



*United States
Department of Energy
National Nuclear Security Administration*

Selection and Optimizing of Testing and Analysis

Practical Example of Analysis and Testing



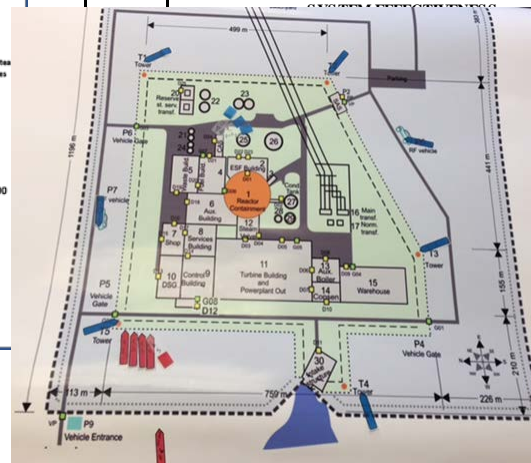
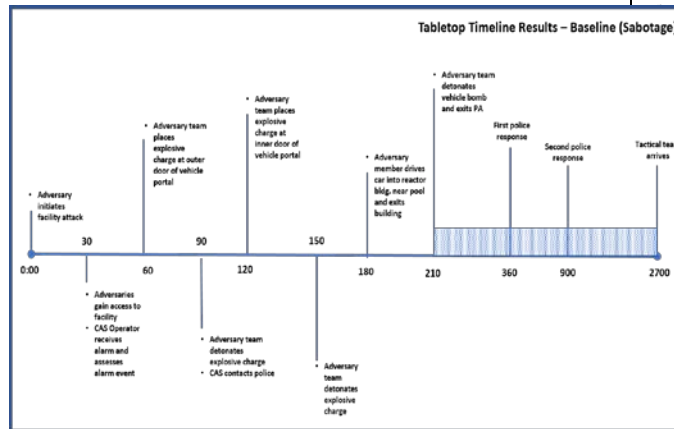
Analysis and Testing

- Types of analysis tools
- Testing Considerations
 - Types of testing
 - Graded approach
- Statistical analysis method
- Key (Critical) Detection Points
- Practical Example

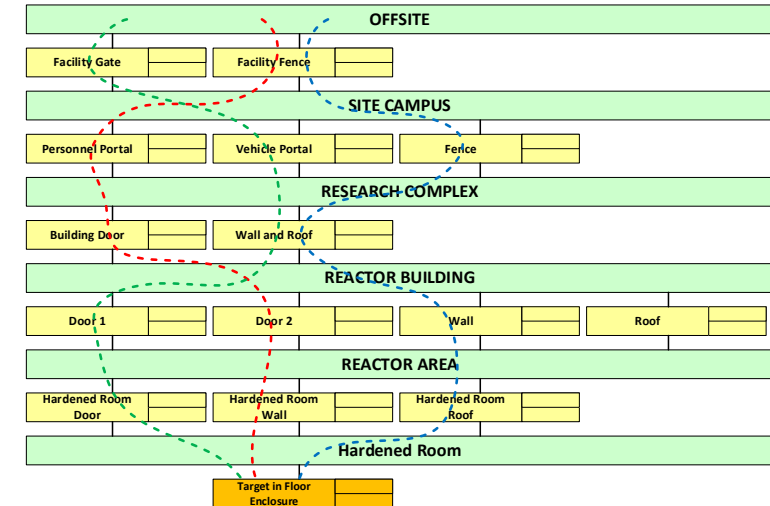
Types of analysis tools

Manual Single Path Analysis Models

Hypothetical Facility - Sabotage Case								
Threat: 4 adversaries + active nonviolent insider				Target: Research Reactor Pool				
Step	Adv. Step Task	Adv. Cuml. Task Time	Step Description	P _S	P _A	P _I	P _N	Step Score
1	5	5	Crash emergency gate W/vehicle	VH	VH	VL	H	VL
2	20	25	Drive 125m to Reactor Building	VL	VL	VL	H	VL
3	30	55	Set up and detonate explosives to defeat outer door of vehicle portal	VH	VL	VL	H	VL
4	30	85	Set up and detonate explosives to defeat inner door of vehicle portal.	VH	VH	M	H	M
30		115	Drive vehicle bomb into the reactor hall and place bomb next to the reactor pool. Adversary vehicle exits reactor hall.	VH	VH	VH	H	H
30		145	Adversary team detonates the bomb	VH	VH	VH	H	H
								VL



Computerized Multipath Analysis Model



Computerized Multipath 2D and 3D Simulation Models

All analysis tools and methodologies require some expert judgement data that must be validated

For more information on analysis tools see *IAEA-TECDOC-1868 - Nuclear Security Assessment Methodologies for Regulated Facilities*
<https://www.iaea.org/publications/13416/nuclear-security-assessment-methodologies-for-regulated-facilities>

Some Testing Considerations

One test is too few, and ten thousand is too many

- Types of testing
 - Prescriptive testing
 - Performance based testing
 - Limited scope test vs force on force exercises
- Graded approach to testing
 - Threat
 - Consequence of event
 - Category of nuclear material (I, II, III)
 - Radiological Source Term (RR vs NPP)

Statistical approach (detection and confidence levels)

Confidence Level (C)
C = 95% C = 90% C = 80% C = 70% C = 60% C = 50%

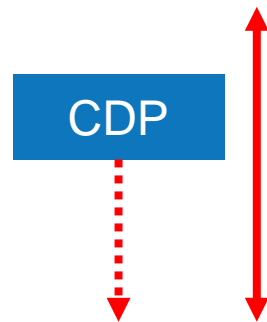
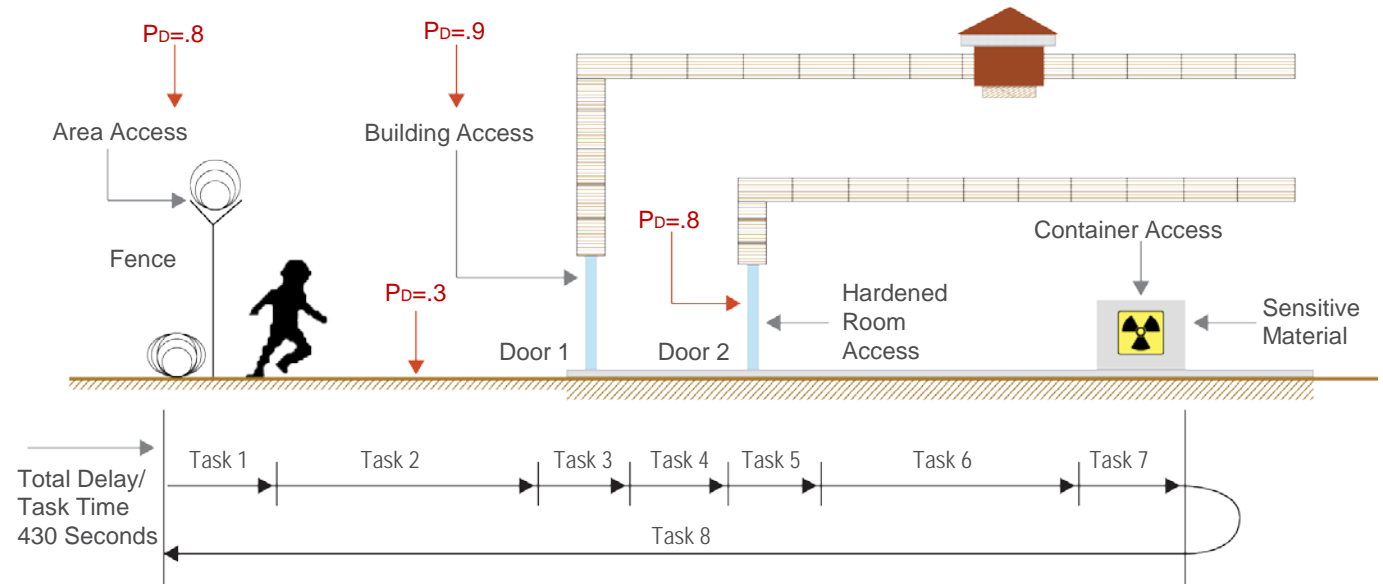
P_d	Number of tests without failure					
0.1	2	1	1	1	1	1
0.2	2	2	1	1	1	1
0.3	3	2	2	1	1	1
0.4	4	3	2	2	1	1
0.5	5	4	3	2	2	1
0.6	6	5	4	3	2	2
0.7	9	7	5	4	3	2
0.8	14	11	8	6	5	4
0.9	30	22	16	12	9	7

- **Established programs** – Numbers of tests based on regulatory criteria
- **New programs** – Increase probability of detection and confidence levels over time to meet regulatory criteria

Key (Critical) Detection Point (CDP)

CDP:

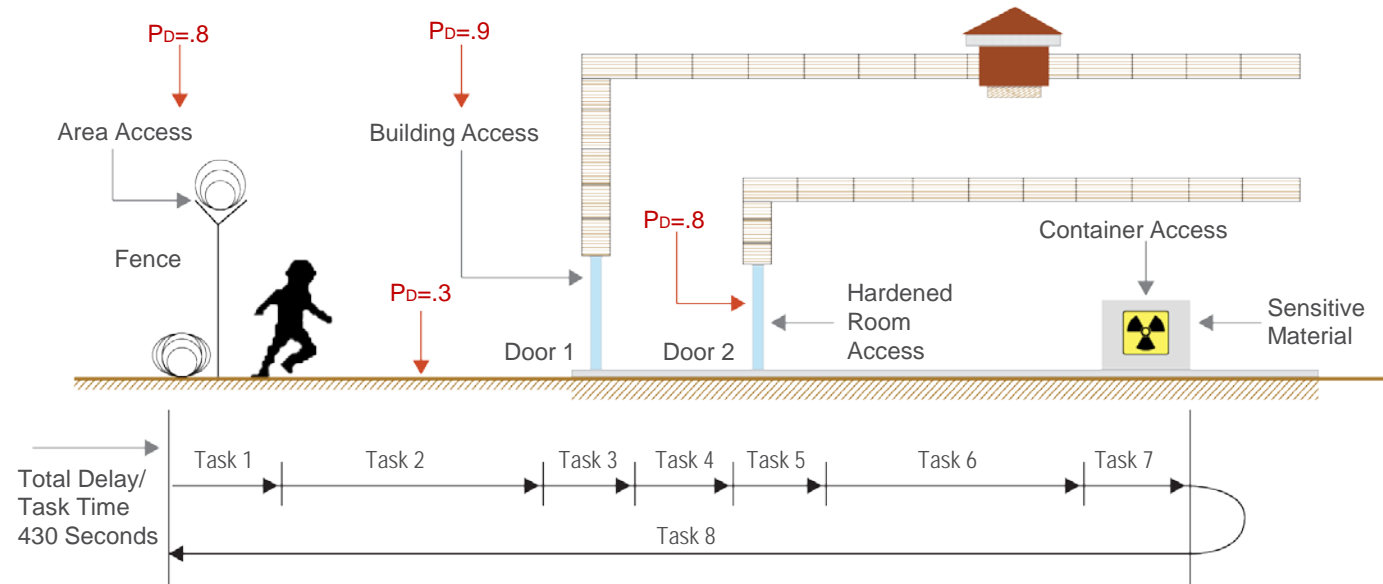
- Most likely change following performance testing results
- Affected by defeat strategy as well as delay/task time
- Closer to the target the more defense in depth of the PPS
- Once established, testing the PPS at the CDP is a priority



Task	General Description of Adversary Actions	Delay/Task Time	Minimum PD
1	Penetrate fence	12	0.8
2	Cross research complex area	12	0.3
3	Penetrate Door 1	48	0.9
4	Cross building floor to hardened room door	24	
5	Penetrate Door 2	48	0.9
6	Cross hardened room to container	10	0.8
7	Open container and gather material	180	0.8
8	Escape by same route used for entry	54	
		Total Delay/Task Time 430 Seconds	

Response time is assumed at 300 seconds

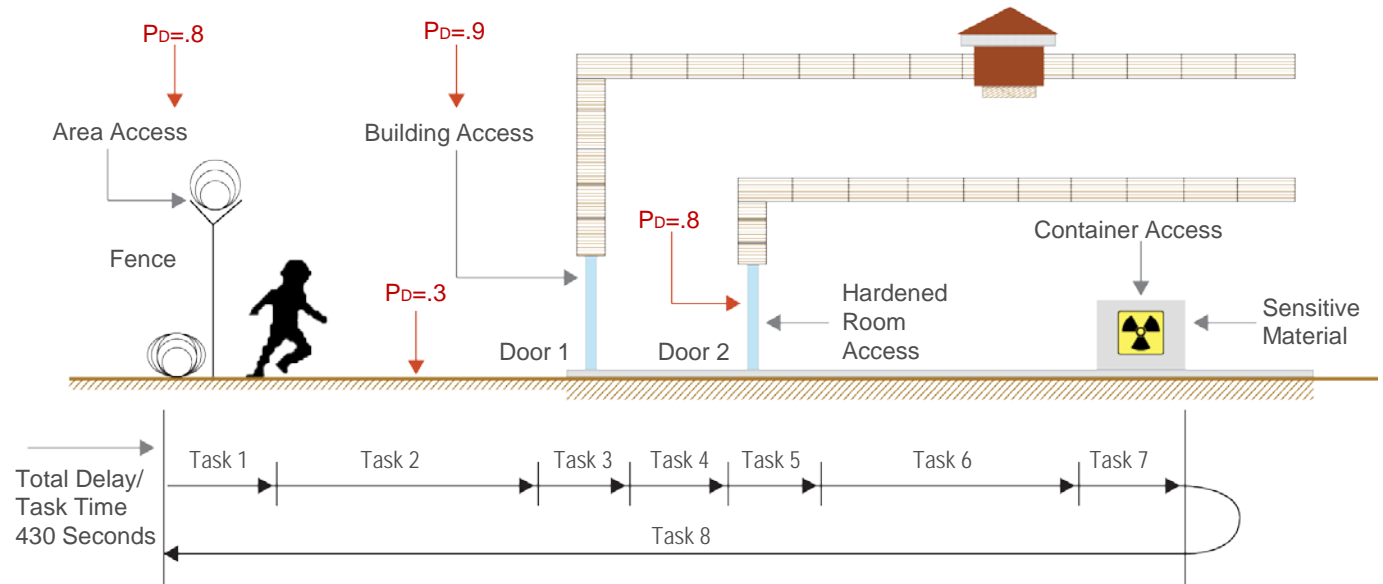
Initial Assumed Adversary Actions and Delay/Task Time



Which task should be limited scope tested to provide the highest benefit to validate the assumed timeline?

Task	General Description of Adversary Actions	Delay/Task Time	Minimum PD
1	Penetrate fence	12	0.8
2	Cross research complex area	12	0.3
3	Penetrate Door 1	48	0.9
4	Cross building floor to hardened room door	24	
5	Penetrate Door 2	48	0.9
6	Cross hardened room to container	10	0.8
7	Open container and gather material	180	0.8
8	Escape by same route used for entry	54	
		Total Delay/Task Time 430 Seconds	

Initial Assumed Adversary Actions and Delay/Task Time



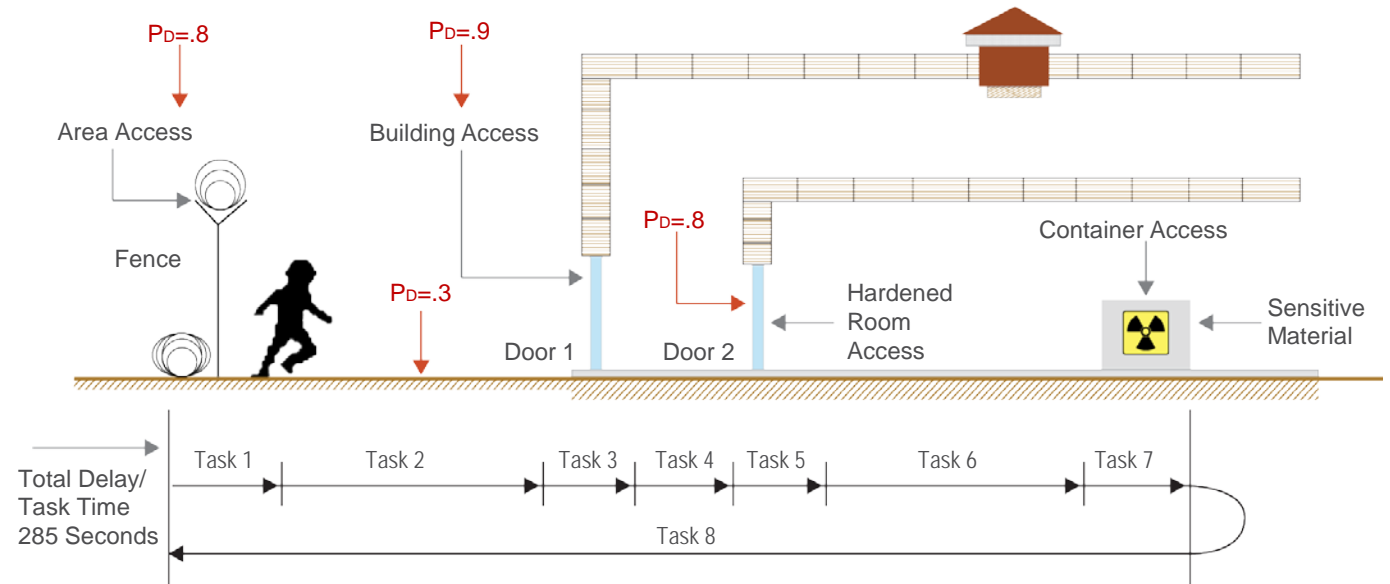
Validation of Task 7 is suggested to provide the highest benefit to validate the assumed timeline

Task	General Description of Adversary Actions	Delay/Task Time	Minimum PD
1	Penetrate fence	12	0.8
2	Cross research complex area	12	0.3
3	Penetrate Door 1	48	0.9
4	Cross building floor to hardened room door	24	
5	Penetrate Door 2	48	0.9
6	Cross hardened room to container	10	0.8
7	Open container and gather material	180	0.8
8	Escape by same route used for entry	54	
		Total Delay/Task Time 430 Seconds	

Response time is assumed at 300 seconds

Revised Adversary Actions and Delay/Task Time

- Initial Step 7 assumed value was 180 seconds
- Performance testing resulted in a new time of 35 seconds
- “Potential” task time is now shorter than the response time
- Next steps?



Task	General Description of Adversary Actions	Delay/Task Time	Minimum PD
1	Penetrate fence	12	0.8
2	Cross research complex area	12	0.3
3	Penetrate Door 1	48	0.9
4	Cross building floor to hardened room door	24	
5	Penetrate Door 2	48	0.9
6	Cross hardened room to container	10	0.8
7	Open container and gather material	35	0.8
8	Escape by same route used for entry	54	
		Total Delay/Task Time 285 Seconds	

Response time is assumed at 300 seconds

Summary

- Analysis tools vary from manual to complex methods
- Graded approach to analysis and testing
- Can building testing data over time
- Test elements of highest certainty

A few well selected tests can greatly increase the confidence of the analysis results



I N S

International Nuclear Security

Reducing Risk of Nuclear Terrorism