National Nuclear Security Administration

United States
Department of Energy
National Nuclear Security Administration

International Nuclear Security

M5-D: Response Forces and Protective Strategy

Research Reactor Sabotage Protection Workshop

SAND2025-02023O

INS International Nuclear Security
Reducing Risk of Nuclear Terrorism

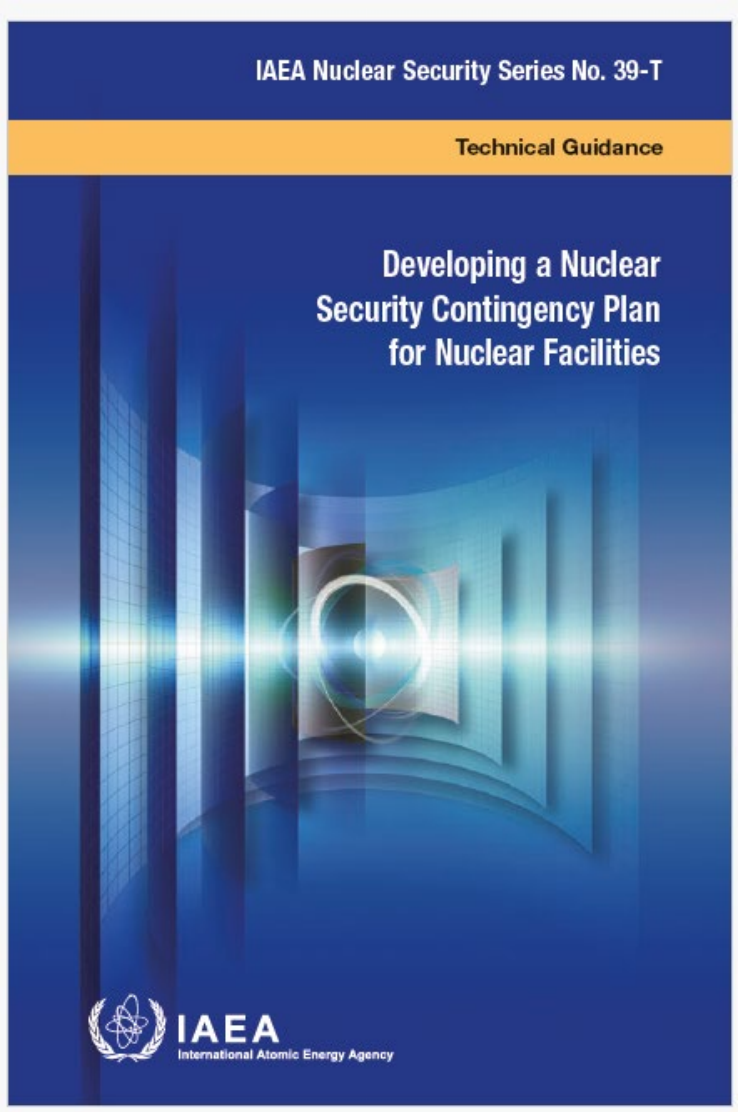
Learning Objectives

Objectives:

- Describe response fundamentals for research reactors
- Understand considerations for protective strategy development
- Discuss considerations for coordination of on-site response and off-site response

Response

- Without a timely and effective response, a PPS will not be able to prevent a determined adversary from completing its mission of radiological sabotage and/or theft of nuclear material
- Response capabilities must satisfy the regulatory requirements
  - Is PPS effective against DBT (or postulated threat)?
- Response is an element of PPS: Detect – Delay – **Respond**
- On-site security response must be coordinated with off-site security response and with emergency response
- IAEA NSS 39-T “Developing a Nuclear Security Contingency Plan for Nuclear Facilities” is a useful reference



Security Forces May Include

- Unarmed guards
  - Response function is limited to observation, reporting, and communication
- Armed guards
  - Similar to unarmed guards but can use weapons in self-defense
- On-site response force
  - Armed personnel with a primary function of providing response to attempted theft or sabotage by implementing protective strategy
- Off-site response forces - local law enforcement agency
  - Outside containment, resolution of minor incidents, investigation
- National-level off-site response forces
  - Specialized capabilities - tactical, EOD, riot control, etc.

On-Site vs Off-Site Response Forces

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Dedicated on-site (or near-site) response force is preferred in many practical situations

- Adversary timelines can be short (but can be increased by delay)
- Adversaries may be able to degrade or prevent off-site response
- Facility's response forces have better knowledge of the site and facility-specific response procedures

The role of local law-enforcement agencies is usually limited to outer containment and resolution of minor incidents

High-level off-site response is required to address protracted situations and to provide specialized capabilities

- Enhanced tactical response, EOD …

Adversary Success Metric (Notional)

- The primary regulatory objective is to prevent a DBT adversary from achieving its objectives against HRC/URC sabotage targets and nuclear material theft targets
- URC = adversaries access a target area(s) and have equipment and time to complete sabotage action
  - Reactor hall
  - Control room
    - URC target area examples are hypothetical!!!
- Nuclear material theft = adversaries remove the target material outside the protected area boundary
  - Target material: 10 kg U-235 in 19.75%-enriched LEU fuel (Category II)

Response Strategies for Research Reactors

- URC targets
  - Primary strategy: Denial of access (denial-of-task)
  - Secondary strategy: Minimize and mitigate
- Theft targets
  - Primary strategy: containment
  - Secondary strategy: locate and recover

Primary strategies are implemented by on-site and off-site response forces according to contingency plans and response procedures

Secondary strategies require extensive coordination with off-site response organizations and with the Operator organizations

Protection of URC Sabotage Targets

- Response strategy - denial of access to or denial of task at target areas
- Implementation
  - Deploy response forces to interdiction positions to prevent adversaries from entering target areas, redeploy as needed
    - Adversary attack must be detected, assessed, and monitored
    - Delay must be adequate to ensure timely deployment
  - Response must be effective and provide defense-in-depth
  - Strategy must account for adversary actions to diminish the effectiveness of response forces
  - Response forces transition to minimize and mitigate strategy should adversaries complete the sabotage action

Protection of Nuclear Material Theft Targets

- Response force implements a containment strategy to:
  - Delay and degrade adversaries on the way to the fuel storage area
  - Minimize opportunities for adversaries to escape with nuclear material by covering potential exfiltration routes and/or preventing adversary's use of vehicles to remove target material off-site
  - LLEA provides outer containment and sets up road-blocks
  - High-level tactical team arrives to retake the area and neutralize adversaries
  - Response elements transition to locate and recover strategy if containment fails

Effective Response

- Integration with PPS measures (detection, delay …)
- Preplanned actions according to contingency plans and procedures
- Response fundamentals
  - Sufficient numbers of appropriately trained and equipped personnel
  - Physical fitness, firearms and tactical skills, knowledge of the site
  - Use of protective positions
  - Command and control
- Defense in depth
- Coordination with off-site response forces and emergency response

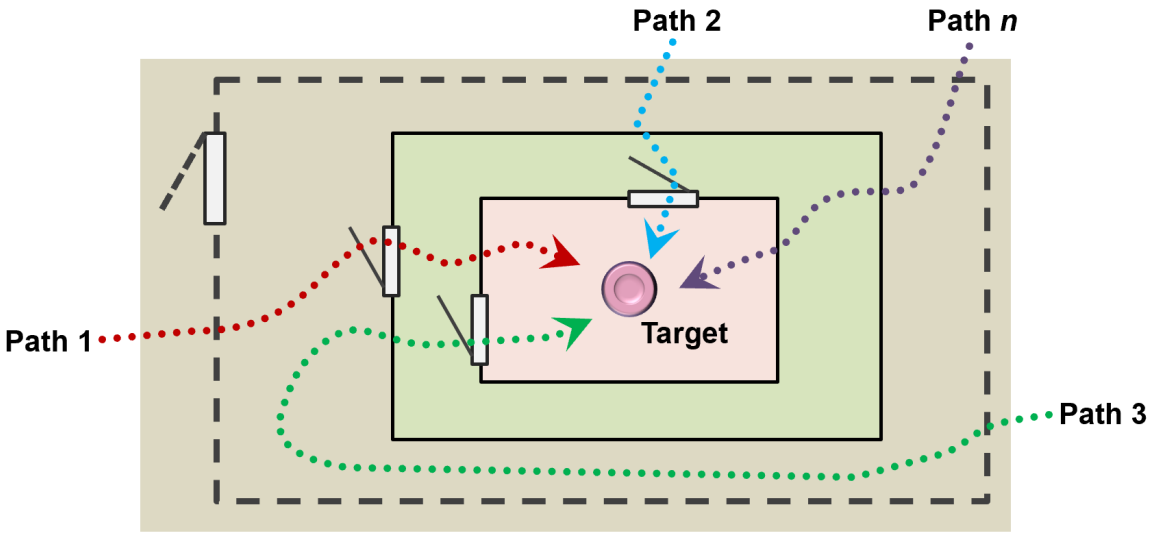
Protective Strategy Development

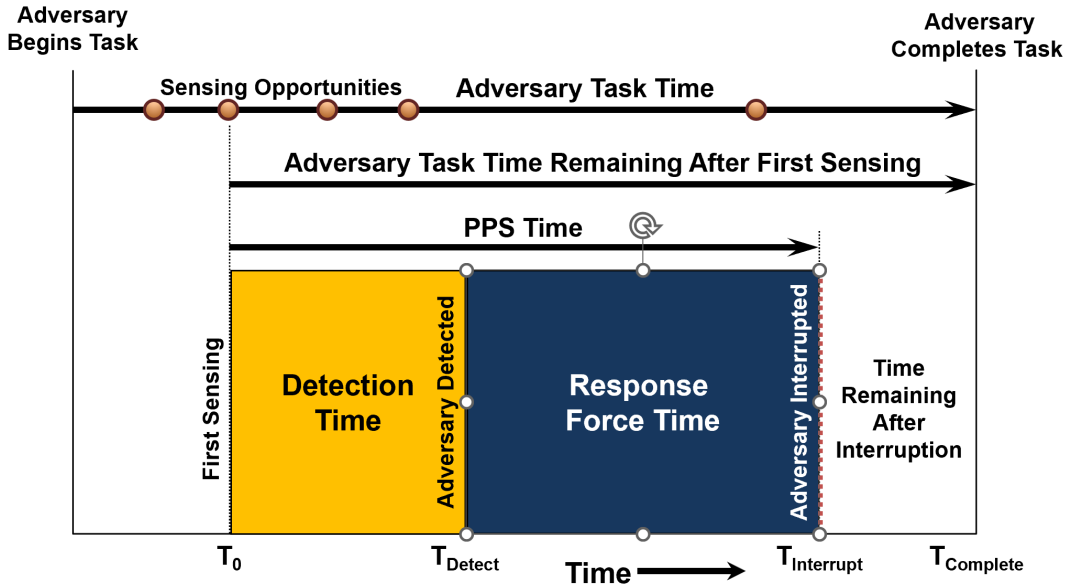
$$Pe = Pi \times Pn$$

- System effectiveness (Pe) - Probability that the PPS will prevent the adversary from completing its objective
- Probability of interruption (Pi) - probability that the response force arrives in time to interrupt the adversary
- Probability of neutralization (Pn) - given interruption, probability that the response force neutralizes the adversary action
- Protective strategy development considers both Pi and Pn
  - Adversary path analysis (adversary sequence diagram)
  - Scenario analysis

Adversary Path Analysis

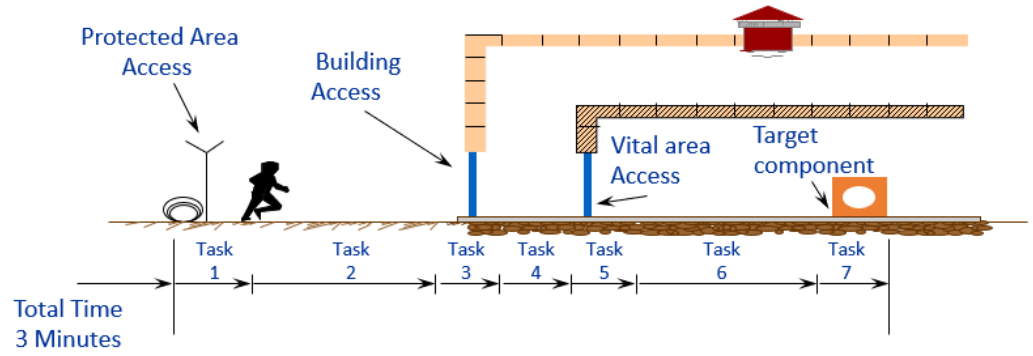
- Analyze all different paths and targets
- Each path has an associated adversary timeline and response timeline
  - Protective strategy is normally developed assuming assured detection at a PA boundary (critical detection point)
- These timelines and Pi may differ for each path
- For an effective response, the protection on each path must be adequate





Adversary Sequence Diagram

- Assists path and scenario analysis
- Is developed utilizing
  - Time-motion study data
  - Delay time data
- Is analyzed against response timelines to determine the timing and location of engagements



Time Estimate

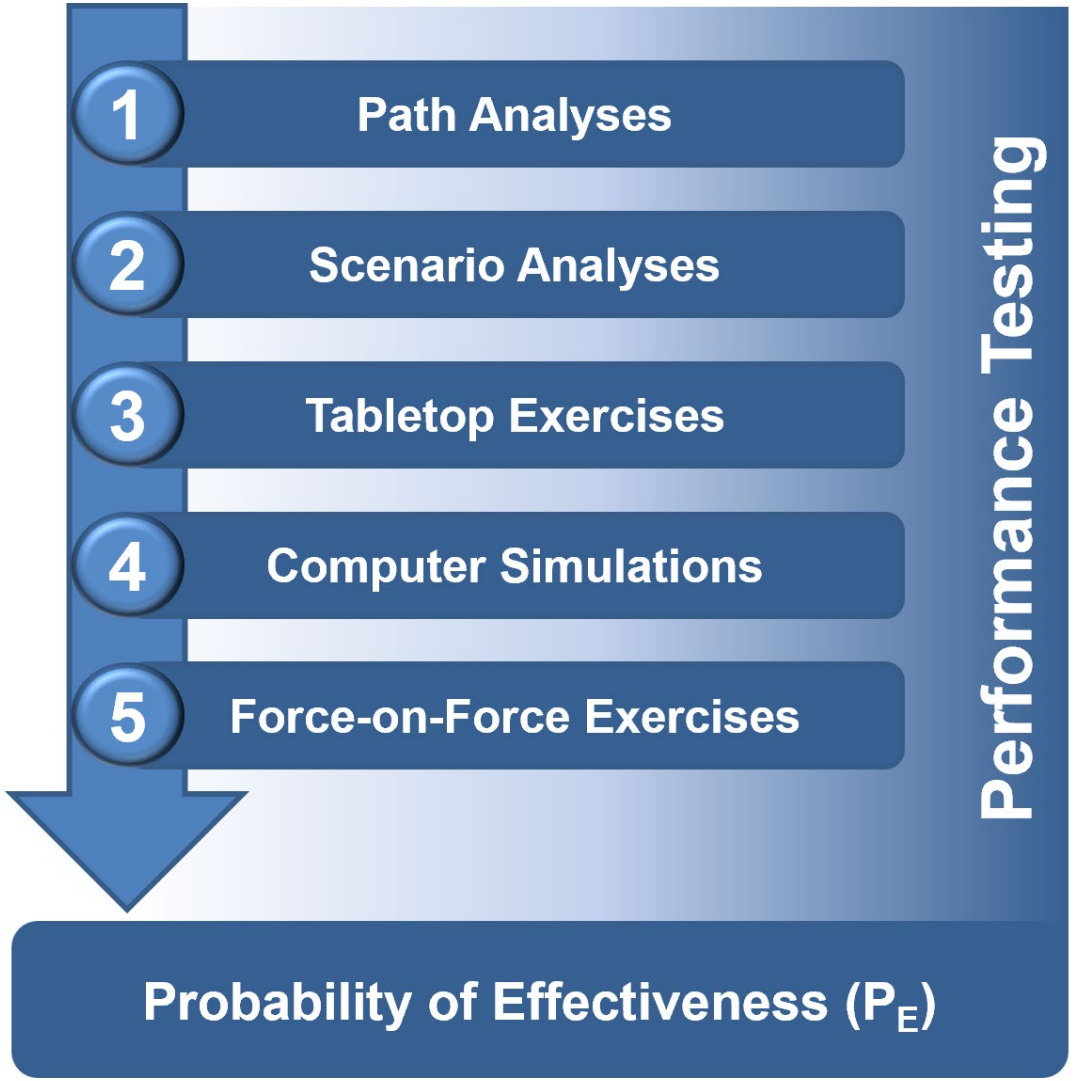
Task	Task Time (seconds)	Cumulative Time seconds	Task Description
1	12	12	Climb over fence
2	12	24	Run 76 m
3	48	72	Force door
4	24	96	Walk 45 m
5	12	108	Cut lock
6	06	114	Walk to target location
7	66	**180**	Locate target and place explosive charge

Scenario Analysis

- Develop an operationally feasible adversary attack scenario (mission plan) against a given target
- Consider PPS effectiveness for a specific adversary path
  - Can response forces interrupt the adversary (Pi)?
  - Can response forces neutralize the adversary (Pn)?
- Neutralization analysis may involve expert judgement, use of TTX and field exercise data, modeling and simulations
- Are there ways for adversaries to alter the outcome? e.g.
  - Compromise communications
  - Use diversions
  - Delay/ neutralize off-site response

Protective Strategy Evaluation

- Performance tests provide critical information
- All evaluation tools and methods have strengths and weaknesses
- TTX can be particularly effective
- Use of different tools is beneficial
  - The use of some tools may be omitted or scaled down



Coordination With Local Law Enforcement

- Local police (LLEA) primary function is to resolve minor incidents and provide containment and control the area outside the facility
- Considerations for LLEA coordination
  - Notification
  - Site familiarization
  - Procedures and protocols
    - arrival and linking-up with on-site security forces
    - on-site operations, communication, command and control
    - Establishment of inner and outer containment
- Training and exercises
- Arrangements are normally documented in a Memorandum of Understanding

National Response Coordination (1)

National response forces serve to resolve significant security incidents beyond the capability of on-site response forces or LLEA

- Specialized capabilities – SWAT, EOD, etc
- Response time is likely to be significant

Considerations for coordination

- Notification and periodic information updates
- Arrival on site and initial briefings
- Transition of the command and control authority
- Support from site security personnel and LLEA

Training and exercises

National Response Coordination (2)

Significant security incidents are likely to require an activation of national response plans and capabilities (e.g, activation of a national crisis response center, NCRC)

Considerations

- Composition and operations of NCRC
- Notification and periodic information updates from the site to NCRC
- Security of other critical infrastructure facilities
- Emergency response
- Intelligence investigation
- International notifications

Training and exercises

In Conclusion

- Protective strategy is established to prevent DBT adversary's success and must account for both sabotage and theft targets
- Both adversary interruption and neutralization must be addressed
- Protective strategy development includes an adversary path analysis and a scenario analysis
- Protective strategy evaluation may include a range of evaluation techniques
- On-site security response must be coordinated with off-site response and with national response

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Questions, Comments, Concerns?

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