GLOBAL THREAT REDUCTION INITIATIVE

Working to reduce and protect vulnerable nuclear and radiological material located at civilian sites worldwide.

SAND2013-5494P

Module C

Critical Components of the Physical Protection System (PPS)

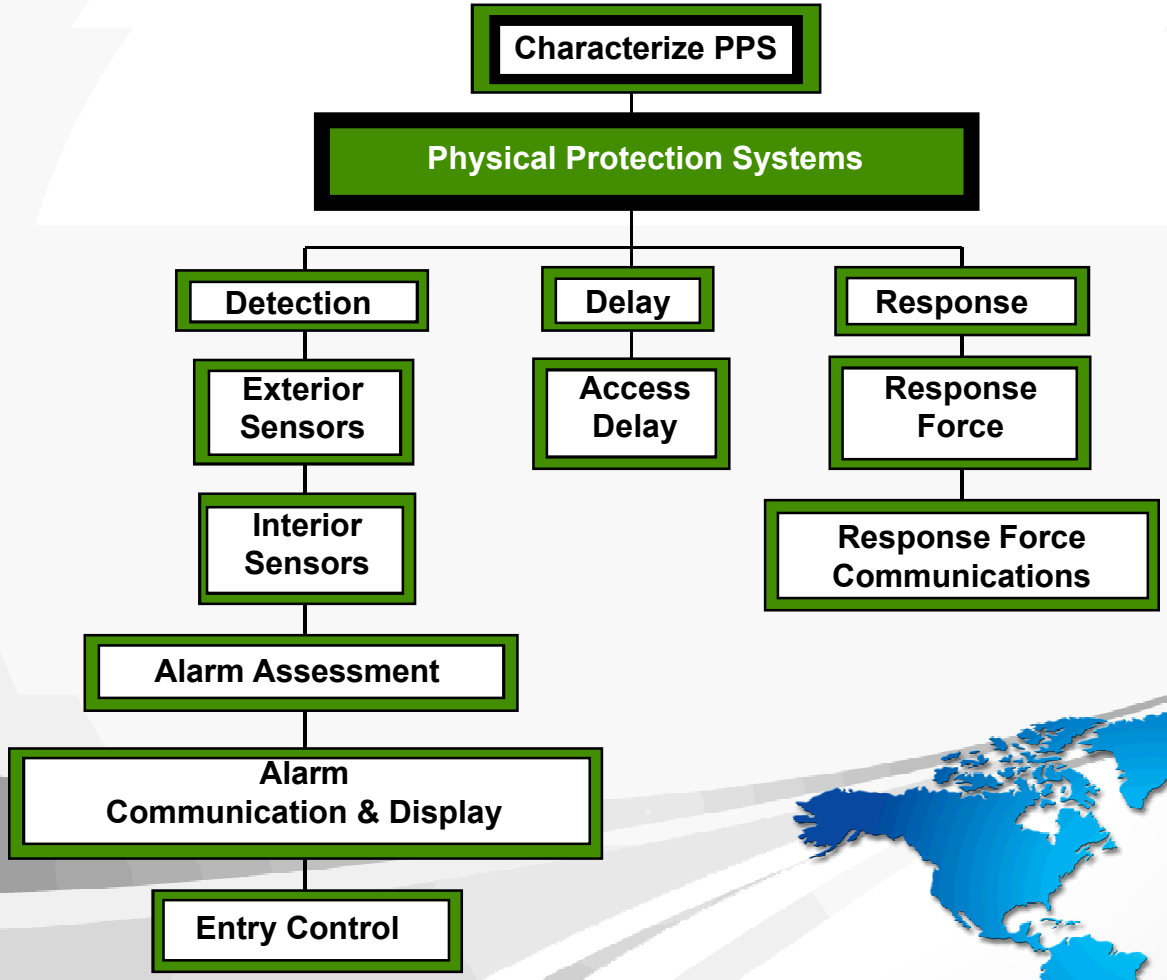
Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Module Objectives

- Identify the basic functions of physical protection (detection, delay, and response) and their interaction.

- Briefly discuss the difference between deterring and defeating the adversary.

DEPO – Physical Protection Systems



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Physical Protection Systems (PPS)

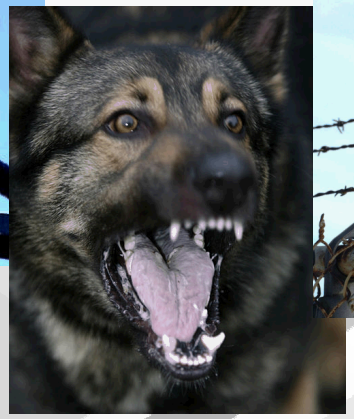
Will be discussed in terms of:

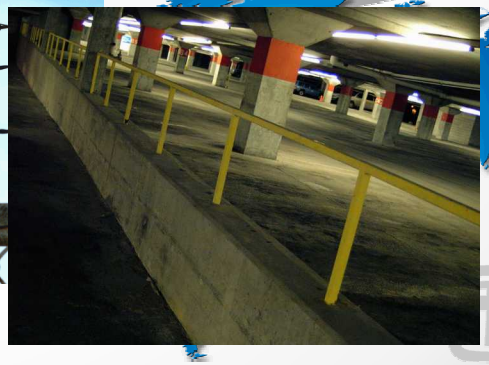
- Overall objectives of the PPS
- Functions of a PPS
  - **Detection**
  - **Delay**
  - **Response**
- Elements that make up the functions
- Characteristics of an effective PPS
- Design criteria of a PPS

System Objective: Prevent Theft and Sabotage

Strategy #1: Deter the adversary.

- Implement a PPS that adversaries perceive as too difficult to defeat.
- **Problem**: Though we intuitively perceive it as useful, deterrence is difficult to measure or predict effectiveness.
- **Problem**: What if the adversary is not deterred?

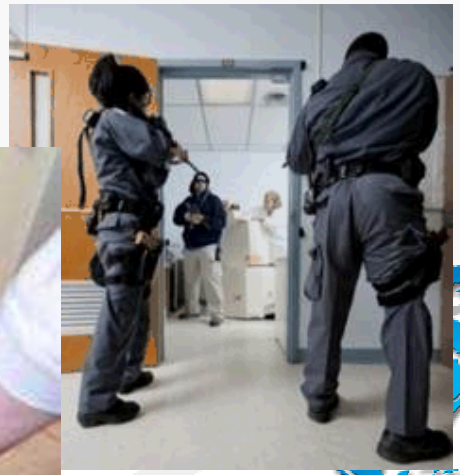





System Objective: Prevent Theft and Sabotage

Strategy #2: Defeat the adversary with PPS.

- PPS functions required: **Detection, Delay, Response.**
- Actions of response force (usually LLEA): Prevent adversary from accomplishing their goal.



PPS Functions

PPS Functions

Detection	Delay	Response
Intrusion Sensing Alarm Communication Alarm Assessment	Barriers Dispensable Barriers	Interruption Neutralization

Interdependence of Elements--Baseline System

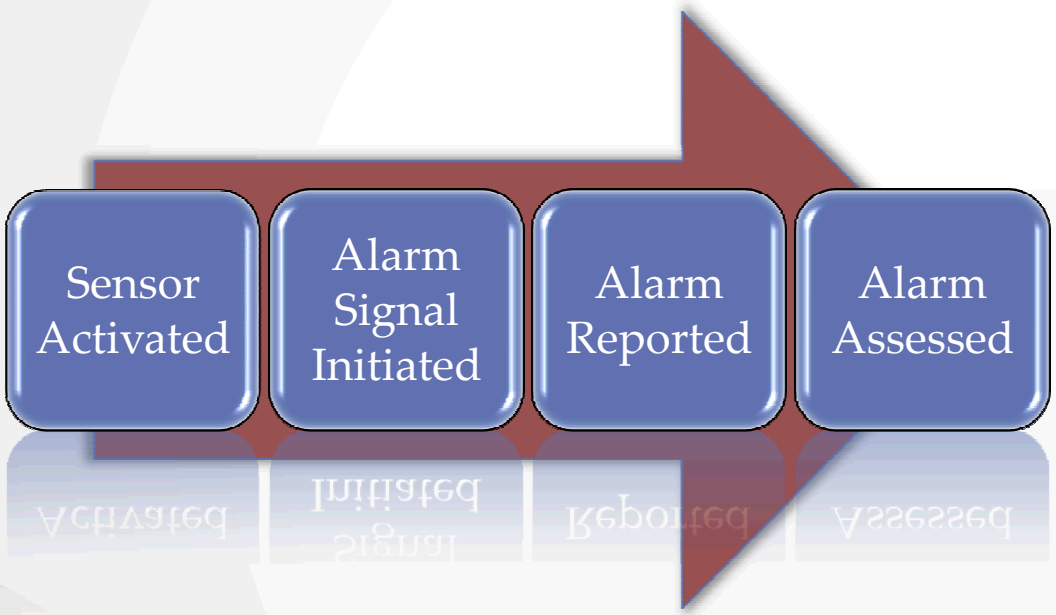
Example scenario:

- Theft
- Moving convoy vs. fixed site

Look for existing PPS elements of:

- Detection
- Delay
- Response

Detection

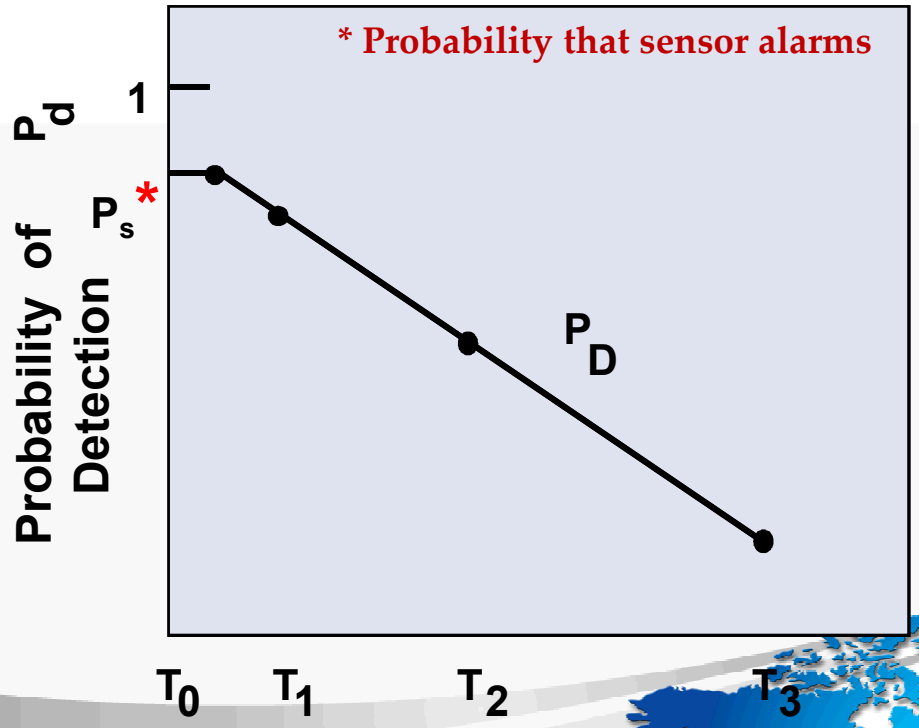


Performance measures

- Probability of detection
- Time for communication and assessment
- Frequency of nuisance alarms
- Probability of assessment

"An alarm without assessment is not detection."

Detection as a Function of Assessment Time

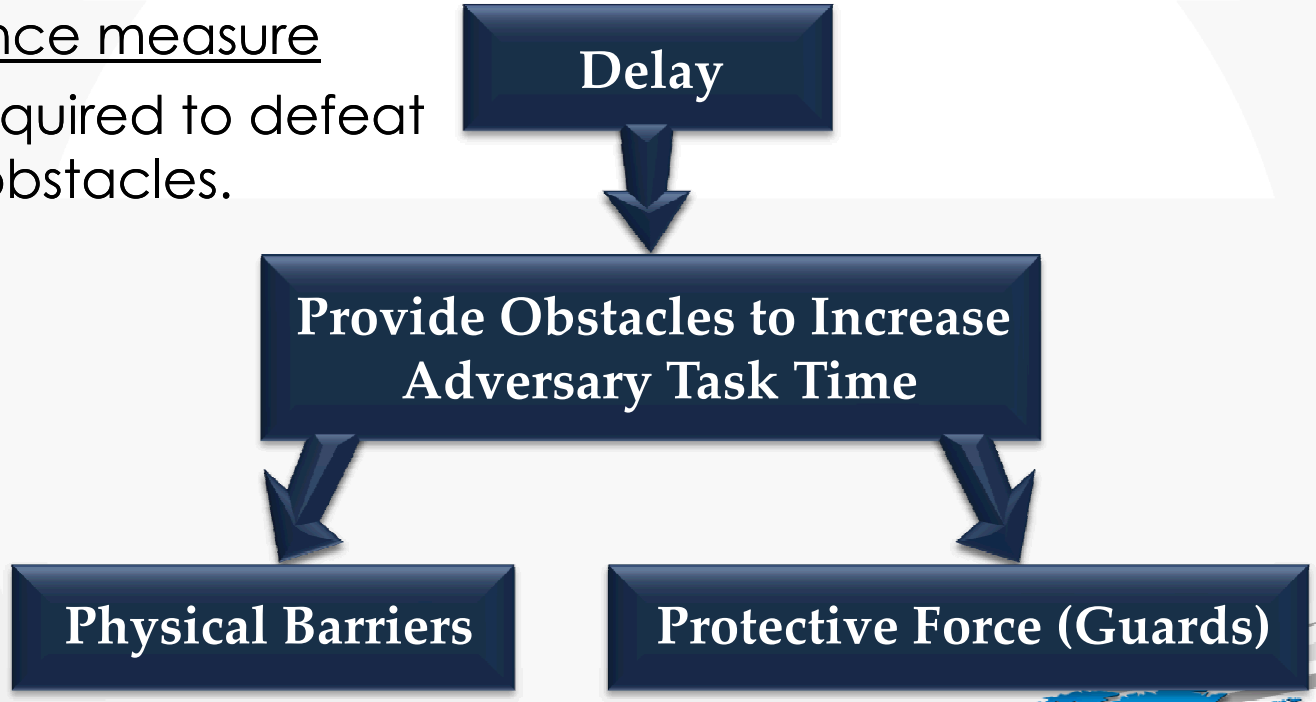


A long time delay between alarm and assessment lowers the probability of detection.

Delay Function

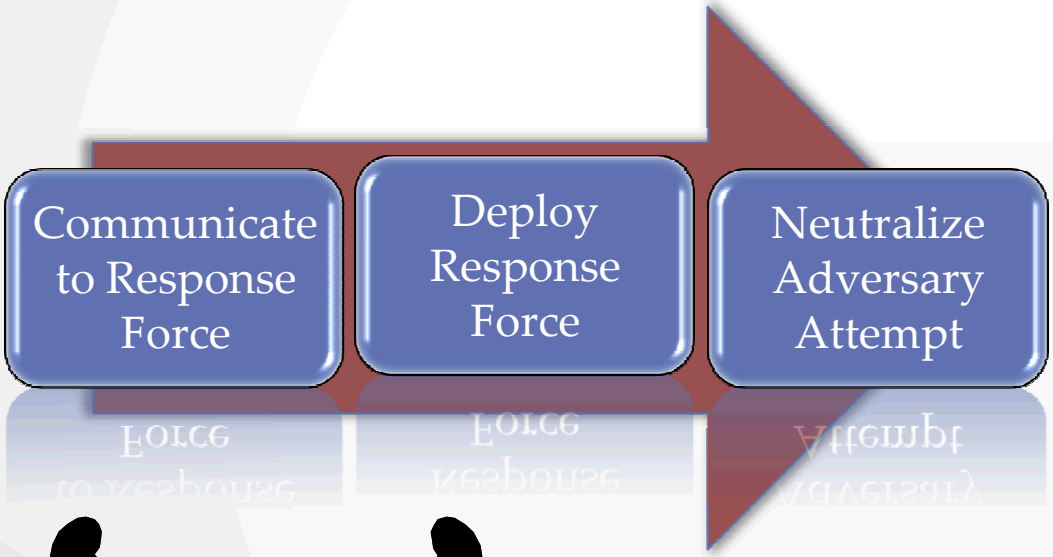
Performance measure

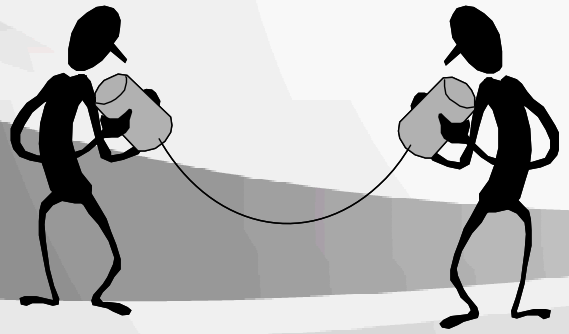
- Time required to defeat these obstacles.

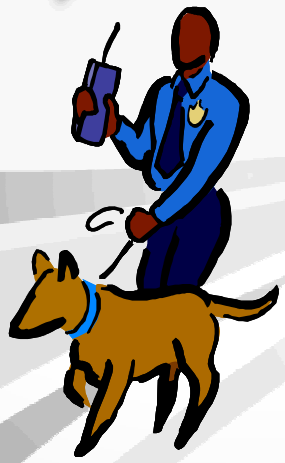


"Delay elements must be located after detection elements."

Response



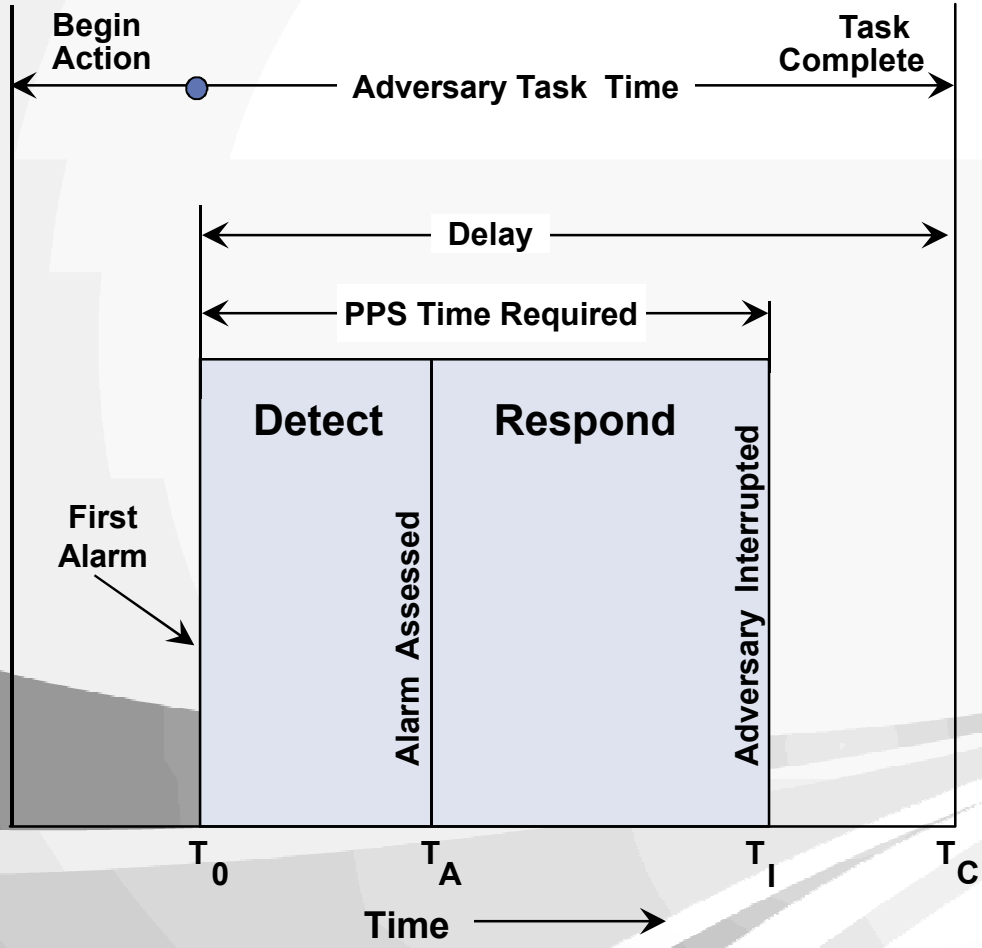




Performance measures

- Probability of communication to response force
- Time to communicate
- Probability of deployment to correct location
- Time to deploy
- Response force effectiveness

Adversary Task Time –vs- PPS Time Requirements



T_0 = First alarm occurs.

T_A = Time at which the alarm is assessed to be valid.

T_I = Time at which the response force interrupts adversary actions.

T_C = Adversary task completion time.

Interdependence of Elements– Upgraded PPS

Example – Upgraded PPS

- Theft
- Moving convoy vs. fixed site

Look for upgraded PPS elements of:

- Detection
- Delay
- Response

Some Characteristics of an Effective PPS

- Protection-in-depth
- Minimum consequence of a component failure
- Balanced protection

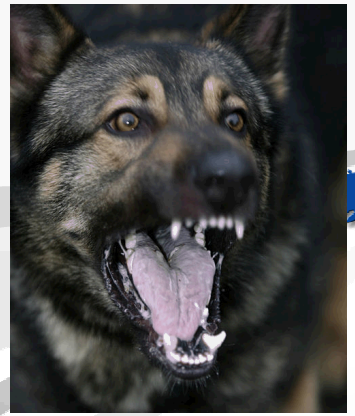
Protection-in-Depth

- Adversary must defeat or avoid a number of protective devices in sequence.
  - Multiple layers of detection, delay are preferred
- Protection-in-depth should:
  - Increase adversary's uncertainty about the system.
  - Require more extensive preparations by adversary prior to attacking the system.
  - Create additional steps where the adversary may fail or abort the mission.

Minimum Consequence of Component Failure

- Contingency plans must be provided so the PPS continues to operate after a component fails.
- Redundant equipment or personnel can take over function of disabled elements.
- Some failures require aid from sources external to the facility.





Balanced PPS

- Provides adequate protection along all possible paths.
- The minimum time to penetrate barriers should be equal, and the minimum probability of detecting penetration of each barrier should be equal.
- Maintains a balance with other considerations.
  - Cost, safety, and structural integrity

System Criteria

Approach	System Goal	Effectiveness Measures
Feature Criteria	Include required features (Example: 3 perimeter sensors required)	Number of features present
Performance Criteria	Meet PPS objectives (Example: System probability of interrupting adversary ≥ 70%)	Overall system performance
Combined Feature and Performance	Able to evaluate adequacy of feature based system	Feature performance

PPS Summary

- A successful PPS requires Detection, Delay, and Response components.
- The total time provided by a facility's detection, delay, and response must be less than the adversary task time.
- Protection-in-depth, minimum consequence of component failure, and balanced protection are all present in a well-designed PPS.

Questions?