
HPS Annual Meeting
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Past

- Limited Radiation Screening for Security Applications
  - Prevent material leaving SNM facilities
- More emphasis on health and safety
  - Prevent spread of radioactive material contamination
    - Scrap metal recycling
  - Minimize health risks
  - Reduce environmental impacts
- Equipment
  - Dose meters
  - Portal monitors for vehicle screening
    - Time, lanes, amounts

However, the world has changed…..
Brief Partial History of Radiation Interdiction at Borders

- Second Line of Defense (DOE NNSA) deploying radiation interdiction equipment around the FSU since 1999 (39 sites)
- Customs and Border Protection (CBP) deployed handheld radiation interdiction equipment at US borders
- CBP deploying Radiation Portal Monitors at the border starting in 2002
- IAEA deploying equipment in Europe and Asia
- ANSI, IEC, and IAEA standards for border security equipment have been developed
- Megaports (DOE NNSA) has begun deployments
The Global View

20-foot Shipping Container Traffic Per Year
Megaport Deployments
The Challenge: U.S. Ports of Entry

- 307 Ports of Entry representing 621 border sites to protect

- 332,622 vehicles per day
- 57,006 trucks/containers per day
- 2,459 aircraft per day
- 580 vessels per day
Layered Approach
Our System of Commerce Was Not Designed for Defense

- Personal Radiation Detectors
- Handheld Radio-Isotope Identifier Devices
- Radiation Portal Monitors
- X-ray/Gamma-ray Imaging
- Human Factors
Primary (Tripwire) Screening

- Rapidly release the majority of vehicles
- Survey all vehicles/containers
- Facilitate the flow of commerce
- High throughput is an operational necessity
  - 5 mph drive through $\rightarrow \leq 20$ sec/vehicle

Primary Portal for Each Lane
Secondary Screening

- Evaluate all suspect vehicles/items
- Confirm primary alarm was not an anomaly
- Identify any real threats within a smaller population
- Resolve cross-talk alarms (multiple-vehicle alarms)
- More measurement time available per vehicle

Secondary Portal
Layered Approach: Imaging

X-ray and gamma-ray transmission or backscatter imaging
Border Security Examples
Border Security Examples
## Alarm Data From 3 Border Crossings

<table>
<thead>
<tr>
<th>Source Material</th>
<th>Location A % of Identified Alarms</th>
<th>Location B % of Identified Alarms</th>
<th>Location C % of Identified Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitty litter</td>
<td>34%</td>
<td>25%</td>
<td>-</td>
</tr>
<tr>
<td>Medical (In, I, Tc, TI)</td>
<td>16%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Abrasives/Scouring pads</td>
<td>14%</td>
<td>5%</td>
<td>-</td>
</tr>
<tr>
<td>Refractory material</td>
<td>8%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Mica</td>
<td>5%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Fertilizer/Potash</td>
<td>5%</td>
<td>13%</td>
<td>-</td>
</tr>
<tr>
<td>Granite/Marble slabs</td>
<td>4%</td>
<td>-</td>
<td>10%</td>
</tr>
<tr>
<td>Ceramics/Tile/Toilets</td>
<td>4%</td>
<td>9%</td>
<td>28%</td>
</tr>
<tr>
<td>Trucks/cars</td>
<td>2%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aluminum</td>
<td>-</td>
<td>15%</td>
<td>-</td>
</tr>
<tr>
<td>Earth</td>
<td>-</td>
<td>11%</td>
<td>-</td>
</tr>
<tr>
<td>Bentonite</td>
<td>-</td>
<td>5%</td>
<td>-</td>
</tr>
<tr>
<td>Salt</td>
<td>-</td>
<td>5%</td>
<td>-</td>
</tr>
<tr>
<td>Other metal</td>
<td>-</td>
<td>3%</td>
<td>-</td>
</tr>
<tr>
<td>Televisions</td>
<td>-</td>
<td>-</td>
<td>27%</td>
</tr>
<tr>
<td>Gas Tankers</td>
<td>-</td>
<td>-</td>
<td>13%</td>
</tr>
<tr>
<td>Smoke Detectors</td>
<td>-</td>
<td>-</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
<td>9%</td>
<td>18%</td>
</tr>
</tbody>
</table>
Future Directions in Radiation Detection for Homeland Security

Domestic Nuclear Detection Office (DNDO)

**Near Term**
- Spectroscopic portal monitors
- Enhanced imaging systems
- Enhanced radioisotope identifiers
- Networked systems – global architecture

**Mid to Long Term**
- Transformational R&D
Spectroscopic Portal Monitors

Pros and cons of NaI(Tl) versus plastic scintillator

- Higher resolution allows for simultaneous identification
- Improved NORM rejection
- Improved identification rate
- Higher cost
- Physical limitations of NaI(Tl)

Automated secondary isotopic identification simultaneously with screening
Spectroscopic Portal Monitors

DNDO tested 10 prototype spectroscopic portal monitors under the Advanced Spectroscopic Portal program

DNDO currently in the process of selection for contract of production units
ANSI Standards

- ANSI developed and developing new standards for radiation detection equipment for homeland security
  - Sets a baseline standard for capabilities
  - Allows for comparison between instruments

- ANSI N42.3x - “Evaluation and Application of Radiation Detection for Use in Homeland Security”
  - ANSI N42.32 for PRDs
  - ANSI N42.33 for Handheld Search Instruments
  - ANSI N42.34 for RIIDs
  - ANSI N42.35 for RPMs
  - ANSI N42.37 for Training Requirements
  - ANSI N42.38 for Spectroscopic Portal Monitors
  - ANSI N42.39 for Portable Neutron Detectors
  - ANSI N42.42 for Data Format
ANSI Standards

- ANSI N42.3x - “Evaluation and Application of Radiation Detection for Use in Homeland Security” (cont.)
  - ANSI N42.37 for Training Requirements
  - ANSI N42.38 for Spectroscopic Portal Monitors
  - ANSI N42.39 for Portable Neutron Detectors
  - ANSI N42.41 for Active Interrogation Systems
  - ANSI N42.42 for Data Format
  - ANSI N42.43 for Mobile and Transportable Systems including Cranes
  - ANSI N42.44 for Cabinet X-ray Imaging Systems
  - ANSI N42.45 for X-ray Computed Tomography

- Additional Proposed Standards
  - ANSI N42.xx for Equipment in Extreme Environments
  - ANSI N42.xx for Spectroscopic Personal Radiation Detectors
  - ANSI N42.xx for Personnel Radiation Dosimeters
Other Programs

- DNDO initiated an enhanced imaging program
  - Cargo Advanced Automated Radiography System (CAARS)

- Advances in handheld isotope identifiers
  - New scintillators (LaBr$_3$, LiI(Eu))
  - New algorithms
  - HPGe

- Improvements in Personal Radiation Detectors (PRDs)
  - Neutron capability
  - Improved user interface

- New direction in detection instruments
  - Neutron search instruments
  - Spectroscopic PRDs
Active Techniques

- Imaging - x-ray and gamma ray methods
- Muon imaging
- Neutron induced fission with neutron or gamma ray return signal (can be specific to SNM)
  - Techniques similar to explosives detection
  - Large source required giving large dose
- Gamma ray induced fission with neutron or gamma ray return signal (can be specific to SNM)
  - Large source required giving large dose
  - Small cross section
- Gamma ray induced nuclear florescence
  - Requires intense broad spectrum x-ray source
  - Response is isotope specific
Change in Commerce

- Centralized ports
- Major redesign of ports using security basis
- Pre-screening centers
- NRC licenses
- Radioisotope usage in medicine