Subgroup 17S
Path Analysis

Session Objectives

After the session, the participants will be able to do the following:

1. Determine the probability of interruption, critical detection point, and Adversary Task Time after CDP for an adversary path using a computerized EXCEL™ version of EASI.

2. Interpret the results of EASI.

3. Find the Most-Vulnerable Path Through an Adversary Sequence Diagram

Exercise 1 - EASI Analysis of Fence Intrusion

Part 1: Using the information in the Exercise Data Book and information from Exercise 3 from your ASD Subgroup, determine the probability of detection, delay time and standard deviation to complete the table for the sabotage path below. When all delay times have been identified, complete the Adversary Task Time Countdown Column. Note that the Response Force Time EASI asks for is called the PPS Response Time in this course.

To compute the probability of detection of a series of sensors, multiply the probabilities of nondetection; then subtract from 1.0 to get the combined probability of detection.

Probability of alarm communication = _____

Response Force Time = _____

Standard deviation of Response Forcee Time = _____

Adversary Action (Tasks)	Probability of Detection	Location	Time Delay (seconds)	Standard Deviation (± seconds)	Adversary Task Time Countdown
1. Climbs the outer wall					
2. Runs to the PTR					
3. Climbs the fence					
4 Runs to the reactor building					
5. Penetrates the vehicle access doors					
6. Runs to D91					
7. Penetrates D91					

8. Locates the Plutonium and sets explosives.					**0**

Note: Be sure to use the same unit of time throughout the problem.

Exercise 1 - EASI Analysis of Fence Intrusion (continued)

Part 2: Use EASI to compute the probability of interruption (P_I) for this sabotage attempt under normal daytime operating conditions

Load and run the computerized EXCEL™ version of EASI.

An example path has been entered into the tool. Modify the entries and evaluate the sabotage path.

1) For this path:

A. Where is the CDP? _____

B. What is the Adversary Task Time after CDP? _____

C. What is the probability of interruption given by EASI? P_I = _____

2) If the guard response time drops to 90 seconds:

A. Where is the CDP? _____

B. What is the Adversary Task Time after CDP? _____

C. What is the probability of interruption given by EASI? P_I = _____

3) What is the probability of interruption if two minutes of access delay are added at the target protecting the plutonium (with the 90 second guard response time)?

A. Where is the CDP? _____

B. What is the Adversary Task Time after CDP? _____

C. What is the probability of interruption given by EASI? P_I = _____

4) What is the probability of interruption if a fence vibration sensor is added to the inner fence (with both changes above)?

A. Where is the CDP? _____

B. What is the Adversary Task Time after CDP? _____

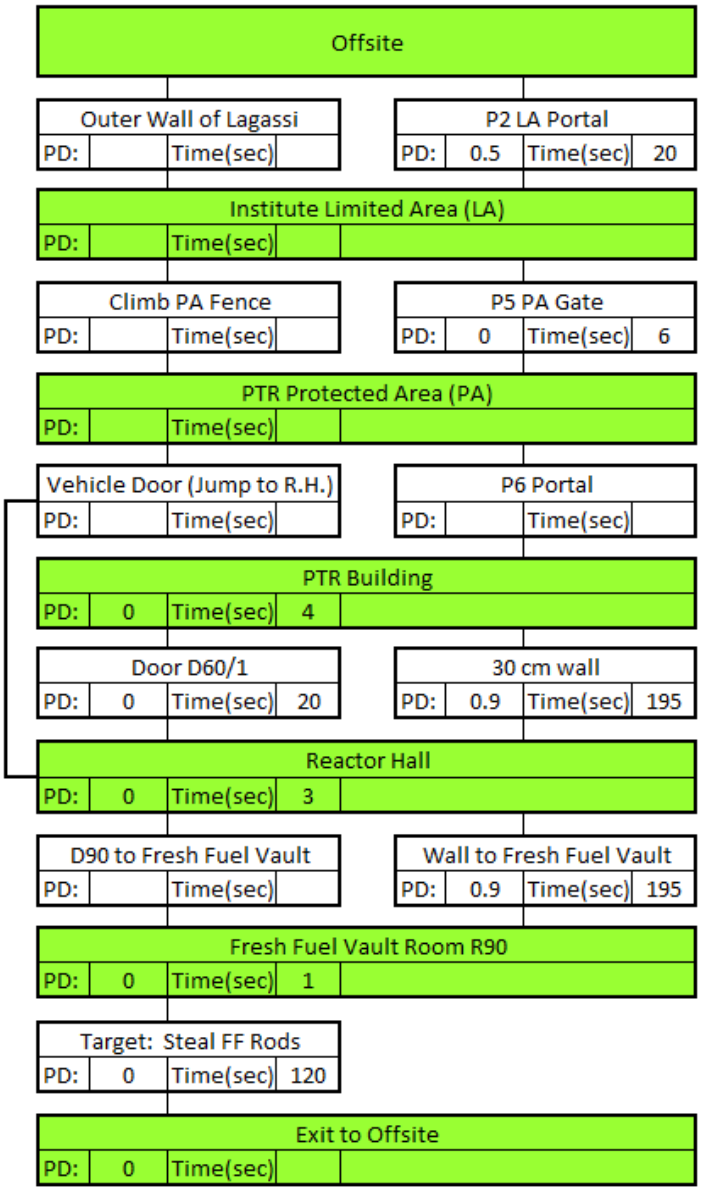
C. What is the probability of interruption given by EASI? P_I = _____

Exercise 2 – Determine the Most Vulnerable Path

Complete the data values needed for the ASD provided below and then determine the Most Vulnerable Path based on the Guard Response Time found in Exercise 1. Indicate the path on the ASD by circling the path elements and areas. Please be aware that there should be two paths; one without a jump element and one with just a jump element.

Note: For the areas and left-hand elements with no P_D or Time delay, use the values you determined from Exercise 1. For P6, assume that the adversary has a stolen badge and PIN. For the area entitled "Exit to Offsite" please sum the delay of the areas down to the target and enter the sum into the Time(sec) cell.

To compute the probability of detection of a series of sensors, multiply the probabilities of nondetection; then subtract from 1.0 to get the combined probability of detection.



Exercise 3 - EASI Analysis ofMost Vulnerable path

1.Enter the data for the path determined in Exercise 2.

Adversary Action (Tasks)	**Probability of Detection**	**Location**	**Time Delay (seconds)**	**Standard Deviation** (± seconds)	**Adversary Task Time Countdown**
					0

2. For this path:

   A. Where is the CDP? _____

   B. What is the Adversary Task Time after CDP? _____

   C. What is the probability of interruption given by EASI? P_I = _____

   D. What is the exit time to Offsite? _____

Application Considerations

1. Which adversary strategies can be analyzed using EASI?
   a) Theft only
   b) Sabotage only
   c) Both theft and sabotage
   d) Neither theft nor sabotage

2. How many paths can be analyzed at one time using the EASI model?
   a) Only a single path at a time
   b) Multiple paths at a time
   c) Both a and b

3. The main purpose in using EASI is to compute:
   a) Probability of interruption
   b) Probability of adversary success
   c) Probability of communication
   d) Probability of neutralization

4. The output of EASI is:
   a) Single path step probability
   b) Cumulative probabilities over the path
   c) Response force times
   d) Path access delays

5. The standard deviations used in an analysis tool should be obtained from:
   a) Experimental test data
   b) Practical experience
   c) Both a and b
   d) Neither a nor b

6. The output from EASI:
   a) Always includes the most vulnerable path
   b) Only includes the most vulnerable path
   c) May include the most vulnerable path
   d) Never includes the most vulnerable path

7. In the EASI model:

a) Detection always follows delay
b) Detection and delay are simultaneous
c) Delay always follows detection
d) Detection and delay are path dependent

8. What is the relationship between the probability of neutralization P_N and EASI?
   a) P_N is independent of EASI
   b) P_N X P_I = system effectiveness
   c) It is cumulative along the path
   d) Both a and b

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1. Determine the probability of interruption, critical detection point, and Adversary Task Time after CDP for an adversary path using a computerized EXCEL™ version of EASI.

2. Interpret the results of EASI.

3. Find the Most-Vulnerable Path Through an Adversary Sequence Diagram

Exercise 1 - EASI Analysis of Fence Intrusion

Part 1: Using the information in the Exercise Data Book and information from Exercise 3 from your ASD Subgroup, determine the probability of detection, delay time and standard deviation to complete the table for the sabotage path below. When all delay times have been identified, complete the Adversary Task Time Countdown Column. Note that the Response Force Time EASI asks for is called the PPS Response Time in this course.

To compute the probability of detection of a series of sensors, multiply the probabilities of nondetection; then subtract from 1.0 to get the combined probability of detection.

Probability of alarm communication = _____ .97

Response Force Time = _____146 sec

Standard deviation of Response Force Time =44 sec_____

Adversary Action (Tasks)	Probability of Detection	Location	Time Delay (seconds)	Standard Deviation (± seconds)	Adversary Task Time Countdown
1. Climbs the outer wall	0.01	E	10	±3	310
2. Runs to the PTR	0.01	E	124	±37	186
3. Climbs the fence	0.01	E	10	±3	176
4 Runs to the reactor building	0.8	E	12	±4	164
5. Penetrates the vehicle access doors	0.8	E	60	±18	104
6. Runs to D91	.01	E	14	±4	90
7. Penetrates D91	1-(0.5×0.1) = 0.95 (BMS x microwave)	E	45	±13	45

8. Locates the Plutonium and sets explosives.	1.0	E	45	±13	**0**

Note: Be sure to use the same unit of time throughout the problem.

Exercise 1 - EASI Analysis of Fence Intrusion (continued)

Part 2: Use EASI to compute the probability of interruption (P_I) for this sabotage attempt under normal daytime operating conditions

Load and run the computerized EXCEL™ version of EASI.

An example path has been entered into the tool. Modify the entries and evaluate the sabotage path.

1) For this path:

A. Where is the CDP? _____Task 4: Runs to Reactor Building__

B. What is the Adversary Task Time after CDP? ____164 sec._____

C. What is the probability of interruption given by EASI? P_I = ____.54 __

2) If the guard response time drops to 90 seconds:

A. Where is the CDP? _____Task 5: Vehicle Access Doors_____

B. What is the Adversary Task Time after CDP? _104 sec . _____

C. What is the probability of interruption given by EASI? P_I = __.88_____

3) What is the probability of interruption if two minutes of access delay are added at the target protecting the plutonium (with the 90 second guard response time)?

A. Where is the CDP? Task 7: Penetrate D91_____

B. What is the Adversary Task Time after CDP? ___165 sec. _____

C. What is the probability of interruption given by EASI? P_I = ___.99_____

4) What is the probability of interruption if a fence vibration sensor is added to the inner fence (with both changes above)?

A. Where is the CDP? Task 7: Penetrate D91_

B. What is the Adversary Task Time after CDP? ___165 sec _____

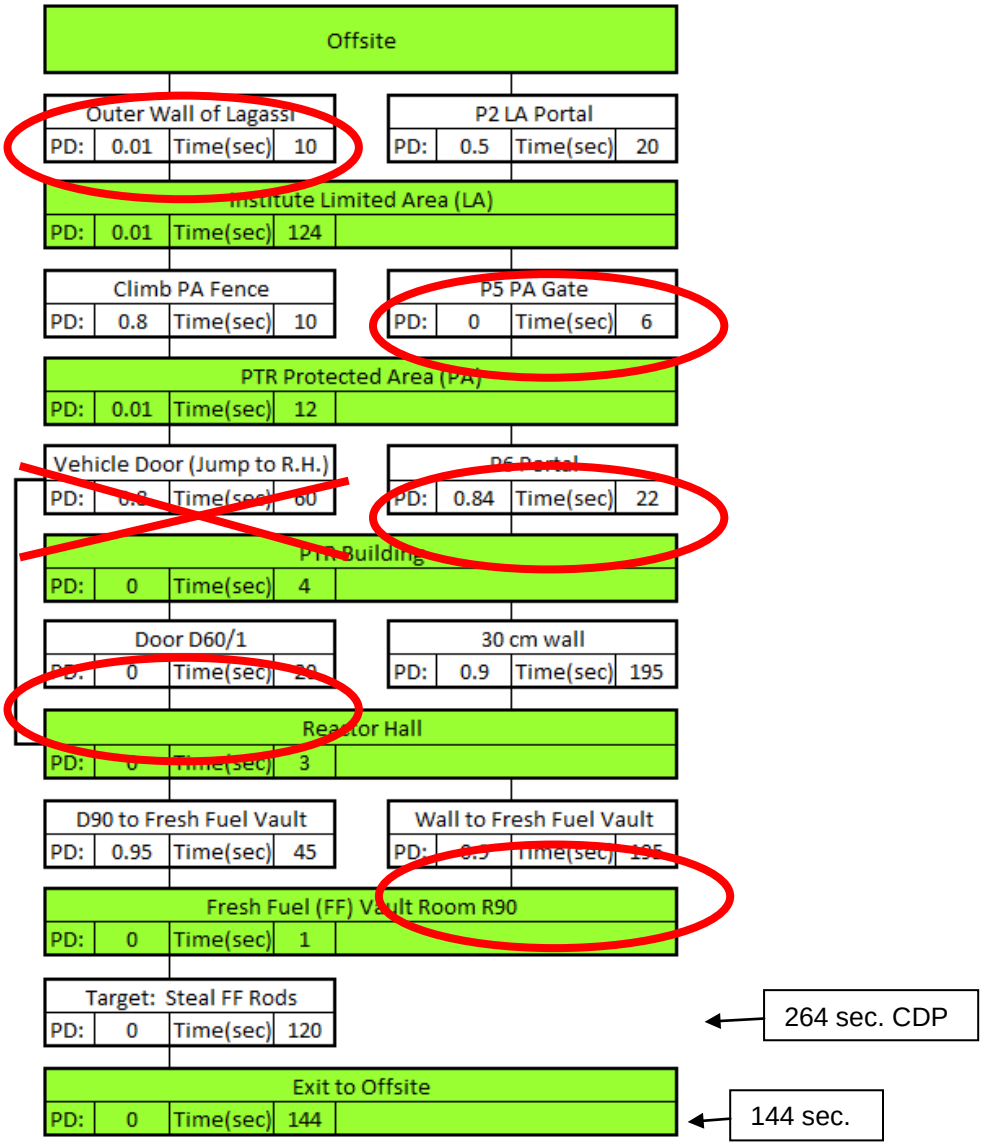
C. What is the probability of interruption given by EASI? P_I = _.99_____

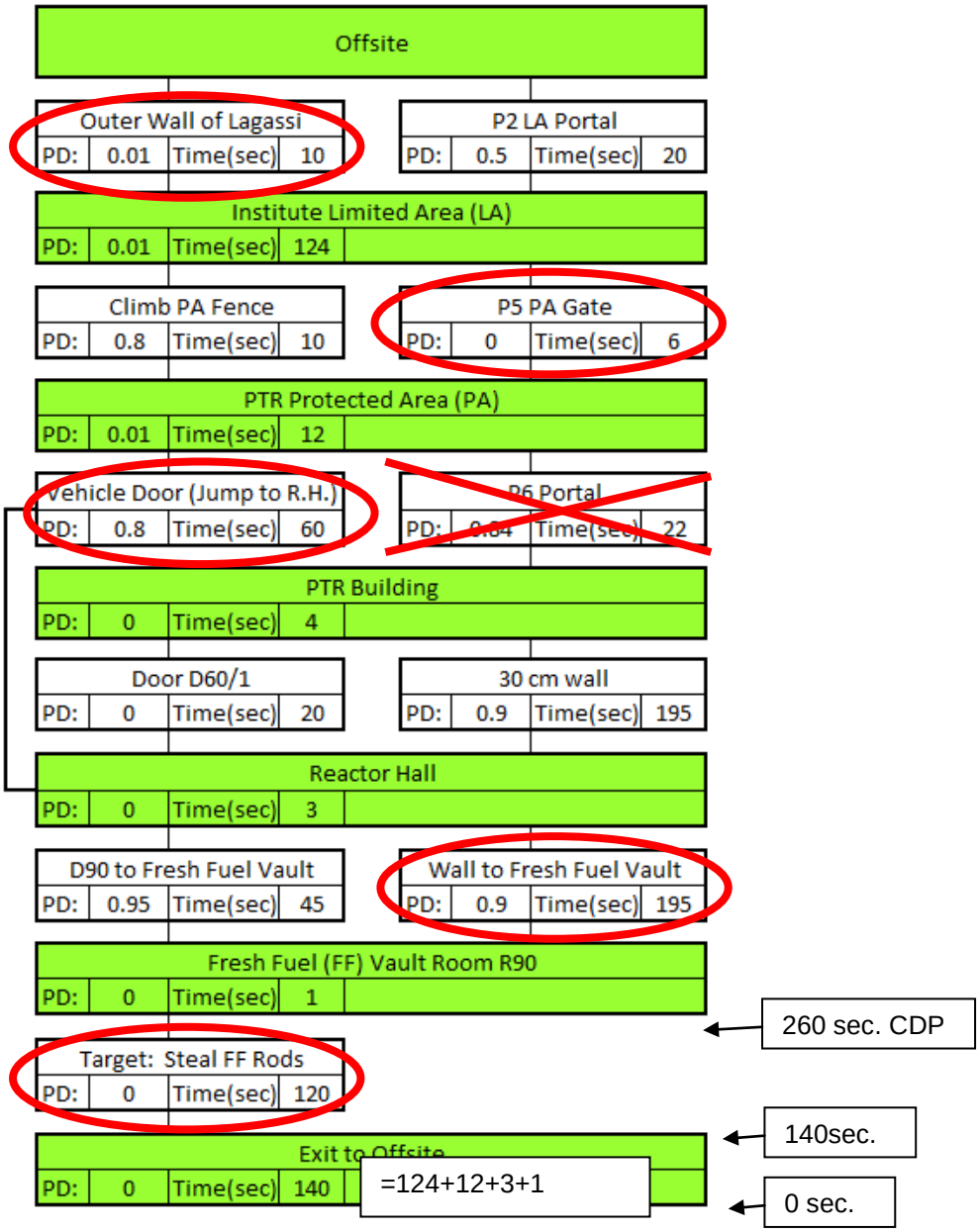
Exercise 2 – Determine the Most Vulnerable Path

Complete the data values needed for the ASD provided below and then determine the Most Vulnerable Path based on the Guard Response Time found in Exercise 1. Indicate the path on the ASD by circling the path elements and areas. Please be aware that there should be two paths; one without a jump element and one with just a jump element.

Note: For the areas and left-hand elements with no P_D or Time delay, use the values you determined from Exercise 1. For P6, assume that the adversary has a stolen badge and PIN. For the area entitled "Exit to Offsite" please sum the delay of the areas down to the target and enter the sum into the Time(sec) cell.

To compute the probability of detection of a series of sensors, multiply the probabilities of nondetection; then subtract from 1.0 to get the combined probability of detection.





Better to use jump path: Vehicle Door PD = .8 versus P6 AND Door 60/1 PD = 1-(1-.84)*(1-0) = .84

Exercise 3 - EASI Analysis ofMost Vulnerable path

1.Enter the data for the path determined in Exercise 2.

Adversary Action (Tasks)	Probability of Detection	Location	Time Delay (seconds)	Standard Deviation (± seconds)	Adversary Task Time Countdown
1. Climbs the outer	0.01	E	10	±3	661

wall					
2.Cross LA	0.01	E	124	±37	537
3. Penetrate P5	0	E	6	±2	531
4 Cross PTR PA	0.8	E	12	±4	519
5. Penetrates the vehicle access doors	0.8	E	60	±18	459
6. Cross Reactor Hall	0	E	3	±1	**456**
7. Penetrate wall to Fresh Fuel Vault	.9	E	195	±59	**261**
8. Cross Vault	0	E	1	±.3	**260**
9. Steal FF Rods	0	E	120	±36	**140**
10. Exit Site	0	E	140	±42	**0**

2. For this path:

A. Where is the CDP? _____Task 8. Cross the Vault_____

B. What is the Adversary Task Time after CDP? ___260 sec._____

C. What is the probability of interruption given by EASI? P_I = __.99 sec. _____

D. What is the exit time to Offsite? ___140 sec._____

Application Considerations

1. Which adversary strategies can be analyzed using EASI?
   a) Theft only
   b) Sabotage only
   c) Both theft and sabotage
   d) Neither theft nor sabotage

2. How many paths can be analyzed at one time using the EASI model?
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