Domestic Nuclear Detection Office (DNDO)

A Revolution in Detection Affairs

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“The danger of nuclear terrorism remains one of the greatest threats to global security…”

President Obama, March 2012
Hankuk University, Seoul, ROK

Nuclear Defense Spectrum
Challenges of Nuclear Detection

Radiation Emitted by Material
Some materials self-shield their emitted radiation

Radiation Transmitted through Intervening Materials

Radiation Propagates through Environment

Sensor Detects

Energy Spectra

Background Radiation
Challenges of Nuclear Detection

- Background: signal to noise
- Improving detection performance
  - Increasing the chance of an encounter
    - Bigger detectors
    - Large number of networked detectors
    - Highly mobile systems
  - Reducing background
    - Higher resolution
    - Imaging techniques
  - Increasing source signal strength
    - Active interrogation
Urban variations in background radiation

In urban environments local variations can be large
**Background Challenges: Signal to Noise**

- **Black**: natural background radiation
- **Green**: 1 mCi Cesium-137 source at 300 ft from the detector
- **Red**: 1 mCi Cesium-137 source 150 ft from the detector

Counts (per 3 keV per 10s)

Energy (keV)

Can greatly impact a system's False Alarm Rate and Minimum Detectable Source Activity
Revolution in Military Affairs

Office of Net Assessments in the Office of the Secretary of Defense defines a Revolution in Military Affairs (RMA):

“RMA is a major change in the nature of warfare brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and operational and organizational concepts, fundamentally alters the character and conduct of military operations.”
Revolution in Military Affairs
From the laboratory to the field
Revolution in technology & gamma spectroscopy

“Electronics” for a 1964 gamma ray spectrometer

And an even more capable version today
Revolution in technology & gamma spectroscopy

“Output” device for 1964 gamma ray spectrometer

And an even more capable version today

26,000 bytes in 1964

32,000,000,000 bytes today
# Next and Future Generation Technology

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<td>Portals and Imaging</td>
<td>Spectroscopic systems Improved radiography Automated detection of high-Z</td>
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<td>Active systems for detection of shielded threats (SNAR) Increased PD and range, decreased FAR</td>
<td>Passive, automated detection of shielded SNM Improved materials-higher resolution, larger, lower cost Detection “at speed,” virtual tagging of vehicles Improved materials – room temperature sensors approaching HPGe, improved electronics, solid state neutron sensors</td>
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<td>Mobile systems</td>
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<td>Better capabilities Increased detection range</td>
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<td>Better materials, better range Tracking and localization</td>
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<td>Hand-Held Detectors</td>
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<td>Directional high-resolution spectroscopic handheld (IPRL) Intelligent networked sensor systems (IRSS)</td>
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Technology Deployments-DHS

- **CBP:** 1,468 RPMs; 1,631 RIIDS; 19,432 PRDs
  - 60 mRPMS or mobile systems
  - RIIDS include 10 new advanced HPRDS

- **USCG:** 922 RIIDs; 6,065 PRDs
  - 240 Wide-Area Search Backpacks,
  - 8 Advanced RIIDs
  - 36 Handheld Radiation Monitors,
  - 12 Linear Radiation Monitors

- **TSA-VIPR:** 50 Backpacks; 75 RIIDs; 275 PRDs
  - All 25 fully-equipped and trained VIPR Teams

[Image of technology equipment]
Support to S&L and Securing the Cities

- DNDO provides technical assistance and program support to state and local rad/nuc detection efforts

- **Mobile Detection Deployment Units**
  - Available for S&L
  - Each (large) unit has 22 Backpack Systems; 5 Mobile Radiation Search Systems; 8 RIIDs; 52 PRDs

- **Securing the Cities Program** (NYC-region)
  - More than 8,000 pieces of detection equipment
  - Trained nearly 13,000 personnel
  - Conducted more than 100 drills
Next Generation

• The RadSeeker’s significant increase in identification capabilities over currently fielded systems is based on advanced spectrum processing and identification algorithms, coupled with a highly sensitive 1.5” x 1.5” Lanthanum Bromide detector.

• The RadSeeker-DL is based on a modular design that has high reliability, includes a Built-in-Test capability, and requires no calibration.

• Advanced Handheld System is an High Purity Germanium based spectroscopy system in a compact and rugged Handheld package. Uses a mechanical cryogenic cooler to maintain extremely low temperatures (-170°C or 100K) required for system operation.
Stand-off Detection Program

Roadside Tracker (RST)

Single sided 1-D coded aperture with video tracking

Stand-Off Radiation Detection System (SORDS)

Trailer-Mounted System
Dual sided 2-D coded aperture with CsI array

Truck-Mounted System
Active mask, dual CA and CI with NaI array
Stand-off Detection Program

Coded Aperture Image

Range Data

Radiation Image

Isotope ID

Overlay

Range = 25m

Color Codes:
- Threat – Red
- Suspect – Yellow
- Medical – Blue
- Industrial – Purple
- NORM – Green

Co-60
Stand-off Detection Program
Long Range Radiation Detection
Limited Use Experiment (LUE)
Program Goals:

- SrI$_2$ and CLYC as GFM
- Time to detect a 100 uCi at 10 m in 10 sec
- Time to ID and locate direction: 20 sec
- Directionality to < 45 deg
- Compact size, low weight, moderate cost
- 72 hour operation on single battery charge
Intelligent Radiation Sensor System (IRSS)

- Characterize the ability of a system of detectors to improve the detection, identification, and localization of threats as compared to the individual detectors
- Characterize the relative importance of individual detector capabilities: NaI (2”x2”, 2”x1”), CZT (imaging and non-imaging), LaBr3 (RadSeeker)
- Demonstrate search and monitoring capabilities across complex operational environments
Summary

The next revolutionary technologies may change the way we deploy and operate detectors.

- Continued integration into an operational architecture
  - Federal, State, and local operations
  - Deployments, training, and exercises

- Research and Development supports the revolution in nuclear detection
  - Allows for wider deployment of more-capable detectors
  - Enables surge and search in response to threat indicators and intelligence