

Radiological Security through Alternative Technology: the DOE/NNSA Approach



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- The risk of radiological terrorism
- The Office of Radiological Security (ORS)
- Alternative technologies
 - U.S. political foundation
- ORS alternative technology strategies
 - Policy
 - Education & outreach
 - Federal incentives
 - Research, development, testing, & evaluation



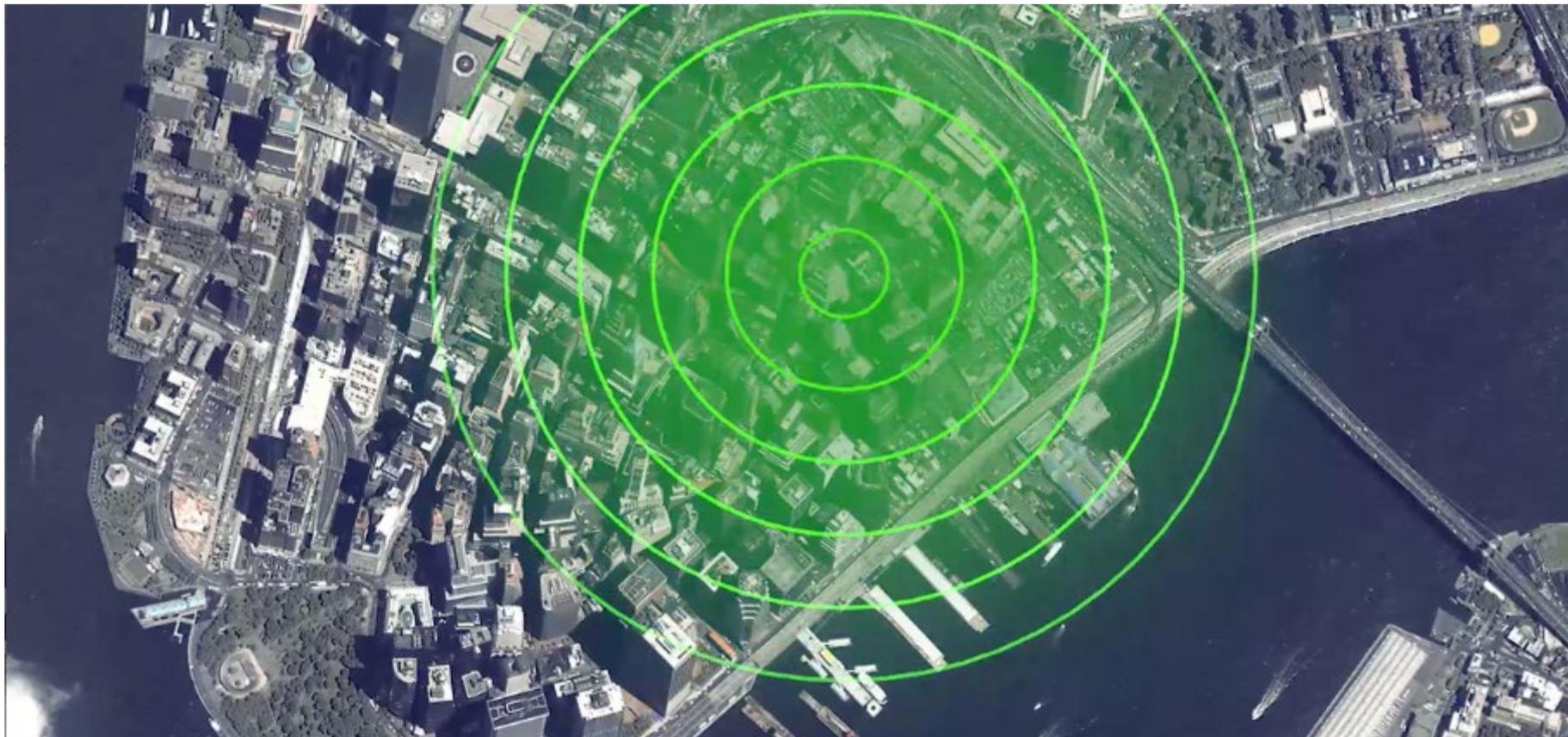
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Consequences of Radiological Terrorism



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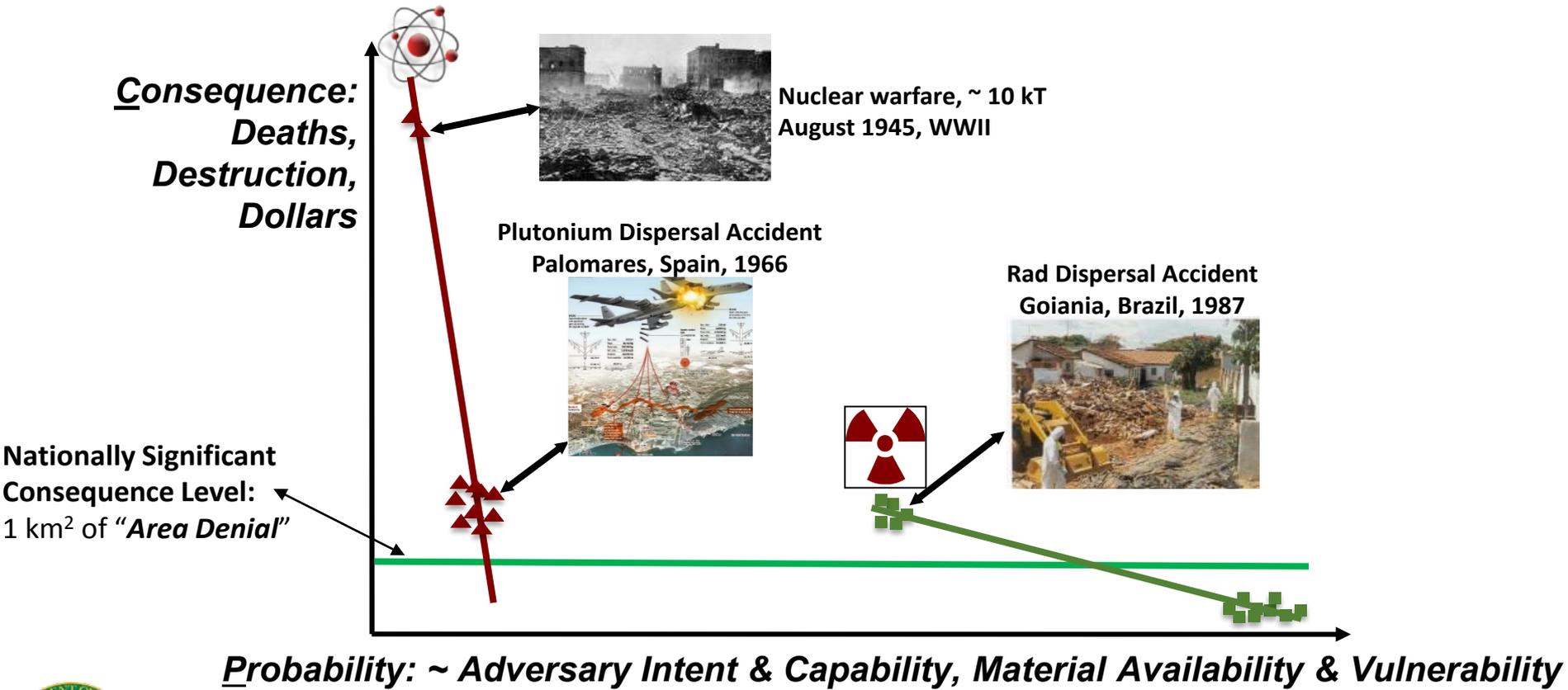


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Nuclear vs. Rad Terrorism Risk

Risk = Consequence X Probability.

Accidents and other events are used to understand Consequence.
Terrorist Probability is hard to quantify.



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Enhance global security by preventing high-activity radioactive materials from being used in acts of terrorism.



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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 by promoting the adoption and development of non-radioisotopic alternative technologies



High Activity Sources



Co-60 (Cobalt -60):

Teletherapy and Gamma Knife units (cancer treatment), self-shielded and panoramic irradiators (research and sterilization)

Radionuclide	Normal Device Activity (Ci)
^{60}Co	1,000 – 1,000,000+
^{241}Am	8 – 20
^{192}Ir	10 - 100
^{137}Cs	1,000 – 50,000

Cs-137 (Cesium-137):

Self-shielded irradiators (research and sterilization), brachytherapy (cancer treatment), and calibrators (dosimeter and detector calibration)



Ir-192 (Iridium-192):

Radiography (industrial imaging)



Am-241 (Americium-241):

Oil well logging (industrial imaging)



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What Are “Alternative Technologies”?

Technologies which do not contain radioactive materials that perform an equivalent (or better) function as a comparable device

Alternative technologies may emit ionizing radiation, like **x-ray irradiators**, or they may not, like **UV pathogen reduction systems**

Application Examples

- Blood Irradiation
- Research Irradiation
- Sterile Insect Technique
- Food/Phytosanitary Irradiation
- Radiotherapy
- Medical Device Sterilization
- Plastic polymerization

Alternative Technology Examples

- Self-shielded X-ray Irradiators (generators)
- Industrial E-Beam & X-ray Conversion
- Linear Accelerators (LINAC)
- UV Pathogen Reduction
- Neutron Generators

New applications & technologies yet to emerge...



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Benefits of Alternative Technology

- Greatly reduced security procedures, requirements, costs
- Elimination of terrorism risk & potential liability
- Reprieve from complicated & costly end-of-life disposition
- Steady device throughput—no source decay!
- Potential for expanded capabilities or technical performance
- Opportunities to consider upgrades as technology advances



Compatibility Assessment & Considerations

1. **Cost** – device purchase, infrastructure requirements, operating costs, radioactive material disposition
2. **Reliability** – operational reliability & maintenance requirements, device throughput & site needs
3. **User preference & awareness**
4. **Site management/administration preference**
5. **Research standards & operating protocols**
6. **Technology differences for certain applications**
7. **Timeline** – financing, disposition, manufacturer installation
8. **Government & industry framework** – licensing regulations, accreditation, standards



National Academy of Sciences Recommendation

- ...the U.S. government should adopt policies that provide incentives (market, regulatory, or certification) to facilitate the introduction of replacements...

Task Force on Radiation Source Protection and Security

- Independent experts from 14 Federal Agencies, and one State organization
- Chaired by the NRC
- 2010, 2014, & 2018 report recommendations: U.S. government (a) incentivize alternatives and (b) lead by example

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- “Task Force recommends that the U.S. Government, as appropriate,1 investigate options such as **voluntary, prioritized, incentivized, programs for the replacement of Category 1 and 2 radioactive sources with effective alternatives**. The Task Force further recommends that U.S. Government agencies, where appropriate, lead by example in the consideration of and transition to alternative technologies that meet technical, operational, and cost requirements.”



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USG Interagency Report, White House National Science & Technology Council

- **Best Practices Guide for Federal Agencies**, Working Group on Non-Isotopic Alternatives to High Activity Radiological Medical Devices

H.R. 5515 – John S. McCain National Defense Authorization Act for Fiscal Year 2019

- To meet the goal of eliminating the use of blood irradiation devices in the United States that rely on cesium chloride by December 31, 2027 through a **voluntary** program (Cesium Irradiator Replacement Project) that:
 1. is voluntary for owners of blood irradiation devices;
 2. allows for the United States, subject to the review of the Administrator, to pay up to 50 percent of the per-device cost of replacing blood irradiation devices covered by the programs;
 3. allows for the United States to pay up to 100 percent of the cost of removing and disposing of cesium sources retired from service by the programs; and
 4. replaces such devices with x-ray irradiation devices or other devices approved by the Food and Drug Administration that provide significant threat reduction as compared to cesium chloride irradiators.

IAEA Information Circular/910, “Joint Statement on Strengthening the Security of High Activity Sealed Radioactive Sources”

- Historical: 2016 Nuclear Security Summit (NSS) Joint Statement
- Also complemented by NSS national statements on alternative technology, including United States

Federation of American Scientists

- NSS letter on radiological security – 35 Nobel Laureate signatories

Reports from Nongovernmental Organizations & Think Tanks

- Nuclear Threat Initiative
- Center for Nonproliferation Studies
- World Institute for Nuclear Security
- Stanley Foundation



ORS Reduce Strategy

Seeks to convert and replace radiological devices to achieve **permanent risk reduction** by reducing the footprint of risk-significant radiological materials.



Policy Engagement

- Explore policies to incentivize the long-term transition to alternative technologies



Device Replacements

- Implement activities to facilitate the voluntary transition to alternative technologies by incentivizing adoption and removing barriers



Outreach & Education

- Information-sharing and outreach efforts to different stakeholder groups via educational tools and events



Research

- Address gaps, improvements, and analytical support for adoption of technology through support for studies & other collaboration with NNSA and DOE research & development offices

Policy Engagement

Non-radioisotopic Alternative Technologies White Paper

- Produced by the DHS-led Alternative Technology Working Group
- U.S. government and private sector members
- Paper includes chapters on industrial sterilization and food irradiation
- Expected to be published this year

Interagency Working Group on Non-Isotopic Alternatives to High Activity Radiological Devices

- Interagency only
- Meets quarterly to discuss alternative technology status and opportunities for Federal support
- Participating agencies: DHS, DOC, DOC/NIST, DOD, DOE/NNSA (co-chair), DOS, EOP, EPA, FBI, HHS/CDC, HHS/FDA, HHS/NCI, HHS/NIH (co-chair), NRC, USDA

Task Force on Radiation Source Protection and Security

- Produces a report to Congress and the White House every 4 years
- Includes a chapter on alternative technology
- Participating agencies: CIA, DHS, DOD, DOE, DOJ, DOS, DOT, EOP, EPA, FBI, FEMA, HHS, NRC (chair), OAS, ODNI



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Outreach and Education



Organize targeted workshops to increase awareness of security concerns and technology options:

- 10 US workshops in 2 years
- 15+ international events
- New York City, University of California, Dallas-Fort Worth, Boston



Provide educational materials via websites, email, Twitter, handouts:

- Brochures and fact sheets
- Videos



Present papers or exhibit booths at industry conferences:

- IAEA
- Institute for Nuclear Material Management
- American Association of Blood Banks
- Health Physics Society
- U.S. Organization of Agreement States
- International Meeting on Radiation Processing



Meet directly with source users to discuss source security and technology options, including source alternatives



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Cesium Irradiator Replacement Project

A voluntary initiative offering financial incentives to U.S. licensees who choose to replace Cs-137 self-shielded irradiators with alternative technologies.

Sites Receive:

- Removal of the Cs-137 device through the Off-Site Source Recovery Project (OSRP)
- A financial incentive toward the purchase price of an X-ray machine (typically 50%)

Progress to Date

- **109** irradiators replaced
- **30%** of the U.S. inventory currently being replaced

Initiative	Irradiator Application	Irradiators to be Replaced
University of California	Mostly research	90%
New York City	Blood & Research	75%
Atlanta	Blood & Research	66%
Vitalant (blood)	Blood	100%

Other Applications?

- **Collaboration with NA-22 Office of R&D**
 - Small Business Innovative Research (SBIR)
 - DOE Labs, universities
- **Technology research comparison studies**
 - Medical product materials
- **Policy & industry landscape studies**
 - Cost studies
- **Technology demonstration Projects**
 - Superconducting Linac



We need your input! What is coming that will impact x-ray or e-beam adoption?

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