Dirty Fires: Radiological Incendiary Devices

by Deputy Assistant Chief Joseph W. Pfeifer

On July 17, and November 25, 2005, the Fire Department conducted high-rise fire exercises. The first exercise was held at the Time Warner Building in midtown Manhattan and simulated a fire on the building's third floor. The second exercise was a complicated downtown fire at the AIG Building on Pine Street, where fire involved a good portion of the 53rd floor. Both exercises required multiple alarms with a commitment of more than 100 Firefighters and medical personnel. High-rise fires are always challenging, but these two fire scenarios were especially difficult because they were caused by terrorists who used incendiary devices and radiological material as weapons to create a so-called dirty fire.

During the AIG Building exercise, units exited the elevator two floors below the fire and were met by a number of injured occupants telling them of people trapped and a raging fire. Arriving on the fire floor, units noticed their Rad-50 radiation detectors were activating. Firefighters correctly concluded an advanced fire during the day in an office building and with radiation present was not accidental. The first-responding Officer on the fire floor radioed to the Incident Commander (IC) that he suspected this was a terrorist attack and asked for instructions. After being told the readings were 5m Rem, the IC transmitted a 10-80 and a second alarm. The Chief then ordered full use of respiratory protection and commanded units to fight the fire and perform search and rescue.

Did the IC give the proper orders? Did his actions balance public safety with Firefighter safety? Was the Fire Department surprised by this attack or were members prepared?

Haz-Mat 1 Firefighter employs a Rad-50 radiation detector during FDNY high-rise drill that featured incendiary devices and radiological material as weapons to create a dirty fire. *photo by FDNY Photo Unit*

Predictable surprises

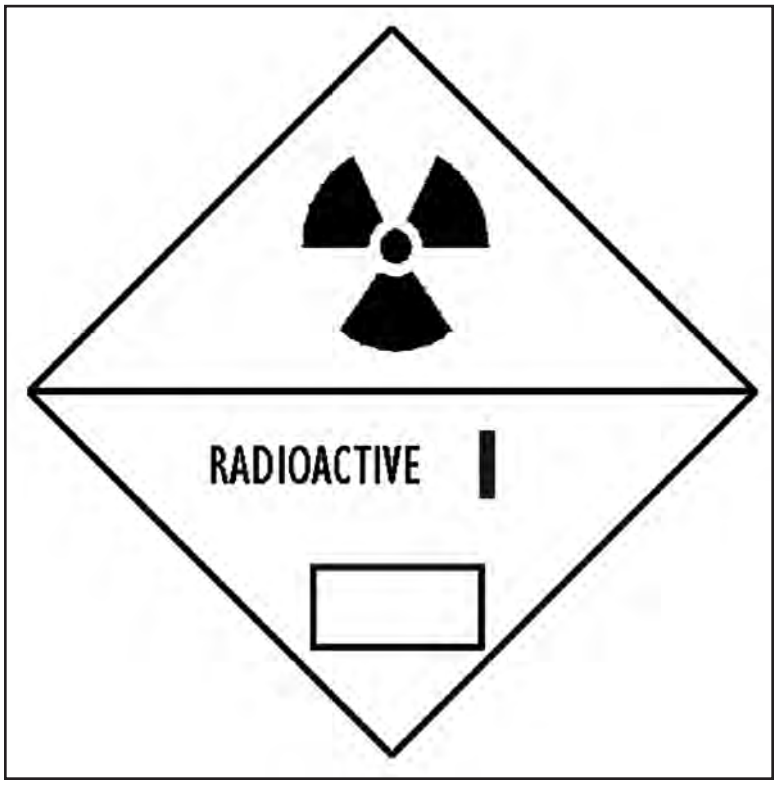
In order to avoid complacency and a false sense of security, Officers and Firefighters must understand that terrorists are extremely adaptive and responsive to changes in the security environment. They seek to exploit the weakness of their targets and are willing to be patient in their planning and execution. They enjoy the tactical advantage of determining the time, place and method of attack.

The recent attacks on Madrid's and London's transportation systems mark a significant evolution in terrorist strategies. Future attacks may be inspired by Al Qaeda, but carried out by small, ad hoc groups with similar mindsets. Chemical, biological, radiological, nuclear, incendiary and explosive weapons span the gamut of crude, improvised devices, to sophisticated military types with both the public and emergency responders as targets. As terrorists move to alternative asymmetric methods of attack, the FDNY must anticipate the move and ensure a high measure of adaptability in their response.

The events of 9/11 took Fire Departments by surprise. However, the intelligence community should have been less surprised by the method of attack. In 1994, a terrorist plot to crash an Air France plane into the Eiffel Tower was thwarted when the terrorists were stopped while refueling the plane in Paris. Yet no one saw this as a potential future threat.

Likewise, the engineering community should have been less surprised by the consequences of mass fires on high-rise buildings. Leslie Robertson, the head engineer of the World Trade Center, constructed the buildings to withstand the impact of a 707 plane, the largest plane in use at the time the buildings were constructed. Robertson and his team never considered the effects thousands of gallons of fuel would have on the structural integrity of the building.

Surely no one is proposing that the specifics of that day could have been known. However, there were indications that terrorists might use a plane as a weapon. And the potential effect of uncontrolled fires in the World Trade Center buildings should have been recognized. Bazerman and Watkins (2004) from Harvard University argue predictable surprise events--such as 9/11 or Pearl Harbor--are events that catch leaders off guard, even though there was sufficient information to anticipate the event and its consequences. They further assert that organizations that adopt broad measures to prepare for disasters are better off than those preparing for specific events.



The FDNY Center for Terrorism and Disaster Preparedness uses dynamic scenarios as a tool to help Incident Commanders deal with uncertainty. Scenarios are used not as predictions of the future; rather, they are vehicles that assist the Department in learning the presence of new threats and alternative tactics (Schwartz, 1991). Scenario building enables Commanders to identify blind spots in static plans and assists in developing adaptability to overcome a broad spectrum of predictable surprises.

Framing the radiological problem

Inherent in Homeland Security is an organizational bias that produces positive in-group favoritism to law enforcement and a negative out-group prejudice against those who are part of a different group. This organizational bias constrains the ability of the Homeland Security community as a whole to fully comprehend potential, but as-of-yet-unseen, terrorist threats. Lynn Eden (2004), associate director for research at Stanford University, stresses that organizations will define problems and identify solutions based on organizational interest. She suggests that organizational interest is a social construct that brings attention and resources to solve one problem, but may not recognize others.

Many emergency responders had never heard the term dirty bomb until June 10, 2002, when Attorney General John Ashcroft announced the arrest of Jose Padilla (aka Abdullah Al-Mujahir) for plotting to detonate radiological dispersal devices (RDD). An RDD is designed to spread radioactive contamination, causing panic and economic disruption over a wide area. The greatest threat to life comes from the explosion and not the radiation. Generally, after an RDD is detonated, radiation levels will be low and people immediately will evacuate the vicinity, thus limiting exposure fatalities. However, areas contaminated by radiation will have to undergo lengthy clean up, thus seriously disrupting normal activity in the vicinity. For these reasons, RDDs are not considered weapons of mass destruction, but weapons of mass disruption.

Overcoming organizational biases is essential to uncovering new types of threats. For example, currently, security agencies focus on the use of conventional explosives as the most probable means of dispersing radioactive material. However, a radiological emission device (RED) is another possible type of attack. An RED is covertly hidden to emit radiation in a local area and if not detected, it could produce a higher level of radiological exposure.

The Fire Department also has discovered the possibility of a dissimilar radiological attack that up to now has been overlooked. The FDNY postulates that terrorists may use radiological incendiary devices (RID) or dirty fires as a means of attack. Dirty fires are set by deploying incendiary devices to disperse radiation throughout a structure or given area. The intent is for the radiation to delay Firefighters' extinguishing efforts. If this occurs, more occupants will be exposed to dangerous levels of radiation, while the fire spreads unimpeded through the building. As the fire intensifies, more radioactive particles will be released. Simultaneously, the building's structural integrity will degrade.

The fear of radioactivity, coupled with the dread of being trapped by fire, will cause occupants to self-evacuate all parts of the building, clogging stairs and further delaying Firefighters. The treatment of the contaminated injured also may be deferred. If one survives the blast of a dirty bomb, one should be able to leave the area before receiving enough radiation to cause injury. A dirty fire, however, requires Firefighters to control the fire in order to rescue those trapped above. The major distinction between a dirty bomb and a dirty fire is when faced with the latter, the life safety problems are exponentially growing until the fire is brought under control.

Doctors Charles Ferguson and William Potter (2004) from the Council on Foreign Relations point out that radiological material in the form of powder, such as cesium-137, in cesium chloride, is more easily dispersed. Solid metal pellets such as cobalt-60 also could be used, yet less easily dispersed. They also reveal that cobalt-60, cesium-137, iridium-192 and strontium-90 are the most frequent radiological materials found in illegal transactions. While we know that terrorist groups have expressed an interest in acquir-

ing radiological material, to date, there has been no RDD or RID incident.

However, several past incidents that have involved the accidental spread of radiological material point to the plausibility of dirty bombs and fires as predictable methods of attack. The first incident occurred in 1987, in Goiania, Brazil, when scavengers stole radioactive material from an abandoned medical waste site and unintentionally contaminated a local town. Four people died and more than 110,000 people demanded to be screened for radiation (Ferguson, 2004). Another incident was the accidental burning of radiological material at a steel mill, which spread contamination throughout a local area. Yet another case involved the incineration of radioactive material at a facility in Spain, which produced low levels of radiation across most of Europe.

By examining these past incidents and combining the expertise from law enforcement, the scientific community and the fire service, the threats of an RDD, RED and RID can be recognized, prevented and prepared for. The Fire Department can take steps to prevent such attacks from occurring through building inspection and protection programs. However, if terrorists succeed in using radiological incendiary devices, the FDNY would not be surprised by the type of attack and would be ready to manage the incident.

Balancing victim rescue and Firefighter safety

The City Incident Management System (CIMS) clearly states that the FDNY will be the Incident Commander at all fires. This would include fires that are produced by radiological incendiary devices. The IC is responsible for balancing rescue and firefighting operations with the safety of first responders.

Hearing a report of a possible dirty fire would send chills down the spine of even the most experienced Fire Chief. The IC must realize that the greatest danger at this type of event comes from the fire. Hazardous material precautions would be taken to deal with the radiation, but this should not hinder search and rescue, firefighting or patient care. The FDNY's ability to perform its core competencies within a radiological environment gives the Department a distinct advantage in saving lives at disasters and terrorist attacks.

Incident assessment--The IC first will make an incident assessment, consisting of gathering situational information and then making a risk-benefit decision.

Situational Awareness Report (Size-up)--The situational awareness report determines the life hazard, level of radiation and extent of the fire. As soon as possible, it is important to assign Haz Tech Units to record radiation readings by employing more sophisticated equipment. Typical questions that would be asked are: What is the location and extent of the fire? What is needed to extinguish the fire? How many people are trapped and injured? Where are they located? What are the radiation levels at each entrance to the fire area and on the floors above?

Risk-Benefit Decision--Following the receipt of a situational awareness report, the IC quickly consults the Protective Action Guidelines (PAGs), performs a risk-benefit analysis and makes decisions on what actions to take. In these scenarios and most RDD/RID events, radiation levels are low enough to deploy an offensive lifesaving and even property protection strategy.

Decision Dose--Emergency Activity Performed

50 Rem--Lifesaving for a Catastrophic Event
25 Rem--Lifesaving or Protection of Large Populations
10 Rem--Protection of Major Property
5 Rem--Radiological Operations

Incident management--At a dirty fire, the IC is concerned with three command objectives: managing life hazards, controlling radiological exposure and extinguishing the fire.

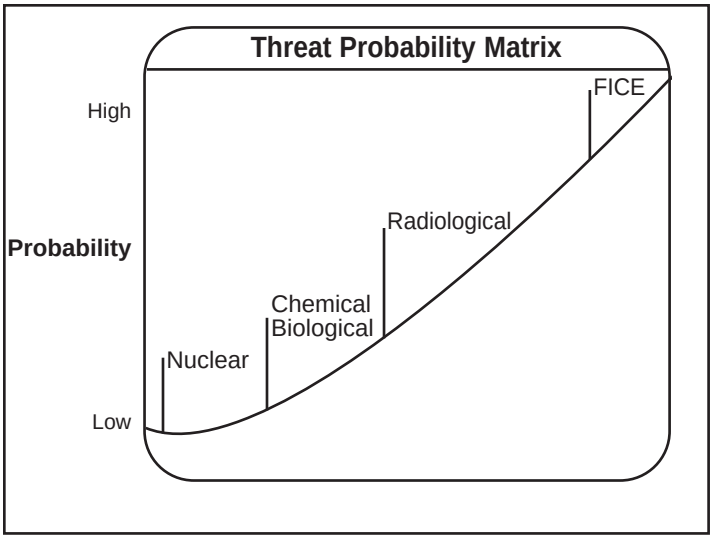
Manage life hazards

- *Isolate* the contaminated area to prevent cross-contamination by restricting access, except for search and rescue and fire suppression. At dirty fires, radiation may be carried by smoke and water runoff. A hot line is set at 2mR/hr. Greater than 2mR/hr is the hot zone and less than 2mR/hr is the cold zone. A warm zone is a specific area near the edge of the hot line, usually superimposed in the cold zone. A warm zone does not encircle the source of radiation. Rather, it is a small, defined location used for decontamination or as a Safe Refuge Area (SRA), where the radiation levels are as low as possible.
- *Contain* the spread of radiation by initially shutting down the HVAC systems to the fire building and the air intakes of surrounding exposures.
- *Evacuate* civilians from the fire building and decide to evacuate or shelter in place surrounding exposures. Evacuation as a plume is passing could result in greater exposure than sheltering in place. Incident Commanders should be aware of the funneling effect on high-rise building stairs. As each floor evacuates, occupants funnel into a very limited number of stairs and elevators, easily creating overcrowding. Building evacuation should be controlled by a fire Officer, as soon as possible, from the fire command station.
- *Decon* should be established and used when necessary. Simple exposure to radiation does not warrant decontamination unless the person is externally contaminated with radioactive particles on skin, hair or clothes. Contaminated Firefighters must continue to wear respiratory protection until decontamination is completed.
- *Emergency medical care* of life-threatening injuries should be addressed prior to decontamination at most types of RDD and RID attacks. According to an article published by NCRP, (2005), "Unlike many chemical and biological agents, radioactive material contamination rarely represents an immediate danger to the health of the victim or the responder."

Control radiological exposure

When an IC decides on an offensive strategy to protect life and property, the exposure to all first responders must be kept **a**s **l**ow **a**s **r**easonably **a**chievable (ALARA). Members should wear dosimeters when operating at dirty fires. However, initial lifesaving and fire suppression should not be delayed to retrieve this equipment. The Rad-50 can act as a dosimeter in an emergency. The IC will manage radiological exposure to fire and medical personnel by applying the concepts of limiting time of exposure, increasing the distance from the source and employing intervening shielding. The Operations Chief, Haz-Mat Battalion and Safety Battalion can assist the IC in limiting radiological exposure to members.

- *Time*--Rotate members to reduce the amount of accumulated dose. This is the most important factor the IC can control. If staffing and equipment are sufficient, members receiving absorbed doses should be rotated at 5 Rem or when one SCBA



tank is depleted. Consult the PAGs for decision dose recommendations. Incident Commanders may need to transmit multiple alarms early to ensure adequate rotation of members.

- *Distance*--Levels of radiation decline exponentially as distance from the source increases. Staging areas usually are established in the cold zone. However, high-rise building features may prompt setting up a forward staging area in other than the cold zone. If the IC establishes a warm staging area, members must use air purifying respirators (APRs) and dosimeters. Total exposure dose must be kept ALARA and monitored by the Safety Battalion.
- *Shielding*--An effective way to protect first responders from airborne radioactive particles is to ensure that members wear appropriate PPE and respiratory protection. When reporting in to a radiological incident, each Firefighter must bring an SCBA and APR. If the fire is extinguished, all other hazards have been identified and the atmosphere has sufficient oxygen, the Operations Chief may decide that members can operate with APR or powered air purifying respirators (PAPRs), which filter air, unlike SCBA. This is especially useful when members need to operate in a non-smoke, but radioactive environment; e.g., patient treatment and removal or when SCBA is depleted.

Note: APR and PAPR are not to be used in any smoke condition. Members must exit a smoke-filled area on air before switching to an APR.

Extinguish the fire

The single most important lifesaving tactic at a radiological incendiary incident is to extinguish the fire. Fire suppression is critical to limiting the spread of contamination and ultimately protecting life and property. Once the IC makes a risk-benefit decision for an offensive strategy, members should don proper PPE and conduct immediate operations. Any delays in fire suppression may expose members to greater risks.

Threat probability

New York City is viewed by many as the financial capital of the world, which makes it an attractive target for terrorism. The FDNY continues to prepare for the worst case scenarios of chemical, biological, nuclear and radiological (CBRN) attacks. However, most experts perceive CBRN incidents as having a low probability of occurring. This is encouraging since some CBRN weapons would produce mass casualties.

Members are urged to review the following references:

- "Predictable Surprises," by Max H. Bazerman and Michael D. Watkins, Boston: Harvard Business School Press (2004).
- "Whole World on Fire: Organizations, Knowledge and Nuclear Weapon Devastation," by Lynn Eden, Ithaca: Cornell University Press (2004).
- "The Four Faces of Nuclear Terrorism," by Charles D. Ferguson and William C. Potter, Center for Nonproliferation Studies, Monterey Institute of International Studies (2004).
- "The Art of the Long View," by Peter Schwartz, New York: Doubleday Dell Publishing Group, Inc. (1991)
- "Key Elements of Preparing Emergency Responders for Nuclear and Radiological Terrorism," National Council on Radiological Protection and Measurements, Bethesda: NCRP (2005).
- "Radiological Operations," Emergency Response Plan, Addendum 4 (2006).
- "ICE Drill: Dealing with a New Reality--Terrorism," by Captain Michael Byrne, in the 1st/98 issue of *WNYF*.
- "The FDNY Center for Terrorism and Disaster Preparedness," by Deputy Assistant Chief Joseph W. Pfeifer, in the 3rd/2005 issue of *WNYF*.

More likely, terrorist attacks would come from the use of fires, industrial chemicals or explosives (FICE) as weapons of destruction. The most lethal terrorist attacks and accidental disasters have come from FICE. These elements are seen as having a higher probability of occurring with a wide divergence of consequences. The World Trade Center was attacked in 1993 with an **i**mprovised **e**xplosive **d**evice (IED). The explosion killed six people and the ensuing fires injured more than 1000 occupants. The 9/11 attack came in the form of an **i**mprovised **i**ncendiary **d**evice (IID). Terrorists used commercial airlines to damage and set fires to buildings. The collapse that followed at the WTC alone killed 2749 and injured scores of others. And, in 1984, the accidental release of industrial chemical pesticides in Bhopal, India, killed more than 3500.

We know Al Qaeda and other terrorists have sought CBRN agents and endorsed the use of fire and explosives as a means of attack. While FICE weapons generally are more available than CBRN weapons, there is one point where these two weapon categories converge. Combining radiological material with explosive or incendiary material is the link, resulting in RDD/RID incidents. Understanding these threats and preparing to mitigate their consequences will enhance public safety and the safety of all emergency responders.

The main lessons learned from the Time Warner and AIG Building exercises were how to make a hazard assessment and manage an RID incident by concentrating on effective fire suppression, pre-hospital care and building evacuation, while assuring responder safety. Exercises such as these reassure the public that the FDNY is equipped and prepared to respond to RDD/RID attacks. The FDNY's recognition of dirty fires as a new threat avoids the likelihood of this scenario as the next predictable surprise.

About the Author...

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