RESPONDING TO A RADIOLOGICAL DISPERSION DEVICE DETONATION AND REMEDIATING THE AFFECTED INFRASTRUCTURE

A. D. Davie
Shaw Enivironmental & Infrastructure, Inc.

ABSTRACT

This paper describes some of the incidents involving orphaned radiological sources: the urgency surrounding the potential of a Radiological Dispersion Device (RDD) being detonated on U.S. soil; the various responses before, during and after an RDD detonation event; and the various remediation strategies that can be implemented in the aftermath of an RDD detonation.

INTRODUCTION

Since there never has been an actual detonation of a Radiological Dispersion Device (RDD) anywhere in the world to date, the challenge is to anticipate an RDD event and determine what proactive measures should be addressed prior to an RDD blast; develop appropriate responses to be implemented during the blast; and identify what remediation strategies are available for cleanup after the blast.

Historical Perspective

Since September 1987, there have been at least seven incidents where orphaned radiological sources have been handled, stolen or deliberately attached to conventional explosives to fabricate an RDD. This paper will present two of these incidents, neither of which were an actual RDD detonations, but both of which illustrate the kind of impact a detonation could have on an unprepared population and government.

Goiaina, Brazil 1987: A scrap yard worker pries open a lead container that was scavenged from an abandoned cancer center and dumped at the yard. Inside the container is some sparkling blue powder. The scrap yard worker has no idea he has just found radioactive cesium chloride. Curious residents near the scrap yard pass the container from home to home. The subsequent investigation revealed that more than 200 people had been exposed. Four people died, including a six year old girl who had rubbed the powder all over her body and hair so that she glowed. She was buried in a lead coffin sealed in concrete. The entire neighborhood needed decontamination and in some cases, houses that could not be cleaned up had to be dismantled and hauled away piece by piece. The decontamination took six months and generated 6,500 cubic yards of radioactive debris. [1]

Greensboro, North Carolina 1998: Nineteen small tubes of cesium turn up missing from a locked safe at Moses Cone Hospital. The tubes, which are ¾ of an inch long by ⅛ of an inch wide, are used in the treatment of cervical cancer. Local, state and federal agencies using sophisticated radiation-sensing devices search the city to no avail. The cesium tubes are never found. The theory is that the suspect in the theft may have been familiar with the material and knew how to handle it since unprotected handling of these tubes could cause serious injury and even death. [1]

A recent event bringing the words "dirty bomb" into sharp focus for the United States was the arrest of Jose Padilla at O'Hare airport in Chicago in June 2002. His arrest was based on the suspicion that he was planning to build and detonate a dirty bomb in an American city. According to an operative within the Al Qaeda terrorist organization, Padilla trained at an Al Qaeda camp in Lahore, Pakistan where he allegedly learned how to wire explosive devices and maximize conventional explosives for radiological dispersion. At the time of his arrest, he was carrying $10,000 cash. He is presently being held in a military brig as an enemy combatant. [1]

Although the bomb has never been located, evidence was recovered in Herat, Afghanistan in January of 2003 that suggests Al Qaeda may have constructed a small dirty bomb. An Al Qaeda lieutenant, now in American custody, told interrogators that a dirty bomb has been fabricated.

Finally, the media has widely reported that during this past holiday season teams of radiation experts were dispatched to New York, Washington, Las Vegas, Los Angeles and Baltimore to scan for RDDs using radiation detectors hidden in briefcases and golf bags. According to the Washington Post article dated January 7, 2004, this effort was initiated not from specific recent intelligence, but because officials are convinced that Al Qaeda is determined to detonate an RDD. The article goes on to state that pager sized radiation detectors were shipped to police departments across the country by the Department of Homeland Security as the threat level was raised to Orange.

On December 29, 2003, the article states, a hit or "spike" was detected in Las Vegas at a rented storage facility near downtown. The White House was notified and a more sophisticated device was brought in to recheck the initial reading. It confirmed the hit and further identified the "spike" as radium. At that point, the FBI secured the storage closet and the surrounding neighborhood. A homeless man, noticing the commotion, approached authorities as they were getting ready to cut his padlock and provided his key. A robot was sent in to retrieve a duffel bag where the homeless man had been storing the cigar-sized radium pellet since he had found the shiny stainless steel object three years earlier. The man, unaware of what the object was, had wrapped it in his pillow. Five hours after the first detection, the crews stood down, concluding there was no security risk in the storage closet. This example of the combined federal, state and local effort nationwide to respond to a potential RDD detonation has been provided to illustrate the type of response that will be implemented again if there is another perception of an RDD being placed on American soil. [2]

URGENCY

The combined incidents of an arrest having occurred; actual hard copies of plans having been discovered for dirty bomb construction; and a captured Al Qaeda operative having stated that Al Qaeda has built a dirty bomb, has brought forward the very real concern that terrorists have already constructed, but not yet deployed and detonated, a dirty bomb. Therefore, it is critical that we as a nation and as a professional community begin to identify and implement dirty bomb response planning, drilling and education. Then, when and if the United States experiences an actual RDD detonation, we will be prepared. In addition, we need to examine post-detonation response actions and remediation strategies for effectiveness.

RESPONDING TO A RADIOLOGICAL DISPERSION DEVICE DETONATION

Federal, state and local governments and especially the private sector will begin the RDD detonation response planning required to be completed before an incident. The Soldier & Biological Command, US Army (SBCCOM) has been tasked with training cities and their first responders on how to respond to an RDD detonation. This program needs to expand and continue as this function is transferred from the Department of Defense to the Department of Homeland Security.

Efforts should be undertaken immediately by federal, state and local resources to educate the public on RDDs and their effects. Just as some of us were trained to get under our desks in elementary school in the 1950s to prepare for a nuclear bomb detonation; we, as a nation, need to begin to defeat the terrorist's intent with an RDD detonation by curing the ignorance that public has regarding a "dirty bomb." Educating the public will minimize the fear and panic the terrorists intend to create with an RDD detonation. That is why some have dubbed an RDD a "Weapon of Mass Disruption."

When the event in Goiaina, Brazil occurred, over 100,000 panicked people showed up at the stadium demanding to be screened. Even when the screeners told them they were too far away when it happened to suffer negative effects, they still demanded to be screened out of fear, panic and distrust of the government. In other words, if we do not educate the public now, the terrorists can use the public's fear of radiation to take what will normally be considered a small and relatively innocuous amount of radioactive material, and turn it into a harmful psychological and economic weapon. It is important to have a public information plan in place to mitigate the potential for the panic and public disorder. Factual and accurate information should be provided regarding the air, water and food chain impacts following an RDD event.

In addition, radiological detection devices need to be widely available, physically secured, calibrated and ready to be deployed at moment's notice. First responders need training on these devices so they can interpret these monitors and report the facts, avoiding false alarms of a detonation being broadcast to the public. These devices need to have the capability to monitor gamma and neutron radiation, as well since the treatment of affected individuals may vary depending on the contaminating source. First responders need to have access to the proper PPE to don in the event of an RDD detonation. The minimum equipment on hand should include SCBA gear, respirators, TYVEK® or SARANEX® suits and dosimeters. First responders need to drill repeatedly, in a variety of settings, to perfect managing the complexities of evacuations while minimizing risk to themselves.

Furthermore, worldwide efforts need to be funded by the countries using radioactive materials to recover missing sources. This effort will be funded by the individual country as a worldwide cooperative joint venture so that each country will be doing its part to safeguard their own country as well as others from the threat of a missing source being used against any one of them.

Beginning immediately, all countries using radioactive materials, for whatever purpose, need to increase the security regarding access to these materials and tighten their tracking systems in relation to their location. In the U.S. for example, in June of 2003 the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) agreed to form a working group to examine four focus areas: "(1) the relative hazards of radioactive materials; (2) the options for establishing a national source *tracking* system; (3) the potential for the use of technological methods for tagging and *monitoring* sources while in use, storage and transit; and (4) actions for facilitating the securing and *final disposition* of unsecured, excess and unwanted sources." [a]

Immediate Responses Post-Incident

Immediately following a RDD detonation, at the state level, the Governor will follow the natural disaster protocol. He or she will formally ask for Federal assistance. When the request is completed and the President declares it a disaster, Presidential Decision Directive (PDD)-39 and PDD-62 will permit the implementation of the Federal Response Plan (FRP) and concurrently, the Federal Radiological Emergency Response Plan (FRERP), which details the federal response to a peacetime radiological emergency, will be implemented. The FBI will execute its Crisis Management role to identify, acquire and plan the use of resources needed to anticipate, prevent and/or resolve a threat or act of terrorism. This role is predominantly one of law enforcement response. The Department of Homeland Security (DHS) and the Federal Emergency Management Agency (FEMA) will execute its Consequence Management, concurrently with the FBI. The role of the DHS and FEMA will primarily be to address the resolution of the issues impacting the public.

A test of the nation's domestic incident management capability was conducted from May 12 through May 16, 2003. Congress mandated Top Officials 2 (TOPOFF2) to uncover vulnerabilities in the response system against a series of integrated terrorist threats and acts in separate regions of the country. The exercise scenario included the detonation of an RDD in Seattle and the release of the Pneumonic Plague at several locations in the Chicago Metro area. TOPOFF2 brought together top government officials from 25 federal, state and local agencies and departments. Many valuable lessons were learned as summarized in the Top Officials TOPOFF Exercise Series: TOPOFF 2: After Action Summary Report for Public Release. The report on lessons learned through the simulated RDD detonation in Seattle concluded that overall rescue operations at the RDD event needed a higher level of regular communication between the Incident Command and the hospitals and that public health officials, medical communities, media and the general public should be educated about the unique procedures required for initiating and executing rescue operations following a terrorist WMD attack. [3]

Under the FRERP, the designated Lead Federal Agency is responsible for overseeing on-site activities and coordinating the federal assistance necessary to perform radiological monitoring and assessment. In addition, protective action recommendations will be developed. Under the Stafford Act, in the case of an RDD detonation, which is a radiological emergency, the Department of Homeland Security (DHS) will use the FRP to coordinate the nonradiological response to consequences off-site. A Unified Command System will be established to coordinate and organize all federal agencies involved in the response effort.

The first task to be completed by the first responders once they arrive on the scene is to calmly control and facilitate the panic evacuation of civilian personnel while minimizing risk to themselves. Exposed individuals will be identified, detained and quarantined to stop the further spread of any radioactive material. Medical triage will be set-up at a safe distance to treat decontaminated individuals and critical-care individuals. Decontamination may only consist of removing one's clothes and submitting to further evaluation to confirm complete decontamination, or it may require more stringent decontamination protocols to achieve acceptable levels. Depending on the identified risks, first responders will have to make difficult decisions regarding dead and injured civilians who are still within the immediate vicinity of the detonation location, the "hot" or exclusion zone. Once the complete evacuation of live, dead and injured civilians has been accomplished, the first responders and ER contractors can then focus on site and scene evaluation. Determining the nature, magnitude and spread of contamination will be critical in defining the parameters of the response.

Within the Unified Command System (UCS) or Incident Command System (ICS), environmental/hazardous material/Emergency Response (ER) contractors will respond and ultimately remediate the site per their HAZWOPER protocols, with some changes to incorporate the new reality of a terrorism response. ER contractors will perform all tasks as if responding to an unknown emergency response with one exception. The FRP, FRERP and Federal Interagency Domestic Terrorism Concept of Operations Plan will need to be incorporated into the planning and execution of the remediation phase of affected infrastructure. As ER contractors, the initial response actions will vary somewhat from traditional HAZWOPER protocols. For instance, because the work area has become a crime scene, the ER contractor will need to work closely with the FBI or their designee to ensure evidence is properly handled as it is encountered from initial site entry and site characterization activities to completion of the remediation phase. The ER contractor will immediately have to set-up their own logistical operations to maintain the flow of tasks and activities during the subsequent phases. Communication between the ER contractor and the UCS/ICS is crucial since the ER contractor will be gathering critical data as site characterization and site assessment tasks are completed. This data will need to be conveyed to the UCS/ICS on a continuous basis so decisions can be made by the command system based on the very latest data and information.

Situation and Scene Evaluation

First responders and ER contractor's primary objective is to control the site. In order to gain control, they need to evaluate the site and scene. Access to the site, thereafter, will be by authorized and qualified personnel only. At no time will civilians be given access, in spite of their good intentions. First responders and ER contractors will evaluate the scene and establish work zones based on the suspected identity and toxicity of the materials involved. Other factors requiring evaluation are weather; wind direction and velocity; local terrain; waterways; and results from real-time air monitoring. In addition, an evaluation must be performed to confirm or rule out the presence of a secondary device rigged to injure or kill first responders, ER contractors or misguided civilians. Once this evaluation is completed, the first responders and ER contractors will establish site boundaries by setting up the three zones typical of a hazardous waste site remediation (support, contamination reduction and exclusion zones). [4]

Establishment of Work Zones

These three zones will be established immediately after the evacuations have been completed. They should be established keeping in mind that these zones may require significant expansion to accommodate activities like debris staging, decontamination of heavy equipment and trucks, treated debris staging and other activities associated with infrastructure remediation. If available, real-time air monitoring and weather data can be used to enhance work zone delineation.

The first zone established is the support zone. This zone needs to be large enough to ensure that a safe buffer is established to protect unprotected site workers and the general public. The zone will include staging areas for personnel, the command post, equipment and vehicles. In addition, the support zone will need to expand as the remediation proceeds to provide space for cranes, roll-off containers, scales and other equipment and materials used in the remediation effort.

Once the support zone confines have been established and the recovery and remediation operations are ready to commence, the contamination reduction zone will be set up. This zone will have two separate and distinct lanes of decontamination. For safety reasons, one lane will be established exclusively for personnel decontamination and another larger and wider lane will be set-up exclusively for heavy equipment, trucks and debris decontamination. Decontamination procedures to be used on personnel and equipment exiting the site will be developed and implemented in the field. This zone may need a separate air monitoring plan to address any potential for off-site migration of contaminated decontamination materials.

Finally, the exclusion zone will be established. Access to this portion of the detonation site will be tightly controlled using ID badges and verification of the individual's *bona fides.* Site security is of paramount importance during all phases of this work. Security will need to be established and strictly maintained initially to preserve and collect evidence, to prevent the spread of any further contamination and to prevent any unauthorized access by the unprotected members of the public or workers. In this scenario, signs will need to be immediately posted around the perimeter alerting personnel of the presence of a source within the zones. Once again, separate lanes will be established in the zone for humans and heavy equipment.

Site Documentation

Site documentation including written, photographic and video, if available, will begin immediately upon arrival of ER contractors. As zones are set-up, baseline air monitoring should begin and continue throughout all phases of the remediation operation. Real-time monitoring of the site will be implemented using several different meters, including a sodium iodide scintillation detector; a thin-window Geiger-Mueller device to detect personal health contamination levels; and a neutron detector and zinc sulfide scintillation telluride device. As soon as it is known that the incident was a detonation of a radiological device, certified health physicists and trained radiological control technicians will be mobilized to the site. The type of radioactive material used in the RDD will be determined using the meters specified above.

Once the source (alpha, beta neutron or gamma) used in the RDD is identified, the appropriate instrumentation will be used thereafter to monitor the site and personnel. Confirmation source samples will be analyzed off-site using filters as the collection media. These health physicists will set-up the personnel monitoring program for individuals who actually work on the site. The use of thermoluminescent dosimeters will be required and issued to on-site workers.

Once the health physicists have performed a preliminary assessment of the immediate site and surrounding area, they will be better able to implement measures to protect the public and on-site workers through the development of a comprehensive Health and Safety plan. After all regulatory interfaces have been made and work is ready to proceed, site assessment activities will begin. It is critical to maintain the site documentation during this phase of initial site entry in order to preserve evidence and perform site assessment activities. [4]

REMEDIATING THE AFFECTED INFRASTRUCTURE

Site Characterization

To begin the remediation phase of the response, it will be necessary to define the spatial limits of the radiological contamination. This sampling and analytical effort will ultimately define the limits, types, depths, media affected and extent of contamination. The plan for this effort will be produced concurrently with other tasks occurring on-site so no time is lost. Once the sampling and analytical plan is approved by the various agencies in the UCS/ICS, the effort to sample the site will begin. It should be understood that air monitoring, sampling and analyzing those samples will be a continuous, major activity of the remediation and will be maintained and documented throughout all phases of the project.

Source Control

From the initial RDD detonation event through project completion, all project personnel will understand that controlling the source and preventing any further spread of the material is of paramount importance. Therefore, implementation of source control measures will occur first, so as to prevent any off-site migration of radioactive contaminants. These measures could include preventing any run-off from rain events or remediation activities to storm sewers or exposed soil areas. Dust minimization controls will be used from day one until project completion to prevent any air-borne migration off-site. Source control measures could include applying a fixative coat to surfaces that are contaminated but will not receive immediate decontamination. [4]

Draft Work Plan Development

Once all source control measures have been implemented and site characterization data has been analyzed revealing the limits, types, depths and extent of contamination, a draft remediation work plan will be developed and published. This work plan will be submitted to the UCS/ICS and the command structure will ultimately determine what cleanup levels will be used. These cleanup levels will likely be the focus of much debate and discussion within the UCS/ICS. The U.S.E.P.A has a set of recommendations for radioactive contamination cleanup levels, as does the DOE.

DOE-STD-1098-99
Radiological Control
Radiological Standards July 1999

Table I Summary of Surface Contamination Values

RADIONUCLIDE (See Note 1)	**REMOVABLE (dpm/100cm²) (See note 2)**	**TOTAL(FIXED+REMOVABLE) (dpm/100cm²) (See Note 3)**
U-natural, U-235, U-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228,Th-230 Th-228, Pa-231, Ac-227, I-125, I-129	200	500
Th-nat, Th-232, Sr-90[6],Ra-223, Ra-224, U-232, I-126, I-131, I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above. Includes mixed fission products containing Sr-90[7].	1,000 beta-gamma	5,000 beta-gamma
Tritium and tritiated compounds	10,000	NA

Notes:
1. Except as noted in Footnote 5 below, the values in this Table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently [see 835 App. D, note 1].
2. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency (Note: The use of dry material may not be appropriate for tritium.). For objects with a surface area less than 100 cm^2, the entire surface should be swiped, and the activity per unit area should be based on the actual surface area. It is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination [see 835 App. D, note 4].
3. The levels may be averaged over 1 square meter provided the maximum activity in any area of 100 cm^2 is less than three times the values in Table 2-2 [see 835 App. D, note 3].
4. This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them It does not apply to Sr-90 that has been separated from the other fission products or mixtures where the Sr-90 has been enriched [see 835 App. D, note 5].
5. Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface in order to ensure the surface radioactivity value provided in this Table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply [see 835 App. D, note 6].
6. These values should be applied to total Sr-90/Y-90 activity resulting from processes involving the separation or purification of Sr-90.
7. These values should be applied to total Sr-90/Y-90 activity resulting from the presence of Sr-90 in mixed fission products [b]

Concurrently cost estimates will be produced based on the remediation work plan and other cleanup approaches. These estimates will also be the focus of much debate. The final remediation work plan will undergo many changes before it is finalized. The discussions about the final remedial approach will center on the balance between costs and benefits. These discussions and debates about remedial approaches and cleanup levels could become quite protracted and heated. Therefore, it has been suggested that these discussions occur now, before we are dealing with an actual incident. If we are proactive, these options can be discussed, debated and agreed upon in a calm and reasonable atmosphere rather than the frenzied and intense environment inevitably created in the hours and days after an RDD detonation event.

Remediation Strategies

The ultimate, specific remedial action taken is, among other factors, dependent on the material contaminated. For this paper, we have assumed that the RDD detonation has occurred in a city where the detonation will have the most detrimental impact, from a terrorist's point of view. Therefore, we have assumed that the majority of surfaces contaminated with radioactivity and subject to remediation will be concrete structures, asphalt streets and intact and shattered glass and metal structures associated with buildings, HVAC systems and automobiles that were functioning during and after the blast. These surfaces will be surveyed as necessary and contaminated materials will be remediated or removed and disposed of as radioactive waste. Contaminated structure surfaces will be remediated to the levels embodied in the final work plan. Remediation techniques that may be used for the structure surfaces include washing, wiping, pressure washing, vacuuming, scabbling, chipping, and sponge or abrasive blasting. Washing, wiping, abrasive blasting, vacuuming and pressure washing techniques may be used for both metal and concrete surfaces. Scabbling and chipping are mechanical surface removal methods that are intended for concrete surfaces. The principal remediation method expected to be used for removing contaminants from concrete surfaces is scabbling.

Scabbling is a surface removal process that uses pneumatically-operated air pistons with tungsten-carbide tips that fracture the concrete surface to a nominal depth of 0.25 inches at a rate of about 20 ft^2 per hour. The scabbling pistons (feet) are contained in a close-capture enclosure that is connected by hoses to a sealed vacuum and collector system. The fractured media and dusts are deposited into a sealed removable container. The exhaust air passes through both roughing and absolute HEPA (high efficiency particulate air filter) filtration devices. Dust and generated debris are collected and controlled during the operation. Scabbling is most appropriate for flat, horizontal surfaces such as sidewalks and concrete floors inside buildings.

A second form of scabbling is accomplished using needle guns. The needle gun is a pneumatic air-operated tool containing a series of tungsten-carbide or hardened steel rods enclosed in a housing. The rods are connected to an air-driven piston to abrade and fracture the media surface. The surface removal depth is a function of the residence time of the rods over the surface. Typically, one to two millimeters are removed per pass. Generated debris transport, collection, and dust control are accomplished in the same manner as for scabbling. Needle gun removal and chipping of media are usually reserved for areas not accessible to normal scabbling operations. These include, but are not limited to inside corners, cracks, joints and crevices. Needle gunning techniques can also be applied to painted and oxidized surfaces.

Chipping includes the use of pneumatically operated chisels and similar tools coupled to vacuum-assisted collection devices. Chipping activities are usually reserved for cracks and crevices but may also be used in lieu of concrete saws to remove pedestal bases or similar equipment platforms. This action is also a form of scabbling.

Sponge and abrasive blasting are similar techniques that use media or materials coated with abrasive compounds such as silica sands, garnet, aluminum oxide, and walnut hulls. Sponge blasting is less aggressive, incorporating a foam media that, upon impact and compression, absorbs contaminants. The medium is collected by vacuum and the contaminants washed from the medium for reuse. Abrasive blasting is more aggressive than sponge blasting, but less aggressive than scabbling. Both operations use intermediate air pressures. Sponge and abrasive blasting are intended for the removal of surface films and paints. Abrasive blasting is evaluated as a remediation action and the cost is comparable to sponge blasting with an abrasive media.

Pressure washing uses a hydro laser-type nozzle of intermediate water pressure to direct a jet of pressurized water that removes surficial materials from the suspect surface. A header may be used to minimize over-spray. A wet vacuum system is used to suction the potentially contaminated water into containers for filtration or processing.

Washing and wiping techniques are actions that are normally performed during the course of remediation activities. The above cited techniques are not the only methods available for radioactive removal from surfaces. Depending on the situation, dilute acid may be utilized to remove and transfer the radioactive particles to another medium requiring disposal. If dilute acid is used, care will be required to confirm that corrosion of the media cleaned will not occur after use. Several washings or rinsings may be required to confirm that the cleaned surface has all the remaining acid removed from its surfaces. Affected HVAC systems will need all of their filters removed and disposed of as radioactive waste. The interior surfaces of the HVAC ducts will need remediation by the most appropriate technique. Verification sampling of the ducts may demonstrate insufficient cleaning and total removal of the ducting may be the only option.

In some cases, vacuuming the surface area with a HEPA filter equipped vacuum, like a mercury vacuum, may be sufficient to remove residual adhering radioactive particles. Just as during a mercury cleanup, the HEPA filter will require disposal as a radioactive waste.

In other cases where structural surficial contamination is persistent and resistant to the removal techniques described above, partial or total demolition of the structure may be the only option. In the event radioactive material spreads to a city park with exposed surficial soils, total removal and disposal of the affected soils will be the only choice. All the air borne dust created by these removal approaches will be collected and disposed of as radioactive waste. If water is used as a dust suppressant, or as a means of cleaning or rinsing, it will be collected and disposed of as a radioactive waste. It is estimated that many tons of radioactive waste will be generated during this remediation. Therefore, a trained/qualified person will determine the radioactive source elements, their total activity and the type of radiation. Once those determinations are made, transportation and disposal facility selection will be considered based on the waste's characteristics. It may turn out that some fraction of the contaminated waste will be classified Class A, requiring off-site treatment and disposal. This waste stream will require specific packaging prior to transportation to the treatment, storage and disposal facility (TSDF). The TSDF will specify how the waste should be packaged based on the regulations governing this particular waste stream and the permit requirements of the facility. In addition, some of the waste may be classified as Class B waste, or an orphaned waste stream. Once again, the specific packaging requirement will be driven by the regulations covering that waste and the TSDF

permit restrictions receiving the waste. Both the water and dust collected will be analyzed to confirm the proper disposal and/or treatment solution
.

Once the remedial and waste disposal portions of the final, approved work plan are complete, post remedial verification/confirmation sampling and analytical will be implemented as per the work plan. Most likely, a high profile panel of experts will convene to review the sampling techniques and the associated analytical, as was done during the recent anthrax post-fumigation verification sampling and analytical effort. The panel will pronounce their findings and if they find no further action is required, the site will be opened up for human occupancy once again.
Regardless of the remedial technique used, the cleanup levels approved, or the clean bill of health issued by a high profile panel of experts the possibility that the area may be permanently abandoned always exists. This risk exists because even though cleanup levels have been achieved, the public's fear and ignorance, coupled with distrust of the government will rule the day and no one will willingly occupy that residential or office space ever again. It will remain a deserted and quarantined monument to the effectiveness of the terrorist attack.

CONCLUSION

At all levels of government, local, state and federal, we need to begin to educate the public as to the facts of an RDD detonation. The facts presented in a calm and reasoned manner will go a long way to defuse the inevitable fear and panic that terrorist organizations are counting on with the use of this device. This nationwide education and planning needs to begin immediately and continue until we, as a nation, fully comprehend what an RDD detonation is and how it can affect humans and infrastructure directly adjacent to the detonation site. This education effort is imperative to minimize the negative repercussions of an RDD detonation.
In addition, we need to decide now, before an RDD event, what the appropriate cleanup levels and techniques are in response to an RDD detonation. We cannot afford to have this heated and protracted debate in the aftermath of an event. This national debate and agreement on cleanup levels needs to occur in a calm and reasoned atmosphere where all stakeholders can speak freely and all sides can be heard and evaluated. Once again, if these decisions are made in advance of an RDD detonation, we, as a nation, can defeat the terrorist's intentions because we will already know how to deal with the remediation and we will not provide the world images of acrimonious debate over these issues. We will present an image of an urgent, but calm response to an event we have anticipated and planned for thereby presenting to the world an example to follow.

REFERENCES

1 "Dirty Bomb," produced by Kirk Wolfinger, Mathew Collins and Kim Shillinglaw, Nova, PBS, WGBH, Boston, February 25, 2003

2 John Mintz and Susan Schmidt, " 'Dirty Bomb' was Major New Year's Worry," Washington Post, January 7, 2004: A01

3 "Top Officials (TOPOFF) Exercise Series: TOPOFF 2," After Action Summary Report for Public Release, December 19, 2003

4 “CHEMICAL, BIOLOGICAL, OR RADIOLOGICAL (CBR) EVENT REMEDIATION GUIDELINE,’ United States Army Corps of Engineers®, August 4, 2003

FOOTNOTES

[a] “Radiological Dispersion Devices: An Initial Study to identify Radioactive Materials of Greatest Concern and Approaches to their Tracking, Tagging, and Disposition,” Report to the Nuclear Regulatory Commission and the Secretary of Energy, Prepared by The DOE/NRC Interagency Working Group on Radiological Dispersal Devices, May 7, 2003

[b] “Radiological Standards,” DOE-STD-1098-99, *Radiological Control*, July 1999, 2-9