind to the windows, roads, and buildings. Farther out, buildings would require intensive washing and even sandblasting. Roads and sidewalks would need to be blasted clean or removed entirely. Topsoil would need to be removed and much of the vegetation would need to be either extensively cut back or removed.[31]

The DHS *National Planning Scenarios* report describes a hypothetical dirty bomb explosion in downtown Washington, D.C. In this study, a terrorist group uses stolen seed irradiators (containing approximately 2,300 curies of Cs-137) in a 3000 pound TNT car bomb. The study predicts that such an attack would kill 180 people from the blast alone and contaminate another 20,000 with radioactive material.[32] The radioactive debris from the explosion would contaminate up to 36 city blocks.

The DHS analysis predicts that, as a consequence of such a dirty bomb attack, an increase in morbidity and mortality related to cancer would also be expected over the longer term. In addition, the study estimates that 5,000-20,000 individuals would require mental health services to help them deal with the psychological impact of such attack.

An additional impact of a dirty bomb attack would be the social disruption associated with the evacuation and clean up. This event would likely require decontamination of tens of square blocks of urban neighborhoods. The DHS' *National Planning Scenarios* document outlines the significant cleanup required, including demolition of buildings, repaving of roads, surface cleaning of sidewalks, re-roof-

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30 Because of the damaging health effects associated with radiation exposure, regulatory bodies in the United States, and internationally, set up and enforce radiation protection standards to protect public health. These radiation protection standards are based on the maximum allowable level of radiation doses, or the quantity of radiation or energy, received by the members of the public or workers, as part of their occupational exposure. The basic unit for measuring ionizing radiation received is called rad (radiation absorbed dose). To determine an individual's biological risk and the probability of harmful health effect, rads are converted to rems. The rem reflects tissue dose and takes into account the type of radiation absorbed and the likelihood of damage from the different types of radiation. Because exposures are normally in fractions of a rem, a more commonly used unit of exposure and regulatory enforcement is the millirem (mrem). The Nuclear Regulatory Commission, for example, requires (in accordance with Title 10 of the Code of Federal Regulations under Part 20) that any NRC licensed nuclear facility limit maximum radiation exposure to individual members of the public to 100 mrem per year, and limit occupational radiation exposure to adults working with radioactive material to 5,000 mrem per year. Source: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/bio-effects-radiation.html

31 Michael A. Levi and Henry C. Kelly, "Weapons of Mass Disruption" Scientific American, November, 2002.

32 DHS, National Planning Scenarios, Scenario 11, page (11-1, 11-7)

ing, removal and replacement of all surface soil, decontamination of all exterior building surfaces, decontamination of interiors of buildings, and stripping of all interior materials, in addition to thorough capture and disposal of solid and water waste from the decontamination effort. The cost of decontamination, according to the DHS study, would be in the billions of dollars.[33]

The extent of the damage from a dirty bomb attack would also depend on the location of the explosion. Should such an attack take place in a confined urban area, such as a tunnel or subway station, the number of casualties would be far greater than if it occurred in an open area where the dangerous particles would be more widely dispersed. A dirty bomb explosion would send radioactive dust particles to the very reaches of the dust cloud, leaving every person in the immediate area exposed and making adequate clean-up and decontamination very difficult, if not impossible.

While under most circumstances the initial injury and death toll from a dirty bomb explosion would be roughly the same as from a conventional bomb attack, there would be additional injuries because of acute radiation exposure in the days and weeks following the attack. There will be extensive mental health effects as people worry that they have been exposed to radiation. These "worried well" will flood local health care facilities in a large area around the actually site of the explosion.[34]

The radioactive material also will cause long term effects. As a recent report by a National Academy of Sciences panel recently concluded, there is no dose threshold at which exposure to radiation is safe.[35] One in ten individuals in the exposed population would experience an increased risk of death from cancer if decontamination were not available.[36] In some cases, the cost associated with decontaminating an area for continued human habitation could be so high that the only practical choice might be to abandon it for as long as radioactive hazards persisted.[37] In addition, inhabitants might feel uncomfortable living, working, or doing business in the area, due to fears of radiation sickness. It could be decades before the economic and public health costs associated with a dirty bomb attack are realized. It is also important to note that the potential cleanup cost in the aftermath of a dirty bomb attack remains one of biggest worries for federal officials dealing with such an incident.

RESPONDING TO A NUCLEAR CRISIS: ARE WE PREPARED?

As we have seen, a nuclear bomb explosion or an attack on a nuclear power plant in a large urban area would bring about death and destruction on an unprecedented scale, and a dirty bomb explosion would cause significant casualties and social disruption. Given these realities, the federal government must have in place a well-coordinated response plan that will limit the casualties and injuries in the immediate post-attack period. The following section presents some elements of an effective response to the scenarios described above, compares these best practices with the current U.S. state of preparedness, and identifies weaknesses in existing plans that merit further consideration.

CENTRAL COORDINATION OF DISASTER RESPONSE

An effective response to a nuclear attack on a large U.S. city requires coordination across many

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33 Ibid, page 11-1.

34 For example, during the 1995 Sarin gas attack on Tokyo subway by Aum Shinrikyo cult, approximately 80 percent of the casualties, about 4000 people, arriving at local hospitals were "worried well." These individuals did not have actual chemical injuries but believed they were ill or suffering as a result of possible exposure to Sarin gas because of their being in the vicinity of the nerve gas attack and demanded medical attention thereby overwhelming available medical resources. See, National Academy of Sciences, High-Impact Terrorism: Proceedings of a Russian-American Workshop (Washington, DC: NAS, 2002), 129.

35 Health Risks From Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2 June 29, 2005, http://fermat.nap.edu/catalog/11340.html.

36 Michael A. Levi and Henry C. Kelly, "Weapons of Mass Disruption" Scientific American, November, 2002.

37 Ibid.

jurisdictions and from multiple federal, state and local agencies. Consequently, one of the most critical decisions, in the event of such an emergency, would be to establish a clear central coordinating authority that would immediately step in to direct the response and rescue efforts. The lack of such a body has been repeatedly identified as a key weakness in current U.S. disaster preparedness and planning policy. When the DHS was designated the main disaster coordinating government body in 2002, the move was touted as a solution to the range of coordination and communication challenges associated with disaster response. While this consolidation did force a number of domestic agencies to share more information, it did little to establish any one body as the coordinating authority. This was made abundantly clear in the days and weeks following Hurricane Katrina's landfall in New Orleans and the Gulf Coast region. A recent Government Accountability Office (GAO) inquiry into the federal government's response to the hurricane listed the "lack of a clear chain of command" and "unclear leadership" as the biggest factors limiting relief efforts.[38] The report blamed the lack of a central coordinating authority and the unclear command issues at DHS for ensuing internal confusion and an indecisive, slow and haphazard response at the federal level. The report further noted that other federal agencies had an "incomplete understanding of roles and responsibilities" under the DHS' new *National Response Plan*.[39]

"We need to be able to have somebody who is clearly responsible and accountable to the president, who has the authority of the president to deal with the overall response,"

— GAO Comptroller General David Walker, on February 1, 2006, presenting the initial GAO report on the failure of the federal government in responding to hurricane Katrina to a Special House Investigative Panel.

EVACUATION AND SHELTERING

In the aftermath of a nuclear explosion or an attack on a nuclear reactor near a population center, the largest number of deaths will result from radiation exposure. The government's ability to quickly and effectively evacuate communities or shelter populations downwind will be the single most important factor in minimizing the casualties and injuries. Unfortunately, current federal preparedness plans do not make clear who would be charged with deciding whether to shelter or evacuate, and these plans do not include clear criteria to assist those charged with making these important decisions. Wind direction and speed and estimates of the isotope content of the fallout cloud will all have an impact on how radiation will be spread, and this information must be communicated in real time to anyone responsible for making evacuation/sheltering decisions. Confusion over evacuation routes and lack of transportation for many underprivileged urban dwellers is likely to compound these problems.

Further there do not appear to be plans in place to effectively communicate an evacuation/shelter decision to the general public, or to carry out an evacuation if that is needed. There is no clear understanding of how to support populations who need to shelter in place for several days, nor is there a program in place to adequately educate the population in advance about this issue so that people will heed instructions they are given. It is important to remember the chaotic circumstances under which these important evacuation and sheltering decisions will be made. Government officials will be forced to respond quickly on the basis of incomplete information and then communicate these decisions both to responsible agencies and to the public. Federal preparedness plans must take into account public fears and misconceptions with regard to the consequences of a nuclear attack. In the event of a nuclear explosion in a city, one's

38 USA Today, "Report: U.S. lacks sufficient prep for catastrophic disasters," available online at http://www.usatoday.com/news/washington/2006-02-01-gao-report_x.htm.

39 USA Today, "Report: U.S. lacks sufficient prep for catastrophic disasters," available online at http://www.usatoday.com/news/washington/2006-02-01-gao-report_x.htm.

instinct will be to flee the area. But, depending on the wind conditions, it may be safer to try to shelter in place for a period of time. In a government analysis of a hypothetical nuclear bomb attack on Washington. D.C., people who tried to evacuate in the first 24 hours received nearly seven times as much radiation as those who sheltered in their basements for 72 hours before trying to evacuate.[40] The federal government must work with states and leaders in the public health community to educate the public about the best strategies to keep their families safe in the event of an attack.

"In the absence of timely and decisive action and clear leadership responsibility and accountability, there were multiple chains of command."

— GAO Comptroller General David Walker, February 1, 2006, presenting the initial GAO report on the failure of the federal government in responding to Hurricane Katrina to a Special House Investigative Panel.

HOSPITAL SURGE CAPACITY

In the event of any major urban disaster, hospitals can expect to see thousands of patients in need of intensive medical care (or hundreds of thousands, if radiation sickness is one of the hazards). In a nuclear attack, many hospitals that lie within the fallout zone of a nuclear explosion may have to be abandoned because they will have been destroyed or contaminated with radiation. Thus, there will be an urgent need for temporary field hospitals. These should be located close enough to the scene for easy evacuation of patients, but far enough to avoid ongoing radiation exposure and contamination. A coordinated system must be in place for transporting patients to field hospitals and making beds available at existing facilities.

No such national system is currently in place. A recent study by the Trust for America's Health warns, "…hospitals in nearly one-third of states… are not sufficiently prepared, through planning or coordination with local health agencies, to care for a surge in extra patients by using non-health facilities, such as community centers sports arenas, or hotels."[41] This assessment is confirmed by an analysis conducted by the American Hospital Association, which concludes that most hospitals, particularly in the major metropolitan areas, have only four to six percent of their total beds available for a potential influx of patients in an emergency situation.[42] Nationally, 62% of all hospitals surveyed reported capacity problems during routine operation.[43] Given increasingly strict criteria for hospital admission, few hospitalized patients can be discharged prematurely without seriously compromising their care. Many hospital emergency rooms, especially in large metropolitan areas, are full of patients awaiting the availability of inpatient treatment rooms, making it unlikely that they can accommodate a sudden influx of new patients.

The DHS *National Preparedness Goal* document emphasizes the urgent need to strengthen U.S. medical surge capacity, because it would play a critical role in determining how to handle effectively large numbers of patients requiring immediate hospitalization following a major terrorist attack.[44] The *NPG* calls for the development of a system where Emergency Medical Service (EMS) "resources are effectively and appropriately dispatched and are able to provide pre-hospital triage, treatment, transport, tracking of patients, and documentation of care appropriate for the incident, while maintaining the capabilities of the EMS system for continued operations."[45] Such a system could be activated in "anticipation of a mass casualty incident

40 DHS, National Planning Scenarios, scenario #1, Appendix 1-A, p 1-29.
41 Trust for America's Health, "Protecting the Public's Health from Disease, Disasters, and Bioterrorism," Washington, D.C., December 2005, page 3.
42 Peter D. Marghella, "Surge Capacity Planning in Health Care Organizations: Hitting the Mark on Enhancing National Preparedness," Homeland Defense Journal, September 2005, page 12.
43 The Lewin Group Analysis of AHA ED and Hospital Capacity Survey, 2002.
44 DHS, National Preparedness Goal, page 20.
45 DHS, National Preparedness Goal, page 11.

that requires supplementing the aggregate surge capacity of local hospitals with an influx of supplemental healthcare assets from mutual-aid partners, the State, and the Federal government."[46] However, no such system has yet been developed.

DISASTER MEDICAL CARE CENTERS

In the case of a major disaster, it would be important that hospitals not be the site of triage and healthcare first response in a disaster. Rather, a system of community sites should be prepared with pre-positioned supplies and equipment to conduct the initial medical response.[47] The goal would be to eliminate crowding, reduce travel, prevent infection and contamination, and maintain the ability of hospitals to offer complex services to their existing and referred disaster patients. One possible solution to the problem of hospital surge capacity is the creation of a system of disaster medical care centers. Disaster medical care centers would be based in existing facilities, such as sports arenas or schools that would be pre-supplied with military-like field equipment, including medical supplies. In addition, a system of mobile field hospitals should also be established to provide coverage for cities without disaster medical care centers and as back-up for those with such centers. These field hospitals also would be useful where there is potential for a natural disaster, such as a major hurricanes, earthquakes, or disease outbreaks.

MOBILIZATION OF KEY RESOURCES: MEDICAL PERSONNEL AND SUPPLIES

In all three scenarios described in this report, local medical personnel would be quickly overwhelmed by the numbers of critically ill patients. Many facilities would not have effective radiation monitoring equipment, decontamination facilities, or personnel to manage them. To adequately address the care and treatment of victims, an immediate mobilization and deployment of trained medical professionals and supplies from outside the affected area would be required.[48]

Recognizing this need, the *National Preparedness Goal* document envisions a public-health system where, in the event of a national emergency, emergency-ready medical personnel, hospitals, and other healthcare facilities would collaborate to handle rapidly a myriad of injuries, including physical and psychic trauma, burns, infections, bone marrow suppression, and other chemical- or radiation-induced injury.[49]

While the *National Preparedness Goal* offers some useful recommendations for addressing the shortage of medical personnel, it does not address the means to quickly deploy additional doctors, nurses, and other health professionals to a disaster zone. The DHS's National Disaster Medical System currently maintains more than 50 Disaster Medical Assistance Teams (DMAT). In the aftermath of Hurricane Katrina, all DMAT were deployed to the Gulf Coast area. It is quite clear that this level of capacity is totally inadequate for dealing with the casualties anticipated in a nuclear terrorist attack. In fact, the DMAT in the New Orleans area were completely overwhelmed by the relatively small number of patients they had to deal with during that crisis.[50]

There is a critical need for the Federal Emergency Management Agency to increase the number of DMAT at its disposal and to establish a system that can quickly mobilize military combat support hospitals and National Guard personnel in an emergency. FEMA also should create a system that will absorb and quickly integrate doctors, nurses, and other health professionals who

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46 DHS, National Preparedness Goal, page 20.

47 Ref: Kipnis, K. Overwhelming Casualties: Medical ethics in a time of terror. *In the Wake of Terror: Medicine and Morality in a Time of Terror* J. D. Moreno editor MIT Press Cambridge MA 2004 pp 95-107.

48 DHS, National Preparedness Goal, 20.

49 Ibid.

50 Sarah A Lister, "Hurricane Katrina: The Public Health and Medical Response," Congressional Research Service, Washington, D.C., September 21, 2005, page 13.

volunteer their services. In 2005, many doctors and nurses who volunteered to help and even traveled directly to the areas affected by Hurricane Katrina could not be put to use because there was no system for integrating them into a coherent, functioning, health care team. Many health professionals volunteered by applying on the Department of Health and Human Services (DHHS) website but were never contacted.

Lastly, to best ensure an adequate and continuous flow of critical medical supplies and equipment, the federal government, in cooperation with state and local governments, must develop a strategy for pre-positioning these essential materials and communicating this plan to those who will need the supplies and equipment in their treatment of patients. The *National Preparedness Goal* appropriately designates this as a priority capability building area for an effective response to a terrorist attack or a major natural disaster.[51] There must be adequate stockpiles of bandages, IV solutions and equipment, antibiotics, pain medication, and other common medicines, as well as the ability to mobilize adequate supplies of blood and blood products.

PREPAREDNESS PLANS: NEW YORK, CHICAGO, AND WASHINGTON, D.C.

While the magnitude of a nuclear terrorist attack demands that the federal government assume primary responsibility for this threat, there is an important role as well for local governments. A survey of state and city-specific preparedness planning for the three cities selected in this study indicates that state and local governments have made some improvements in the management of health consequences since the last major terrorist attack on September 11, 2001. However, there remain fundamental problems with the city-specific recommendations and a clear need for a thoughtful and effective plan for preparing communities in the event of a nuclear attack.

New York City

The City of New York has published a preparedness guide that is available on-line at www.nyc.gov/readyny. More than two million copies in eight languages have been distributed to the public, in an attempt to inform New Yorkers of the city's disaster preparedness and evacuation plan. Since the September 11 attacks, the city also has made vast improvements in its ability to communicate with the public by radio and television. In a survey of disaster preparedness for America's fifty largest cities, the American Disaster Preparedness Foundation ranked New York as the second best-prepared city giving it high marks for public education and communication of its disaster planning and first responders training.[52]

The capacity of New York City officials to communicate with each other and among various agencies, however, remains severely limited. Most importantly, four years after the Sept. 11 attacks and one year after Hurricane Katrina, there still is no single plan to evacuate all of New York City.[53] Orderly and safe evacuation for a city of more than eight million people, the majority of whom are without cars, is considered difficult to impossible, even by the officials responsible for carrying out such an evacuation.

According to Joseph F. Bruno, New York City's Emergency Management Commissioner, the city is

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51 DHS, National Preparedness Goal, 20.

52 American Disaster Preparedness Foundation, "How Prepared is Your City? A Study of the Preparedness of the Largest Metro Areas in the U.S.," January 2006, page 24. Using data compiled from several sources, including city disaster plans, county disaster plans, meeting records, disaster records, mitigation plans, news reports, census data, government publications, interviews with emergency management and other government employees, non- governmental organization reports, accreditation records, interviews with residents, and other sources, the American Disaster Preparedness Foundation report ranked selected cities' preparedness levels based on a number of criteria. The report used criteria such as a city's disaster preparedness planning, training, public education, general awareness of the city's disaster plan, communication, the city's ability to help its most vulnerable and poor citizens, technology, infrastructure, external support to assign grades of A-F.

53 Sam Roberts, "Planning the Impossible: New York's Evacuation," New York Times, September 11, 2005.

ACUTE RADIATION SYNDROME

One condition that surely will challenge health care workers following a nuclear incident is radiation sickness (acute radiation syndrome (ARS). ARS is a serious illness that occurs when the entire body (or most of it) receives a high dose of radiation, usually over a short period of time. Many survivors of the Hiroshima and Nagasaki atomic bombs in the 1940s, and many of the firefighters who first responded after the Chernobyl Nuclear Power Plant accident in 1986, became ill with ARS.

People exposed to radiation will get ARS only if:

- the radiation dose was high (doses from medical procedures such as chest X-rays are too low to cause ARS; however, doses from radiation therapy to treat cancer may be high enough to cause some ARS symptoms):
- the radiation was penetrating (that is, able to reach internal organs):
- the person's entire body, or most of it, received the dose: and
- the radiation was received in a short time, usually within minutes.

The first symptoms of ARS are typically nausea, vomiting, and diarrhea. These symptoms will begin within minutes to days after the exposure, will last for minutes or up to several days, and may come and go. Then the person usually looks and feels healthy for a short period of time, after which he or she will become sick again, with loss of appetite, fatigue, fever, nausea, vomiting, diarrhea, and possibly even seizures and coma. This seriously ill stage may last from a few hours up to several months.

People with ARS typically also have some skin damage. This damage can start to show within a few hours after exposure and can include swelling, itching, and redness of the skin (like a bad sunburn). There also can be hair loss. As with the other symptoms, the skin may heal for a short time, followed by the return of swelling, itching, and redness days or weeks later. Complete healing of the skin may take from several weeks up to a few years, depending on the radiation dose received by the person's skin.

The chance of survival for people with ARS decreases with increasing radiation doses. Most people who do not recover from ARS will die of exposure within several months. In most cases, the cause of death is the destruction of the person's bone marrow, which results in infections and internal bleeding. For the survivors, the recovery process may last from several weeks to as long as two years. Treatment may include blood transfusions, antibiotics, and the use of hematopoetic stimulating agents. If these fail, bone marrow transplant in specialized units is required."

Excerpted from: The Centers for Disease Control and Prevention, Fact Sheet on Acute Radiation Syndrome (May 20, 2005). Available at http://www.bt.cdc.gov/radiation/ars.asp

only prepared to move from 400,000 to two million people out of the path of a hurricane, a challenge made a little less daunting by advance warning; knowing which flood-prone areas to evacuate; and identifying how many poor, elderly, disabled, and non-English speakers live there.[54] This reflects the enormity of the problem in evacuating the majority of New York City residents following a nuclear attack with little notice. It seems clear that many of News York City's population, if not most, would need to shelter in place in the event of a major nuclear attack, but there is no system to support them with basic necessities like food and water.

"Would it be difficult to move two million people? Absolutely," Mr. Bruno said. "I hope we never have to do it." This means that evacuating eight million would be beyond difficult. "We have plans for area evacuations, and if you take them to their logical conclusion an area could be the entire city of New York," Mr. Bruno said. "Those are doomsday type things, a nuclear attack. We're definitely not throwing our hands up. But it would be a catastrophic event that would be extremely difficult for New York City to have to deal with." How long would it take to virtually empty the city? "I wouldn't even hazard a guess," Mr. Bruno replied.

Chicago

The American Disaster Preparedness Foundation ranked Chicago as one of the fifteen best-prepared cities among the 50 largest cities in the U.S.[55] The study gave Chicago an overall C+, with high marks for technology and first responder training and low scores for uniformity of response, public education, and general awareness of disasters. The study cites poor communication of evacuation plans to the public as the major concern. The study faults Chicago for being one of the most tight-lipped cities in disseminating public information on disaster preparedness. City officials refuse to release disaster-preparedness plans to the public, which makes it difficult to examine the city's strength or weakness in this area.[56]

Chicago's first responders have participated in mock catastrophe exercises, for events ranging from a terrorist attack to a major disease outbreak or a natural disaster. The city is equipped with high-tech devices like emergency notification systems and sensors that could detect the presence of certain biological agents and chemicals. City officials plan to acquire radiological sensors in the near future. However, it appears that Chicago first responders are neither prepared fully nor equipped to quickly distinguish a radiological or nuclear attack from other emergencies.

Since the city government has not communicated adequately with the public, the average resident, and even some involved at a planning level, remain unaware of the details of Chicago's preparedness planning. The official advice in the event of a disaster is to seek shelter and tune in to local radio and TV stations for evacuation information.

"As a resident of Chicago, I know very little of what they are doing. This is the same level of irresponsibility we saw in New Orleans: denial of the problem, reassurance without substance and lack of leadership."

— Charles Baum, Vice-President of Health Affairs for the Alexian Brothers Hospital Network in Arlington Heights and a member of the Cook County Department of Public Health Pandemic Disease Response Task Force

54 Roberts, New York Times.

55 American Disaster Preparedness Foundation, "How Prepared is Your City? A Study of the Preparedness of the Largest Metro Areas in the U.S.," January 2006, page 24.

56 Christina Le Beau, "Thinking the unthinkable," December 2005. Available electronically at http://www.chicagobusiness.com/cgi-bin/mag/article.pl?article_id=25103&postDate=2005-12-31.

Washington, DC

The same American Disaster Preparedness Foundation report cited above ranked Washington, D.C. seventh for its preparedness efforts giving it a B-.[57] City officials have participated in mock WMD terrorist attack response training as part of the Top Officials, or TOPOFF terrorism response exercises.

The D.C. government plans do not spell out the designated authority to make decisions on evacuation. This is critical, as D.C. has no governor to make the necessary decisions. City officials have identified fourteen evacuation routes out of downtown Washington D.C. that commuters could use for an emergency evacuation. The map is provided on the D.C. Department of Transportation website, and the city government has attempted to publicize it through local media and on the public transit system.[58] The official evacuation plan shows evacuation routes extending toward the Capital Beltway.

However, there are no road signs to identify emergency routes. During a major disaster, the D.C. plan calls for traffic signals to be re-timed to allow a maximum number of cars to leave the city and for some traffic signals to operate on four-minute cycles. The evacuation plan provides no specifics about how the District of Columbia would coordinate with surrounding states — Virginia and Maryland — or where the evacuated individuals should go to once they are out of the D.C. city limits. Thus, it is difficult to imagine how the city would manage the safe evacuation of hundreds of thousands of people at once, given the traffic congestion on I-495 during a normal rush hour commute.

NOTE

When one goes to the DC government webpage's emergency information section and selects the link for information on nuclear and radiological emergency, a blank page comes up with the following link: FILE:/eic/LIB/eic/cwp~558855~44723~3~6287~13930.cwp

57 American Disaster Preparedness Foundation, "How Prepared is Your City? A Study of the Preparedness of the Largest Metro Areas in the U.S.," page 24.

58 The map is available at http://ddot.dc.gov/ddot/frames.asp?doc=/ddot/lib/ddot/information/pdf/ddot-event-map-large.pdf&open=|32399|

Recommendations

The threat of a nuclear terrorist attack or other large-scale urban disaster is real, and the potential consequences are disastrous. Five years after September 11, the federal government still has not developed an adequate response to these threats. The DHS's *National Preparedness Goal* and the work that went into developing the *National Planning Scenarios* represent useful preliminary steps, but a fully developed and working plan is critical.

Physicians for Social Responsibility has a three point prescription to address these dangerous deficiencies in planning, organization, and communication. PSR recommends the Department of Homeland Security adopt the following measures:

PLANNING

- **Designate a central coordinating authority** and a clear chain of command that would be activated in the event of a nuclear terrorist attack, or natural disaster, to direct the response and rescue efforts.
- **Establish and communicate clear criteria** to guide this authority in deciding whether to evacuate people or shelter them in place. Establish plans for carrying out any evacuations deemed appropriate and for supporting populations instructed to shelter in place.
- **Include nuclear scenarios** in most regular desk-top and field planning exercises and give the U.S. Weather Service capacity to map and broadcast radiation fallout plumes in real time.

ORGANIZATION

- **Establish an adequate National Disaster Medical System** with significantly increased numbers of Disaster Medical Assistance Teams and establish a mechanism for quickly mobilizing existing military medical teams and integrating volunteer health professionals.
- **Pre-position radiation protection and monitoring equipment** in areas felt to be high risk potential targets. Pre-position stockpiles of medical supplies that can be moved quickly to the affected areas in response to nuclear terrorism or natural disasters such as hurricanes or floods.
- **Train and equip first responders** so they can quickly identify a radiological emergency and perform their duties while also ensuring their own safety.
- **Establish Disaster Medical Care Centers** in high risk urban areas and mobile field hospitals that can be moved quickly to areas where existing medical facilities are overwhelmed.

COMMUNICATION

- **Establish a plan for communicating evacuation** or sheltering decisions to the public and educate the public in advance about these issues so that they will follow instructions in the chaotic aftermath of an attack.
- **Ensure that the coordinating authority has access to real time information** and can communicate the location and expected spread of radioactive fallout plumes.

PSR's study has raised a number of key focus areas for those charged with protecting communities from the threats posed by major disasters. It is important to note that the context in which we are raising these issues. The U.S. public health system, which would bear the burden of respond-

ing to events like these, is currently underfunded and understaffed. Any thoughtful strategy on addressing a nuclear terrorist attack must take this into consideration. Future plans must consider preparations for a nuclear attack in the broader context of competing public health priorities like flu prevention or natural disaster response. We cannot afford to pull funding away from existing public health needs to fund new preparedness initiatives. We must acknowledge that new sources of funding and other resources are needed and must be supplied to strengthen the existing public health system and guarantee that a preparedness system is in place to ensure an effective response to a wide range of threats.

A NOTE ON NUCLEAR TERRORISM PREVENTION

While there is much work to be done in the area of preparedness for a nuclear terrorist attack, we also must recognize that even the best efforts in this area will not be enough to keep our communities safe. Given the potentially devastating consequences of a nuclear terrorist attack, a clearly focused program of prevention strategies centered on having the U.S. and other nuclear weapons powers move toward the elimination of nuclear weapons would be the key to our safety. In tandem with this, well-funded and rigorously enforced programs aimed at keeping nuclear weapons and materials out of the hands of terrorists, including securing the facilities which house this dangerous material and reducing and ultimately eliminating U.S. reliance on nuclear weapons and power in the longer term should be considered mainstays of prevention of nuclear terrorism.

Specifically, PSR recommends that the federal government:

1. Limit the availability of nuclear weapons and materials by:

- Providing adequate funding to complete security upgrades of all vulnerable sites where nuclear weapons or materials are stored
- Promoting and supporting policies that would secure U.S. borders, such as mandating stricter cargo shipment requirements
- Leading all nuclear weapons states in meeting their legal obligation under article VI of the Nuclear Nonproliferation Treaty by pursuing nuclear disarmament in good faith and setting a timetable for reducing and ultimately eliminating nuclear arsenals

2. Protect nuclear power facilities by:

- Working with the nuclear industry to ensure the security of all nuclear reactors in the country against any possible threat, leading to a permanent, nuclear industry-funded and NRC monitored security system
- Strictly enforcing a no fly zone over nuclear power reactors and installing anti-aircraft missiles on guard towers. Serious steps must also be taken prevent the threat of a truck bomb or bomb from surrounding bodies of water
- Mandating the storage of spent nuclear fuel on-site, below ground, in hardened dry cask storage to lessen vulnerability to a terrorist attack, while continuing to develop a long-term storage solution

Ultimately, the only protection from a terrorist threat against nuclear power plants and the considerable radioactive waste they generate is to move the U.S. away from nuclear power and towards renewable and less dangerous energy sources. Nuclear power plants provide enticing targets, and the continued production of fissile materials as waste or as potential bomb-making material threatens the health and safety of our children and future generations. Furthermore, nuclear power plants increase the likelihood of nuclear proliferation and create a double-standard where certain countries have the right to produce nuclear fuel and others do not.

WHO IS PSR?

Guided by the values and expertise of medicine and public health, Physicians for Social Responsibility works to protect human life from the gravest threats to health and survival. PSR is a nonpartisan, nonprofit organization representing 26,000 physicians, public health professionals, and concerned citizens working to eliminate nuclear weapons and address the public health and environmental legacy created by our military and civilian nuclear enterprise, including the testing, production and stockpiling of nuclear weapons. Since its founding forty-five years ago, PSR has dedicated its efforts to educating the medical and public health community, the public, policymakers and the media about the menace of accidental or intentional nuclear war and proliferation of nuclear weapons and materials.

PSR also has a long history of bringing to light the fallacy of U.S. nuclear weapons policy and inadequacy of U.S. public health infrastructure in responding to a full-scale nuclear war scenario. Throughout the Cold War years, PSR physicians published articles and studies in medical journals, such as the *New England Medical Journal* and the *Journal of American Medical Association,* detailing the medical consequences of a nuclear war between the United States and the Soviet Union. Through research, public education and advocacy, PSR, with our international federation the International Physicians for the Prevention of Nuclear War, highlighted the health effects associated with testing, production and stockpiling of nuclear weapons and the nation's continued reliance on nuclear weapons and nuclear power. This work was recognized globally when IPPNW was awarded the Nobel Peace Prize in 1985, in which PSR shared.

Over the last two decades, PSR's work has focused on educating the public and policy makers about the continuing threat of nuclear proliferation and the health legacies of nuclear weapons build-up during the Cold War. PSR continues to advocate for rapid reduction and eventual elimination of U.S. and global nuclear stockpiles — ultimately the only sure way to eliminate the threat of the use of nuclear weapons whether by an adversary state or by a terrorist group.

Recognizing that new dangers now threaten us, PSR in 1992 expanded its mission to include environmental health, addressing issues such as global climate change, proliferation of toxics, and pollution.

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