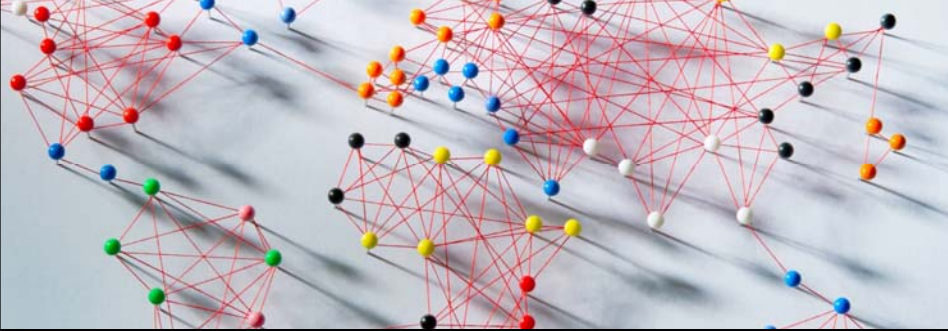



INTERNATIONAL TRAINING COURSE
on the Physical Protection of Nuclear Facilities and Materials



8. Intrusion Detection System

April 29 – May 18, 2018
Albuquerque, New Mexico, USA



INTERNATIONAL TRAINING COURSE
on the Physical Protection of Nuclear Facilities and Materials

Intrusion Detection System

Learning Objectives

After completing this module, you should be able to:

- State the function of an Intrusion Detection System (IDS)
- Evaluate exterior and interior sensor placement effectiveness
- Consider trade-offs that influence exterior IDS design effectiveness
- Identify factors that influence interior sensor effectiveness

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IAEA Nuclear Security Series 13 (NSS-13)

- 2.2 The State's physical protection regime should seek to achieve these objectives [protection against malicious acts] through ... an integrated system of detection, delay, and response.

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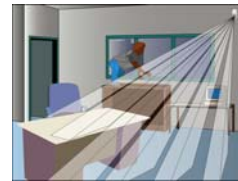
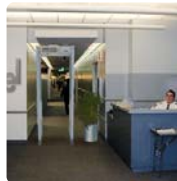
Intrusion Detection System Function

- Detects unauthorized personnel entry into a facility
- Allows a Central Alarm Station (CAS) operator to quickly assess the cause of the alarm
- Provides a prompt notice for the response force to respond to an alarm event

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Where Will You Find Intrusion Detection?

- Exterior
 - PIDAS - Perimeter Intrusion Detection and Assessment System
- Interior
 - Entry control points
 - Building boundaries, Target locations, credible paths
- Our focus in module is on exterior and interior sensors
 - Assessment, Entry Control described in separate modules



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PIDAS

- Detects unauthorized personnel entry into a facility
- Defines a boundary around the facility
 - Detection sectors (sensors, cameras)
 - Entry Control Point(s)
 - Delay and response features
- Subsystems
 - Detection elements (sensors)
 - Assessment systems (cameras, lighting)
 - Communications and power distribution
 - Fences, delay elements



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Key Security Design Principles

- High probability of detection and low nuisance / false alarm rates
- Detection before delay
- Detection
 - Integrated with delay
 - Balanced system
 - Along all credible paths
 - Layered approach
- Tamper protection and line supervision
- Response force integration
- Site specific system design

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Exterior Sensors

- Sensor classifications
 - Active or passive
 - Covert or visible
 - Volumetric or line
 - Line of sight or terrain following
 - Mode of application
 - Buried line
 - Fence associated
 - Freestanding
- You will have opportunity to become familiar with sensor technologies during field exercises



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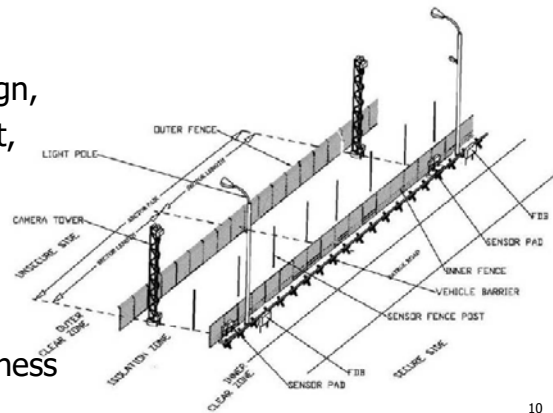
Sensor Selection Process

- What are the requirements for the PIDAS?
 - Specified probability of detection (P_D), nuisance alarm rate, vulnerability to defeat, likely adversary modes of attack, lines of detection, volumetric sensors
- What are the constraints?
 - Terrain, soil conditions, weather, traffic, PIDAS width, frequency restrictions, approved sensor lists, costs
- Prioritize remaining sensors based on features
 - Strengths and weaknesses, reliability, availability, sustainability, maintenance, performance characteristics, compatibility, site preferences, factory support
- Examine potential sensor combinations

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PIDAS Profile

- Analyze design against possible attack methods
 - Jumping
 - Crawling
 - Bridging
- Consider sensor design, overlaps, assessment, sector boundaries, entry control points, when designing performance tests to measure effectiveness



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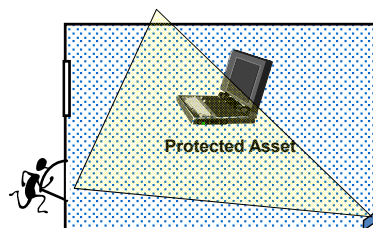
Optimizing Sensor Effectiveness

- Alignment and calibration
- Maintenance procedures
- Nuisance alarm reduction
 - Improve PIDAS drainage
 - Erosion control
 - Weed control
 - Animal control
- Sensor upgrades

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Purpose of Interior Sensors

- Detect unauthorized entry into a building or room
 - Provide location of intruder for effective response
- Detect insider
- Protect entry control when no guard is posted
- Ensure integrity of prohibited items detection equipment



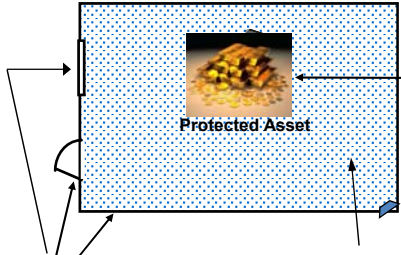
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Interior Sensor Design Principles

- Similar to exterior sensor design principles
 - Site-specific performance-based design
 - High probability of detection (P_D)
 - Low nuisance alarm rate (NAR)
 - Appropriate sensors
 - Complementary
 - Layered
 - Protection-in-depth
 - Placement
- Design with DBT in mind

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Interior Security Modes of Application

- 
- Boundary Penetration
 - Detection at doors, windows, walls, vents, floors, ceilings, etc.
 - Detection zone easily identified
 - Interior Motion
 - Detection in a volume of space
 - Detection volume (not visible)
 - Proximity
 - Detection at the target

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Boundary Sensor Design Considerations

- Boundary
 - Wall construction
 - Ceiling construction
 - Floors
 - Ventilation
 - Doors
 - Windows



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Door and Window Penetration Detection

- Balanced Magnetic Switch (BMS)
- Active infrared
- Glass break
- Break wire

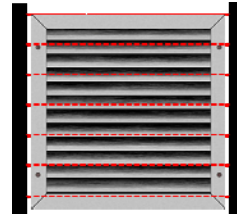
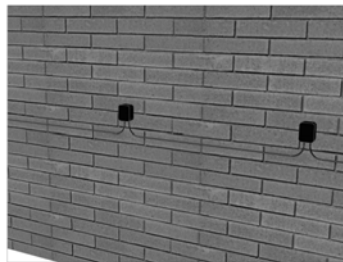


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Wall, Ceiling, Floor, Ventilation Protection

- Break wire
- Vibration sensor
- Active infrared



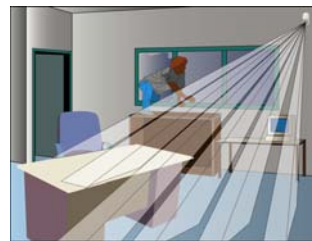
Multi-Beam
Active
Infrared

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Motion Sensor Design Considerations

- Adversary path
 - Direction of travel in relation to target and sensor
- Detection area
 - Credible pathways
 - Total volume
- Interferences that block detection
- Nuisance alarm sources



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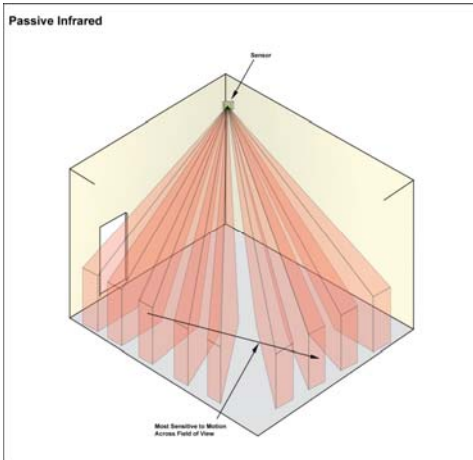
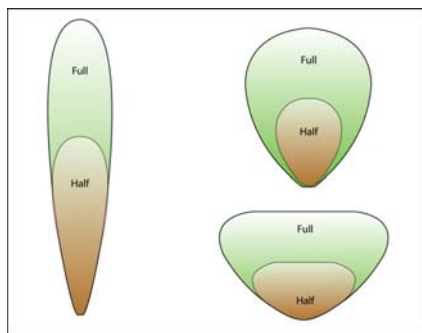
Interior Motion Sensor Types

- Microwave
- Passive infrared (PIR)
- Dual technology
- Video motion detection (VMD)

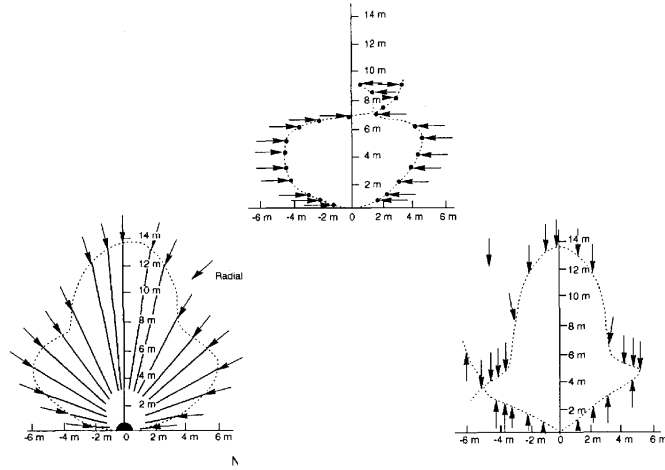


Provide volumetric coverage of area

Advertised Microwave, PIR Detection Patterns



Interior Microwave Measured Detection Patterns



Note: Arrows indicate the walk-test direction

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Proximity

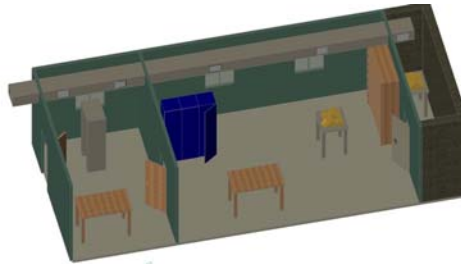
- Detection at target
 - Vibration
 - Local passive infrared
 - Cage



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Sensor Selection Requirements, Constraints

- Requirements
 - Probability of detection, nuisance alarm rate, adversary paths
 - Likely adversary (insider, outsider, or collusion)
 - Containment or denial
- Constraints
 - Target location
 - Building construction
 - Interior configuration
 - Access controls
 - Approved sensor lists
 - Costs

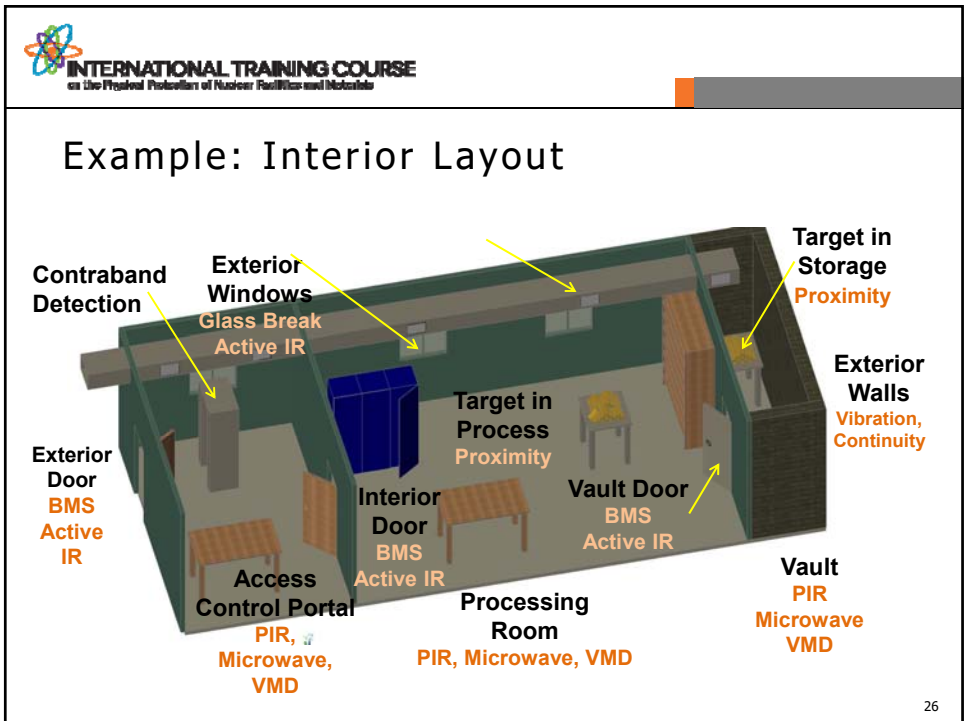
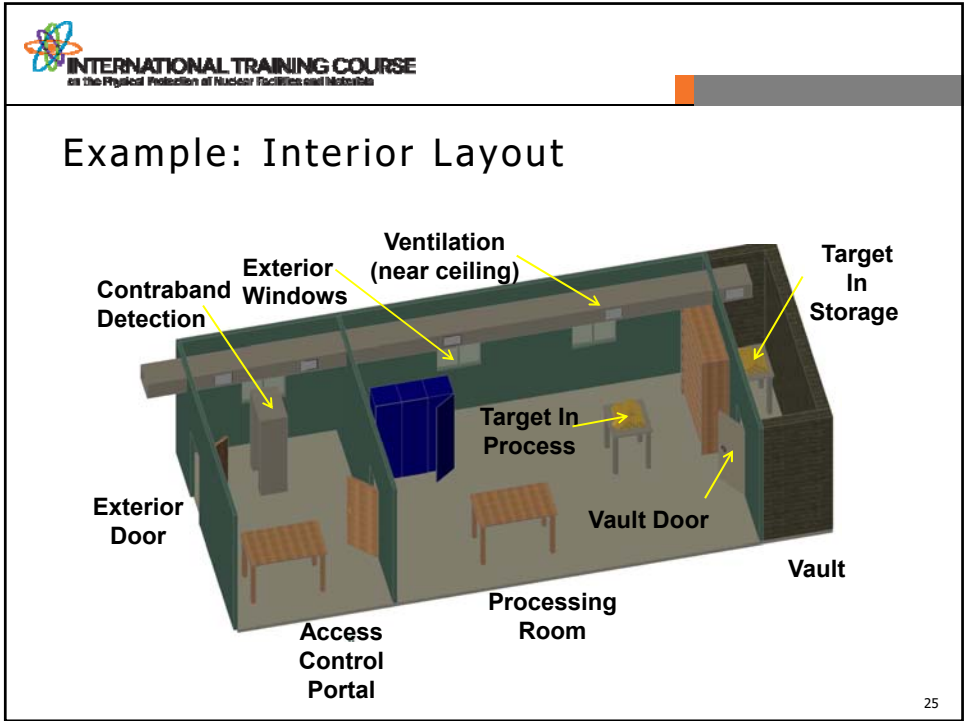


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Sensor Selection Considerations

- Consider operational concerns
 - Access control
 - Target in storage or in processing
 - Two person rule
- Selection process
 - Prioritize sensor choices based on features
 - Strengths and weaknesses
 - Reliability
 - Availability
 - Performance characteristics
 - Compatibility
 - Site preferences
 - Select from prioritized list

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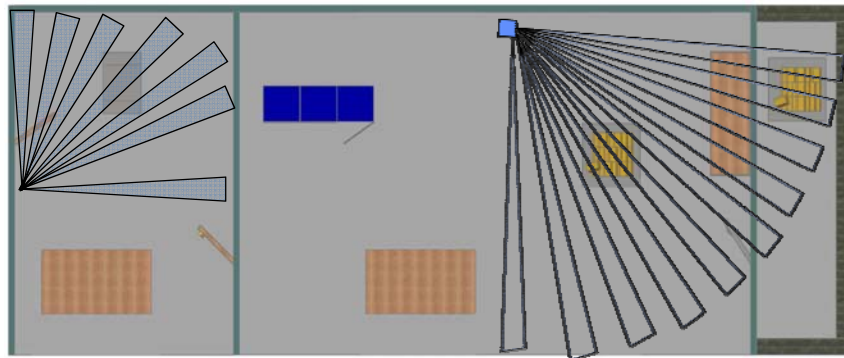


Determining Interior Layout

- Considerations
 - Sensor technology
 - Building layout, interferences
 - Assessment capability
 - Entry control portal configuration and/or requirements
- Path or target coverage
 - In storage
 - In process

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Example: Interior Sensor Layout



Only one sector per room shown for clarity

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Other Design Concerns

- Maintenance and testing
- Spares (minimize types of sensors)
- Good installation practices
 - Mounting brackets
 - Tamper protection
 - Sensor placement
 - Credible pathways
 - Line supervision
- Assessment
 - Coverage of entire detection zone
 - BMS sensors in general do not require assessment because of high reliability

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Key Takeaways: PIDAS Sensor Design

- Create site-specific system
 - Apply a performance-based design
 - Use continuous line of detection
 - Apply protection-in-depth
- Select appropriate sensors
 - Complementary sensors
 - Combination of sensors
- Apply appropriate sensor placement
- Integrate subsystems

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Key Takeaways: Interior Sensor Design

- Characterize building, interior, and target areas
- Design for sensor performance
 - High probability of detection
 - Low nuisance and false alarm rates
 - Balance detection with delay
- Understand sensor characteristics and capabilities
- Accommodate sensor design for effective assessment
- Detect along all credible paths
 - Layered detection
- Provide tamper protection and line supervision