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Monitoring Official Ports of Entry

Global Security Programs (GSP)
Sandia National Laboratories

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Core Capabilities and Objectives at Ports of Entry

Identify people and goods approaching the ports of entry.
To assess risk, determine admissibility, or take law enforcement actions, agents must know the real identity of incoming people and the true nature of the goods.

Assess the risk level of people / goods intending to cross through the ports of entry.
Determining a level of risk allows POE decision-makers and front-line officers to focus their attention on higher-risk targets.

Inspect all people and goods according to their assessed level of risk.
All people, goods, and conveyances should be consistently inspected at POEs, according to their assigned risk level.

Detect potential threats and inadmissible people and goods.
At the POEs, inspections should detect dangerous goods and illegal individuals and initiate enforcement actions.

Enforce the law and take action against violators.
The primary mission is to enforce the laws and to prevent threats from entering the country.

Record events at the POEs, including findings and crossings.
The ability to retain and use information gathered is key to making good decisions at ports of entry.

Analyze results, at a micro and macro level, to address emerging threats.
To improve operations at POEs, agents must continually evaluate its activities from both a threat and performance perspective..

Deter potential violators from crossing or shipping goods through the ports of entry.
By continually improving the security and processes at the ports, discourages potential violators from attempting to cross through them.

Physical signatures of threats - objects

- Weapons
  - Magnetic
  - Weight
  - High density material
  - Shape and size (could be broken down into pieces)
  - Radiological signature (gamma rays, neutrons, heat)
- Bulk Explosives
  - Weight
  - Chemical emissions
  - Medium density material
  - Mass
- Ammunition
  - Weight
  - Shape
  - Chemical emissions (less than explosives)
  - High density material
- Drugs
  - Weight
  - Chemical emissions
  - Low density material

Improve ability to detect contraband at a port of entry

- Apply screening techniques for drivers and vehicles
  - Ask questions based on terrorist profiles to identify suspicious drivers
  - Weight scales to detect suspicious loads
  - All trucks larger than a certain size are directed to an inspection facility
- Inspection facility
  - Dedicated facility
  - X-ray screening of selected vehicles and packages
  - Tools to open packages
  - Hand-held chemical detection equipment

San Diego, California – Tijuana, Mexico port of entry

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Operational Concepts

- Probability of Detection = P_D
  - How likely are we to detect explosives?
- Limit of Detection
  - What is the smallest quantity that can be detected successfully?
- Throughput Rate
  - How many people/vehicles does the portal screen per unit of time?
  - Crucial at high-traffic areas such as airports (pedestrians) and border crossings (vehicles)
- Interference
  - What chemical compounds may mask explosives (false negatives) or indicate explosives are present when they are not (false positives)?
- Nuisance Alarms
  - When does the system alarm due to real explosive material from innocuous sources, e.g., a heart patient with nitroglycerine tablets?

Technical approach: Detection of explosives, drugs, weapons and radioactive material on pedestrians

Explosive/drugs sniffer detector

Explosive/Drug Detection Portal

Package Scanner

Radiation Detection Portal

Narcotics Identification Test Kit

Swipe for explosive and drug residue

Metal Detector

Hand-held Radiation Detector

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Metal Detectors

- **Portals**
  - Quick and effective
  - Doesn't detect all weapons
- **Handheld**
  - Scan any given area, anytime
  - Inexpensive
  - Time intensive

Metal detector for personnel or small package inspections

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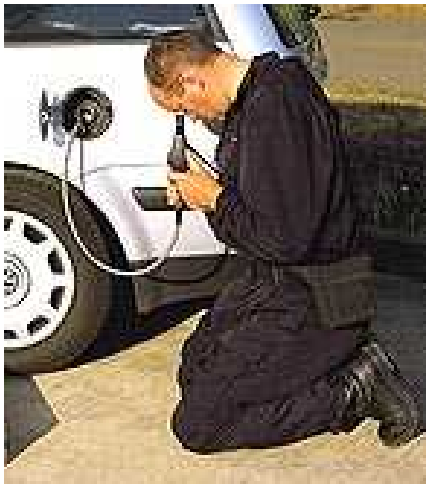
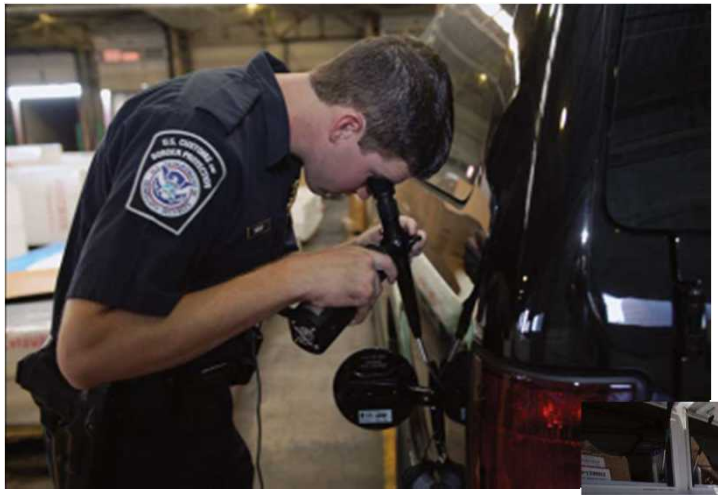
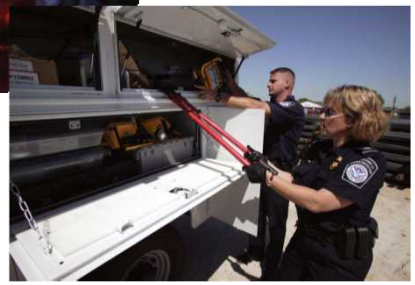
Inspection Tools







Fiber-optic tool to look inside enclosed spaces

Inspection Mirrors

Inspection Dogs

Hand Inspection

Trace Detection Using Swipe Technology

Sample collection from people or containers for explosive and drug residue

Smiths Detection IONScan 400 B

Narcotics identification

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Chemical sensors: detect explosives and drugs

Hound II with ITI
Vapor Tracer

Smiths Detection
Sabre 2000

- Detectors use gaseous samples
- Samples can be from people, cargo, or the vehicle itself
- Current gaseous detectors are hand-held
- Gaseous sampling of entire vehicles is not currently available but is under development

Trace Detection: A Personnel Portal

- Nozzles briefly puff the subject (½ s)
- Puffs dislodge particles
- Particles or vapor get entrained in ceiling-to floor air flow and into air vent
- The air flows through a pre-concentrator that collects the explosives vapor and particles
- The sample is heated, releasing the explosives into the detector

Smiths Detection Sentinel

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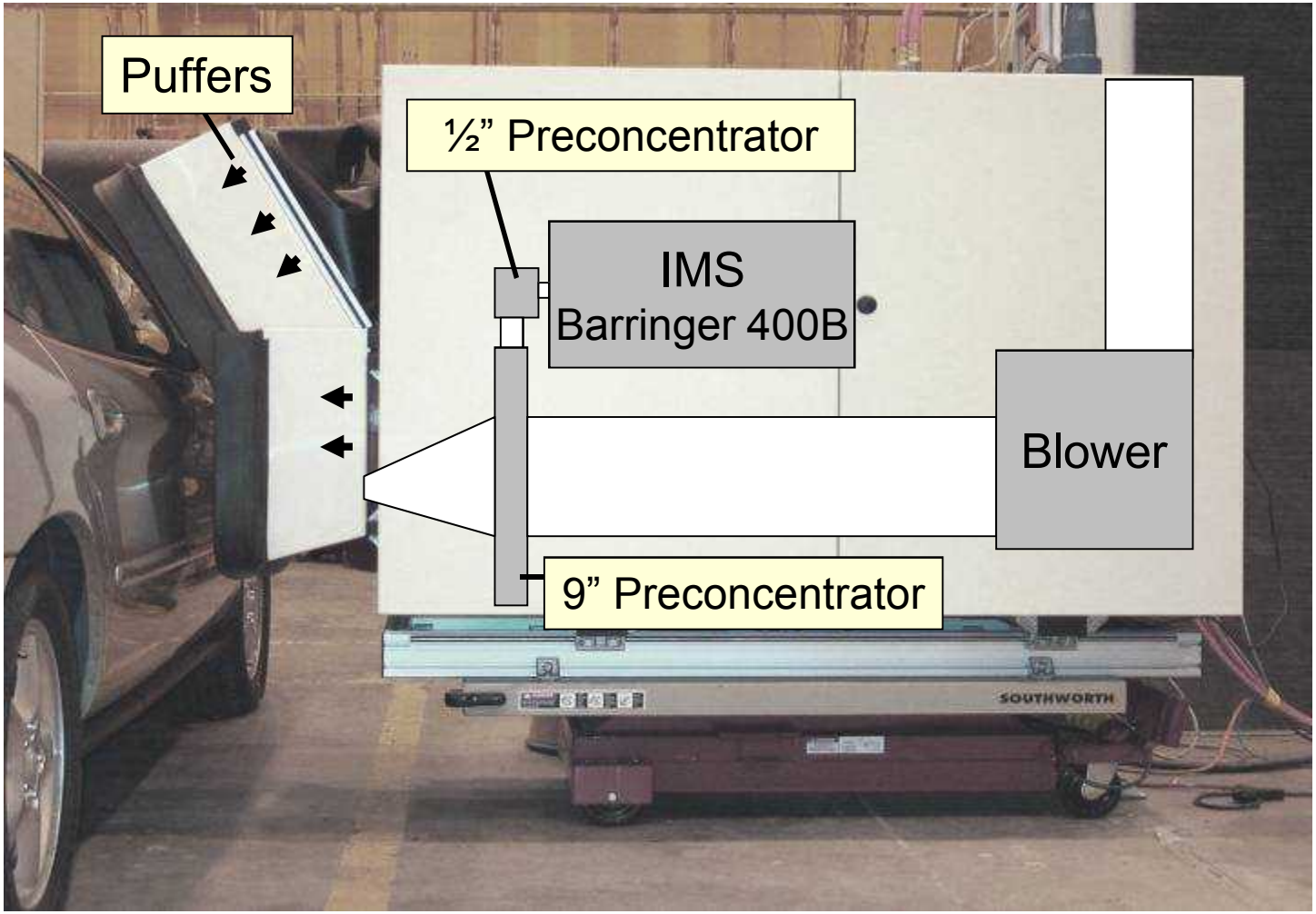
Trace Detection: Vehicle Portals

- Applications for “checkpoint” vehicle inspections at borders, military facilities, embassies, etc.
- The experimental system dislodges particles, collects them, and analyzes them for explosive compounds

The portal system with side panels installed



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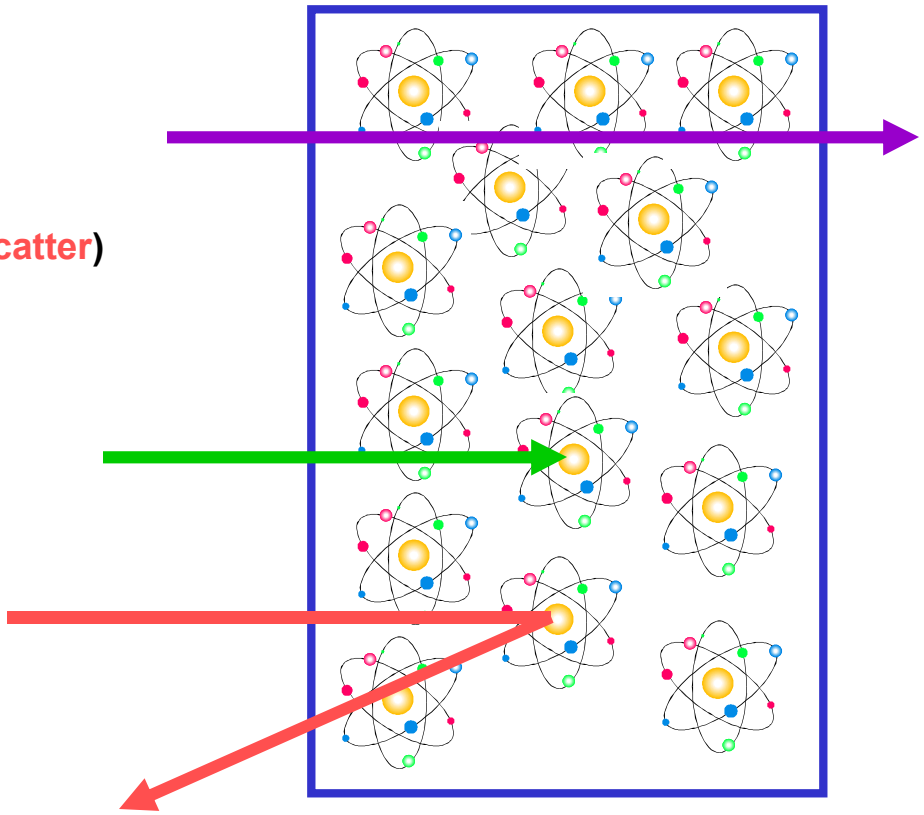
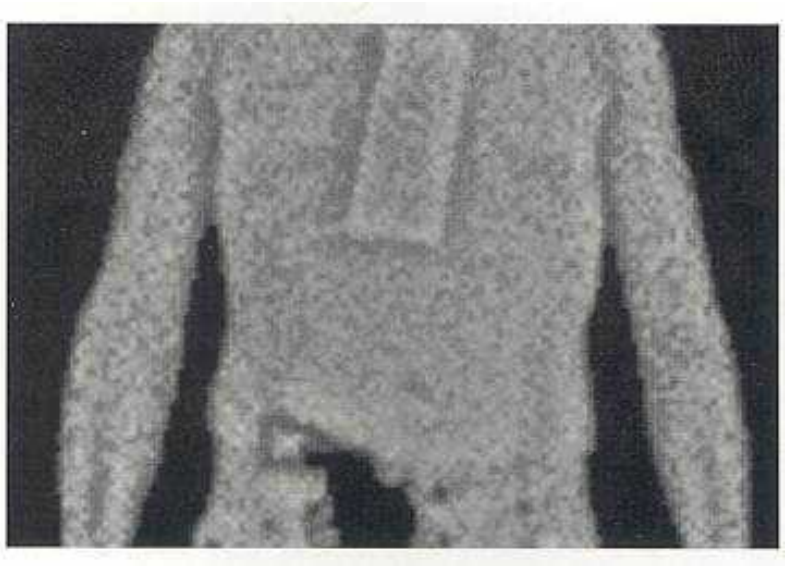
Bulk Detection Systems: How X-Rays Interact with Matter

- When directed at a subject material, X-rays may:
  - Continue through material (transmission)
  - Be absorbed
  - Be redirected back (backscatter)



X-ray Imaging of People

- X-ray backscatter imaging
- Detects dynamite, C-4, and detasheet (and other contraband)
- 3-second scan (front and behind)
- Operator examines image to determine if contraband is present
- Software to deal with privacy issues



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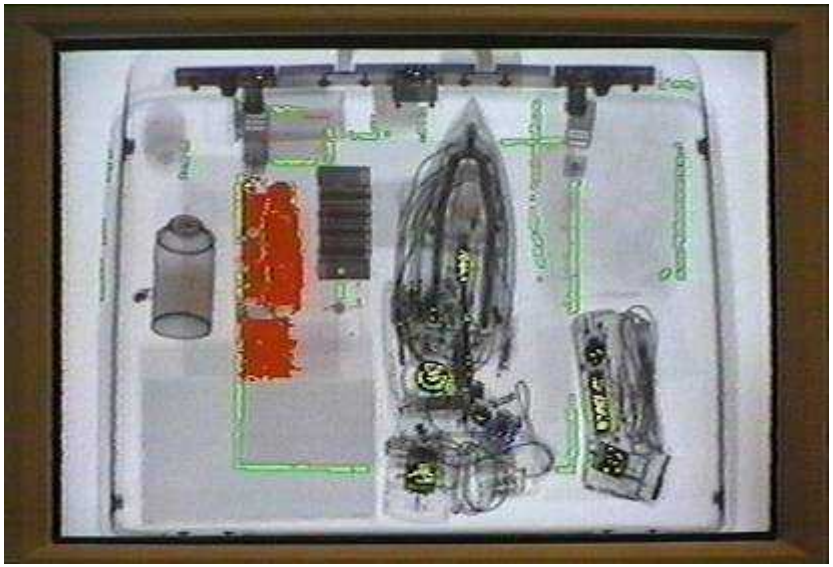
Using a Millimeter Wave Detection

X-Ray Imaging of Packages

An image of the interrogated object is formed based on transmitted or back-scattered rays.

Dual Energy Transmission Device and Output



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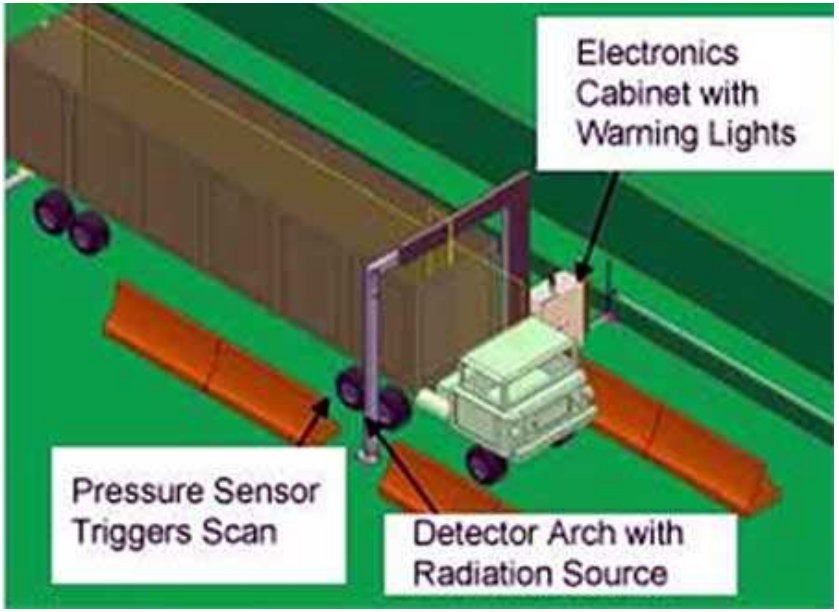
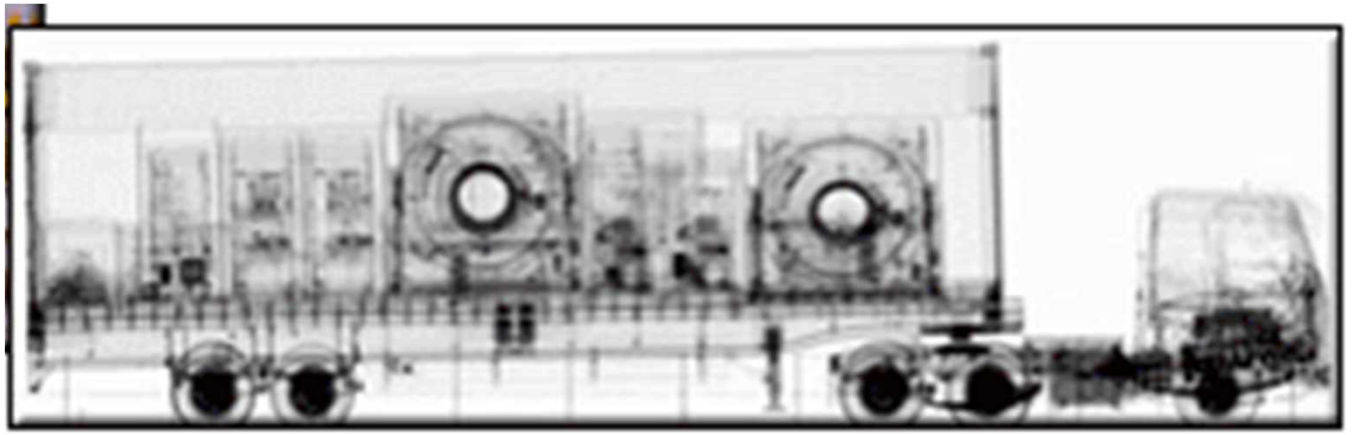
X-Ray Inspection of Trucks – Fixed Location





Note: radioactive source requires security protection

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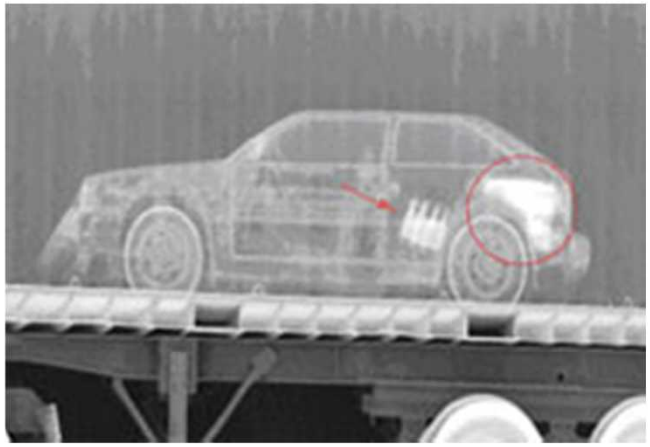
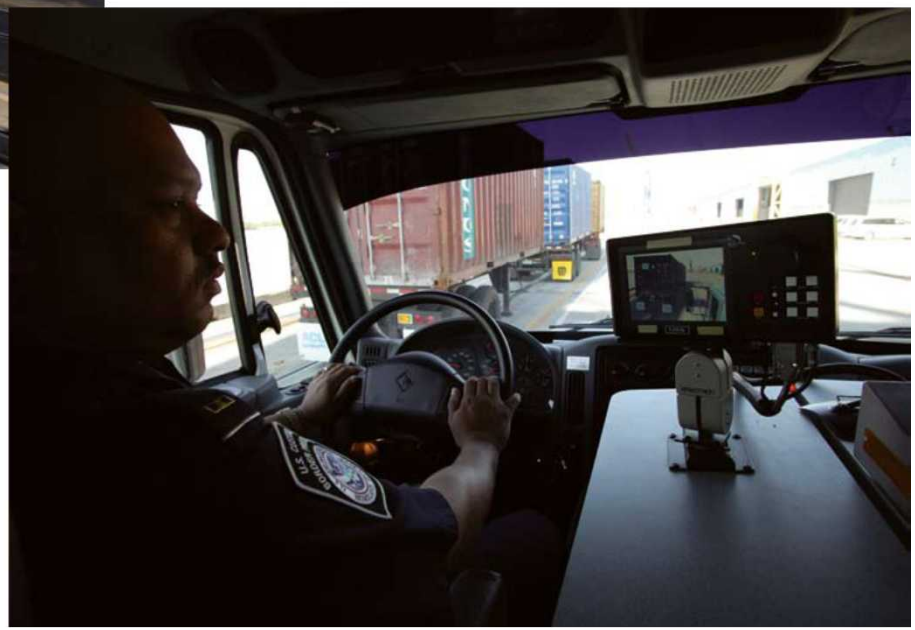
X-Ray Portals for Vehicles

- **AS&E (American Science and Engineering, Inc.) CargoSearch™**
  - **Designed to help U.S. Customs' agents inspect difficult cargoes, e.g., tanks on trucks**
  - **Uses both conventional transmission images and backscatter images of objects**
  - **Identifies organic contraband (drugs, explosives, people) and metallic objects such as guns**

X-Ray Inspection of Trucks – Mobile Location





- Vehicles provide power for mobile systems
- Interpretation of images requires training

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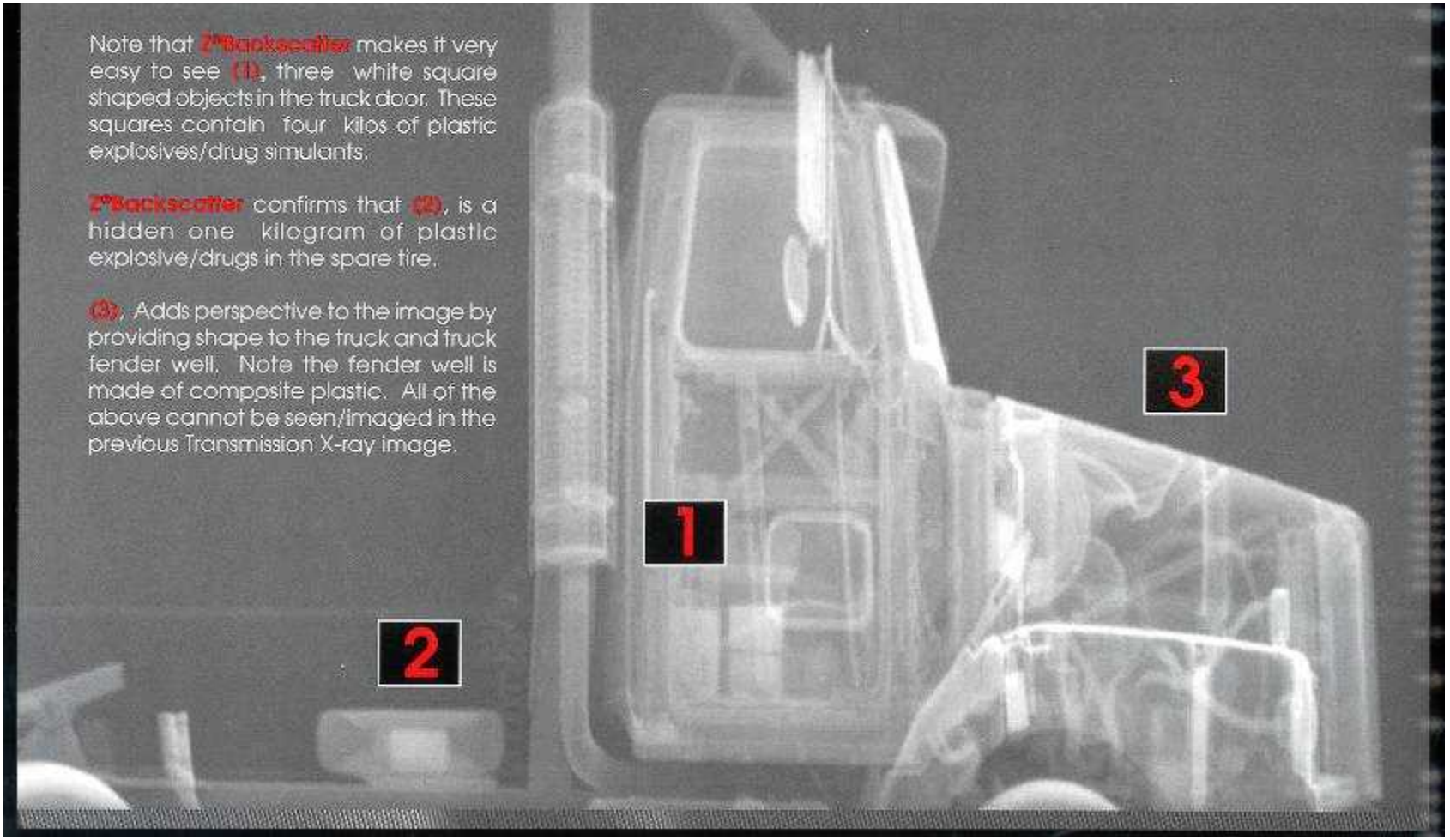
Example of a Vehicle X-ray Image



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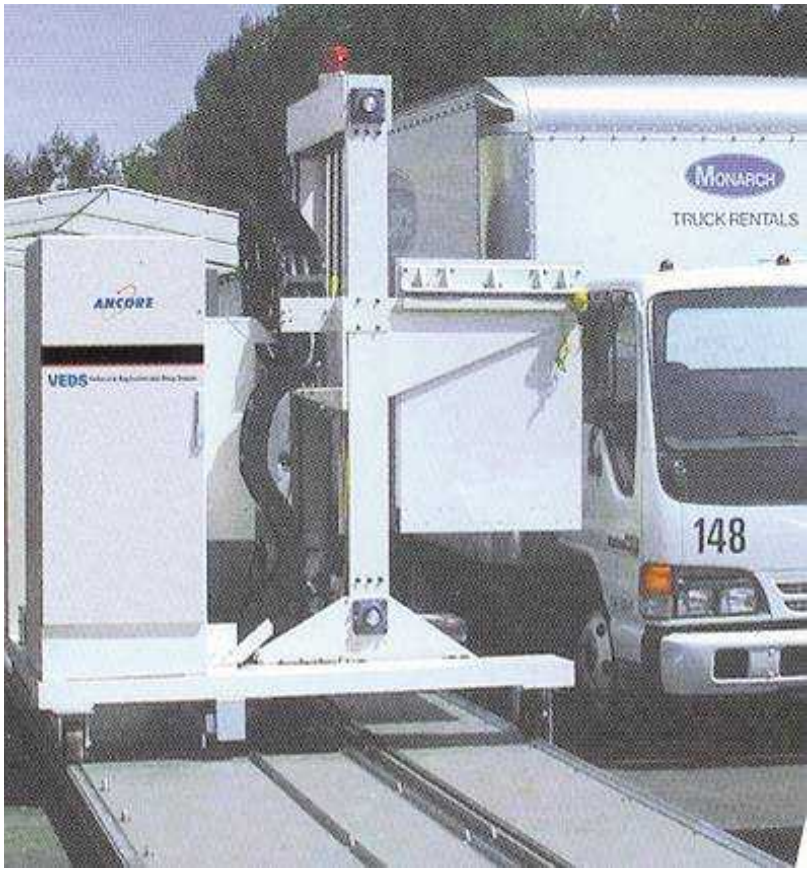
Bulk Detection: Neutron-based analysis

- System sends a stream of neutrons into a vehicle or container
  - Many elements can be detected with neutrons
  - Results in a 3-dimensional image
  - High cost system
- Cargo Inspector (Stationary)
  - Throughput rate of 20 trucks per hour
  - Does not require unloading of cargo, but people must exit
- Vehicular Explosive and Drug Sensor (Mobile)
  - Can be moved to a particular site



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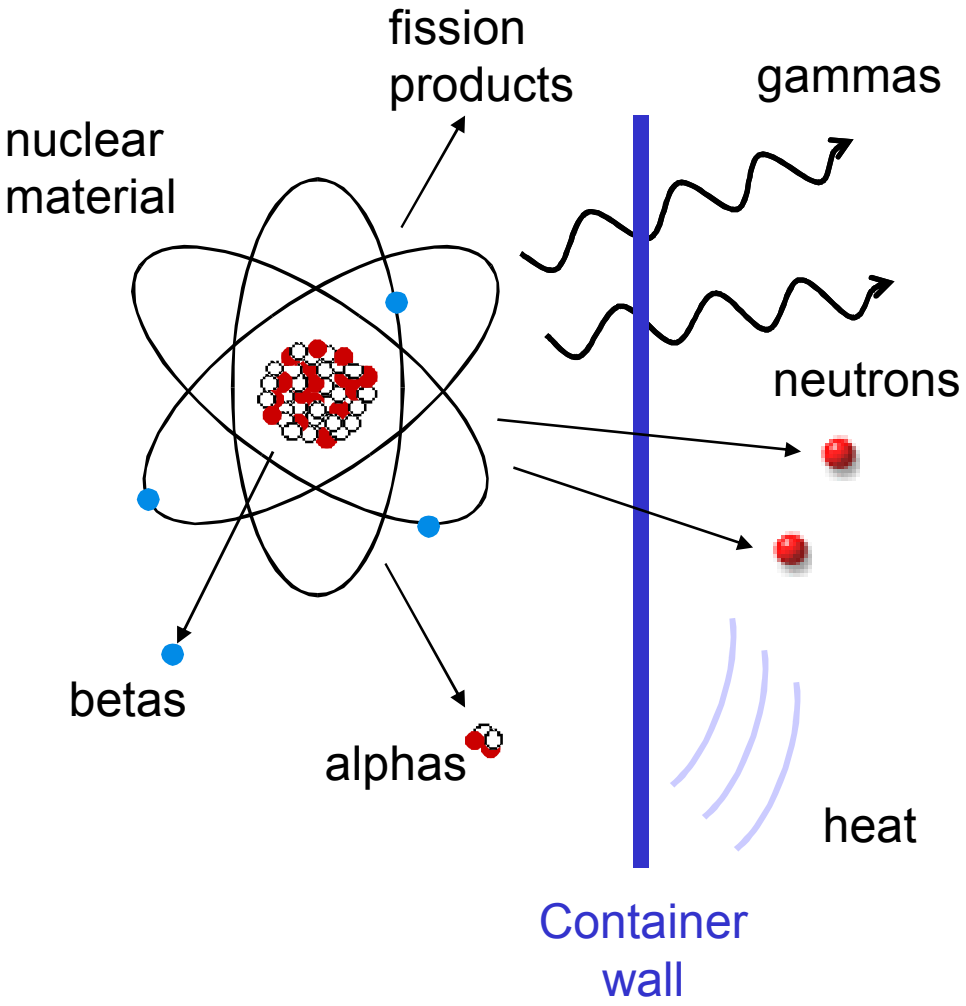
Review of Explosive Detection Screening Methods

	Pros	Cons
Canine	• May be quickest and most reliable now available • Works for any explosive (in principle) • Low purchase cost	• No 24 hr/day operation; poor for busy checkpoints • Labor intensive • Day-to-day performance varies
Physical Search	• Low equipment costs • Low-tech; only need guards • Fewer technical problems than with other techniques	• Very slow • Superficial, unless you really tear items apart • High labor costs
X-ray	• Gives image • Can be automated (CT) • 24 hr/day operation	• Expensive (up to $1M) • Radiation hazard • Rather slow (5-10 sec/item) • Conventional x-ray not specific
Trace	• Moderate ($50-100k) cost; detects trace amounts • 24 hr/day operation	• Fairly slow (sample collection) • No automation
Nuclear	• Now becoming available • Cost is less than x-ray (but still high - $750k) • Some material specificity	• Speed, cost not what we'd like • Still in development • Some materials (e.g., fertilizers) may give false alarm • Radiation hazard

Radiation Detection can be a Component of Border Monitoring

- Radioactive material dispersal devices pose a possible threat
- Use nuclear monitoring at portals
  - monitor traffic passing through fixed chokepoints
  - wide-area monitoring is not generally practical
- Control the traffic through the portal
  - Type
    - Pedestrians
    - Vehicles (car, truck, train)
    - Cargo/ freight, luggage, etc.
  - Number
    - One at a time
  - Time / speed
    - Wait-in portals
    - Pass-through portals
- Enlist complementary measures
  - Look for evidence of potential radiation shielding by using weight sensors
  - Use both gamma and neutron detection

Nuclear materials emit neutron and gamma radiation, which can be monitored readily



The *type* and *intensity* of the radiation can reveal precisely what nuclear material and how much of it is present. It is a *"signature"* of the nuclear material.

Emission is affected by other elements present, which may give rise to *secondary radiation.*

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Hand-held monitors

- Use is time consuming
- Operator must be trained
- Useful for follow-up:
  - Localize the source
  - Identify isotopes

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Radiation Detection Portals for People

Commercial example:
TSA Systems PM-700

- **Detectors:**
  - **plastic detectors in each pillar**
- **Sensitivity:**
  - **Highly Enriched Uranium: 3g**
  - **Plutonium: 0.08g**
- **False alarm rate:**
  - **less than 1:1000**
- **A similar model adds neutron detection:**
  - **Can detect 120g ^{239}Pu that is 99% shielded**

Radiation Detection Portals for Vehicles

- More difficult detection problem
  - Larger portal: greater source-detector distance
  - Need to account for shielding by vehicle structure and other contents

- Detectors are above and below the portal, as well as in the side pillars

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Summary

- There are many types of monitoring sensors
- The best one to use depends on
  - Type of activity you are trying to detect
  - The operating environment
- A systematic design process can select the best types and configuration of sensors for a specific mission