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HOMELAND SECURITY & DEFENSE

Radiological and Nuclear Countermeasures Program at Sandia National Laboratories

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Briefing for Institute for Security Science & Technology
Imperial College, London, UK

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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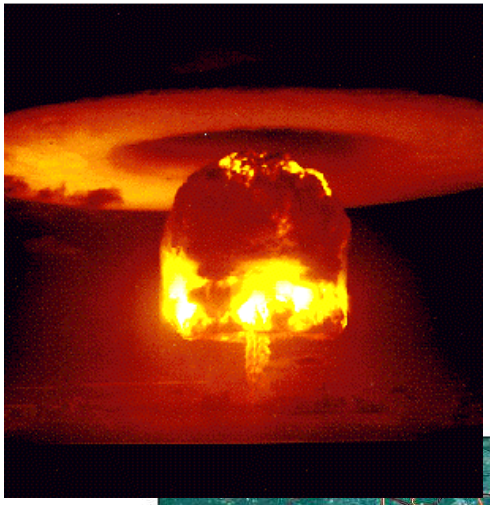
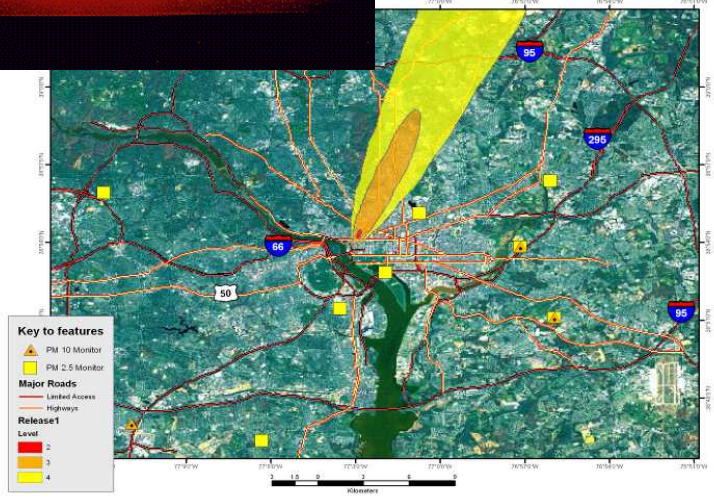
Overview

- **The challenge:**
  - Why are we worried about radiological and nuclear attacks?
  - Why is detecting weapons a difficult problem?
- **Sandia's approach:**
  - How does Sandia go about solving this problem?
  - How does a systems approach and modeling and simulation enable better solutions?
- **Technology solutions:**
  - What needed technologies does Sandia provide?
  - What technologies will we provide to meet future needs
- **Support to DHS**
  - How else do we support DHS?

Nuclear attacks are the most deadly and costly of all terrorist threats

- **Nuclear bombs are deadly**
  - Hiroshima: 140,000 killed (40% of population)
  - Nagasaki: 95,000 killed (36% of population)
- **Dirty bombs (Radiological Dispersion Devices or RDDs) are deadly and highly disruptive**
- **Related economic and psychological damage is high in either case**



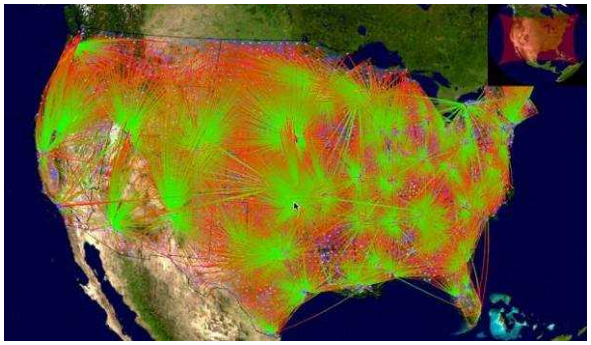


Physics makes it difficult to detect the special nuclear material used in bombs

- **Special nuclear materials (enriched uranium and plutonium) have low-energy gamma rays that are hard to detect**
  - Uranium is very easy to shield; plutonium is somewhat easier to detect than Uranium
- **Detection capability is a function of detector size, time, distance, and shielding**
  - Ideal detection requires large detectors very close to objects for long periods of time
  - Economic and operational barriers usually prevent ideal detection

$$S = \frac{A_d t}{4\pi R^2}$$

Sandia develops systems and technologies to prevent nuclear and dirty bomb attacks

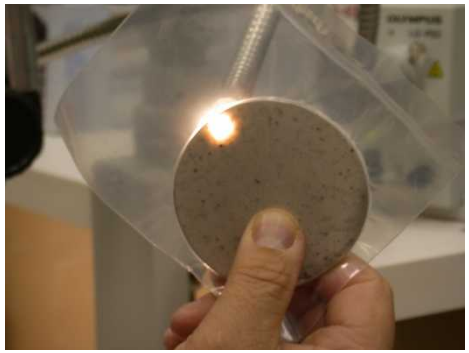


Risk assessment methods

Defensive architecture studies

Modeling and simulation

Passive isotope identification detection systems



Advanced detector materials

Active interrogation methods

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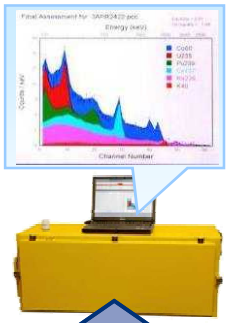
Sandia's systems approach ensures robust and cost-effective solutions



Problem

Systems analysis

Research

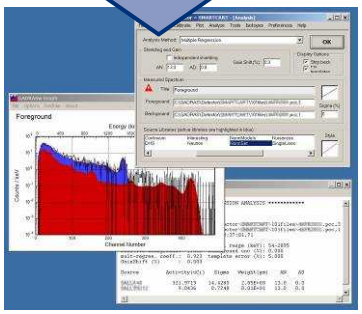
System designs

Component designs

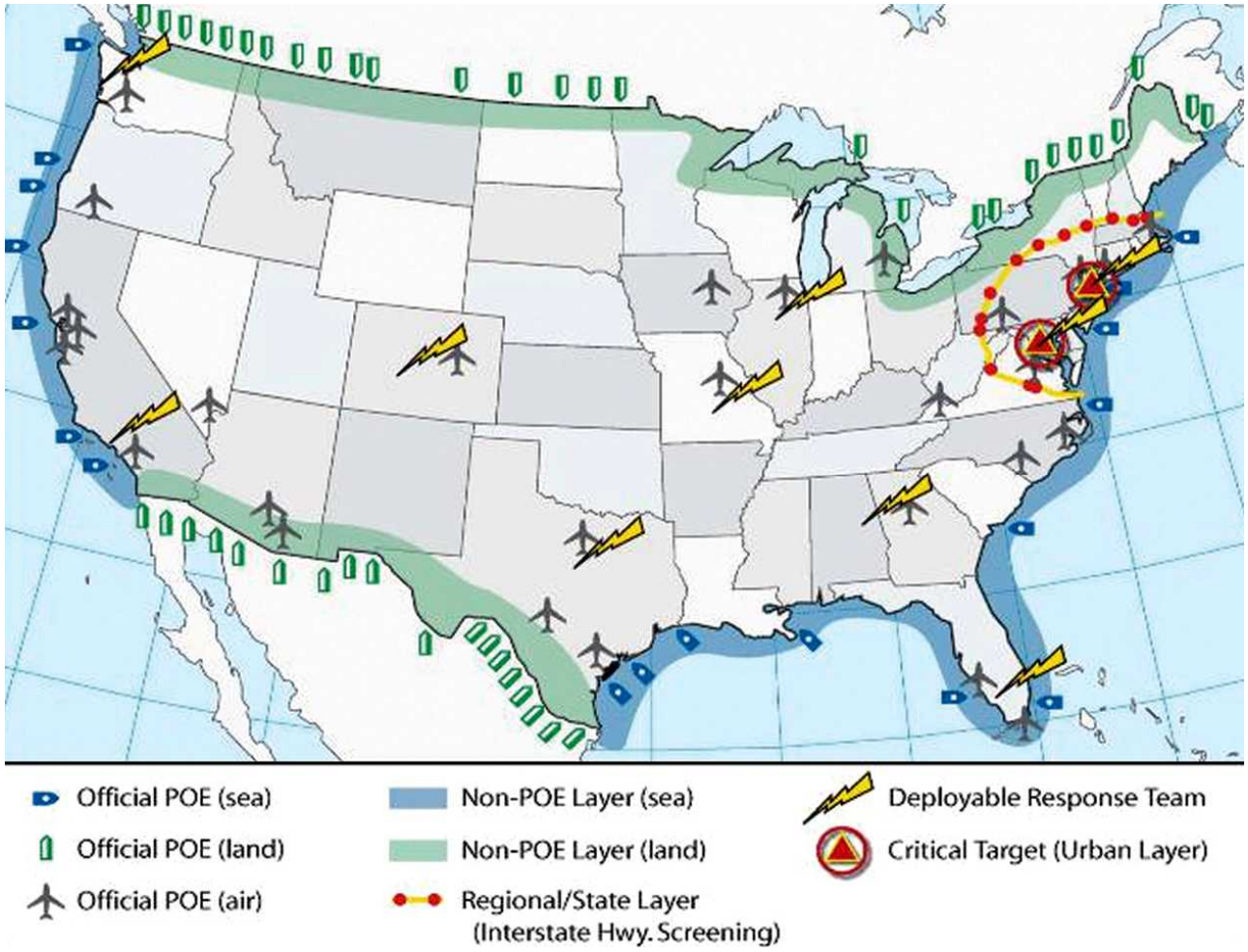
Systems testing

Systems integration

Solutions

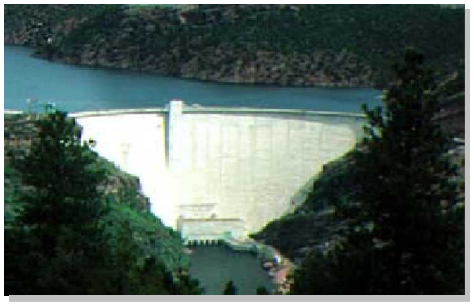


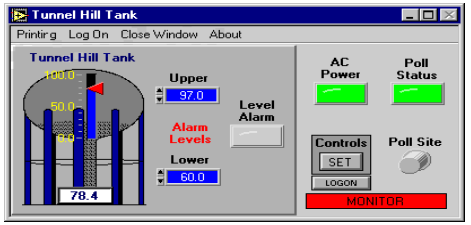
Systems analysis information helps DHS select effective policies and technology applications

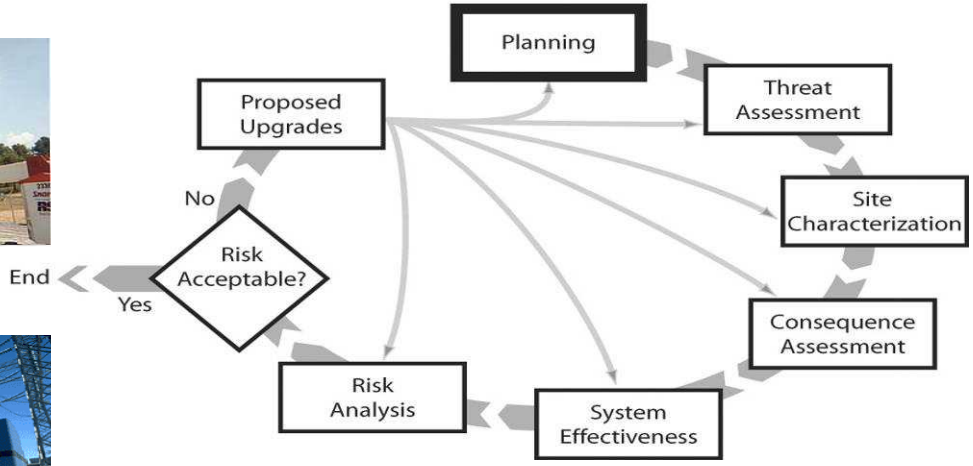


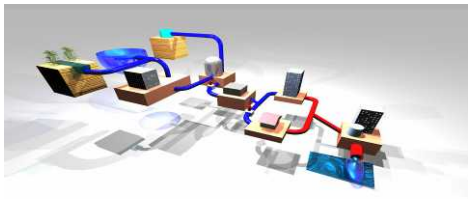
Modeling and simulation of U.S. borders show the costs and benefits of technologies

We "red team" and assess risks to make solutions more robust

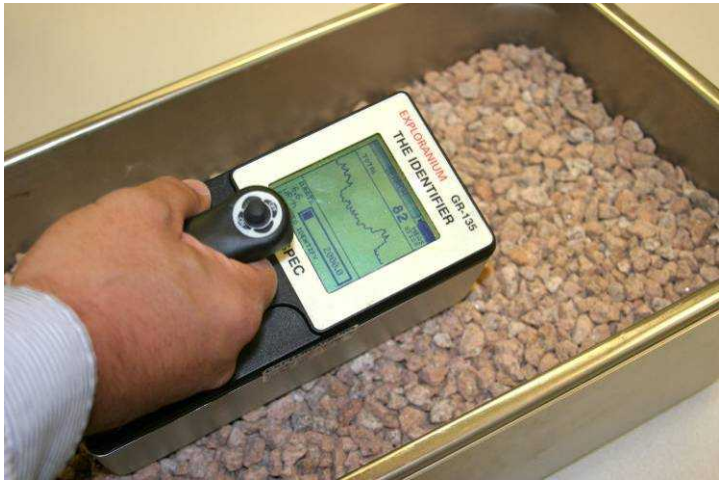






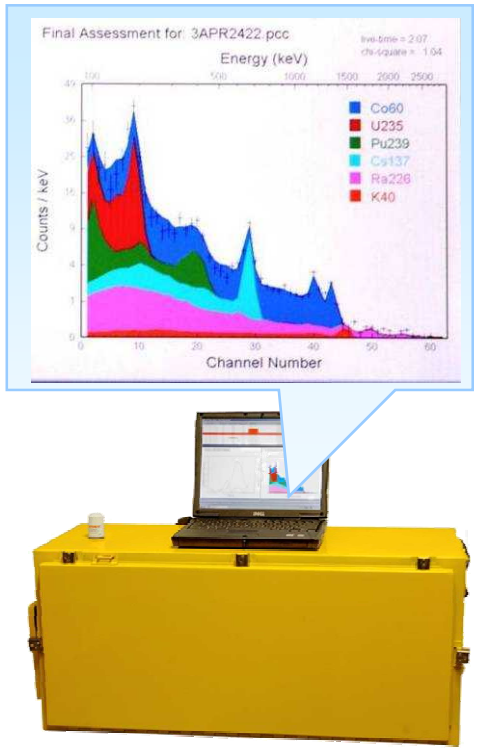


The detection challenge: Distinguishing benign naturally occurring nuclear material from SNM



SMART passive detection distinguishes SNM isotopes from NORM

- Detects γ-ray and neutron emitting materials passing within a few meters
- Automatically identifies the isotopes, including mixed sources, in real time
- Indicates the probability (very low, low, fair, high, or very high) that the material is SNM



SMART: Sensor for Measurement and Analysis of Radiation Transients

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SMART is being commercialized for many applications

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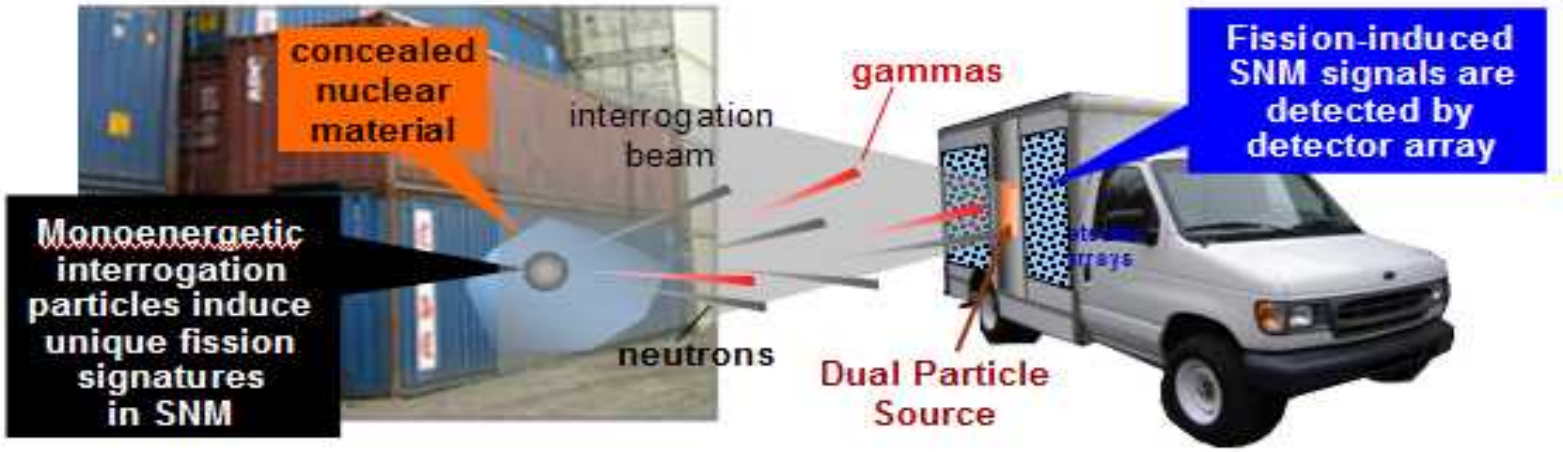
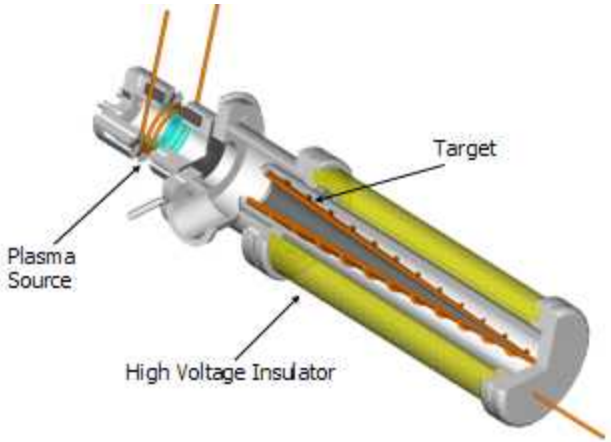
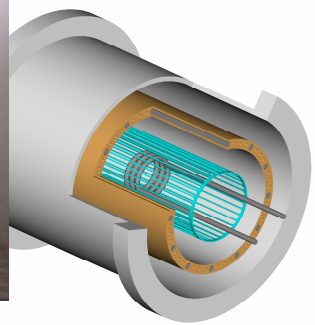
Mobile active interrogation system to ease search for hidden fissile material

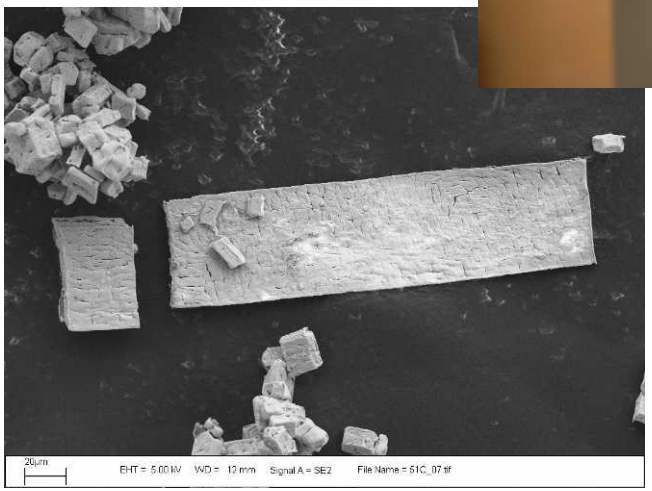


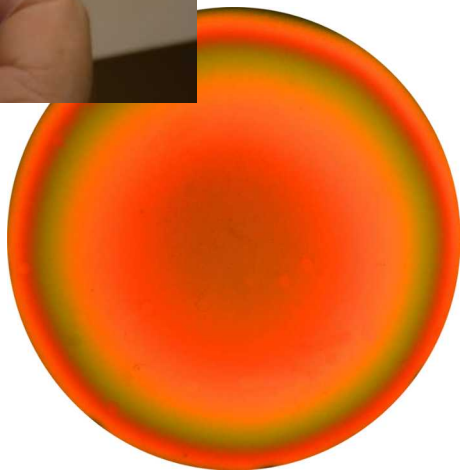




Advanced materials research could enhance detection

- Large, optical-quality polycrystalline lanthanum halide scintillators
- Heteroepitaxially grown single crystal diamond



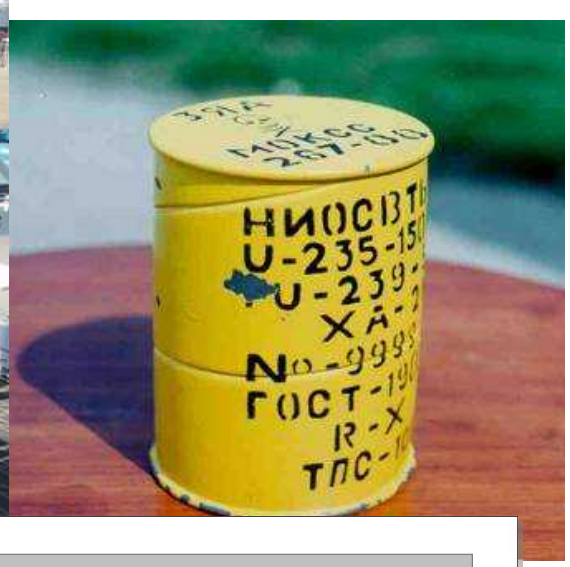


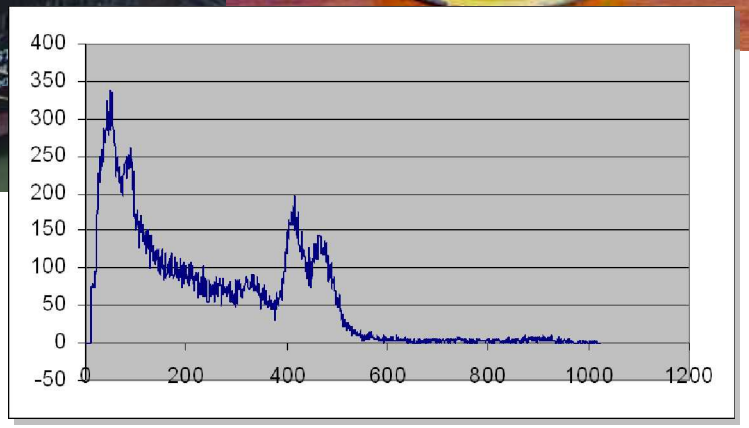
Placing detectors on ships at sea will examine detection probability and false alarm rates

Sandia offers other contributions to DHS

- Operations: Reachback activities to interpret law enforcement data
- Better understanding of RDDs to defend against attacks and support forensics and attribution activities
- Decontamination coating to aid in recovery
- Support for the DNDO Assessment Directorate

Sandia has expertise needed for DHS technical reachback





Better understanding of RDD supports defensive planning; forensics and attribution

- **Planning**
  - Test create understanding of dirty bomb particle size and dispersion
  - Blast modeling and simulation helps predict effects
- **First Responder Guidance**
  - Keep out zone 1 km diameter covers all threats
  - Evacuate and control entry
- **Attribution operations**
  - Sample collection and analysis adds to signature library
  - Knowledge management enables practical use of data collected

Source Term Characterization Facility

Nuclide	Quantity needed for RDD	Quantity in typical application	Number of applications	Ease of dispersal	Theft Risk
A	40 Ci	1000s Ci	Hundreds	Very easy	Medium
B	11 Ci	1000s Ci	Hundreds	Not easy	Medium
C	25 Ci	10-20 Ci	Thousands	Very easy	High
D	110 Ci	100 Ci	Thousands	Not easy	High
E	431 Ci	100,000 Ci	Hundreds	Easy	Medium
F	29 Ci	100,000 Ci	Few	Easy	Low

Radiation containment coating restores sites contaminated by radioactive materials

We support DNDO assessments of detector performance real traffic and weather

Our Radiological and Nuclear Countermeasures Program is making an impact

- Systems Analysis
- Research and Development
- Technology Assessment
- Operational Support
- Response and Recovery
- Forensics and Attribution

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