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Introduction

Chairman Young, Chairman Hunter, Mr. Larson, and members of the subcommittee, thank you for the opportunity to testify. I am Dr. Charles Potter, a systems analyst and health physicist from Sandia National Laboratories in Albuquerque, New Mexico. Sandia is a multiprogram national security laboratory owned by the United States government and operated by Sandia Corporation for the National Nuclear Security Administration (NNSA). I have come to speak to you today about the current state of the threat of the use of a radiological dispersal device or RDD in the US.

The RDD threat is a very complex and multi-dimensional problem The US government (USG) programs to understand and counter the RDD risk have evolved and matured, and we are gaining a better understanding of how to be effective both domestically and internationally. The science that helps us understand risk has progressed and we at Sandia have been engaged in focused studies that have refined our understanding of some of the specific risks. At this time, we are, at the request of NNSA, just embarking on what is planned to be a multi-participant effort to update and refine our estimates of the potential economic impacts of an RDD attack.

The US government and many of our foreign partners have been working for more than a decade to reduce the risk of a successful RDD attack. “Success” in this context means that an adversary with the intent and the capability manages to acquire the radioactive materials needed, and to launch an attack that results in significant harm, or consequence. The United States government has designed and implemented programs based on scientific studies by Sandia National Laboratories and others to reduce the RDD risk, by reducing the availability and vulnerability of the radioactive materials that could lead to such an attack. This is done by taking an end-to-end systems approach to the problem, looking for those scenarios which would most likely lead to adversary success, and then reducing the possibility of those scenarios. However, the scientific understanding of the consequences, in terms of cost and methods of cleanup as well as the psychological effects of a successful RDD event, are less well understood and there is currently no single standard on radiation limits for cleanup.

Major Points of This Testimony

- *Terrorist adversaries have shown an interest in RDDs and have attempted to build and use them against targets in the US.As the passage of time allows organizations to gather better understanding of what material is available and how it might be used, this threat may increase.*
- *High-activity radioactive material is common throughout the US and in foreign countries due to its use in medical and industrial applications. In many cases adversaries can find out where these materials are located. The security of high-activity radiation sources during transport is also of concern.*
- *Programs backed by risk analysis and technical study exist throughout the USG to address material security, pathway detection, and threat response. However, much work remains, for example, the development of a capability for disposal of high-activity cesium chloride sources.*
- *Mitigation and long-term recovery has not yet been studied in enough detail to support the development of standards for cleanup, nor the development of large scale decontamination methods. This limits our ability to produce credible cost estimates.*

The Terrorist Threat as Pertaining to RDDs

Al Qaeda publications indicate that the organization considers the main consequences of an RDD attack to be both economic and psychosocial due to the long term effects associated with a quarantine on a high population area and the attendant forced relocation of the public from their homes and businesses. Dhiren Barot in 2006, Jose Padilla in 2007, and Glendon Crawford in August of this year were convicted for attempting to develop and use an RDD in New York City, Chicago, and elsewhere. RDDs can be developed by a spectrum of adversaries, from a relatively low capability "lone wolf," such as these three individuals, to a highly capable and technically competent adversary such as Aum Shinrikyo who perpetrated the coordinated sarin attacks on the Tokyo subway system in 1995. The more technically capable an adversary is, the more likely they would be to find ways to spread the radioactive material over larger areas and at higher radioactivity levels. In addition, as was seen in the World Trade Center attacks in 1993 and 2001, the adversary is adaptive and able to gain knowledge from previous attempts. Obtaining a clear picture of adversary planning is difficult, and it is it is prudent to assume that the necessary motive and intent exists. Our duty then is to ensure that credible scenarios leading to high-consequence RDD attacks are made as difficult as possible to our potential adversaries.

The report *"Dirty Bombs": Technical Background, Attack Prevention and Response, Issues for Congress*[1] describes the motivation an adversary may have for perpetrating an RDD attack. The immediate results indicated are prompt casualties and panic. Prompt casualties will be caused mainly by the explosion itself. Prompt radiological health effects due to the explosive dispersion of the radioactive material are limited roughly to the explosive damage zone, a few tens of meters from the blast. The explosive consequence may still be significant; consider the effects of the Boston Marathon bombing in 2013. The known presence of radioactive material would only add to the panic and could result in additional casualties from the stress of the situation.[2]

Addionally, the report states that the following four motivations would result in effects felt over an extended period of time following the event, and some would likely affect the entire nation. These would be economic disruption due to the suspension of commerce in the area, area denial or quarantine that could last months or years, decontamination — a high cost endeavor that could result in considerable demolition and long-term casualties from exposure to radioactive material.

Availability of Radiological Material for RDD

In 2008, the report *Radiation Source Use and Replacement*[3] by the National Research Council described the then current use and availability of radiological sources in the US. The report also provided an overview of the risks posed by the malevolent use of the various radioactive materials and made recommendations for alternative technologies, both through use of a radiation generating device instead of a radioactive material source and through non-radiological means. Combined with the general security posture following the September 2001 attacks, this report stimulated USG programs for hardening of radiological devices, enhancing security systems in radiological facilities, and encouraging users to consider changing to technologies that do not require the use of radioactive sources.

The US NRC, through the Title 10 CFR Part 37 regulations on radioactive source security, requires manufacturers and users to have appropriate security controls based on the type and amount of material in use. Security upgrades on cesium chloride blood and research

[1] Jonathan Medalia, "Dirty Bombs": Technical Background, Attack Prevention and Response, Issues for Congress. Congressional Research Service, June 14, 2011.
[2] Fukushima stress deaths top 3/11 toll. *The Japan Times.* Feb 20, 2014
[3] National Research Council. Radiation Source Use and Replacement: Abbreviated Version. Washington, DC: National Academies Press, 2008.

irradiators, a considerable concern identified in the report, have been implemented on approximately 60% of irradiators in use in the US and this work is still ongoing.

Past accidents involving cesium-137 indicate extreme difficulty in decontaminating surfaces exposed to this highly chemically active element. Because of the breadth of the liabilities associated with high-activity cesium chloride sources, the 2008 US National Research Council study recommended phase-out of these sources and replacement with lower risk alternatives. In 2008 the USG instead opted for enhanced security of these sources[4] but new developments in alternative technology are making phase out more feasible. For example, France and Norway have enacted legislation aimed at ending the use of cesium chloride irradiators in those countries. Irradiators using cesium chloride sources are located in most of the major US cities and in locations such as hospitals and universities, where a full spectrum security minded culture typically does not exist.

While security at fixed facilities using high-activity radiation sources has been increased by the NRC and enhanced by NNSA for those posing special risks, there is still work to be done in ensuring the sources are equally secured during transport in and through the US. Multiple government agencies (federal, state, and local) are involved in transportation security and more work is needed in harmonizing the security protocols for high-activity radiation sources.

Programs to Address the RDD Threat

Since the 2007 UCLA study on RDD risk at the ports of Los Angeles and Long Beach, many policies, programs, and systems have addressed the threat likelihood. The USG has implemented programs to address both security of materials and pathway interdiction. The DOE's Office of Radiological Security has an extensive program that helps businesses, hospitals, and universities that employ radiological sources considered at risk, to enhance the security of those sources, above the Title 10 Part 37 requirements, and operate in an environment where the risk is reduced. The office also runs the Off-Site Source Recovery Program where unused sources are safely removed and protected. The In-Device Delay Program and other security enhancements focus on preventing and deterring theft of cesium chloride irradiator sources. The Domestic Nuclear Detection Office (DNDO) oversees the Global Nuclear Detection Architecture, a multi-faceted, layered, defense-in-depth framework, with the objective of making the illicit acquisition, fabrication, and transport of a nuclear or radiological device, material, or components prohibitively difficult. DNDO also relies on a well-conceived arrangement of fixed and mobile radiological and nuclear technical detection capabilities to

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[4] US Nuclear Regulatory Commission. NRC Staff Recommends Security ofver Replacement of Cesium Chloride Radiation Sources. *NRC News*, 08-223, Dec. 12, 2008.

present terrorists with many obstacles to a successful attack, greatly increasing costs, difficulty, and risk, and thereby deterring them.

If a device is identified prior to detonation, multi-agency response teams are on 24-hour watch and able to respond and interdict quickly. If the worst happens and an RDD is detonated, the multi-agency consequence management function within the USG is there to monitor, treat victims, and make recommendations regarding recovery.

An additional program worthy of mention is *Securing the Cities*, an effort first implemented in New York and currently being expanded to the Los Angeles/Long Beach area. This DNDO program funds the development of area wide security and radiological detection and response capabilities to address the radiological and nuclear threat as well as training and equipping law enforcement and other stakeholders in the area. The program covers all aspects of the threat including material security, pathway interdiction, and target protection. The high-activity sources which could lead to a serious area denial consequence can be detected with existing technologies being used by DHS. This program increases awareness of high risk sources in larger cities and builds programs for fast response to alarms.

There is no current process for disposal of high-activity cesium chloride devices in the US once they are past their useful life. The existing radioactive material waste disposal sites accept only low-level waste designated Class A and Class B, with only a single facility in Texas accepting Class C, the highest activity sources still considered as low-level waste. However, most of the cesium chloride irradiator sources are designated "Greater than Class C," and those that do not fit the generic Class C definition would not likely be accepted by a commercial facility's waste acceptance criteria. Remaining sources become the responsibility of the US government.

Long-Term Recovery from an RDD Event

RDDs are unlikely to result in large immediate health effects beyond those caused by the explosive blast, although there may be some long-term effects to more exposed individuals. However, depending on the radionuclide involved, the economic consequences could be considerable. If the radionuclide is difficult to remove from surfaces, as some are, the contaminated area could be off limits for months or even years. This would result in businesses within those areas being effectively shuttered and residents being relocated semi-permanently or permanently, while costly decontamination efforts are undertaken. Additionally, there would be interdepencies in a quarantined area between the residents and the businesses they patronize. Internationally, there have been three major events causing widespread contamination: the Chernobyl accident in 1986, the spread of contamination from a discarded cesium-137 source in Goiania, Brazil in 1987, and more recently the Fukushima Daiichi disaster in 2011. At Chernobyl and Fukushima, cleanup of the areas is still ongoing and has been a considerable struggle, albeit those events are larger in area and more contaminated than would be expected from an RDD event. In Goiania, where a relatively small amount of radioactivity was spread by human action, 85 houses were contaminated and 45 public places and 50 vehicles required decontamination. Seven of the houses were demolished because decontamination was not feasible.[5]

Since there is no single US standard for post-cleanup radiation levels, it is difficult to estimate the costs that would be directly associated with decontamination. The Department of Homeland Security in 2006 published their *Protective Action Guides for Radiological Dispersal Device and Improvised Nuclear Device Incidents*[6] which stated:

> Because of the broad range of potential impacts that may occur from RDDs and INDs ranging, for example, from light contamination of a street or building, to widespread destruction of a major metropolitan area, a pre-established numeric guideline was not recommended as best serving the needs of decision makers in the late phase. Rather, a site-specific process is recommended for determining the societal objectives for expected land uses and the options and approaches available to address RDD or IND contamination.

While this philosophy is understandable, a seemingly small decrease in the radiological limit standard for decontamination limits can result in a vastly more expensive and time consuming decontamination.. If this philosophy is retained, it is important to understand the ramifications of cleanup criteria for use in decision-making, but it may be preferable to prepare a technically-based general process and recommendations that could be somewhat tailored to the specific event. At this time, the International Commission on Radiological Protection recommends a residual radiation dose to residents over the long term of 1 mSv/year[7], the National Council on Radiation Protection and Measurements recommends 0.25 mSv/yr[8], and the CERCLA "Superfund" law requires a risk-based evaluation that has resulted in cleanup standards at the Hanford and Rocky Flats DOE sites of 0.15 mSv per year.[9]

A growing trend worldwide is the concept of resilience in cities around the world, and the Rockefeller foundation has recently established the *100 Resilient Cities* initiative that funds the

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[5] International Atomic Energy Agency. The Radiological Accident in Goiania. Vienna, 1988.

[6] Department of Homeland Security. Protective Action Guides for Radiological Dispersal Device and Improvised Nuclear Device Incidents. *Federal Register* Vol 17(1), 174–196, Jan. 3, 2006.

[7] International Commission on Radiological Protection. Application of the Commission's Recommendations to the Protection of People Living in Long-term Contaminated Areas after a Nuclear Accident or a Radiation Emergency. *Annals of the ICRP* Vol. 39 (3), 2009.

[8] National Council on Radiation Protection and Measurements. Management of Terrorist Events Involving Radioactive Material. Bethesda, MD, NCRP Report No. 138, 2001.

[9] Comprehensive Environmental Response, Compensation, and Liability. Title 42 United States Code Chapter 103.

creation of resilience programs. The vision of the initiative is to encourage cities to prepare for significant disasters through planning and development of response capabilities. A better understanding of the costs and required actions following an RDD attack would provide important considerations for this and similar programs as they prepare for the consequences of an RDD event.

Conclusion

In summary, the RDD risk is real and multi-faceted, and the US government has implemented a number of programs to increase the security of US radiological materials and increase the difficulty of illicit movement of these materials, resulting in a reduced likelihood of an RDD attack. However, there is still significant uncertainty in our understanding of the costs that would accrue after such an event. The development of policies and technical capabilities for effective cleanup to allow for resumption of normal operations following an RDD attack would constitute an important element of the multi-dimensional, integrated solution for addressing the RDD threat.

Thank you.