PNNL-SA-63388

Radiation Portal Monitor Project

# DHS Radiation Portal Monitor Project at PNNL

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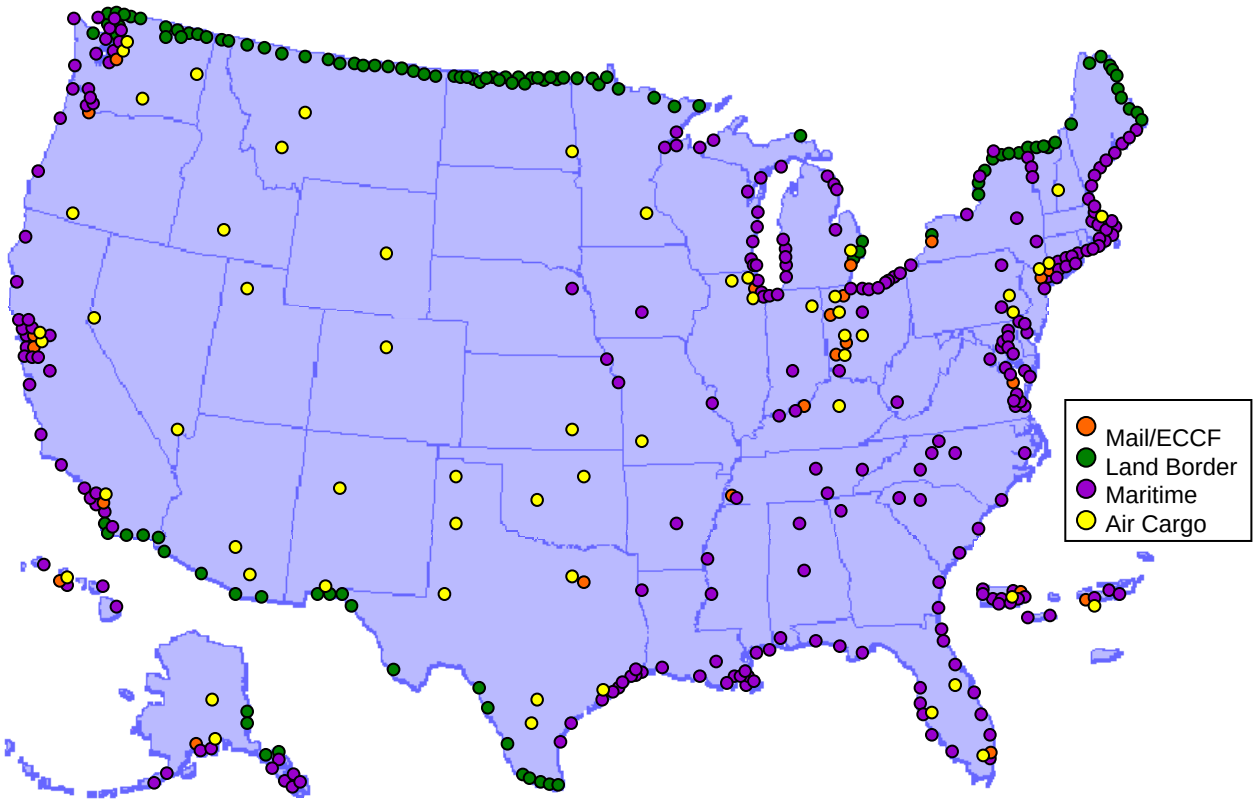
# The Challenge: U.S. Ports of Entry

**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**

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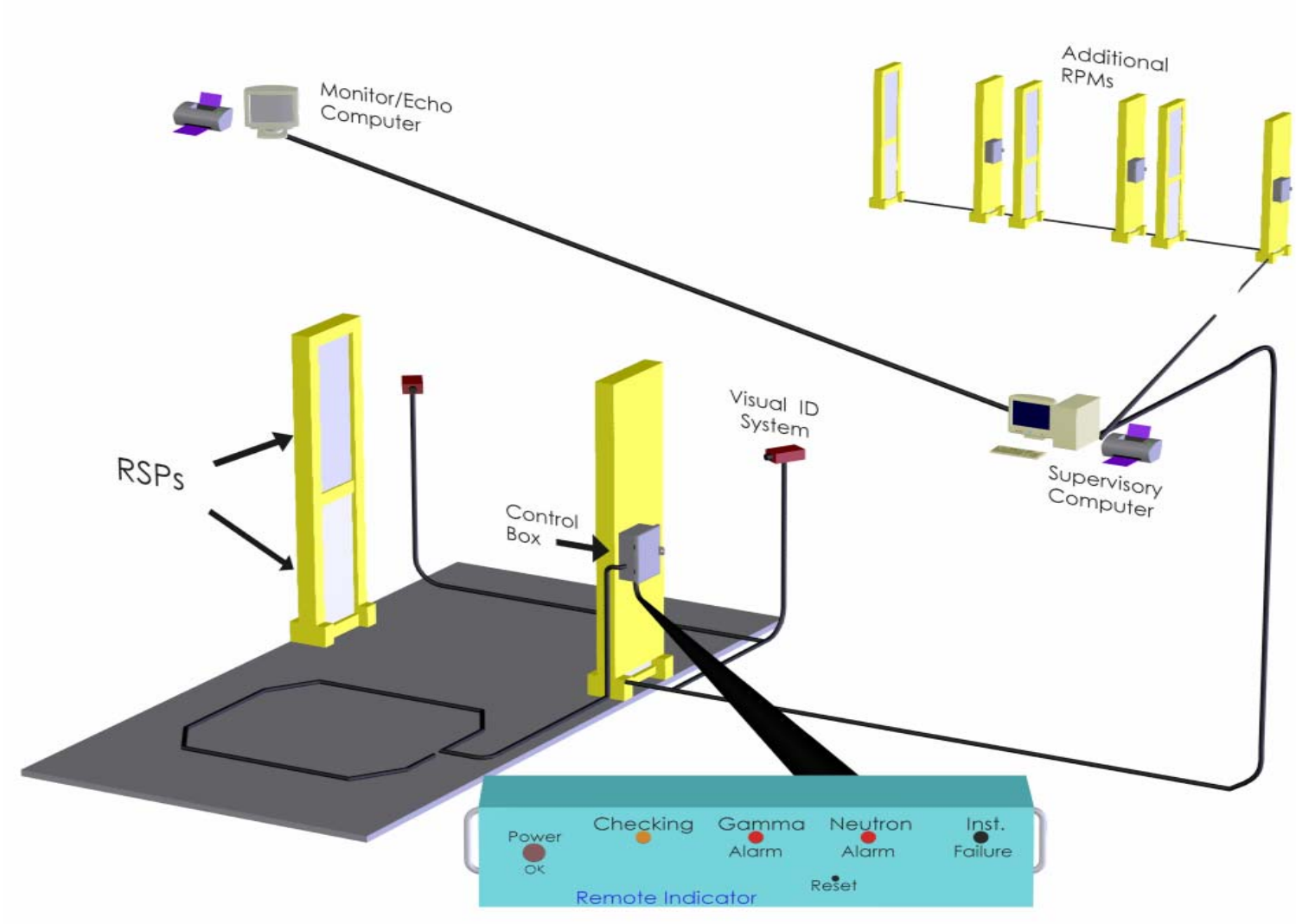
# Layered Approach of Equipment and Personnel

- Equipment
  - Personal Radiation Detectors
  - Handheld Radio-Isotope Identifier Devices
  - Radiation Portal Monitors
  - X-ray/Gamma-ray Imaging
- Human Factors
- Domestic Nuclear Detection Office (DNDO) coordinating and acquiring detection equipment

# Radiation Portal Monitor System



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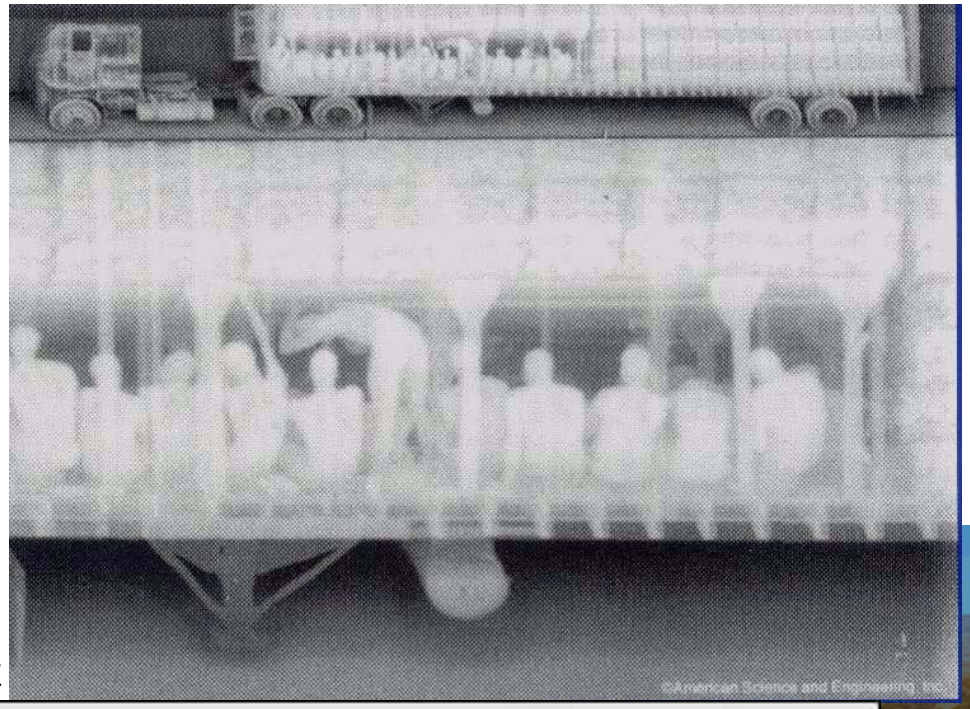
# Radiation Portal Monitors

- Current Generation
  - Large-area plastic scintillator gamma-ray detectors and poly-moderated 3He neutron detectors
  - Used for decades in the scrap steel industry
  - Sensitive to small quantities of SNM and RDD materials
- Next Generation:  Spectroscopic Gamma Detectors

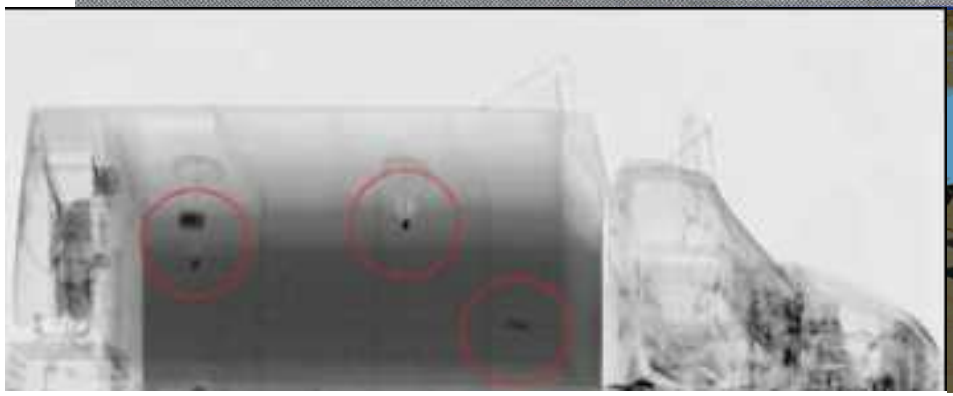
# Imaging Equipment




AS&E

X-ray and gamma-ray transmission or backscatter imaging

Aracor Eagle



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# Radiation Portal Monitor Project at PNNL

- Deploy RPMs for DNDO/CBP
- Provide technical support for RPM deployment
  - Science, Engineering, and Testing
- Started in 2002, estimated completion 2013
- ~1100 RPMs installed
  - >90% of all cargo containers and vehicles entering the U.S.


RPMP
Radiation Portal Monitor Project

U.S. Customs and Border Protection | Domestic Nuclear Detection Office

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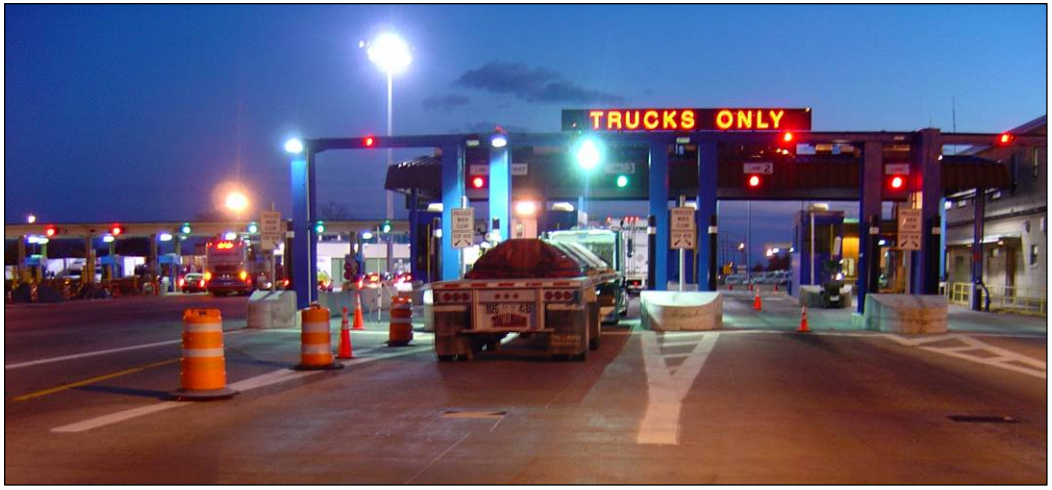
# Border Security Examples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# Border Security Examples





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# Border Security Examples




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# Naturally Occurring Radioactive Material and Man-Made Sources

- NORM and technologically enhanced NORM
  - Uranium series ($^{238}U$; 4.5 billion years)
  - Thorium series ($^{232}Th$; 14 billion years)
  - Potassium ($^{40}K$; 1.3 billion years)
- Commercial isotopes: $^{241}Am$, $^{133}Ba$, $^{137}Cs$, $^{57}Co$, $^{60}Co$, $^{192}Ir$, $^{226}Ra$, $^{252}Cf$, nuclear fuel, and depleted uranium
- Medical radioisotopes
  - $^{99m}Tc$ (92% of procedures)
  - One in 2,600 Americans carries radioactive burden

# “Nuisance” or “Innocent” Alarms

- Agricultural products like fertilizer
- Kitty litter
- Ceramic glazed materials
- Aircraft parts and counter weights
- Polishing compounds and abrasives
- Propane tanks
- Road salt
- Welding rods
- Camera lenses
- Ore and rock
- Smoke detectors
- Televisions
- Medical radioisotopes

# Alarm Data From Three Border Crossings

| Source Material | Location A % of Identified Alarms | Location B % of Identified Alarms | Location C % of Identified Alarms |
|---|---|---|---|
| Kitty litter | 34% | 25% | - |
| Medical (In, I, Tc, Tl) | 16% | - | - |
| Abrasives/Scouring pads | 14% | 5% | - |
| Refractory material | 8% | - | - |
| Mica | 5% | - | - |
| Fertilizer/Potash | 5% | 13% | - |
| Granite/Marble slabs | 4% | - | 10% |
| Ceramics/Tile/Toilets | 4% | 9% | 28% |
| Trucks/cars | 2% | - | - |
| Aluminum | - | 15% | - |
| Earth | - | 11% | - |
| Bentonite | - | 5% | - |
| Salt | - | 5% | - |
| Other metal | - | 3% | - |
| Televisions | - | - | 27% |
| Gas Tankers | - | - | 13% |
| Smoke Detectors | - | - | 4% |
| Other | 6% | 9% | 18% |

# Current Scanning Issues

- Primary Scanning
  - High nuisance (gamma) alarm rate in cargo scanning – NORM
  - Spectroscopic information useful
    - Energy windowing for current PVT
    - Spectroscopic portals
- Secondary Scanning
  - Handheld radiation isotope identifiers (RIIDs) are challenging to use in some environments (reaching high enough on containers, larger enough crystal)
  - Spectroscopic RPM systems can provide large detector size and vertical coverage

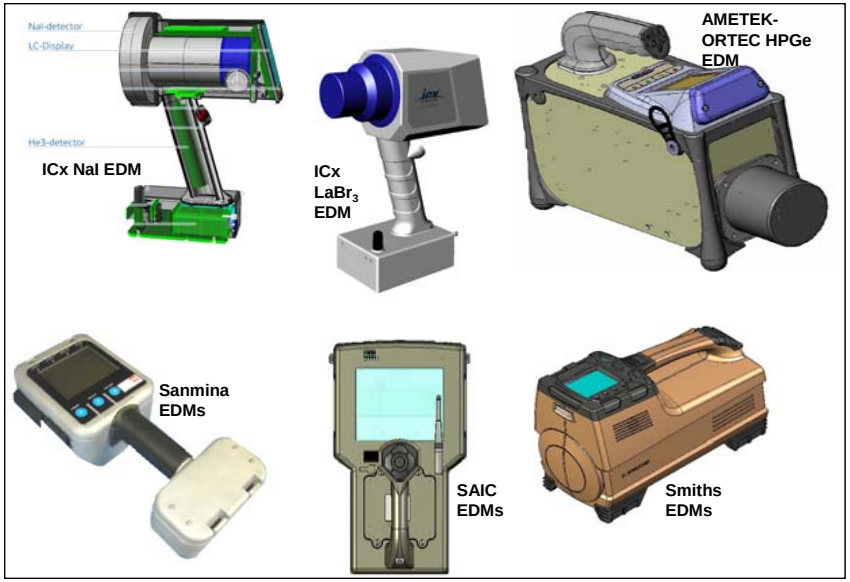
# DNDO Advanced Spectroscopic Portal (ASP) Program

- Three Vendors Developing Systems
  - Thermo Fisher Scientific
  - Raytheon (with Bubble Technologies Industries)
  - Canberra
- Limited-Rate Initial Production (LRIP) Systems
  - Currently undergoing testing for DHS certification
    - System Qualification Testing
    - Performance Testing
    - Integration and Field Validation
    - Operational Testing
- Deployment of ASPs will be Phased in
  - Secondary locations
  - High volume primary
- PVT-Based Systems will Continue to be Deployed

# DNDO – Near to Mid-Term Technologies

- **Joint Integrated Non-Intrusive Inspection (JINII)**
  - Perform as well as current non-intrusive imaging systems for detecting traditional contraband without impeding the flow of commerce
  - Automatically detect small (volume > 100 cm3), very dense (Z > 72) objects in containerized cargo
  - Increase penetration capability to 16 inches of steel

- **Human Portable Radiation Detection System (HPRDS)**
  - Improve the identification capabilities of human portable systems so they can distinguish between threat and non-threat material quicker and with greater accuracy
  - Reduce the weight of units so they are less burdensome to use

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# Summary

- Brief overview of radiation detection for homeland security
- RPMP at PNNL has deployed many RPMs in CBP environments
- DNDO has initiated many programs to attack various aspects of the task
- Many challenges and opportunities to providing adequate coverage