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DEVELOPMENT OF PHYSICAL PROTECTION MEASURE PERFORMANCE DATA FOR RADIOACTIVE MATERIAL FACILITIES

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Outline

- Performance data required for compliance-, performance- and combined regulatory approaches
- Process for collecting and using performance data
- Creating qualitative robustness factors based on testing
- Testing methods to collect detection, delay, access control and communications performance data
- Probability models for evaluating facility detection
- Communications and response considerations evaluated/analyzed during facility vulnerability assessment (VA) process
- Regulator activities based on operator's VA results
- Determining timeliness and effectiveness by incorporating response data
- Summary

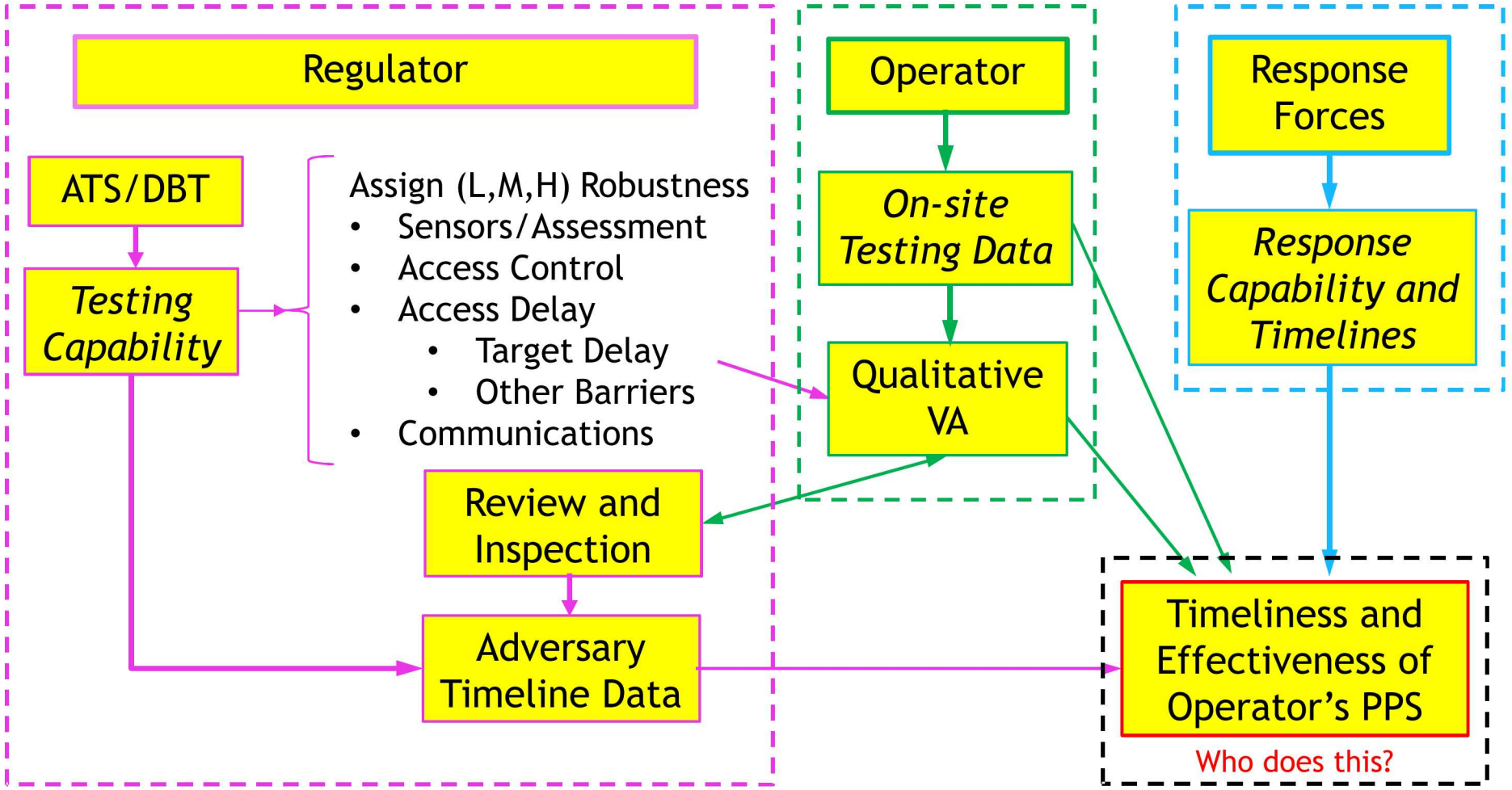
Performance Data Required for Compliance-, Performance- and Combined Regulatory Approaches

- Performance data is needed to validate requirements even for compliance-based regulatory approaches
- A Design Basis Threat (DBT)-based regulatory approach requires the full range of tests shown below
- Example of a "Non-DBT Performance"-based approach would be associated with use of an Alternate Threat Statement (ATS)
  - Delay testing would be performed away from the operator's facility
  - Typically results from these tests would not be known by the operator

Type of Testing	Compliance	Non-DBT Performance	DBT Performance
Maintenance (e.g., "30 out of 30 tests")	X	X	X
Training Proficiency (including procedures)	X	X	X
Auditing Records	X	X	X
Evaluation of Physical ProtectionEquipment	X	X	X
Limited Scope Performance Tests (for training, times)		X	X
Access Delay Measure Testing		X	X
Adversarial Performance Testing			X
Force-on-Force Exercises			X

Process for Collecting and Using Performance Data

Diagram shows how radioactive material facilities can be evaluated for effectiveness combining performance data from the regulator, operator and response force organizations



Creating Qualitative Robustness Factors Based on Testing

- Regulator assigns Low, Medium and High Robustness, based on their graded approach, the ATS/DBT and the results of testing

Regulator

- Operator performs a qualitative VA without knowing the basis of those assignments

Category of Detection	Type of Detection	High	Medium	Low
Electronic Detection	Door Position	Balanced Magnetic Switch (BMS)	Frame-mounted (covert) magnetic switch	Plunger Contact switch
				Magnetic Switch
	Volume/room	Dual Tec with OR'd outputs	Passive Infrared	Audible Sensor
			Microwave	
		Video Motion	Dual Tec with AND'd outputs	

Assign Detection Robustness

ATS/DBT

Testing Capability

Assign Delay Robustness

DELAY ROBUSTNESS

Category of Delay	High	Medium	
Surfaces	Reinforce Concrete	Sheet metal	Pla
	Filled Block with rebar	Plywood	Co
	Steel plate (>1/4" thick)	Hollow brick (1-2 layers)	Cha
	More than 3 layers of brick		We
	1-inch diameter thick grating/ expanded metal/ welded rebar surface		
Windows	Ballistic Resistant/ Forced Entry rated glass	Laminated glass	Sta
	Exterior & Interior Heavy Metal Grating over Windows	Tempered glass	Wi
			Filn
Doors	GSA Class IV & V Vault	Solid wooden doors with hinge pins and quality locks	Hol
	UL 608 vault doors or other burglary rated doors	Hollow steel doors with steel frames with hinge pins and quality locks	Any win allo unl
Locks	Shrouded "Hockey Puck" Locks	Multiple Deadbolt	Sin
	Shrouded Padlocks		Cip
	Electromagnetic Locks		Typ
Source	Industrial Irradiators	Brain Tumour Irradiators	Rad
		Blood Irradiator	

Testing Methods to Collect Detection, Delay, Access Control and Communications Performance Data

- Suggest using a dedicated test facility

Regulator Testing Capability

- Otherwise, get data from a national testing facility supporting physical protection for other targets needing high security
  - Government buildings, military facilities and airports
  - Industrial targets/transport: jewelry/art, drug and money-handling
- Collect data informally, e.g., collect delay and task times performed by:
  - Construction/machine shop and building demolition companies
  - Military and police units
  - Small, relatively simple, tests:
    - Running, driving, lifting and crawling
    - Simulating placing explosives

Possible On-site Testing by Operator ***Perform Only if It can be Done safely***

- In limited cases, facility tests to collect times and set robustness factors
  - Example: To see if a mis-aimed sensor can be defeated (Medium → Low)

Probability Models For Evaluating Facility Detection

- Complete Detection Model (T = Adversary Tactic)

$$P_D(T) = P_{(Sensing)}(T) * P_{(Alarm\ Communication)} * P_{(Assessment\ at\ j\ |\ Alarm\ Communication)}$$

  - $P_{(Sensing)}(T) = P_S(T \mid MA_s) * P(MA_s)$

    Where MA_s = condition that the sensor is:

    - Maintained and operated using proper training and procedures AND
    - Available and functioning properly at the time of the adversary intrusion/malicious act

    Operator

  - $P_{(Alarm\ Communication \mid MA\text{-}ACD)} * P_{(Assessment\ at\ j\ |\ Alarm\ Communication,\ MA\text{-}ACD)} P(MA_{ACD})$

    Where MA_{ACD} = is conditioned on the same information about AC&D system

    $P(MA_s)$, $P(MA_{ACD})$ derived based on quality programs for the sensor/AC&D system

- $P_S(T \mid MA_s)$ come from the regulator testing facilities — Regulator
- $P_{(Assessment\ at\ j\ |\ Alarm\ Communication,\ MA\text{-}ACD)}$, Time to Assess derived based on on-site tests

One Way to Test Whether $P_s(T|MA_s)$ is Indeed the Robustness Factor You Assigned It

Sequential Test

Failures

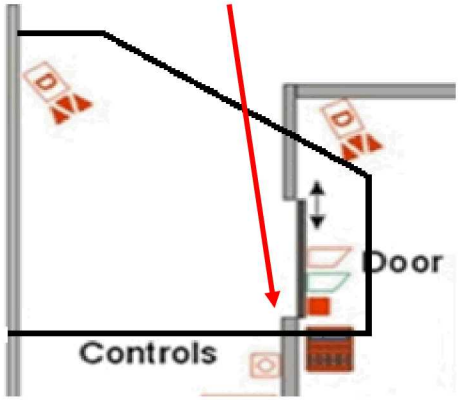
Passes	0	1	2	3	4	5	6
0	M	L			L		
1	H				L		
2						L	
3				M	M		
4	H	H		M			
5			H				
6							

Assumptions about robustness *before* tests

Conclusions about robustness *after* tests

In this case Low ≅ .3, Medium ≅.5 and High ≅ .7

Example: try to move slowly along wall to reach door handle



Note: Don't use confidence intervals to *estimate* probabilities since the lower bound can be much lower than the true probability

Communications and Response Considerations Evaluated/Analyzed during Facility VA Process

- Communications — Operator
  - Alarm communications: sensor to alarm station
  - Communications from alarm station with on-site forces
  - Communications from alarm station with off-site forces (involves off-site dispatch)
  - Times associated with these processes
- Response (from off-site)
  - Interaction with the site in VA: plans developed, target folders developed and scenarios performed using Table-top Exercises — Operator
  - Note: Effectiveness of off-site response force typically defined by regulator and response force organization: e.g., hypothetically, 6 responders with X equipment and capabilities should be sufficient to neutralize the adversary — Regulator, Response Forces

Regulator Activities Based on Operator's VA Results

Operator (VA) Results

Regulator

Room Boundary Summary

Adj. Detn. Robustness$_{1Sum}$	H
Adj. Delay Robustness$_{1Sum}$	M

(1) Find first layer with Summary Detn. Robustness = M or H

← Treat as if a CDP: Count Delay Thereafter

P_D: (High Dual-Tech OR'd) → *Meets Requirements*

Delay: (Medium Door) → *Door Delay* Testing Data Set*

Cage Summary

Adj. Detn. Robustness$_{2Sum}$	NA
Adj. Delay Robustness$_{2Sum}$	NA

(2) Find largest Delay Robustness at that layer* or later

Delay: None (No Measures) → *Delay = 0 seconds*

Teletherapy Unit Summary

Adj. Detn. Robustness$_{3Sum}$	H
Adj. Delay Robustness$_{3Sum}$	M

*Adjusted for Time After Detection at that Layer

Not counted Here → *Delay = 0 seconds*

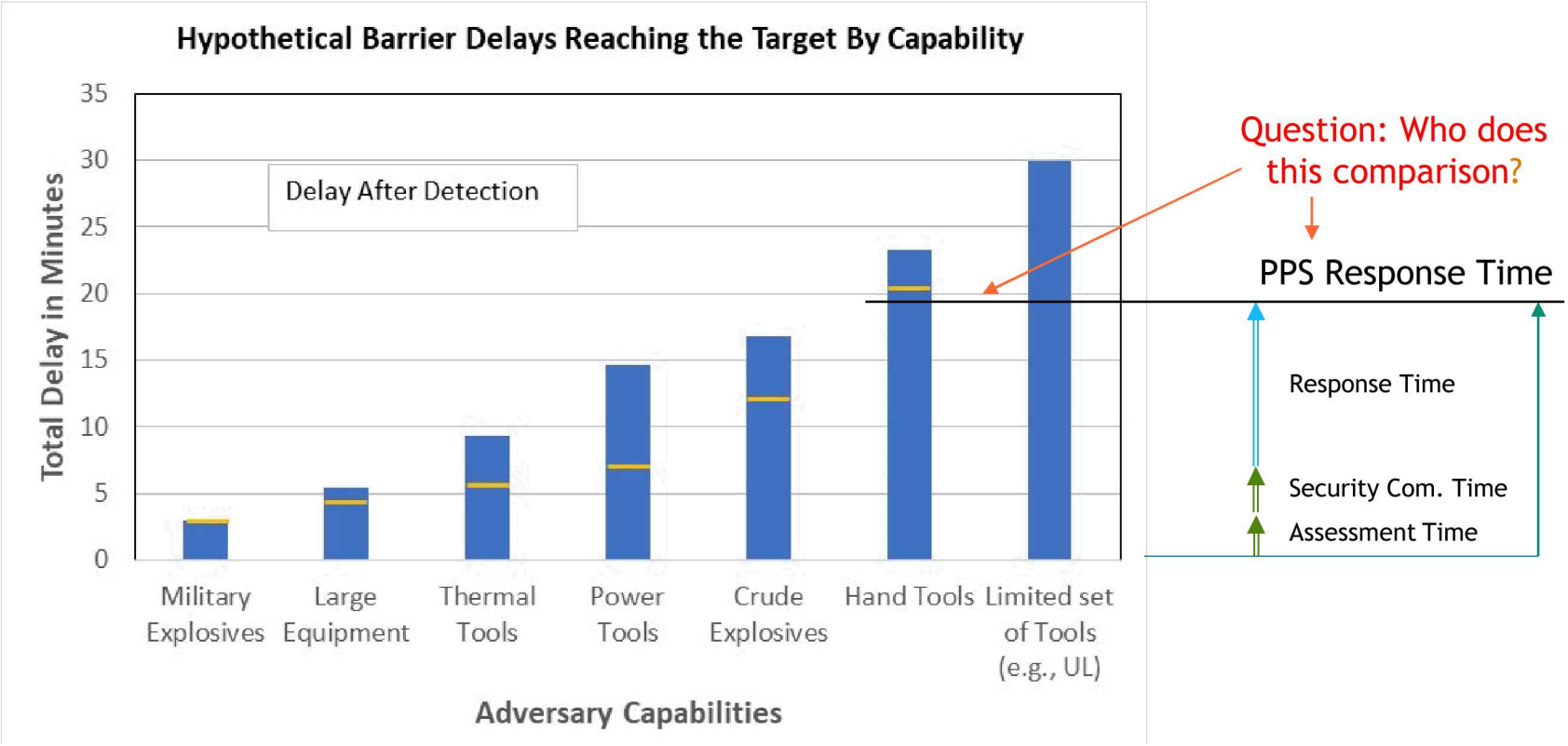
*Set of Total Delay(s)**

Determining Timeliness and Effectiveness of Operator's Physical Protection System by Incorporating Response Data

Hypothetically, a policy on graded protection might indicate that a timely response against an adversary with hand tools is adequate for a Brain Tumour Irradiator

DELAY ROBUSTNESS			
Category of Delay	High	Medium	Low
Source	Industrial Irradiators	Brain Tumour Irradiators Blood Irradiator	Radiography Cameras

Timeliness and Effectiveness of Operator's PPS



A hypothetical graded protection policy might also indicate that the 6 police who arrive within this PPS Response Time provide an adequate P_N

Summary and Closing Thoughts about the Approach

- Combines regulator, facility and response organization testing data
- May be appropriate to support Qualitative VA performed by facility as part of a combined regulatory approach using an ATS
- Similar approach might be created when facility operator works with an on-site response
- Issue: Who combines regulator and facility analysis with response organization data to see whether the entire system is effective?