Office of Counterterrorism and Counterproliferation
Nuclear Incident Policy and Cooperation

International Radiological/Nuclear Training for Emergency Response - Major Public Events Virtual Workshop

U.S. Department of Energy, National Nuclear Security Administration
Office of Nuclear Incident Policy and Cooperation

Date 2022
Washington, D.C., U.S.A.



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Office of Counterterrorism and Counterproliferation
Nuclear Incident Policy and Cooperation

Workshop Overview

Day 1 Major Public Events Overview and Nuclear Security Threats

Day 2 Radiation Detection and Emergency Response Equipment

Day 3 Nuclear Security Planning and Operations

Day 4 Alarm Interdiction and Adjudication and Source Recovery

Monday – Thursday

09:00-11:00 Washington, DC Time

Office of Counterterrorism and Counterproliferation
Nuclear Incident Policy and Cooperation

Virtual Workshop Guidance

The chat box will be monitored for questions during presentations.

Please keep your microphone on mute. All microphones will be muted at the beginning and during presentations.

If not presenting, please turn off video to preserve bandwidth.

Questions?

Office of Counterterrorism and Counterproliferation

Nuclear Incident Policy and Cooperation

Major Public Event
Nuclear Security Operations

Objective

This module will provide a basic overview of radiological/nuclear search operations, including the application of radiological detection instrumentation and best practices for operational tactics, techniques and procedures.

Goals

This module will introduce basic radiological/nuclear search operations and include the following:

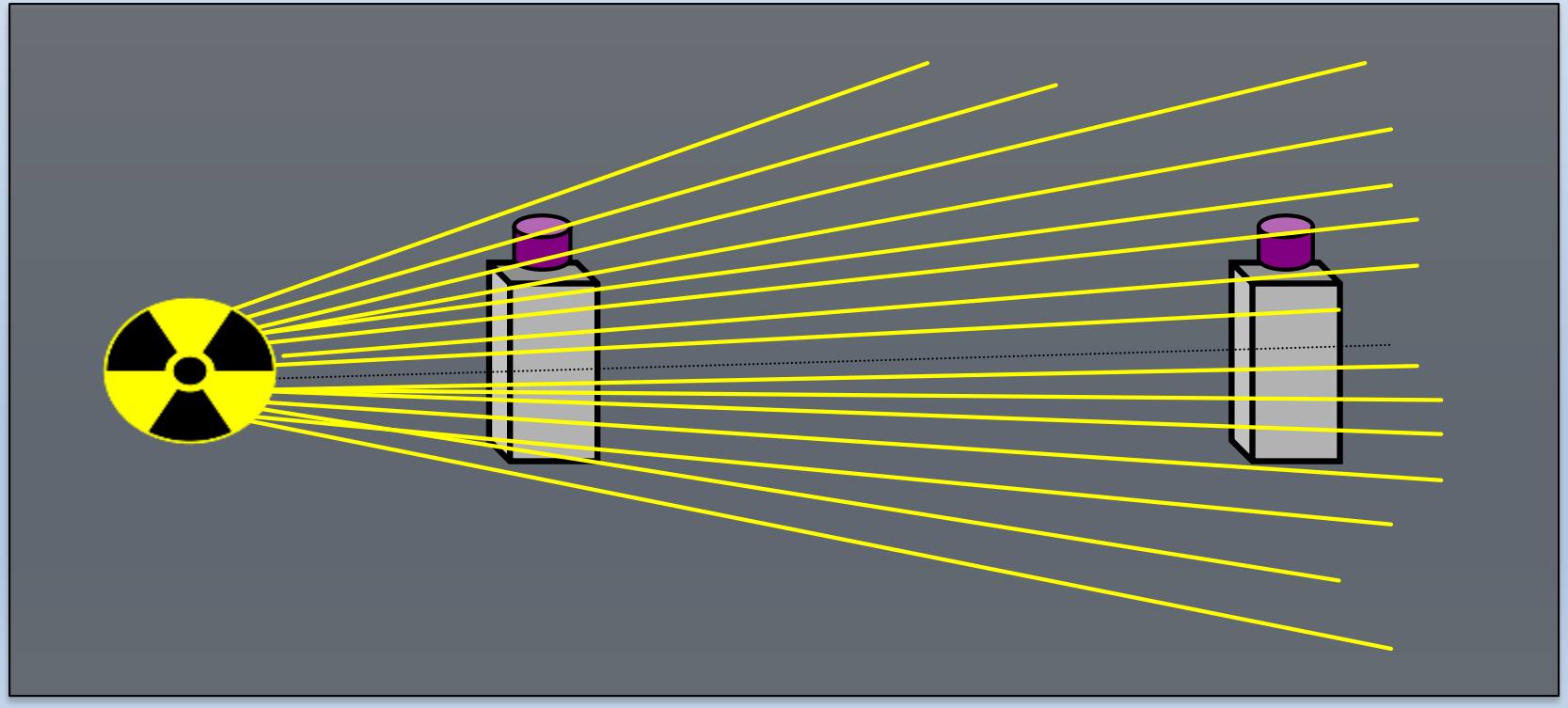
- Review the principles of optimizing detection
- Understand radiation hazards and alarms
- Examine nuclear security measures best practices for:
  - Buildings and stadium complexes
  - Large areas, roadways and parking areas
  - Pedestrian and vehicle entrance portals

What is Radiological/Nuclear Search?

- Definition: Radiological/Nuclear (RN) search is the process of locating specific materials or devices that could create a radiological exposure health hazard, cause radioactive contamination, or result in a radiological/nuclear incident.

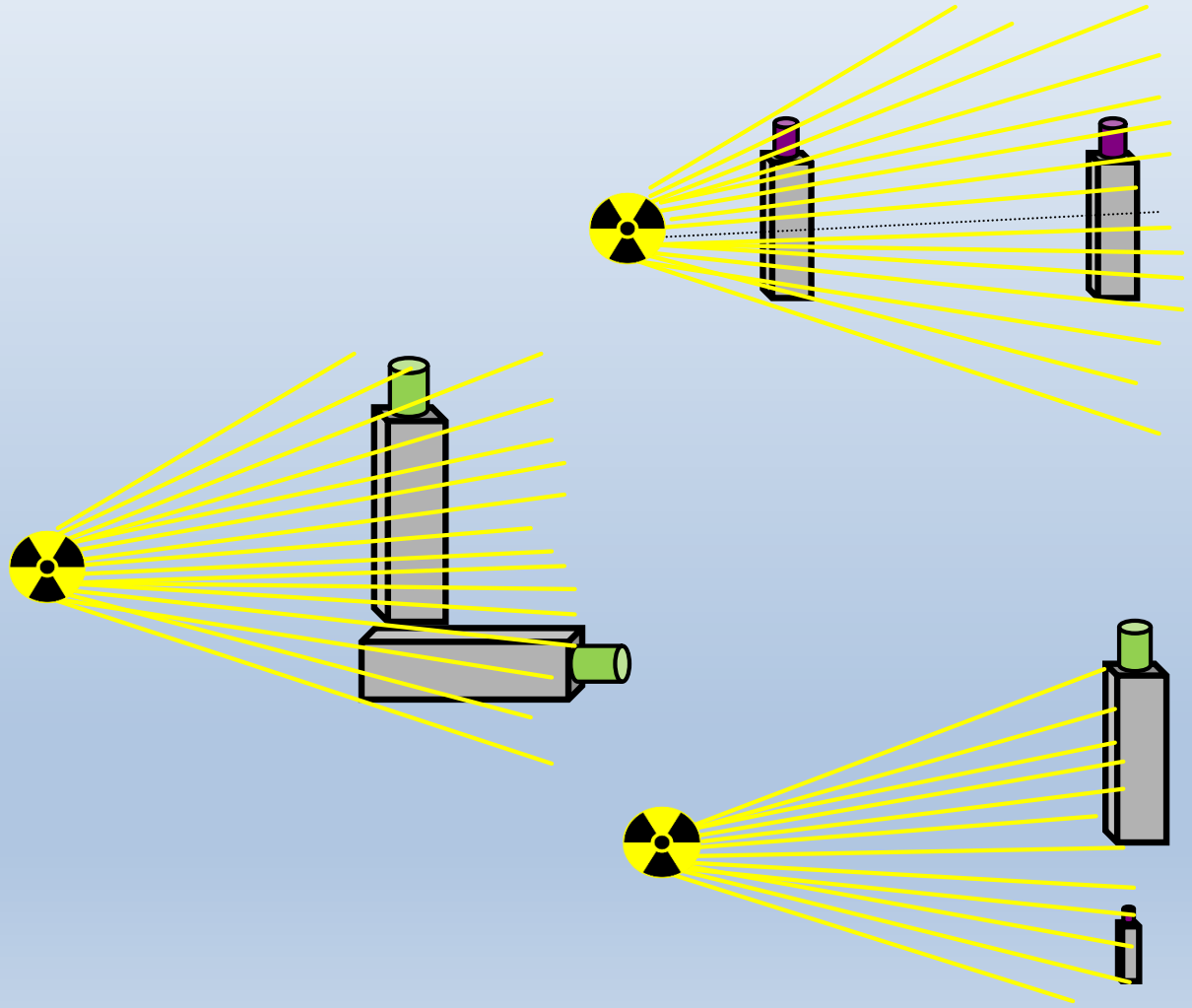
- A radiological/nuclear search may be required to support the following incidents:
  - Lost or stolen source
  - Terrorist threat
  - Intelligence information
  - Law enforcement investigation
  - Environmental concern
  - Material out of regulatory control
  - **Nuclear security at a Major Public Event**

Principles of Optimizing Radiation Detection



Factors that Affect Detection

- Time
- Distance
- Shielding
- Geometry
- Detector Size



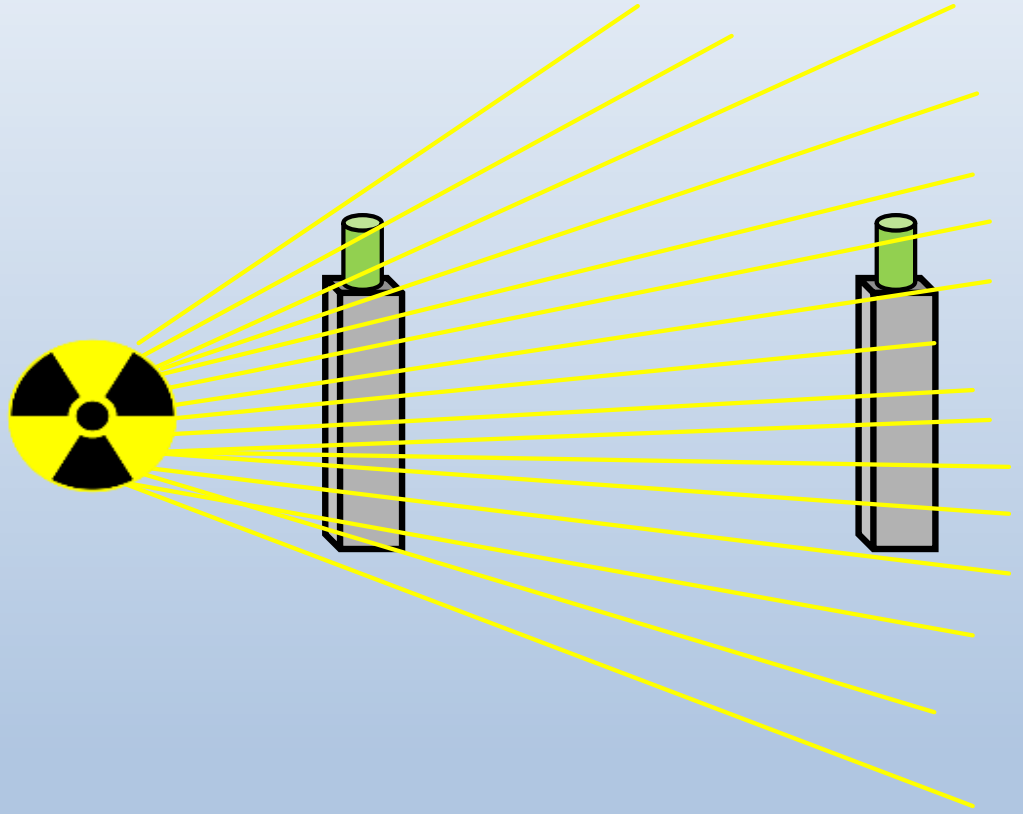
Principle Factor 1 - Time

- ***Time***
- Distance
- Shielding
- Geometry
- Detector Area

- The longer a detector can detect a source, the more sensitive and accurate the measurement
- Sensitivity is influenced by:
  - Relative speed of detector and source activity
  - Distance
  - Shielding
  - Geometry
  - Detector Area

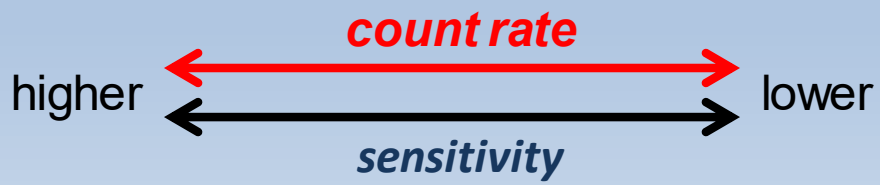
Principle Factor 2 - Distance

- Time
- ***Distance***
- Shielding
- Geometry
- Detector Area



The closer the detector is to the source, the higher the count rate and sensitivity

As the distance from detector to source increases, the count rate decreases, lowering sensitivity

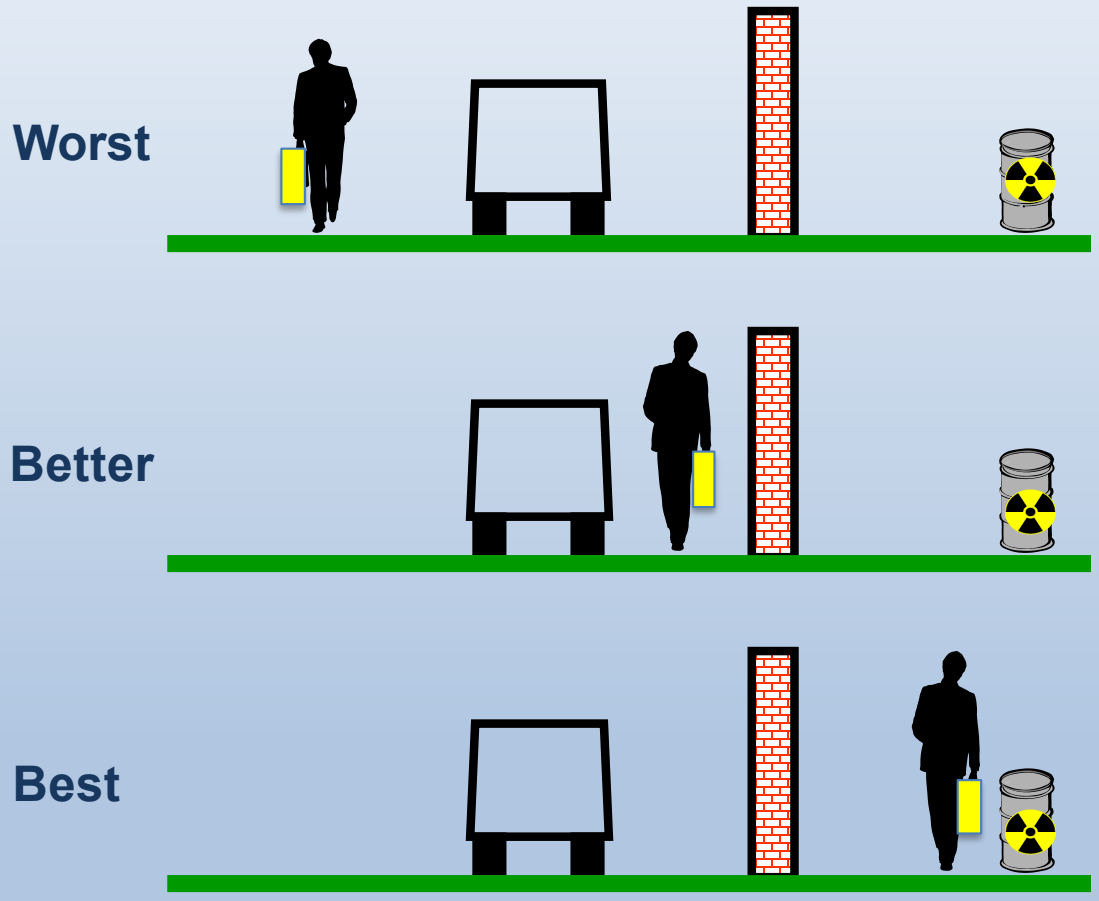


Principle Factor 3 - Shielding

- Time
- Distance
- ***Shielding***
- Geometry
- Detector Area

Minimize shielding between the detector and source for highest sensitivity

Even shielding by your body can lower sensitivity

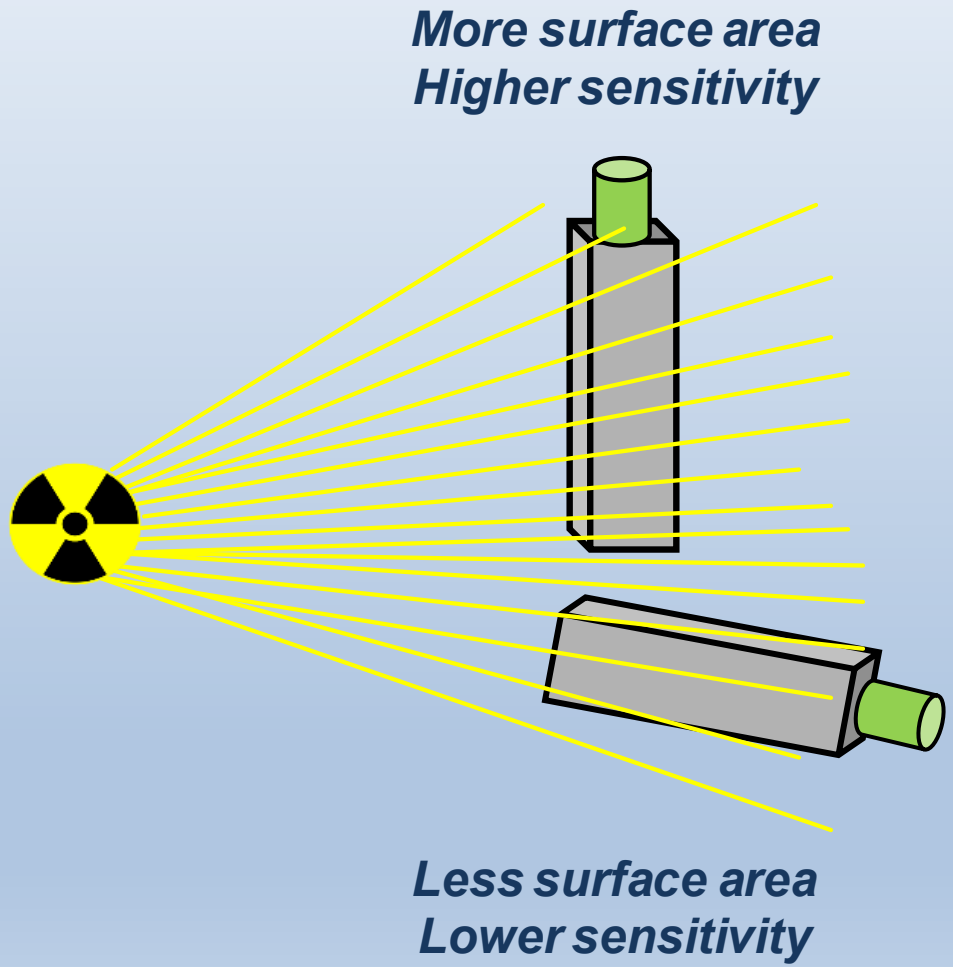


Principle Factor 4 - Geometry

- Time
- Distance
- Shielding
- ***Geometry***
- Detector Area

The more detector area facing the source, the higher the sensitivity

The detector to source orientation or geometry is very important to sensitivity and detection



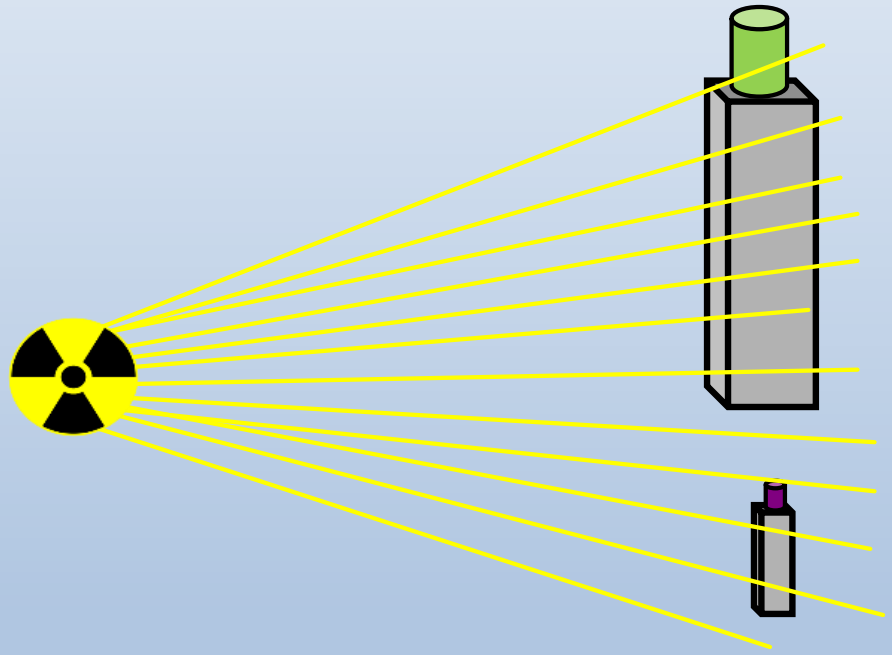
Principle Factor 5 – Detector Area

- Time
- Distance
- Shielding
- Geometry
- ***Detector Area***

A large detector (with more surface area facing the source) has more sensitivity

Important to maximize detector surface area facing the source when detecting from long distances (vehicles and aircraft)

Larger size
Higher sensitivity



Smaller size
Lower sensitivity

Polling Survey and Discussion

Question 1 (2 minutes)

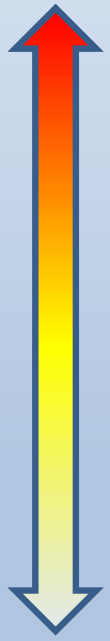
What are the 5 principle factors that affect optimizing the detection efficiency?

Enter your answer in the chat box

What is the Threat?

A lost or stolen industrial source is the most likely concern for a radiological threat

Most likely



Least likely

Industrial: Cs-137, Co-60, Ir-192, Sr-90, Ra-226	***Medium to high activities***
Medical: Tc-99m, Tl-201, Ga-67, I-123, I-125 I-131, In-111, Cs-137, Co-60, Ir-192	***Low activities***
Naturally Occurring Radioactive Materials (NORM): K-40, U-238, Th-232 and decay products	***Very low activities***
Special Nuclear Materials (SNM): U-235, Pu-239, U-233	***Very hard to acquire***

Industrial/Medical Sources

High activity Cs-137, Ir-192, and Co-60 radiation sources are routinely used in industry

Radiography Camera

Activity from 750–3700 GBq (20–100 Ci)

Dangerous - Out of shield > 0.5 Sv/h (50 R/h) at 1 m

Gamma Irradiator

Activity from 3700–37000 GBq (100–1000 Ci)

Dangerous - Out of shield > 1 Sv/h (100 R/h) at 1 m

Tele-therapy Unit

Activity exceeding 220,000 GBq (6000 Ci)

Dangerous - Out of shield > 1 Sv/h (100 R/h) at 1 m

What do you expect to find?

During a search, expect to respond to several alarms caused by "real" radioactive materials

On people or handbags

- Medical treatments
- Radium watch
- Pacemaker
- Camera lenses
- Jewelry/gemstones

At building complexes

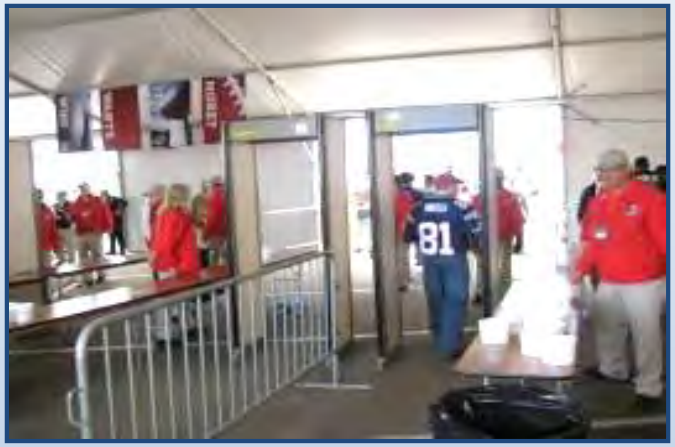
- Chemicals (pallet)
- Water softener (pallet)
- Granite/brick facade
- Porcelain/ceramics
- Smoke detectors

In delivery trucks

- Industrial gauges
- Food products
- Commercial products
- Laboratory sources
- Porcelain/ceramics

Concept of Operations

- **Pre-event Phase**
  - Background survey / sweeps of venues
  - Background survey / sweeps of roadways
  - Locate radiation hotspots and adjudicate
- **Main Event Phase**
  - Pedestrian portal monitoring
  - Vehicle portal monitoring
  - Alarm interdiction and adjudication
- **Response Phase**
  - Radiological search
  - Consequence management



Each phase of an MPE may have different requirements for detection instruments, training and expertise

Search Techniques for Buildings and Stadium Complexes

Stadium/Building Venue Search

A venue stadium or building baseline search may be required to clear it prior to the MPE Opening Ceremony

Stadium/Sports Venues

Building/Warehouse Venues

Typical Radiation Hotspots

During searches, all radiation hotspots should be located, identified and documented on all floor plans

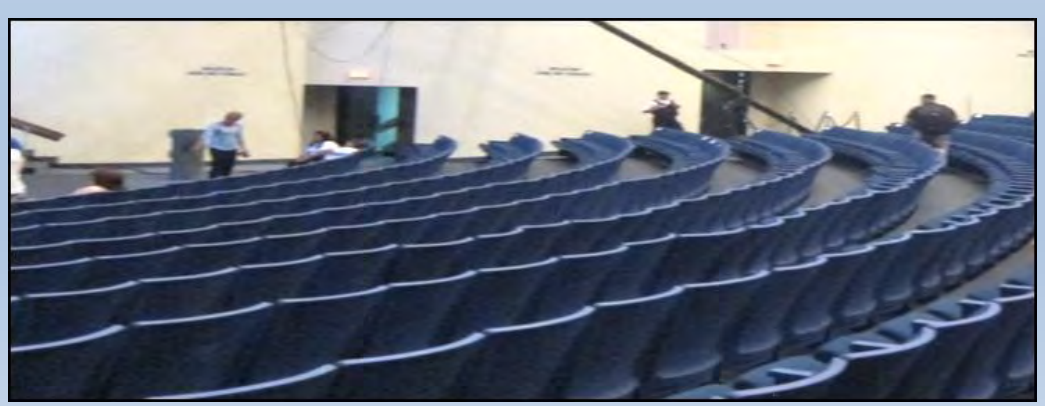
Examples of non-hazardous or benign radiation hotspots include:

- Building materials – ceramics, tiles, red brick, granite
- Industrial supplies – fertilizer, chemicals, water softeners
- Structures – tunnels, enclosed entrance ways, columns (mass effect)
- Surfaces – interfaces between grass, brick, asphalt

Materials used in these items can contain slightly elevated levels of Naturally Occurring Radioactive Materials (NORM) which is sufficient to cause an alarm in most detection instruments

Venue Search/Survey

Teams conduct baseline surveys of seating areas, conference halls, offices, vendor areas, walkways, storage areas and mechanical rooms



Backpack Search Detector

Backpack detectors provide a general, all-purpose tool for radiological search operations

High sensitivity, dual gamma/neutron backpack sensors can be used to search for radiation hotspots in a low profile, but deliberate manner

Interior Search Techniques

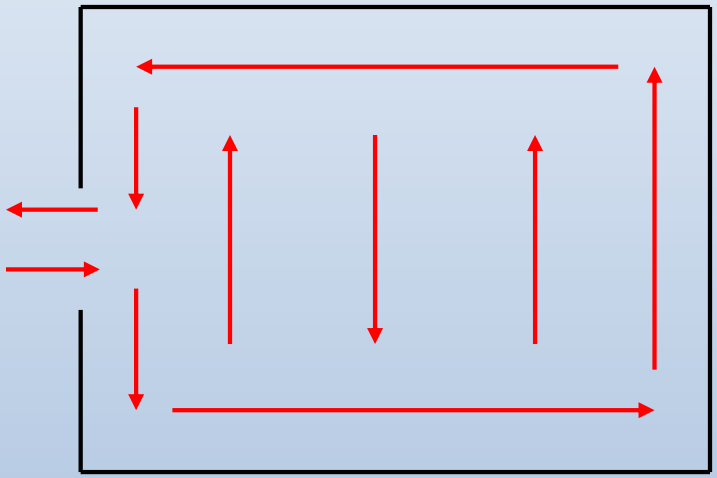
Internal Building

Areas of interest:

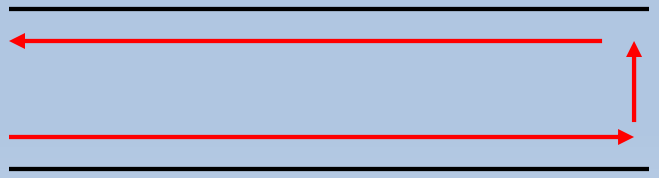
- Common areas
- Auditoriums/Halls
- Offices
- Hallways
- Stairwells
- Mechanical areas
- Storage closets

Technique:

- Walk close to walls, doors, desks, cabinets, etc.



Room Perimeter Search



Hallway Search

Exterior Search Techniques

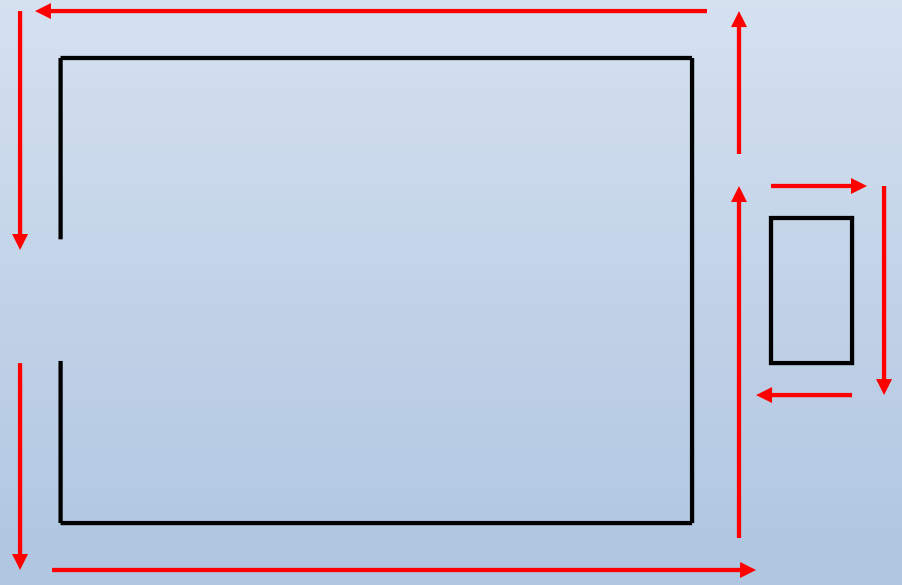
External Building

Areas of interest:

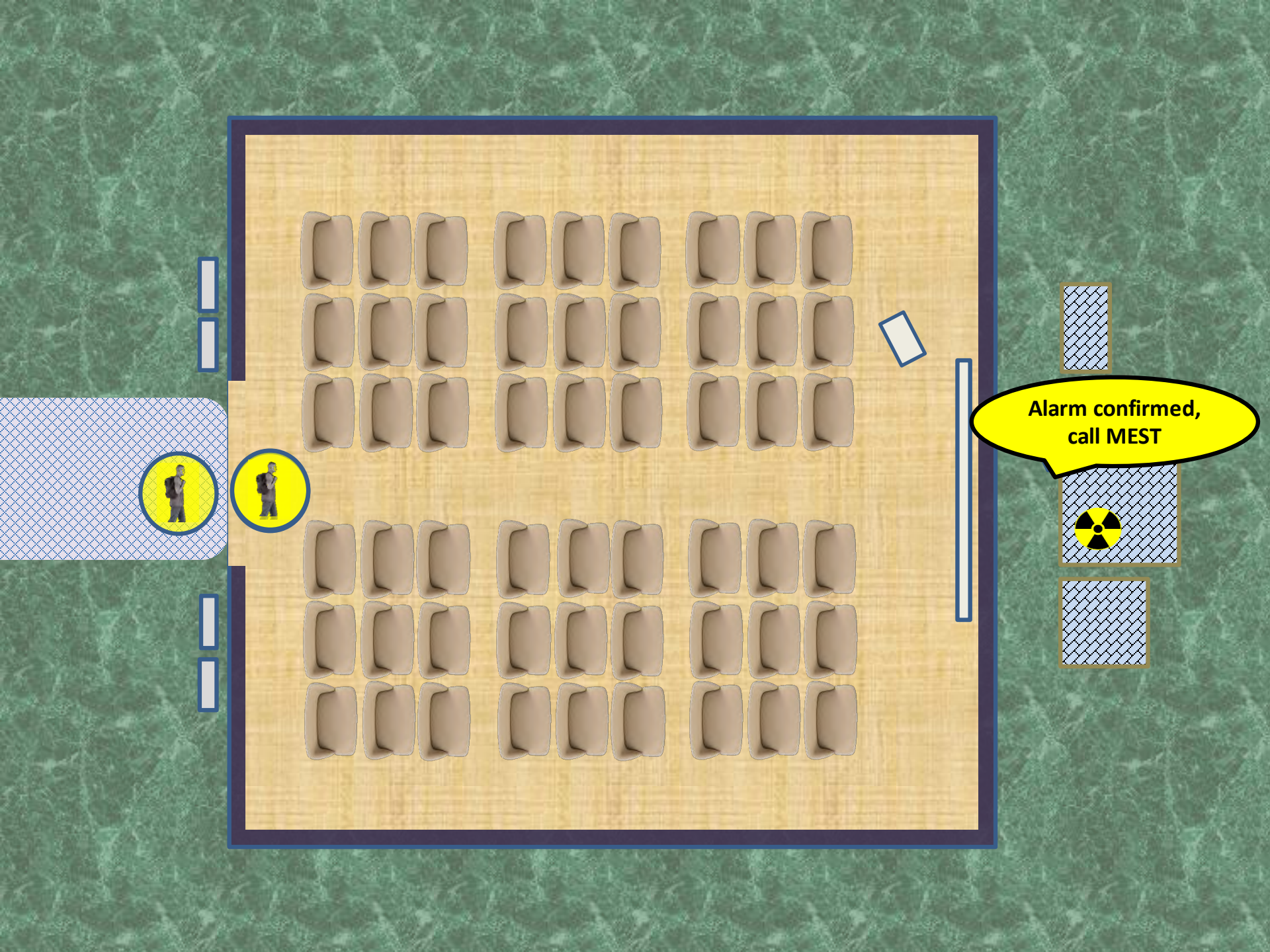
- Storage areas
- Trash cans
- Mailboxes
- Vegetation
- Mechanical areas

Technique:

Walk close to walls, doors, structures, containers, and vegetation



Building Perimeter Search


Alarm confirmed,
call MEST

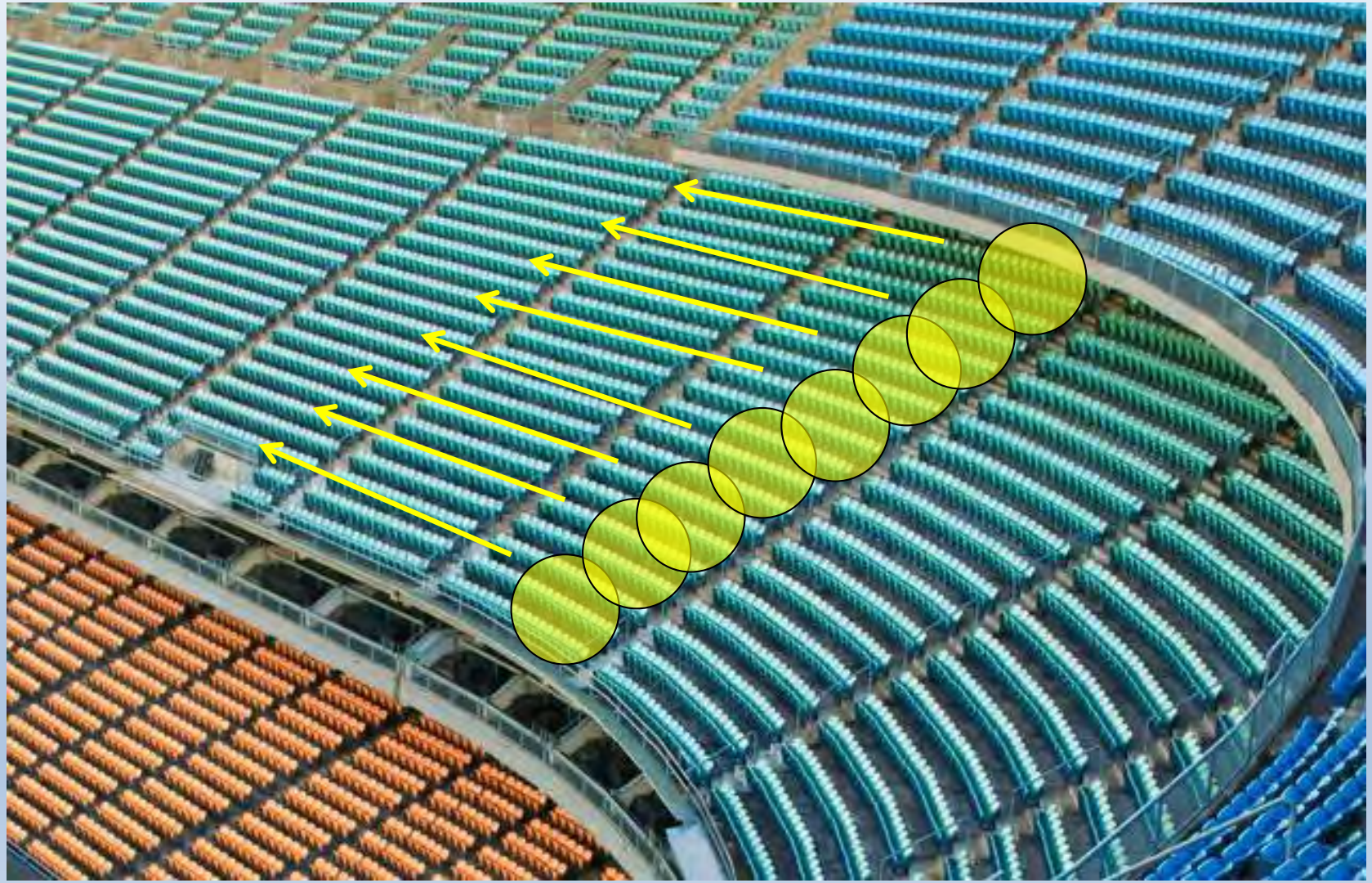
Search/Survey of Venues with Seating Areas

The search/survey of the seating area at a venue requires advanced planning and organization to ensure 100% coverage. Some best practices are shown in the following slides.

Venues with seating areas

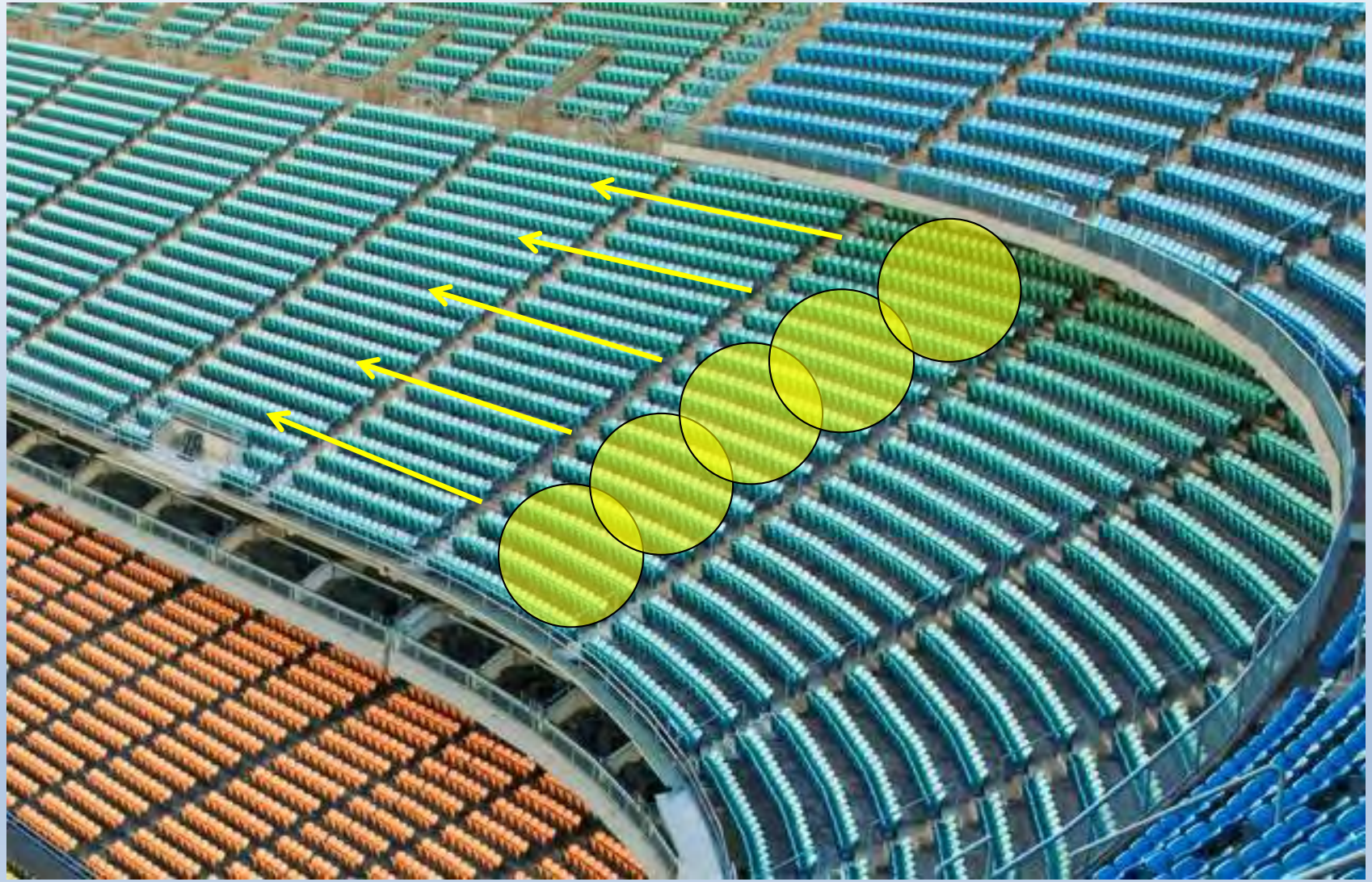
PRD Search of Seating Area

Small detector with low sensitivity, walk every 2nd row



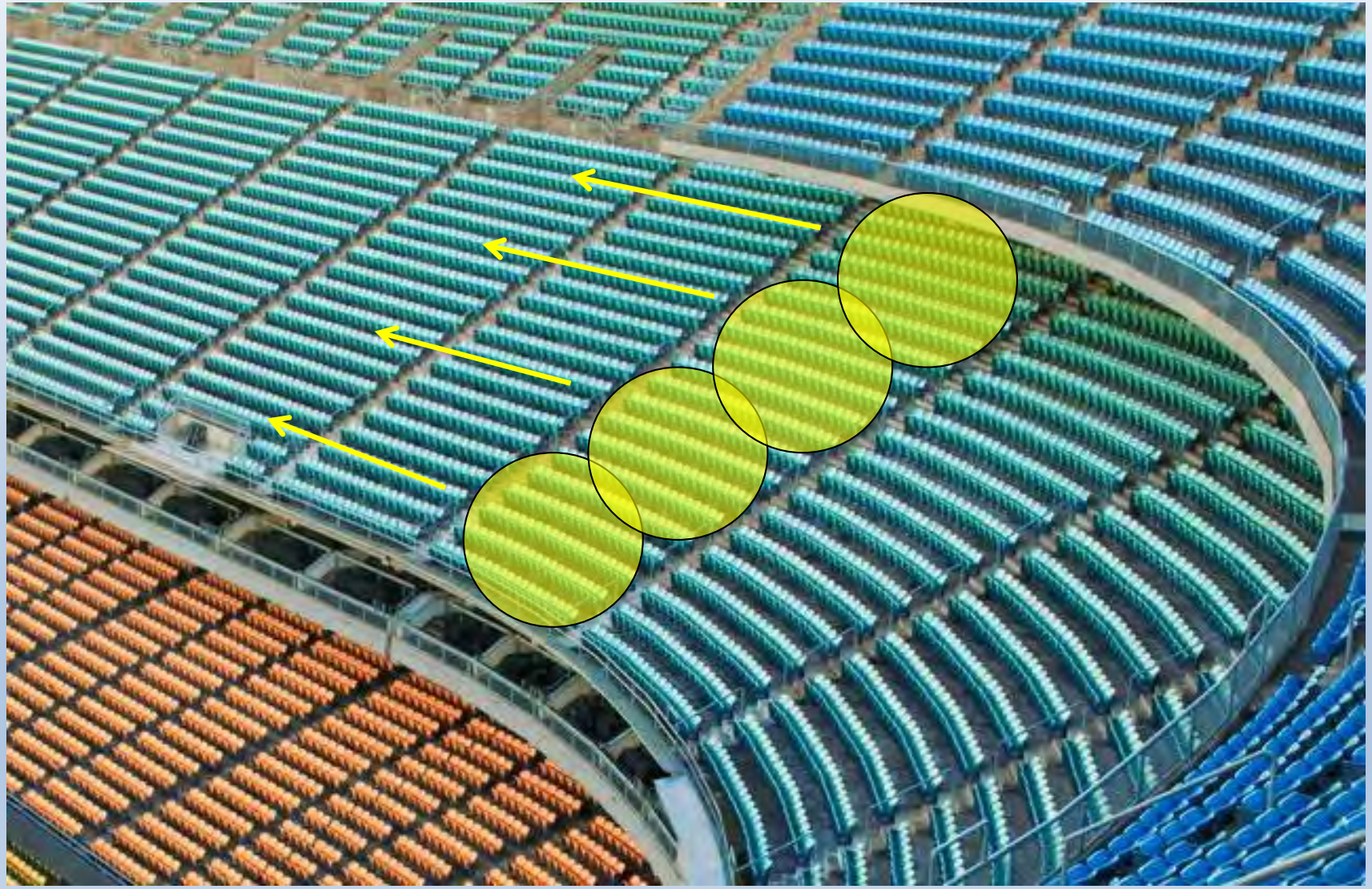
RIID Search of Seating Area

Medium detector with moderate sensitivity, walk every 3rd row



Backpack Search of Seating Area

Large detector with high sensitivity, walk every 4-5 rows



I'm going to confirm

Alarm confirmed, call MEST

Call to MEST – we got an alarm in Section 205 on a small box under a seat, area has been evacuated and secured, sending a picture

Polling Survey and Discussion

Question 2 (2 minutes)

Based on what you have learned so far, what are the primary challenges for conducting baseline searches of large building and stadium complexes?

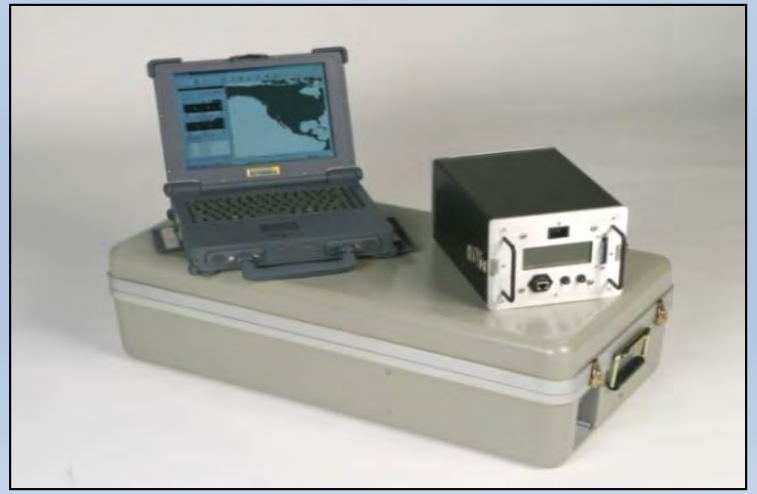
Enter your answer in the chat box

Roadway/Parking Area Search

Vehicle mounted search system

High sensitivity gamma modular detector system for roadways and parking area search

Real-time tracking via GPS and readily installed in vehicles, watercraft or aircraft



Parking Lot Search Techniques

Parking Lots and Garages

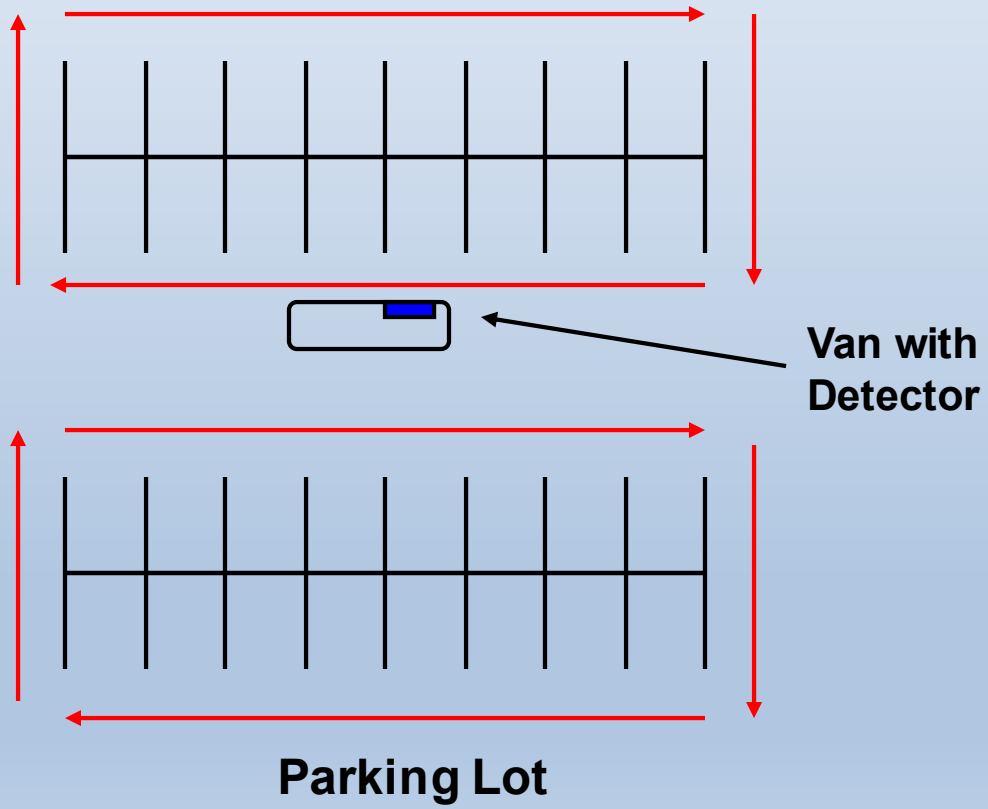
Areas of interest:

- Parking lots and garages
- Vendor parking
- Storage yards

Technique:

- Drive ~ 8 km/h (5 mph)
- Gamma detector on right side of vehicle closest to parked cars

Note: a car engine is an excellent shield for radiation



Street/Urban Search Techniques

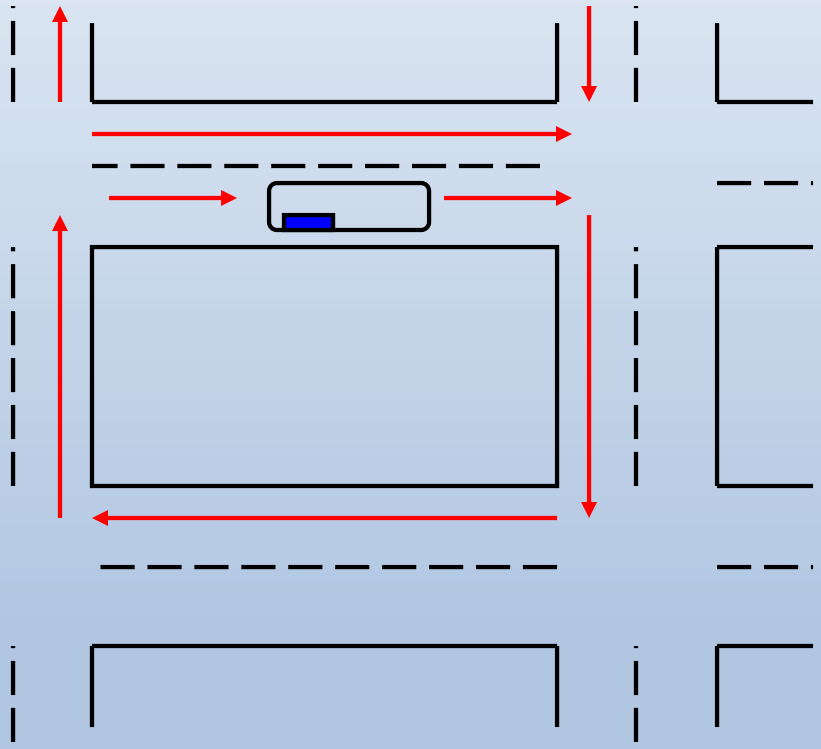
City Streets

Areas of interest:

- Parked cars and trucks
- Storage containers
- Vendor vehicles

Technique:

- Drive 32 km/h (20 mph) or less
- Gamma detector on the right side of vehicle closest to the side of street



City Streets

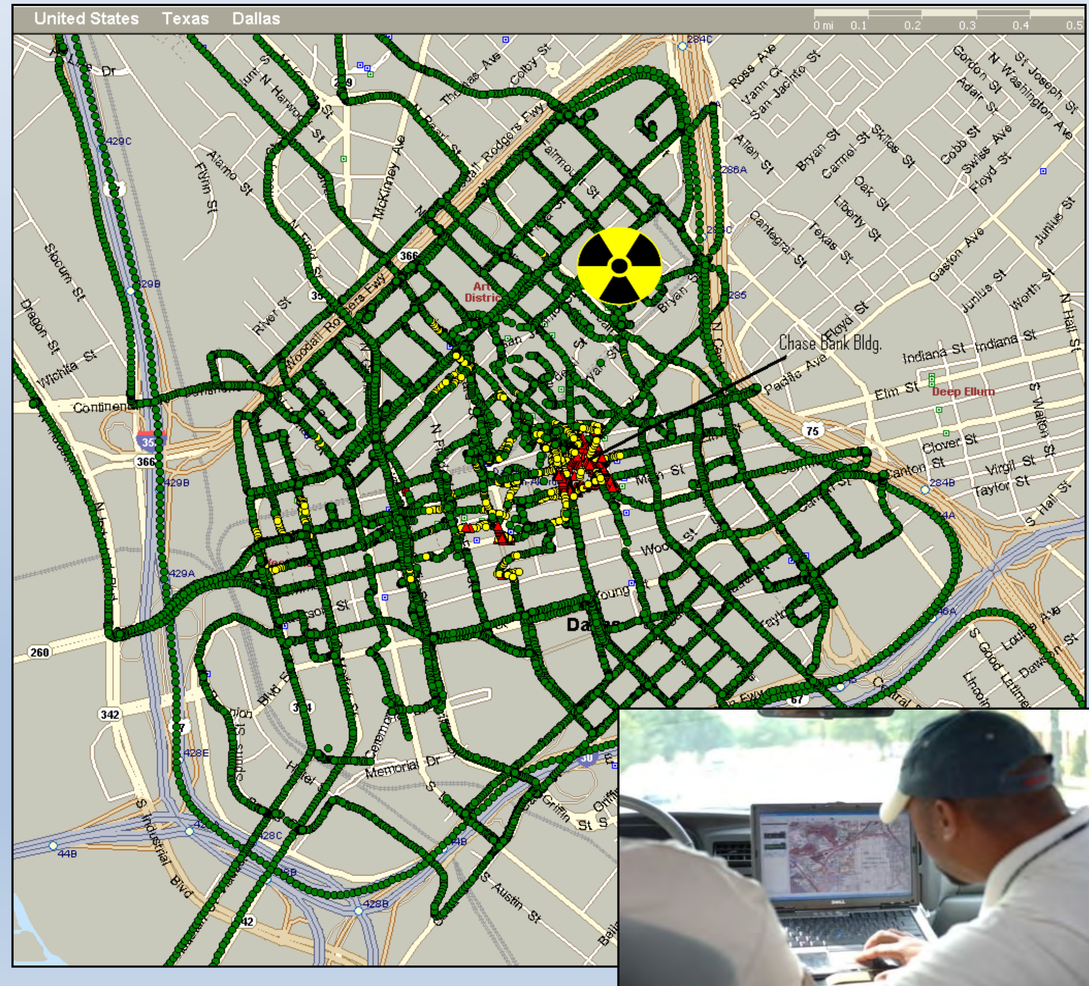
Alarm confirmed,
call MEST

Search Techniques for Large Areas

Large Area Search Techniques

Large area or city search

- Situation may dictate that a large section of a city be searched
- Multiple mobile teams can be deployed to accomplish the search mission
- Requires about 8 hours for one mobile team to search a 12 square-kilometer area (5 square-miles)



Maritime Search

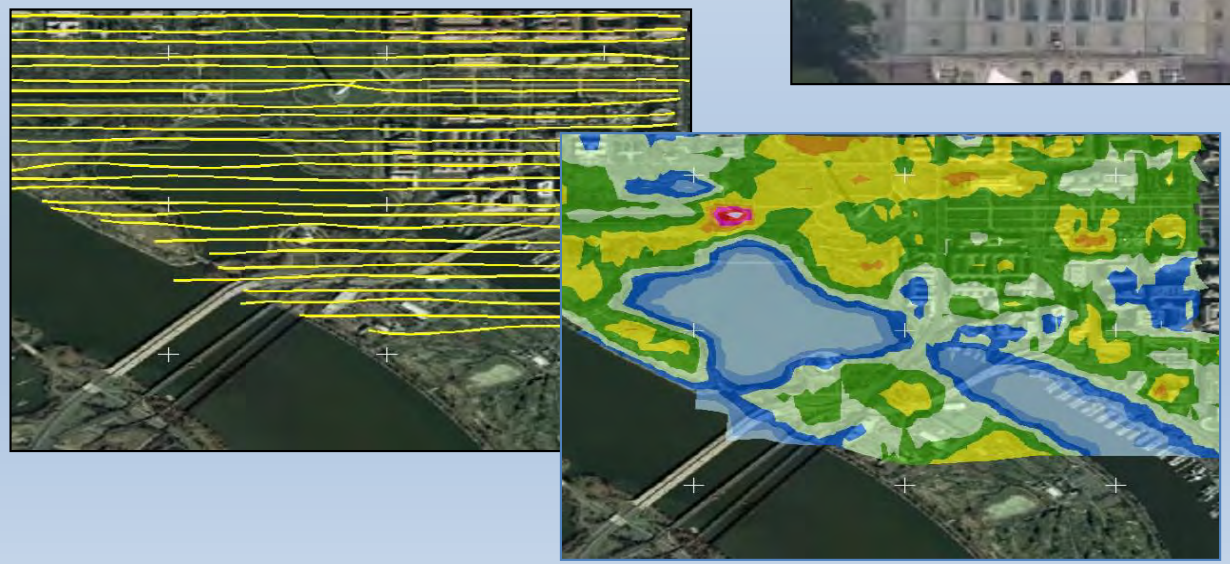
Maritime radiological searches of marinas and ports

Mobile detection systems can be installed in security patrol boats

Aerial Search

Aerial radiological search can be conducted over very large, open areas

An aerial search of Washington, DC was conducted with a mobile detector system in a helicopter prior to a Major Public Event



Flight profile:

- Altitude 50-100 m
- Line spacing 100 m
- Speed 100 km/h

Aerial Survey for Presidential Inauguration 2020

Venue Entrance
Portal Search Techniques

Entrance Portal/Choke Point Operations

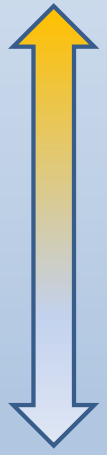
- **A choke point is a location in which people or vehicles can be channeled:**
  - Pedestrian Portal Entrance/Choke Point
    - Slow pass example - metal detector
    - Quick pass example - turnstile
  - Vehicle Portal Entrance/Choke Point
    - Slow pass example - event parking
    - Quick pass example - tunnel entrance
- **Establish a primary inspection area for alarm interdiction**
  - Locate primary station upstream of the choke point
  - Channel pedestrians/vehicles close to detector
- **Establish a secondary inspection area for alarm adjudication**
  - Locate secondary station downstream of the choke point
  - Designate a secure area to conduct investigation and adjudication

Medical Radiation Sources

The primary source (99%) of radiation alarms at MPEs are individuals with medical radiopharmaceutical treatments

As such, establish an efficient procedure to rapidly identify the medical radioisotope and adjudicate the alarm

Most likely



Least likely

Diagnostic – radiation source injected for imaging

Tc-99m (most common), Tl-201, Ga-67, I-123, I-125, I-131, In-111

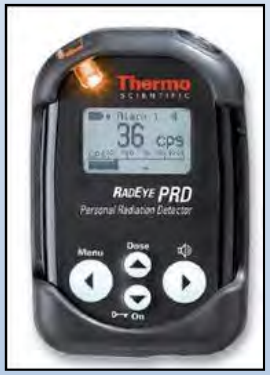
Therapeutic – radiation source inserted for treatment

Cs-137, Co-60, Ir-192 (inserted sources removed after treatment)

Rule of Thumb – 1 in 10,000 individuals will give a radiation alarm

Personal Radiation Detector (PRD)

A Personal Radiation Detector (PRD) is the most widely used detection instrument for routine monitoring, detection, localization and pinpointing of radioactive materials.



For best practices at MPEs, it is the primary tool used for nuclear security measures for pedestrian entrance portal monitoring

It is low profile and easy-to-operate with minimal training

Pedestrian Portal Search

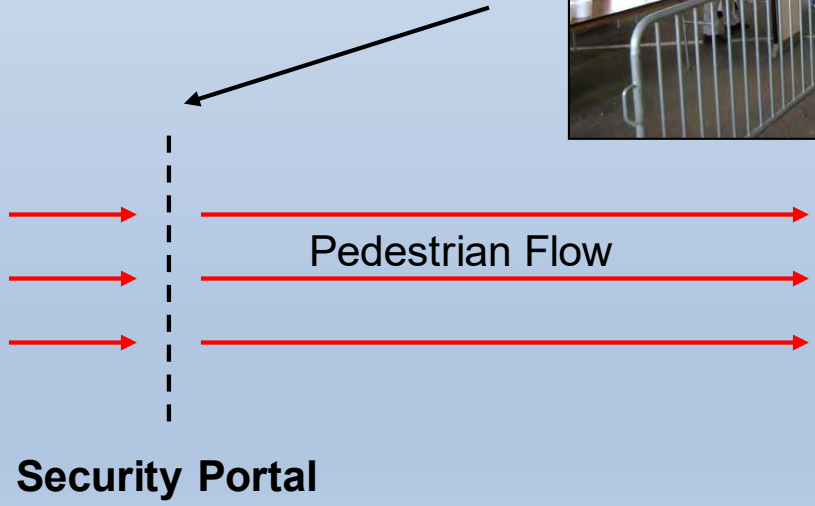
Basic approach is to provide security screeners at portals with individual radiation pagers and training

Areas of interest

- Pedestrians
- Handbags

Technique:

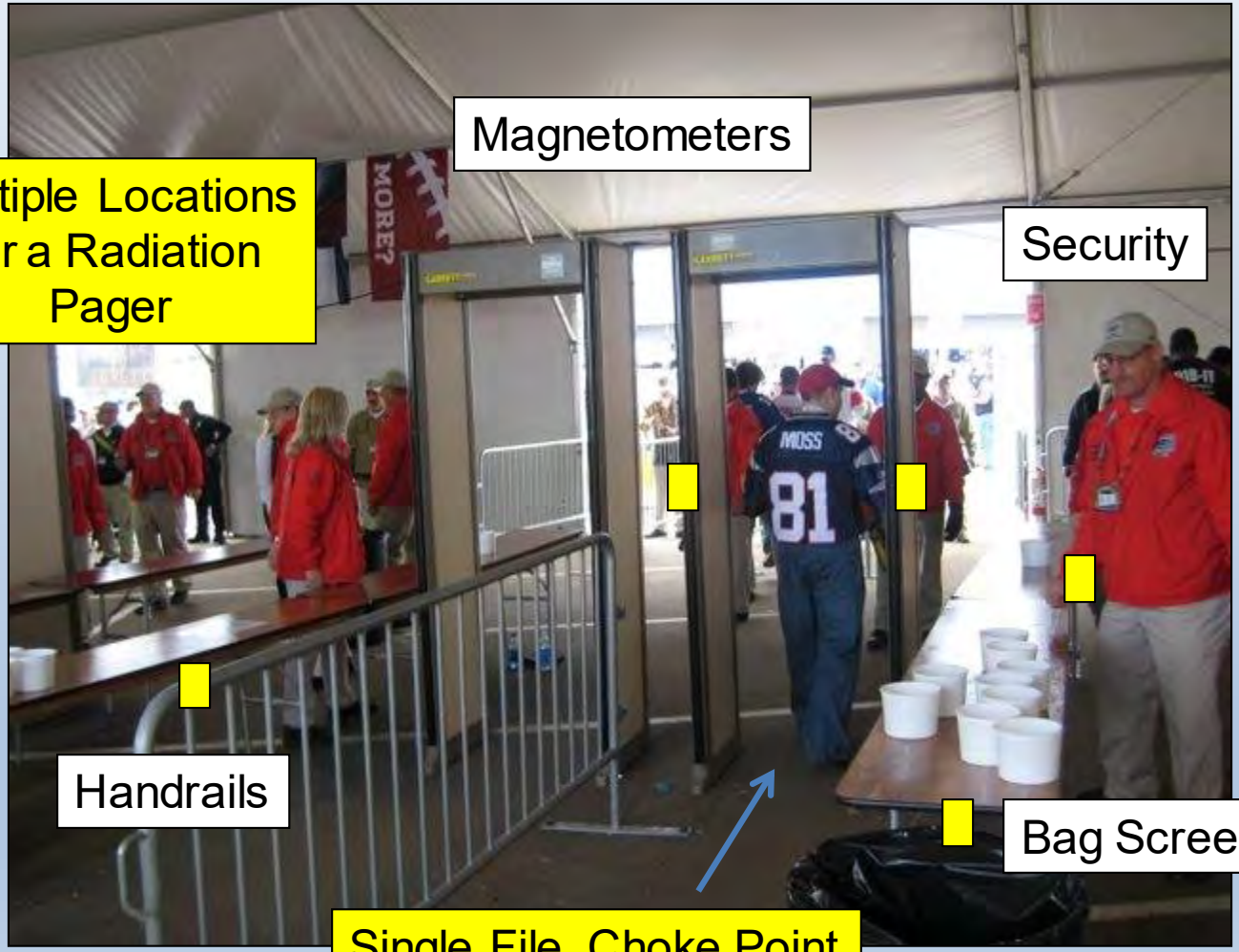
Incorporate radiation monitoring into routine individual and bag screening process

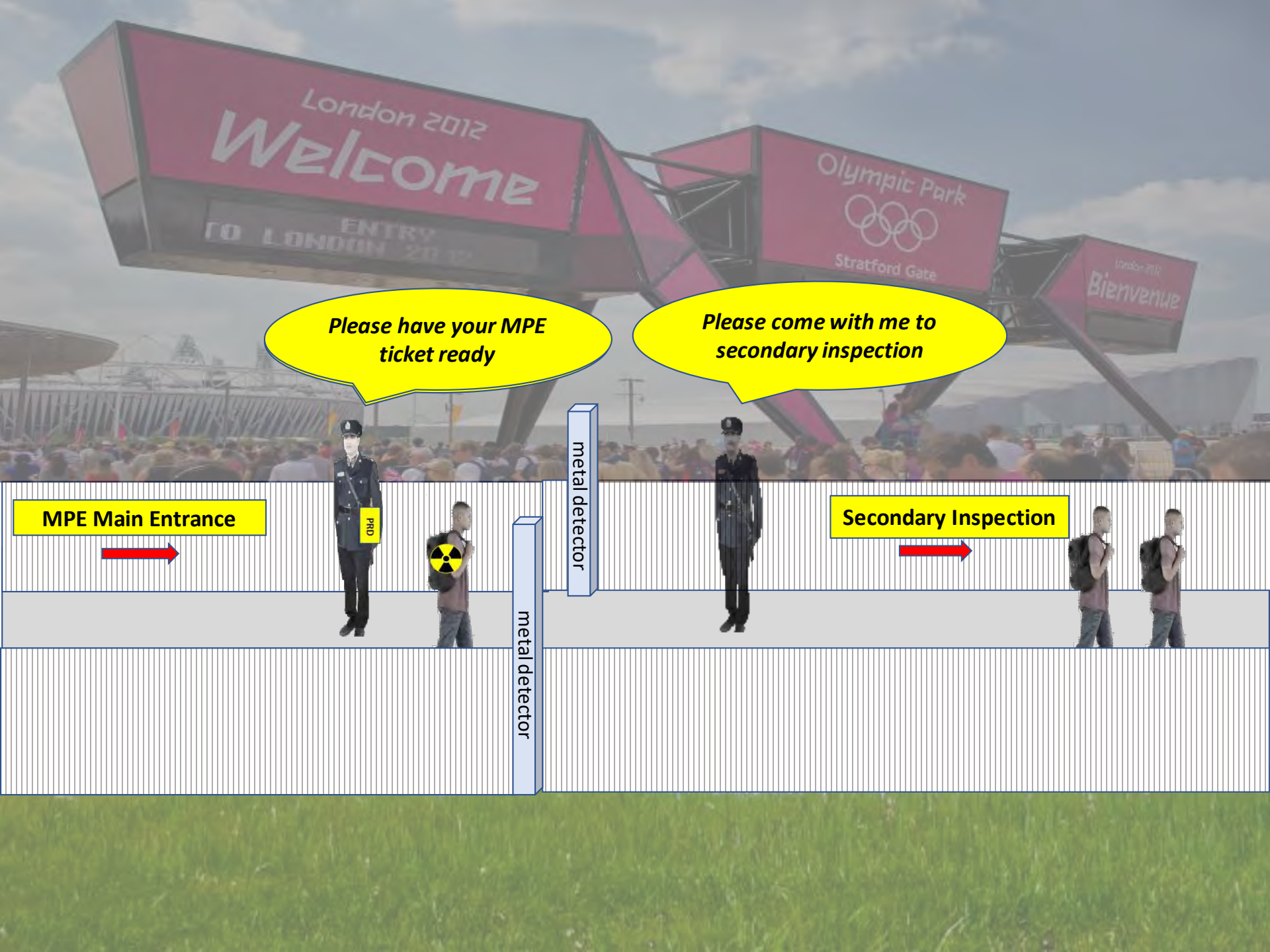


High Volume Pedestrian Entrance

Pedestrian Search at Venue Entrances

PRD Placement Options




London 2012
Welcome
ENTRY
TO LONDON
Olympic Park
Stratford Gate
Bienvenue
Please have your MPE ticket ready
Please come with me to secondary inspection
MPE Main Entrance
PRD
metal detector
metal detector
Secondary Inspection

Backpack or Mobile System

A backpack or mobile detection system can provide a high sensitivity tool for vehicle entrance portal monitoring for radioactive materials.









It has a larger profile and more training required to operate

Vehicle Portal Search

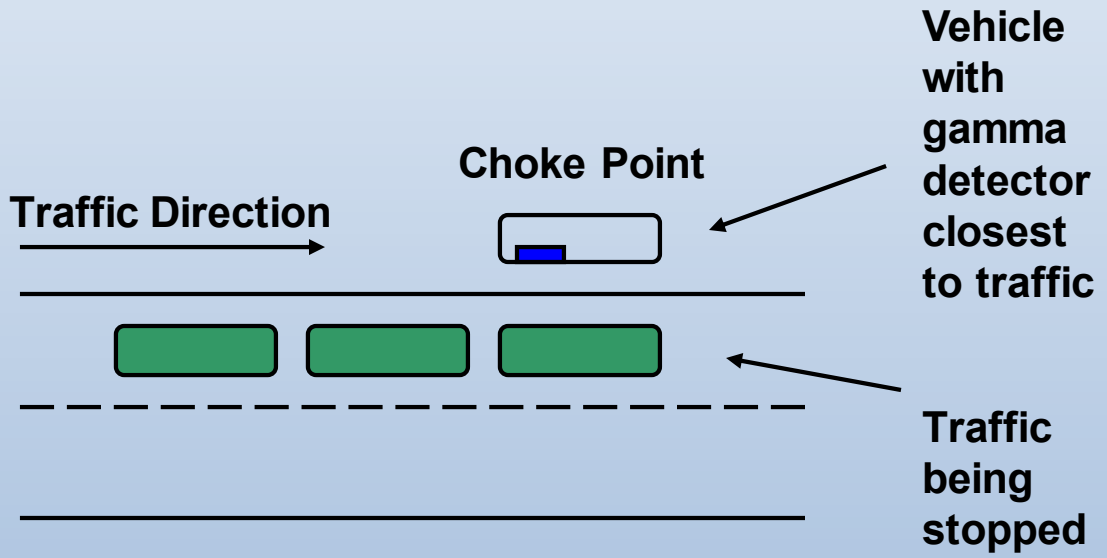
Roadway Choke Point Monitoring

Areas of interest

- Vehicle traffic
- Parking entrance
- Border crossing

Technique:

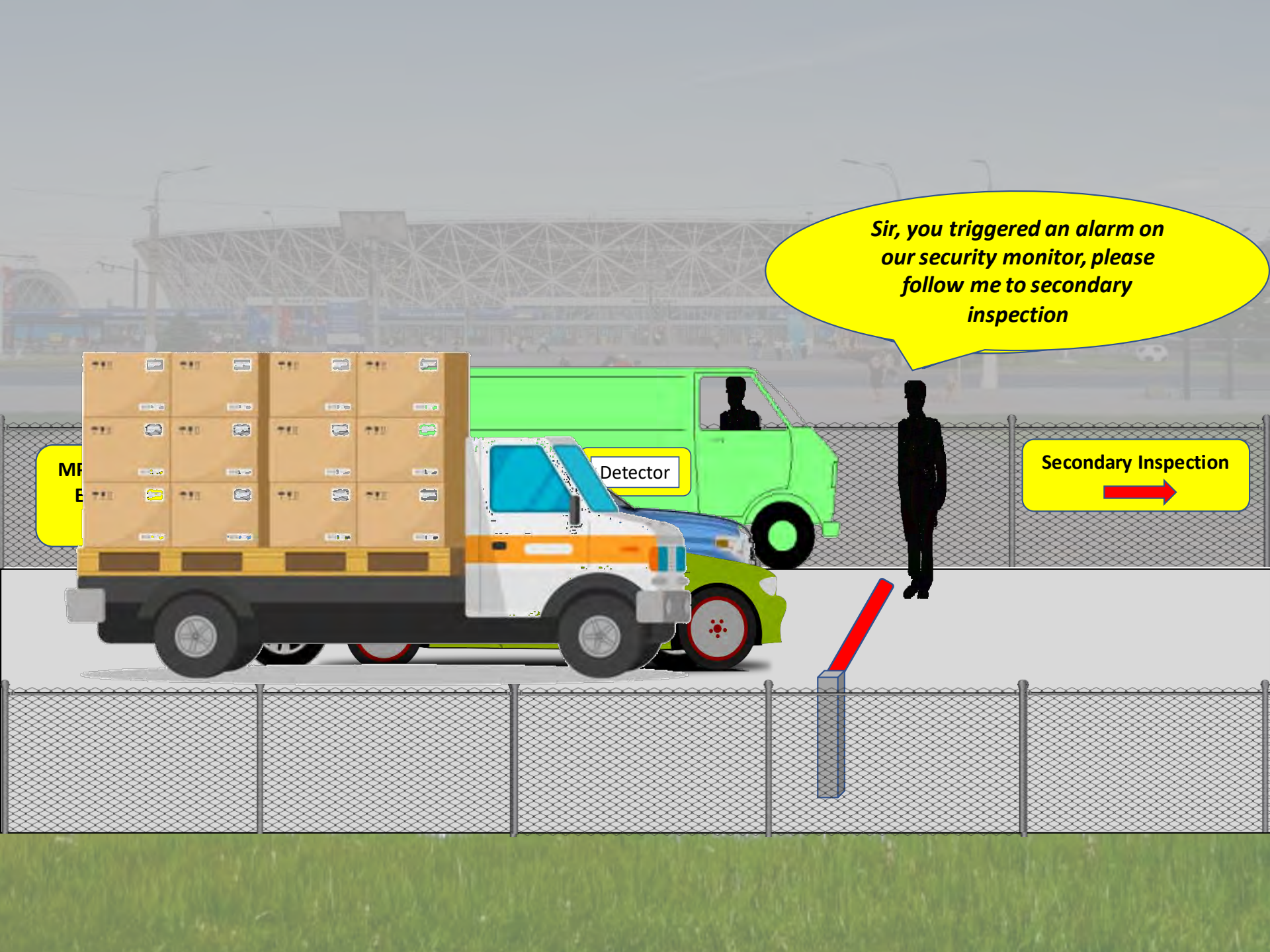
Park mobile system vehicle at a choke point close to traffic lane with slowing vehicles; place gamma detector on side closest to lane



Vehicle Portal Monitors

Roadway Choke Point Monitoring

- Silver van with radiation detector closest to road is set up as vehicle portal on a single lane road; security officer nearby to support if alarms
- As vehicle approaches, alarm sounds and security officer approaches vehicle for questioning, radioisotope identification is conducted from inside silver van
- Security officer and radiation monitor confer to determine release or detain


Sir, you triggered an alarm on our security monitor, please follow me to secondary inspection
Detector
Secondary Inspection

Polling Survey and Discussion

Question 3 (2 minutes)

Based on what you have learned so far, what are the primary challenges for conducting venue pedestrian and vehicle portal monitoring?

Enter your answer in the chat box

Alarm Interdiction and Adjudication

Phased Approach:

Phase I – Primary Inspection

- Search/screening
- Detect, verify, localize

Phase II – Secondary Inspection

- Detain individual or vehicle
- Conduct investigation with security
- Identify the radioactive material
- Assess radiation threat

Phase III – Expert Technical Assistance

- If not resolved, request MEST
- Mitigate the hazard

Phase IV – Resolution of Incident

- Law enforcement prosecution
- Document incident and report data

MEST – Mobile Emergency Support Team

Roving Patrols

Roving patrols can be deployed in soft zones where perimeters are difficult to secure

Areas of interest
- Pedestrians
- Unattended bags
- Vehicles

Techniques
- Work in teams
- Maintain low profile
- Circulate through crowd
- Call security to resolve alarms

Equipment
- PRDs, RIIDs, backpacks

MEST

Mobile Emergency Support Team

Expert team on-call
- Rapid response to alarms
- Vehicle with lights
- Teamed with CBRN

Incidents
- Unattended bags
- Suspect packages or vehicles
- Alarm investigation
- Assist law enforcement

Equipment
- Search - PRD, Backpack
- ID - RIID, HPGe
- Safety - HP Kit, PPE
- Comms

Collecting a spectrum

Situation Update

A security officer saw suspicious activity by that black vehicle. They were moving a box with hazmat/ dangerous goods labels.

MEST

MEST Analysis

The box contained an industrial gauge. The shipping manifest and Radioactive Yellow II label are correct for Cs-137 and a legal shipment. Sending a picture.

POLIC

O NOT CROSS

Summary

- Radiological/nuclear search operations are complex missions that often require specialized skills and detection instruments
- Each search mission or area can present its own challenges requiring planning, coordination and execution
- Nuclear security measures incorporate all known information about the radiation source(s) and available resources required to implement best practices to maximize the mission success
- Nuclear security measures should be documented, resourced and trained to as much as possible for increased operational readiness

Office of Counterterrorism and Counterproliferation

Nuclear Incident Policy and Cooperation

MPE Nuclear Security Operations Questions/Discussion