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What Every Certified Health Physicist Should Know about Securing Radioactive Sources

William G. Rhodes III, CHP

Sandia National Laboratories

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Discussion today…

Risk equation

- Threat
- Consequences of malevolent use

potential effects of an RDD

- Summary of Sandia's research in this area
- Economic impact

Security Concepts

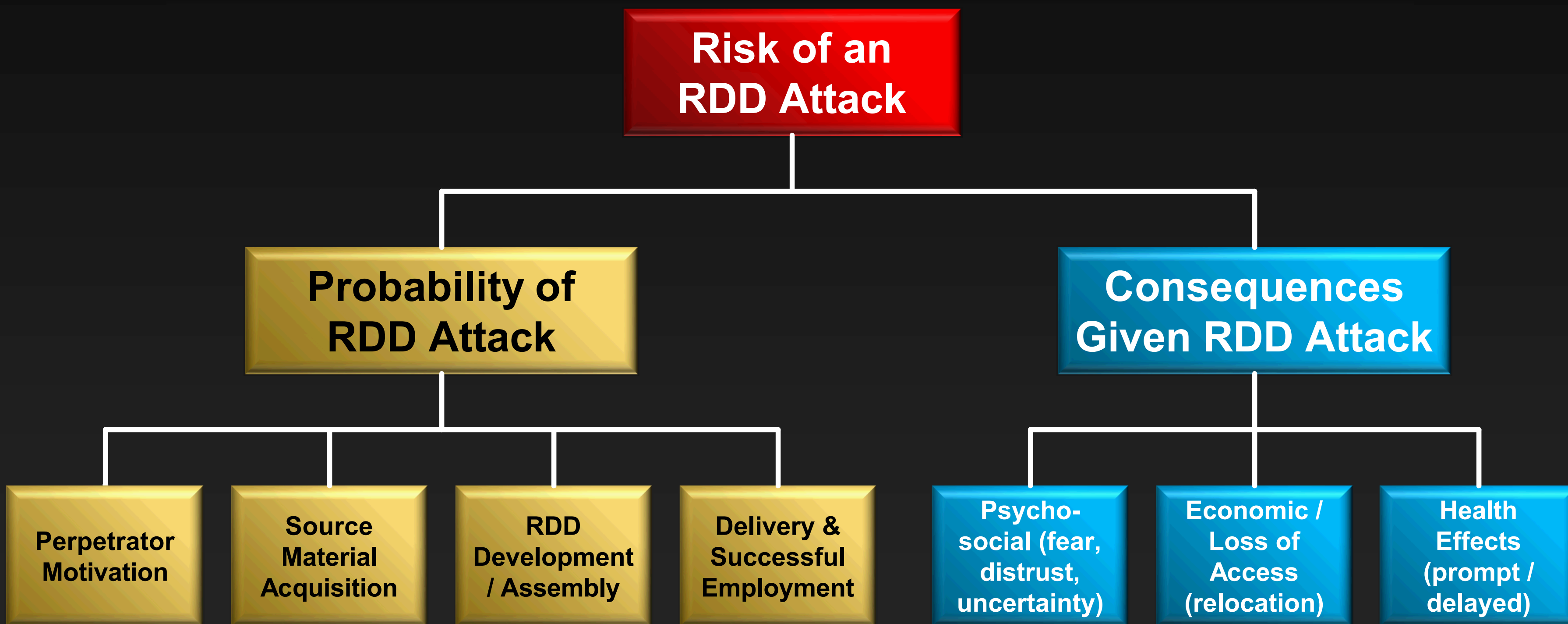
- Detect, delay and respond

Working Definition of an RDD

Radiological Dispersal Device (RDD):

Any device (whether passive or active) with any amount of radioactive material used to maliciously contaminate people, equipment, and/or the environment without a nuclear explosion.

RDD Risk Equation



Developed by Dr. Len Connell, Sandia National Laboratories

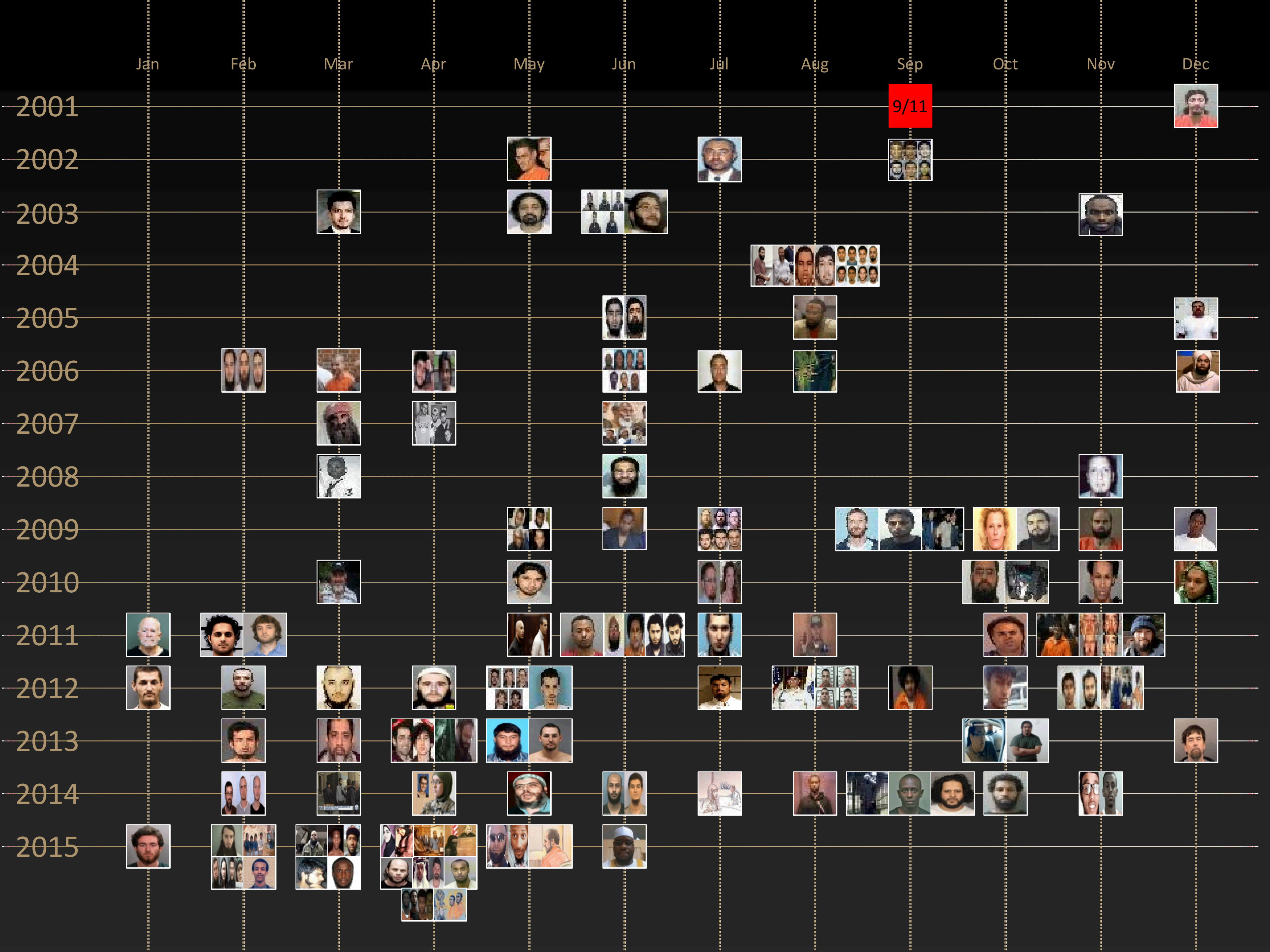
Categories of Threats

External Threats

- Terrorists
- Criminals

Internal Threats

- An insider is anyone with authorized, unescorted access who could:
  - Act alone or in collusion with an external threat
  - Be passive or active
  - Be violent or nonviolent



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Terrorist Interest In RDDs*

- 1998: Egyptian Islamic Jihad, systematic, programmatic efforts to acquire a WMD (including radiological) device
- 1999-2001: al Qaeda basic radiological training
- 2001: Radiological-related documents found in Kabul
- 2002: al Qaeda capture senior operative says they received radiological training in Bagdad
- 2004: Dhiren Barot plots RDD with Am-241
- 2008: Aafia Siddiqui arrested with sketch of a dirty bomb

*Al Qaeda Weapons of Mass Destruction Threat: Hype or Reality, Mowatt-Larssen, 1/2010

Criminal Threat Example

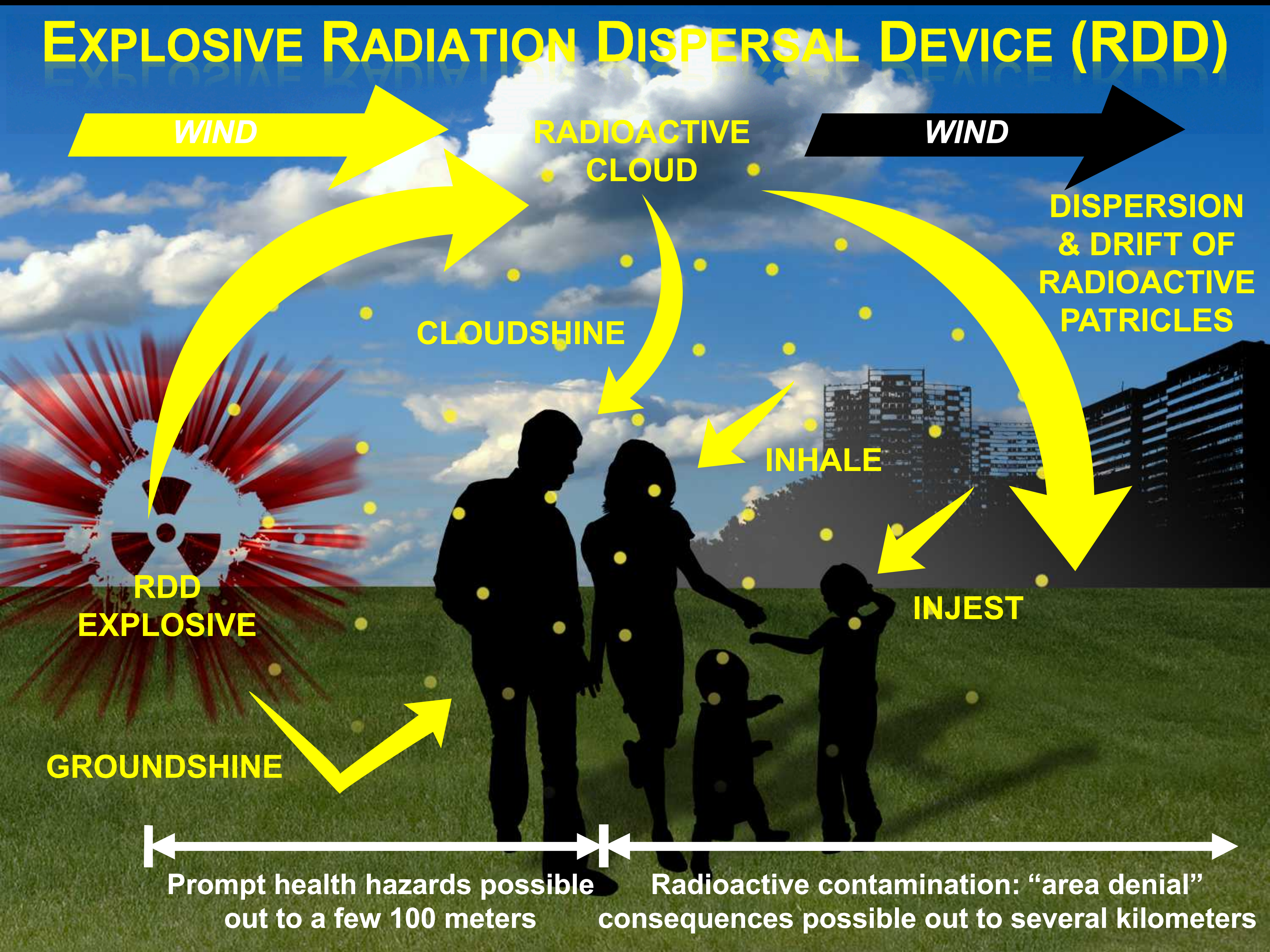
Stuart von Adelman

- Had various positions in radiation protection in the US since the 70's
- Fired from many positions for various issues
- Stole rare documents from the Folger Library in Washington, DC, fled US while on Parole in 1992
- 1993, the US issued a Fugitive Warrant
- America's Most Wanted, Stolen Tritium in Canada,
- Caught stealing radioactive material at the University of Rochester in 1996.

Insider Threats

Entire range of personnel who have authorized, unescorted access:

- Managers
- Guards
- Device operators
- Maintenance workers
- Material custodians
- Technicians


EXPLOSIVE RADIATION DISPERSAL DEVICE (RDD)
WIND
RADIOACTIVE CLOUD
WIND
DISPERSION & DRIFT OF RADIOACTIVE PATRICLES
CLOUDSHINE
INHALE
RDD EXPLOSIVE
INJEST
GROUNDSHINE
Prompt health hazards possible out to a few 100 meters
Radioactive contamination: "area denial" consequences possible out to several kilometers

Potential Effects of an RDD*

Slides courtesy of Fred Harper, Sandia National Labs

RDD Characterization Tests

Experimental Facility to Characterize WMD Aerosols

1000 m^3 explosive aerosolization chamber
Capacity -- 0.5 lb high explosive

Close to 1000 RDD characterization tests have been performed at SNL in the last 25 years

Have semi-empirical models for metals in different geometries, liquids, salts ceramic powders, and preliminary models for ceramics.

MATERIAL	PHYSICAL FORM	DEVICE STRATEGIES TESTED
Ag	Metal	17
Al	Metal	5
Bi	Metal	3
Co	Metal	1
Cu	Metal	2
Mo	Metal	1
Pb	Metal	1
Ir	Metal	3
Stainless Steel	Metal	2
Ta	Metal	1
U	Metal	1
CeO_2	Ceramic (2 densities per device)	7
$SrTiO_3$	Ceramic (3 densities per device)	8
Tb/Pd	Cermet	1
Co	Liquid	2
CsCl	Liquid (several different relative humidity and temps)	6
$BaSO_4$	Slurry	1
CeO_2	Ceramic Powder	7
MnO_2	Ceramic Powder	4
UO_2	Ceramic Powder	1
CeO_2	Pressed Powder	3
CsCl	Powdered Salt	7
$BaSO_4$	Powdered Salt	2

THE FACTS

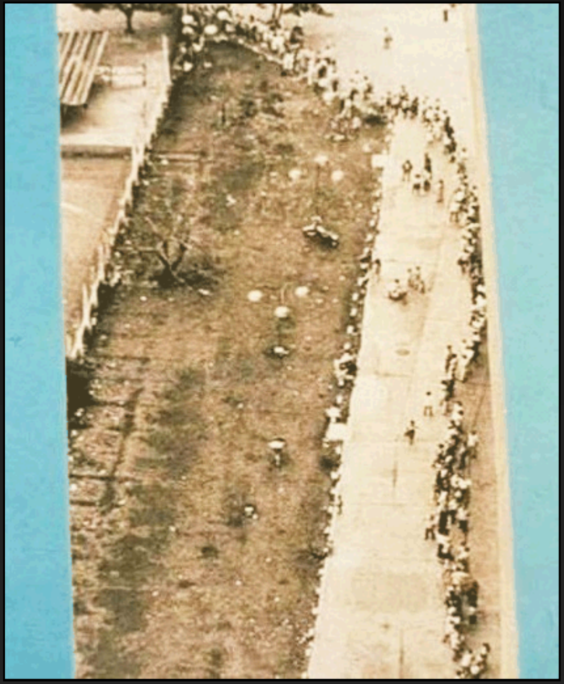
UNSECURED ^{137}CS SOURCE WAS ABANDONED IN A BUILDING WHERE A RADIOTHERAPY CLINIC USED TO FUNCTION. ACTIVITY WAS 1350 CI

Impact to local population

- Persons monitored 112,800
- Persons contaminated 271

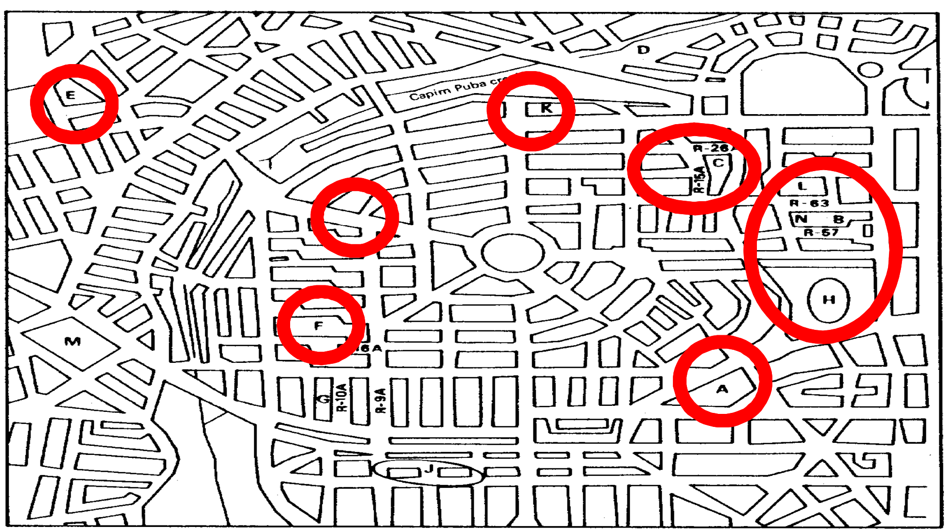
  Clothes and shoes contamination 120

  Skin & internal contamination 151
- Radiation injuries 28
- Hospitalized 20



Contaminated sites & surroundings

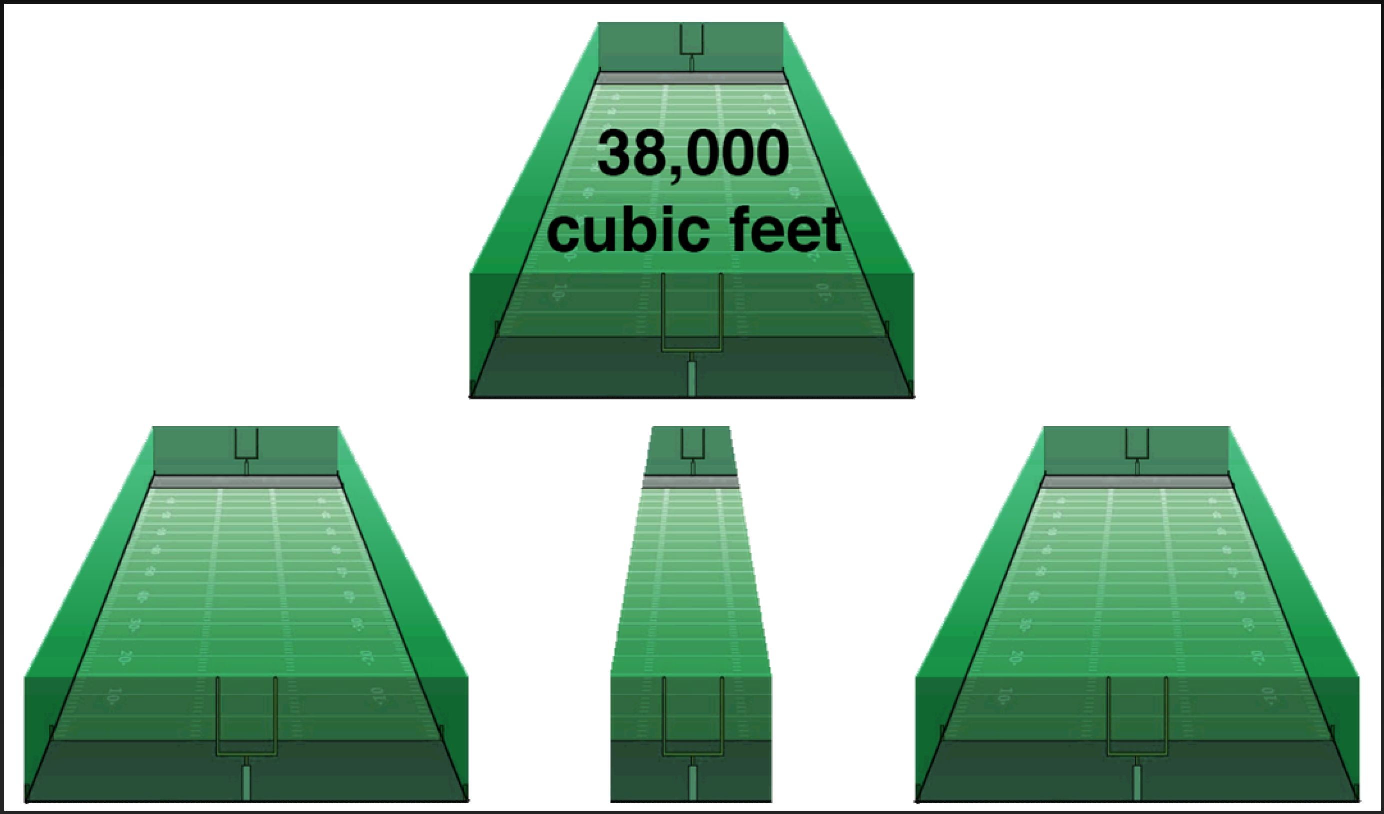
- 159 houses monitored, 101 houses contaminated
- 200 persons evacuated from 41 houses
- 42 houses decontaminated, 6 demolished & 53 recuperated



A: IGR clinic
B: Source first exposed
C: Junkyard I
D: Junkyard II
E: Junkyard III
F: Vigilância Sanitária
G: Physicist W.F.'s house
H: Olympic stadium
J: General Hospital
K, L: Other contamination points
M: Initial CNEN command post
N: Present CNEN office

FIG. 7. Plan of Goiânia showing the principal sites of contamination.

Amount of Waste Generated = 123,602 cubic feet



Social disruption (continued)

- Initial response lasted for 6 months
- Large amounts of money spent during and after the recovering phases
  - Around $42 million US spent (current dollars)
  - 1009 workers involved in clean-up operations
  - Need for construction of a large deposit to store radioactive waste
  - Negative economic impact
- Intense psychological consequences amongst population such as fear and depression

Economic Impacts Studies

Studies

- NNSA Studies
- Port of LA/Long beach, University of Buffalo, 2008

  $12.6 B impact for a one month closure
- MIAN Phase 1 Study, various Scenarios

  $25 M to $102 B to owners/operators of assets
- Canadian Studies, 5 Locations, Various Large Radioactive Sources, Defense R&D Canada, 2007

  $1 B to $250 B impacts depending on source and location

Physical Security Concepts

Elements of a Balanced Physical Security System

Detection

Delay

Response

- Think about familiar concepts of time, Distance and Shielding

Concepts Not Included

Security culture

Deterrence

- Security signs
- Lighting

Sustainment of the system


ВНИМАНИЕ!
РАДИАЦИЯ!

Detection
IAEA NSS 11 Definition

- The discovery of an attempted or actual intrusion which could have the objective of unauthorized removal or sabotage

- Can be achieved by several means, including:

  Visual observation

  Video surveillance

  Electronic sensors

  Records


SEP 3 2003

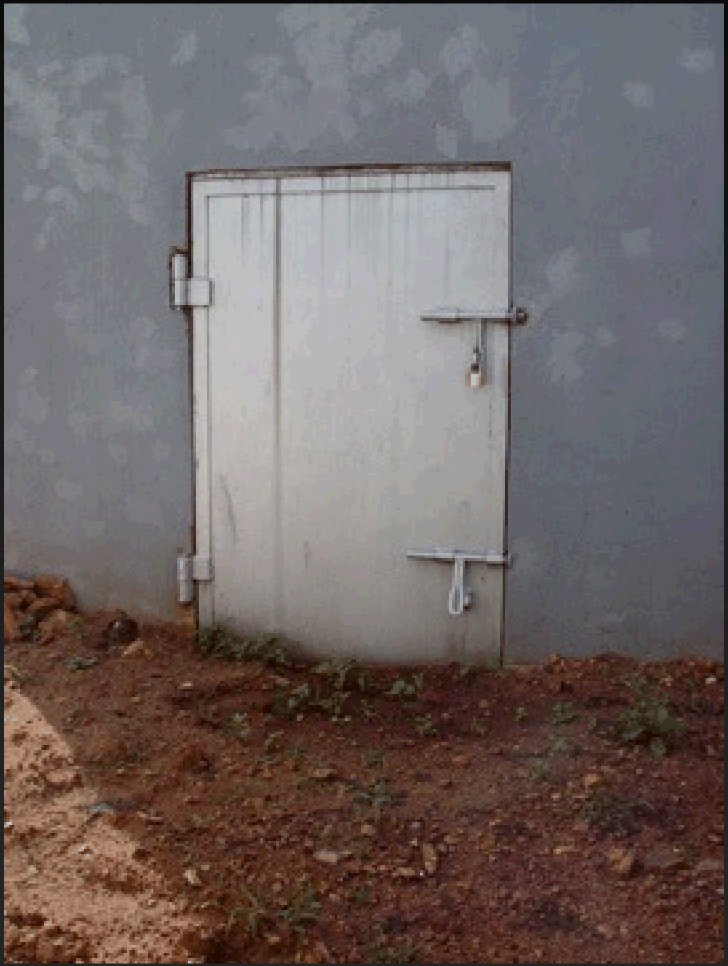
Delay

Delay impedes an adversary's attempt to gain unauthorized access or to remove or sabotage a radioactive source.

- A measure of delay is the factor of time, after detection, that is required by an adversary to remove or sabotage a source


AUG 8 2004


AUG 8 2004



Response

Encompasses the actions undertaken following detection to prevent an adversary from succeeding or to mitigate potentially severe consequences

Design and Evaluation

- Detection before delay
- Detection requires assessment
- Delay time must be greater than assessment plus response time
- Balanced protection against all threats along all pathways
- Table top exercises and actual response exercises

Design Concepts

- Defense in depth
- Integrate safety and security measures
- Graded Approach

Ask an Expert for Help

ORS
Office of Radiological Security
Protect · Remove · Reduce

Office of Radiological Security

MISSION: The Office of Radiological Security enhances global security by preventing high activity radioactive materials from use in acts of terrorism.

PROTECT

PROTECT radioactive sources used for vital medical, research, and commercial purposes

REMOVE

REMOVE and dispose of disused radioactive sources

REDUCE

REDUCE the global reliance on radioactive sources through replacement with viable non-isotopic alternative technologies

Conclusions

Our adversaries are interested in RDDs

The impacts could be costly

A well designed physical security system can help protect your assets

Q & A