United States
Department of Energy
National Nuclear Security Administration
International Nuclear Security

M5-B: PPS Design – Detection and Access Control

Research Reactor Sabotage Protection Workshop

SAND2025-02023O

Learning Objectives

Objectives:

- Understand considerations for the implementation of exterior and interior intrusion detection systems

- Review examples of intrusion detection technologies

- Discuss considerations for alarm assessment

Intrusion Detection

- Probability of Detection

$$P_D = F(P_S, T_C, P_A, NAR)$$

- Probability of sensor alarm (P_S)
- Communication and assessment time (T_C)
- Probability of correct assessment (P_A)
- Nuisance alarm rate (NAR)
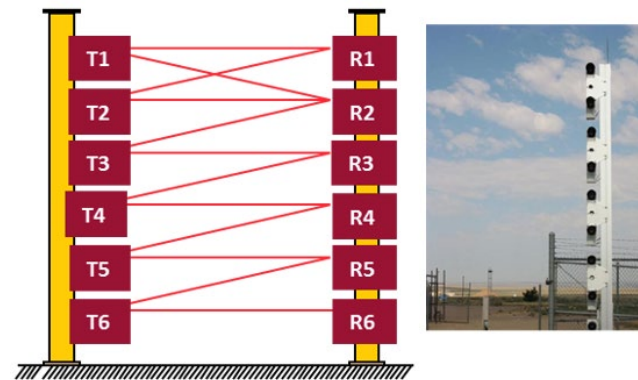
Probability of Detection (P_D)

$$P_D = P_S * P_A$$
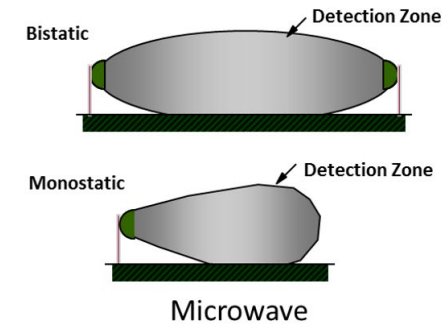
Exterior Intrusion Detection Systems (1)

- Examples of IDS systems
  - Microwave sensors
  - Active IR sensors
  - E-field sensors
  - Fence mounted systems
 - Video analytics

Tautwire

Microwave

Active Infrared

Fence Disturbance

Exterior Intrusion Detection Systems (2)

- Considerations for the design and implementation of exterior IDS
  - Continuous line of detection
  - Environment
  - Sensitivity
  - Reliability
  - False and nuisance alarm rates
  - Vulnerability to defeat
  - Cost and maintenance
  - Tamper and cyber protection
  - Integration with assessment and delay
- How many lines of detection for complementary sensors?
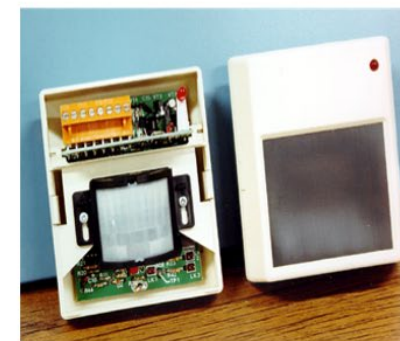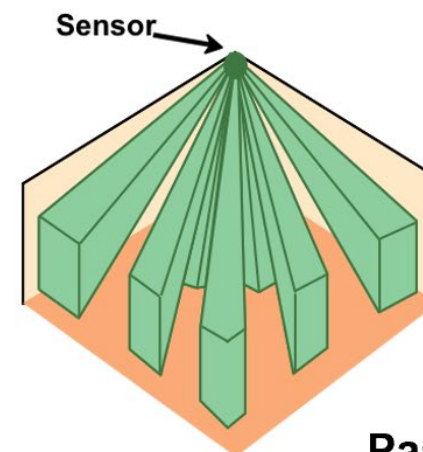- Performance testing

Vegetation

Wildlife
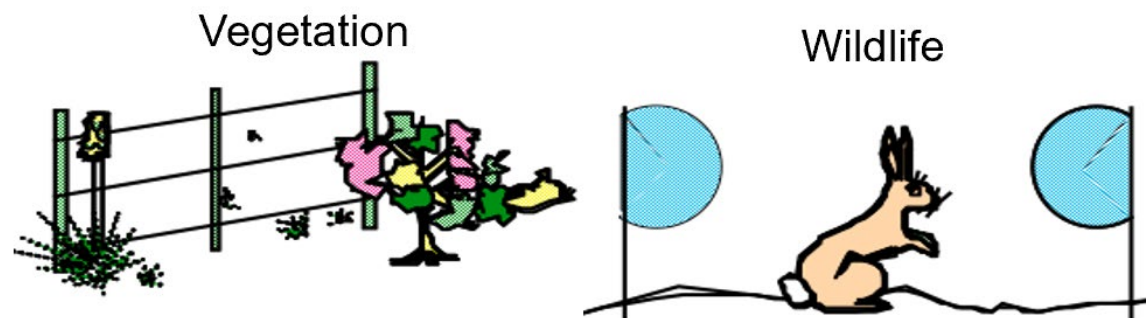
Interior Intrusion Detection Systems

- Examples of interior IDS systems
  - BMS
  - PIR
  - Microwave or dual technology
- Considerations are similar to those for exterior IDS

Sensor

Microwave

Sensor

Passive Infrared

Assessment and Surveillance

- There is no detection without assessment

- Fixed cameras are standard for alarm assessment
  - Complete coverage of the sensor zone
  - 100% of time coverage
  - Integration with the alarm communication and display system
    - Assessment is supported by pre- and post-alarm recording
  - Resolution sufficient for image classification and/or identification

- PTZ cameras are normally used for surveillance
  - Adversary tracking and situational awareness
  - Stop-and-stare detection for certain tasks

Assessment Resolution

Detection – Determine the presence of object

Appropriate lighting is required to facilitate assessment and surveillance

Categorization – Determine nuisance or real alarms

Identification – Determine the identity of object

Access Control and Contraband Detection

- Access authorization and insider threat mitigation
- Access control
  - Technologies (e.g., card reader and biometrics)
  - Procedures (e.g., key control)
- Contraband detection
  - Vehicles searches
  - Inbound personnel and packages searches
    - What does "subject to search" mean (IAEA NSS-13)?
  - Nuclear material searches

Alarm Station

Communications Systems: connects the CAS and SAS with all nuclear facilities and response forces

Intrusion Detection System: incorporates all exterior and interior sensors depicting them in a map display (to include extended detection).

Access Control System: incorporates all access devices for controlled areas throughout the site (to include Intercoms)
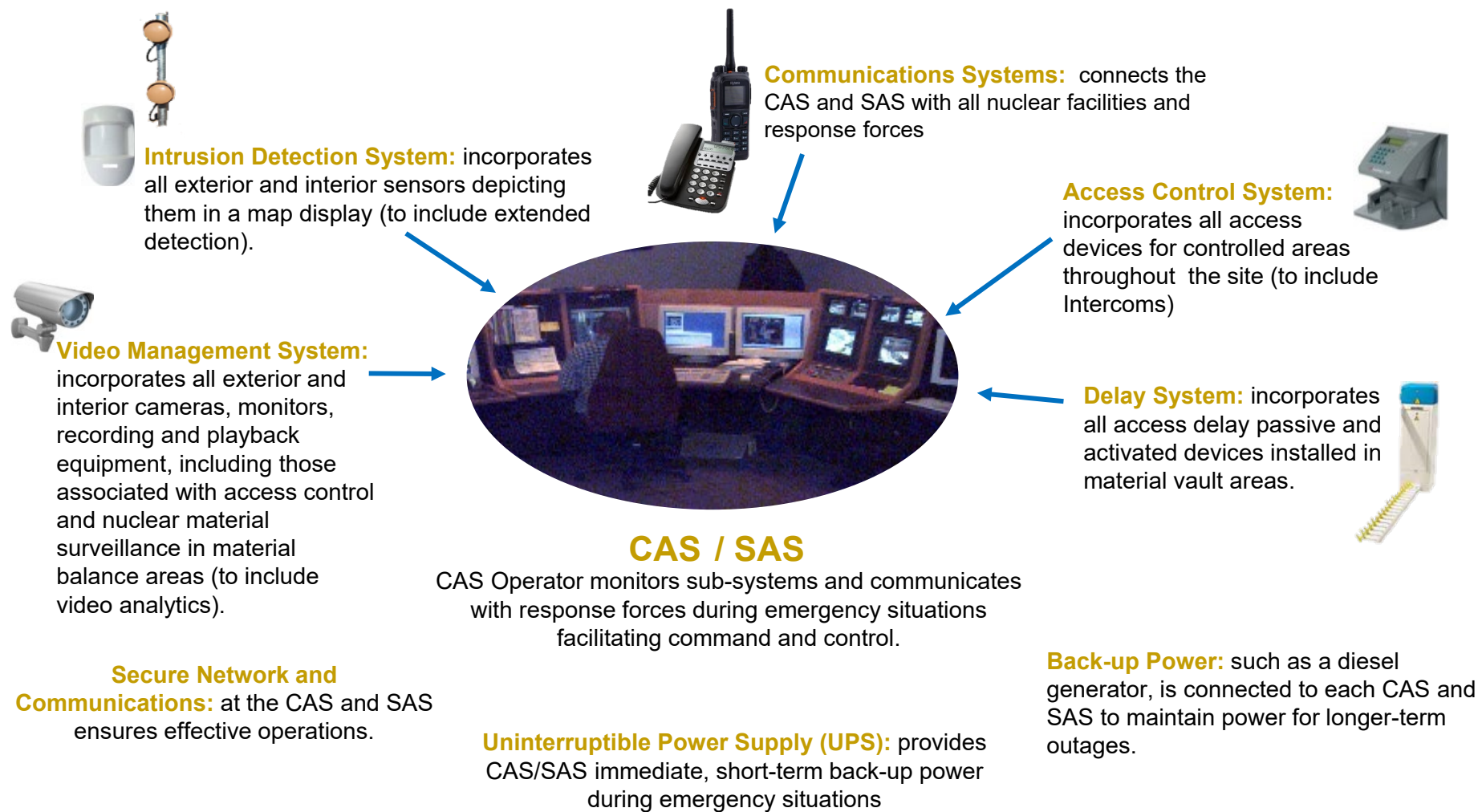
Video Management System: incorporates all exterior and interior cameras, monitors, recording and playback equipment, including those associated with access control and nuclear material surveillance in material balance areas (to include video analytics).

Delay System: incorporates all access delay passive and activated devices installed in material vault areas.

CAS / SAS

CAS Operator monitors sub-systems and communicates with response forces during emergency situations facilitating command and control.

Secure Network and Communications: at the CAS and SAS ensures effective operations.

Back-up Power: such as a diesel generator, is connected to each CAS and SAS to maintain power for longer-term outages.

Uninterruptible Power Supply (UPS): provides CAS/SAS immediate, short-term back-up power during emergency situations

In Conclusion

- There are many mature intrusion detection and access control technologies and new technologies are being developed

- Technology selection must be considered in the context of the overall PPS

- Assessment is a critical element of detection

Questions, Comments, Concerns?