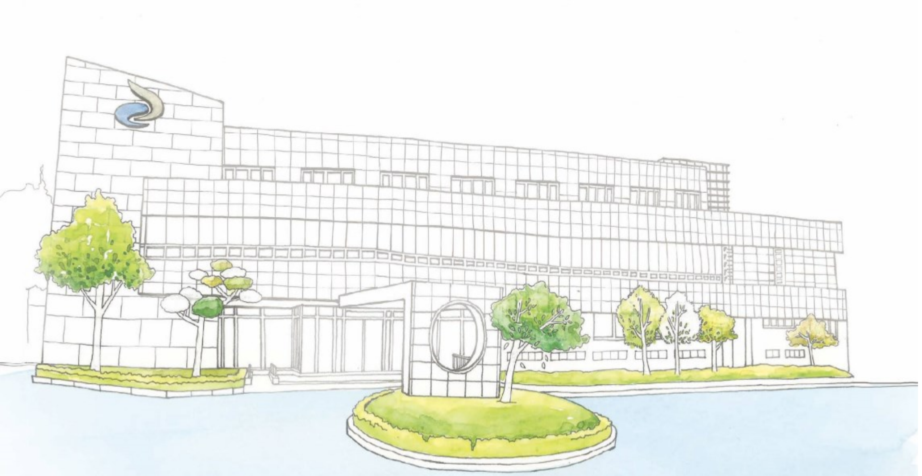
IAEA CN-254 (IAEA HQ 2017.11.13-17)

TESS: Tool for evaluation security system

Introduction and Development status



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Contents

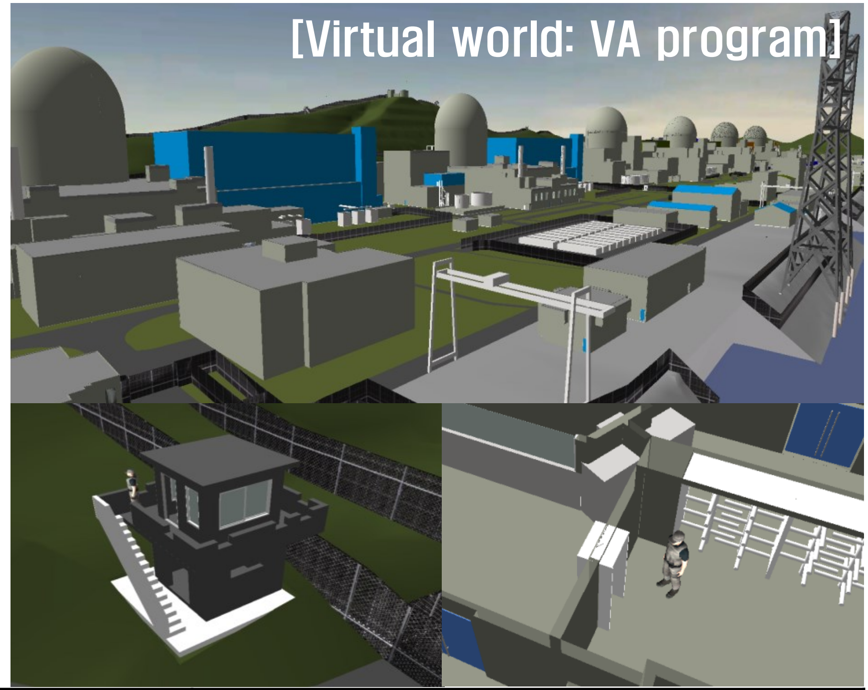
Background

- Status of evaluating PPS vulnerability
  - [IAEA INFCIRC/225/REV.5]
  - [US 10 CFR PART 73.55]
  - → Licensee evaluates PPS performance and regulatory body to review it
- Status of evaluating PPS vulnerability (R.O.K)
  - [*APPRE/Article16/Requirement for protection of nuclear facilities]
  - → Regularly evaluate PP regulation and reflect the results
  - [APPRE/Proposal]
  - → Licensee evaluates PPS performance and regulatory body to review it
  - → Detailed scope and method of evaluation
  - → Expectation of linkage with VA program

(*)Act on measures for the protection of nuclear facilities, prevention of radiation disasters

Background

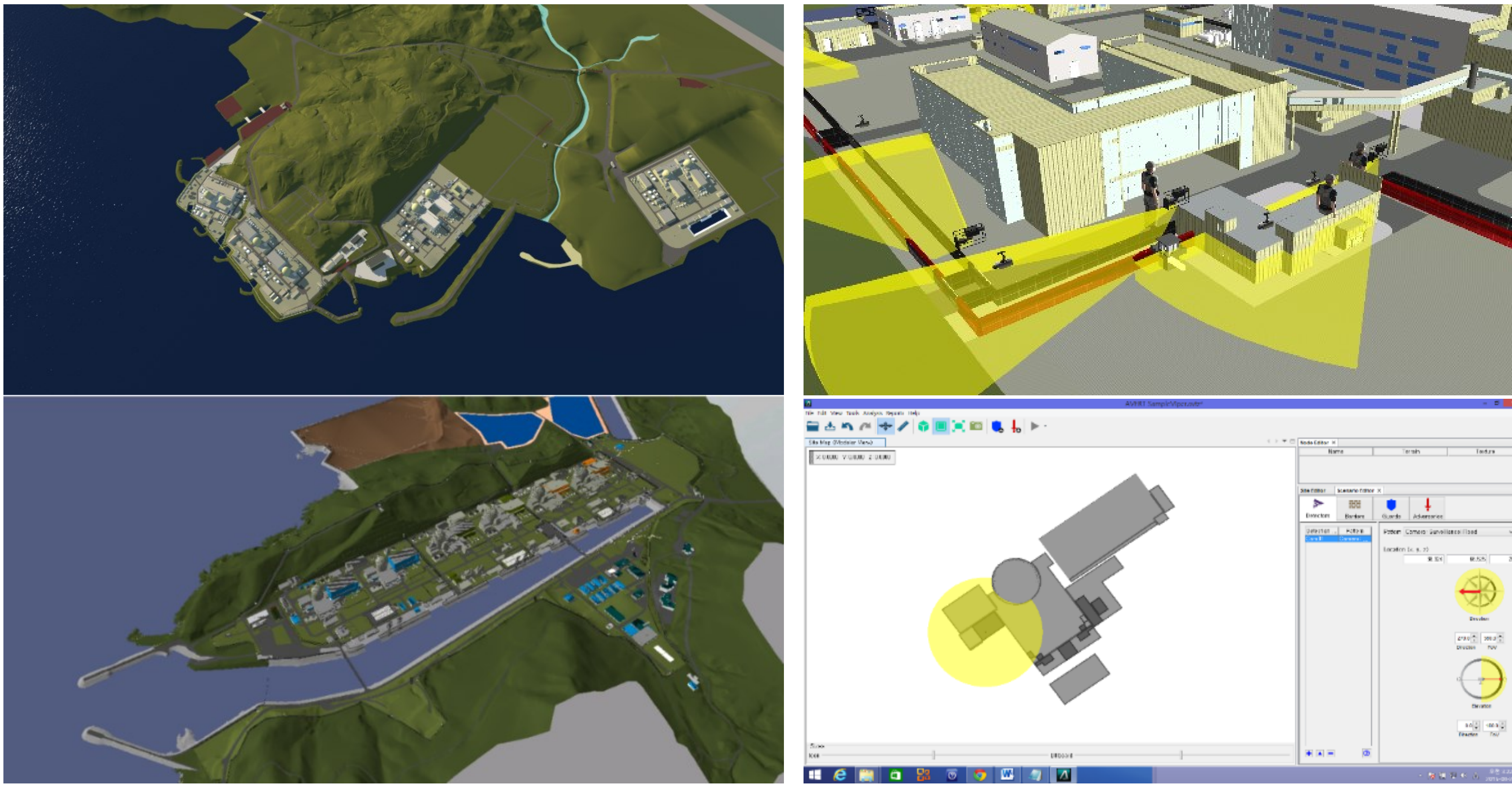
Why we need a VA program



	Force on Force	VA program	Remark
Manpower	Need a lot	Relatively low	military, police, adversary, etc.
Budget	Need a lot	Relatively low	Manpower equal to budget
Time	Need a lot	Relatively low	More than a week (include preparation)
Reality	Relatively good	-	FOF is also constrained by safety reasons
Usability	Only for training	Regulatory purpose	Regulatory examination, facility inspection

Program development strategy (1)

■ Benchmark of latest commercial programs (AVERT)



→ VA was conducted through AVERT for two NPP from 2015 to 2017

→ To be implemented for all regulated nuclear facilities by 2019

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Program development strategy (2)

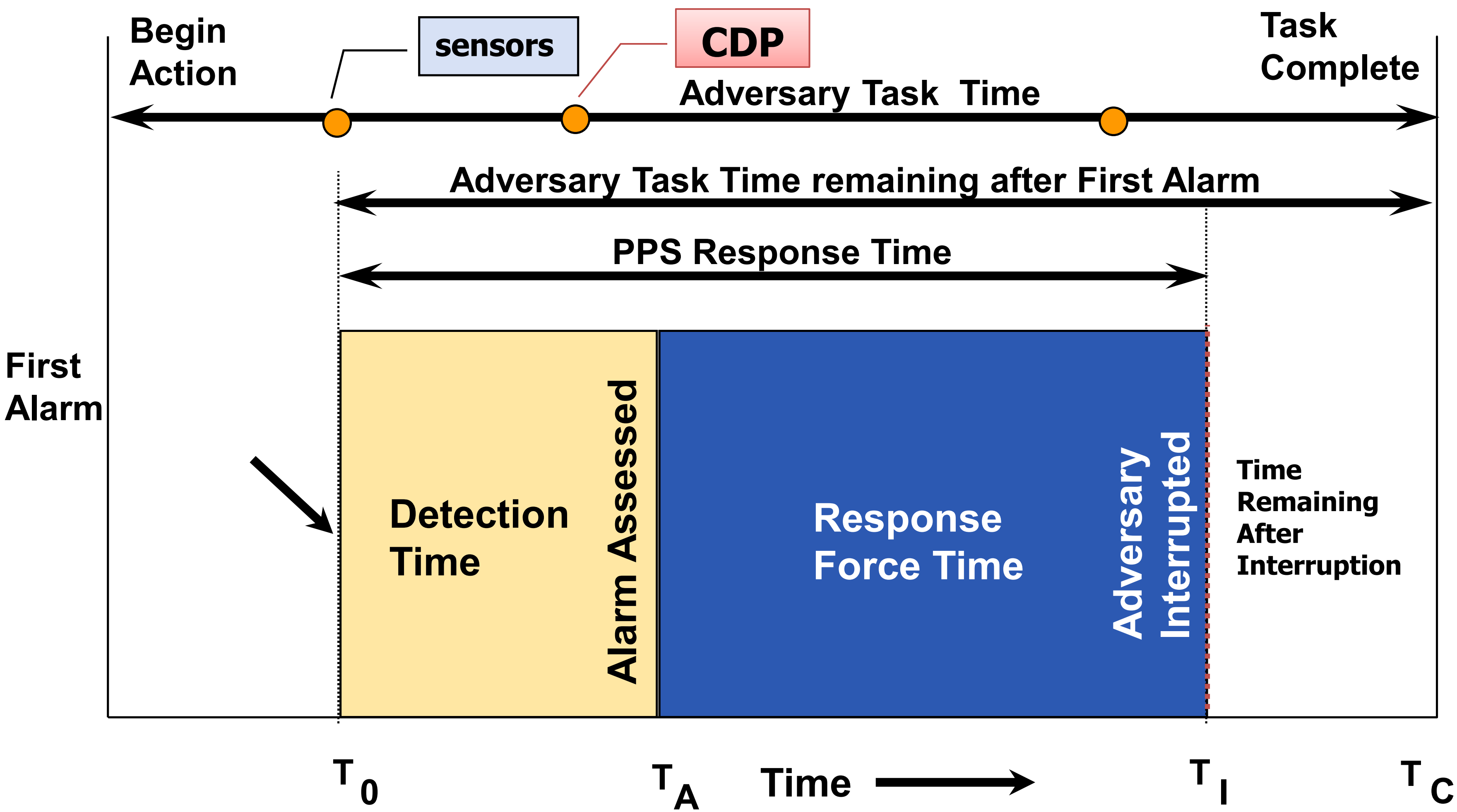
■ Requirement for regulatory VA program

- Experience using AVERT
- Experience in regulating nuclear facilities
- IAEA NUSAM Project (2013~2017) Results

Regulatory program requirements	
Conservative	Assumptions should be set conservatively rather than licensee.
Deterministic	The result of program should always be same. (Compare with monte carlo method)
Accuracy	Must be proved that route that is searched is weakest.
Clarity	The algorithm used should be easy and understandable.
Implement Same condition	Able to implement the same condition as simulator of licensee.
Reality of data	Data should be based on experiments and logical reasoning, not by the manufacturer.
Ease of analysis	Evaluate vulnerability versus protection requirements.

Main concepts (1)

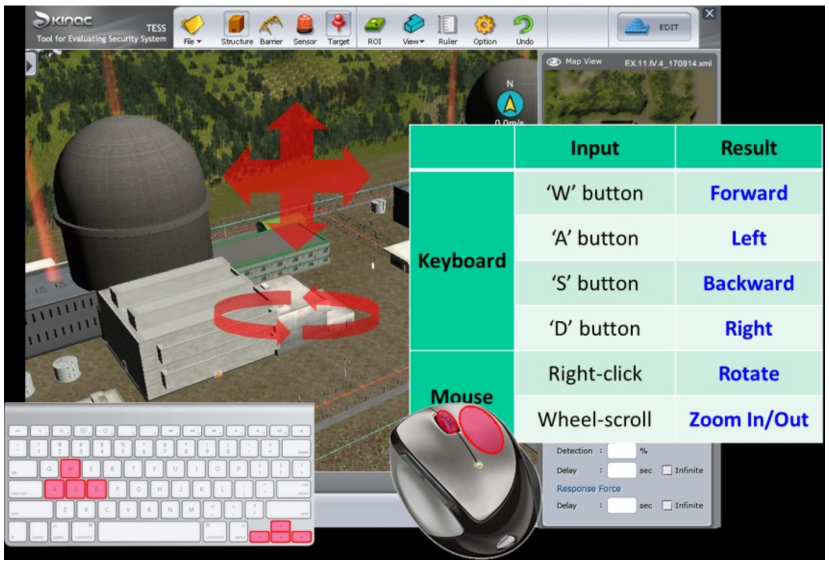
■ Critical detection point (Timely detection)



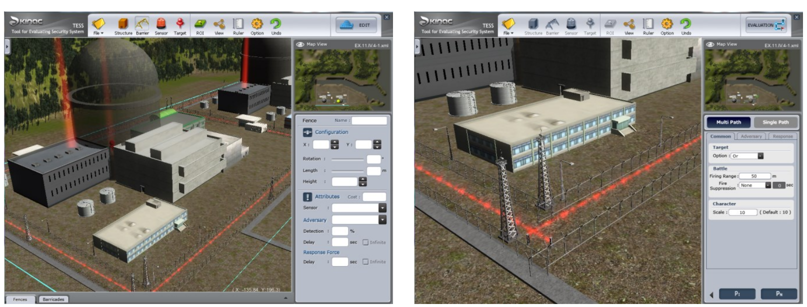
→ Vulnerable path is minimum detection path before CDP, and minimum time path thereafter

Main concepts (2)

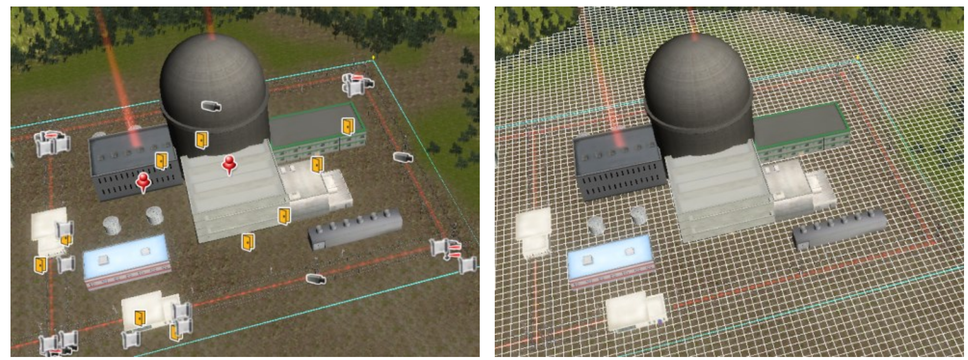
- 3D GUI Applied (view, move, installation, etc.)
- 2D Mesh based Algorithm (Apply after 3D data projection)



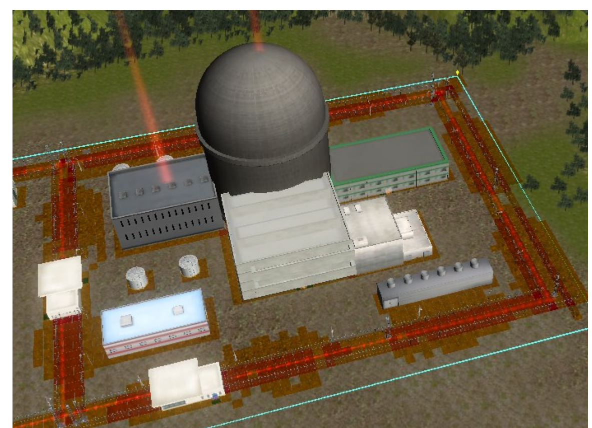
	Input	Result
Keyboard	'W' button	Forward
	'A' button	Left
	'S' button	Backward
	'D' button	Right
Mouse	Right-click	Rotate
	Wheel-scroll	Zoom In/Out



Install building and PPS (CCTV, sensor, guard)



Object data projection to 2D mesh

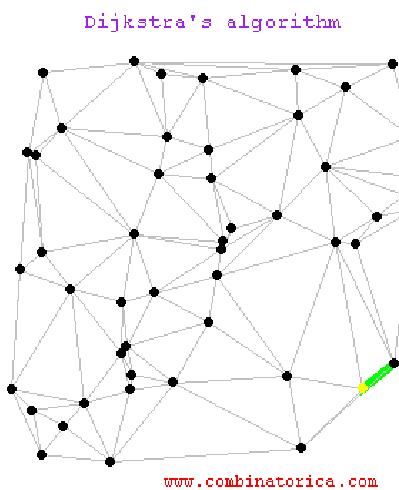


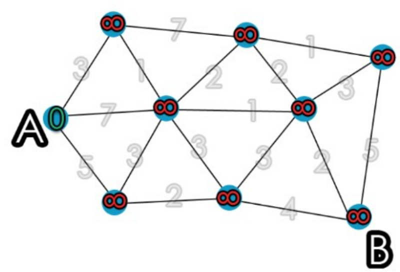
2D mesh has detection and delay data

Algorithm

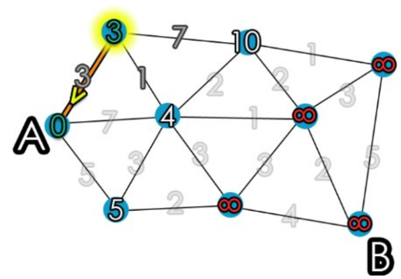
■ Dijkstra algorithm

– [Path finding]

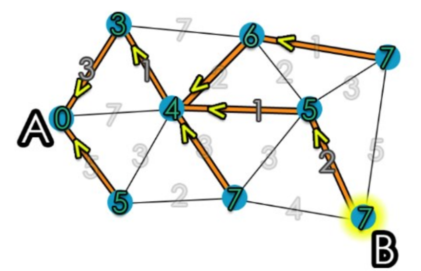




A: Start point B: Target



Collect data nearby A
chose smallest one



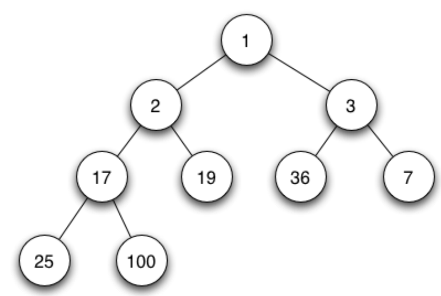
If small value is found, updated

■ Priority Queue(Min heap)

– [cost evaluation: detection rate and delay]

→ Always return minimum data

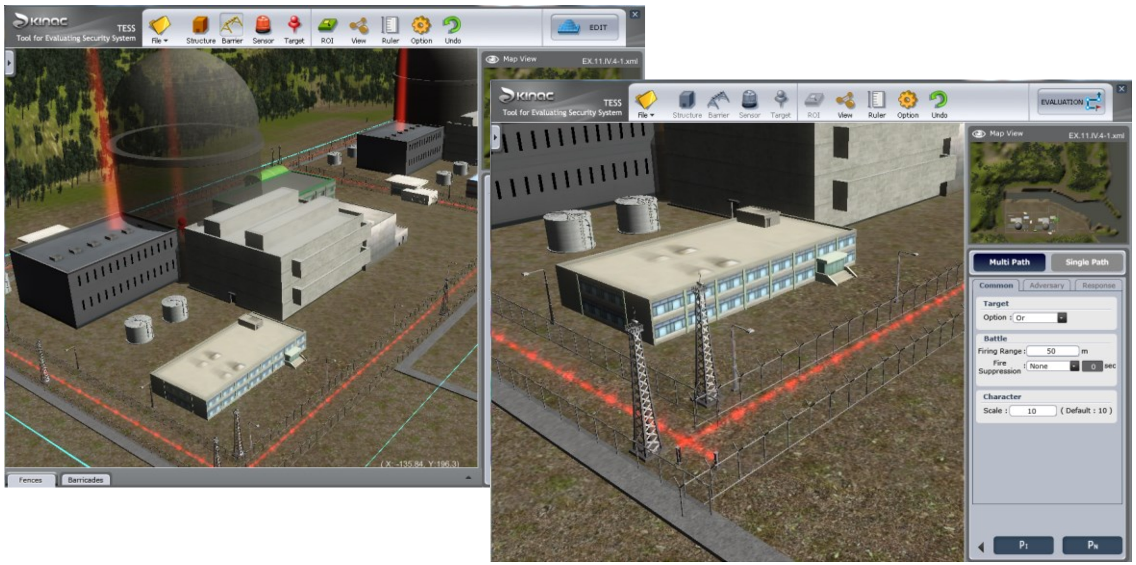
→ Maximum efficiency with Dijkstra



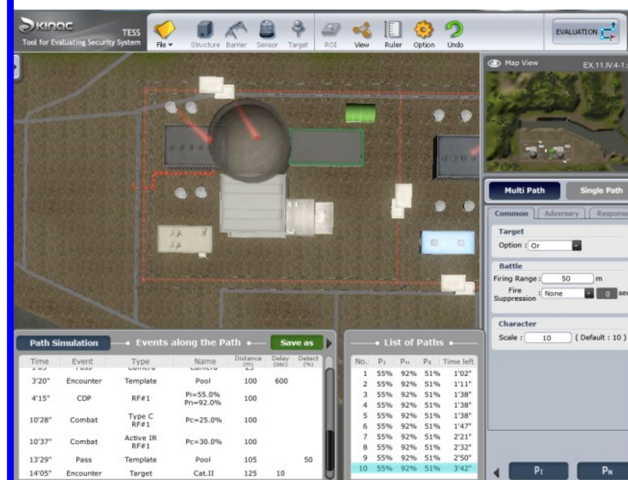
Implementation results (1)

TESS – Overview

EDIT Mode



EVALUATION Mode



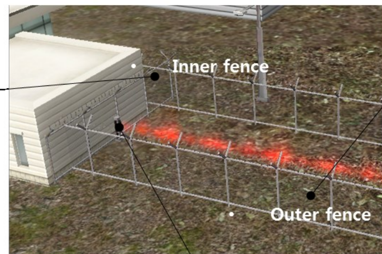
Build a nuclear facility → Build a physical protection system → Evaluation of physical protection system

Implementation results (2)

EDIT Mode

Attributes Cost : 0
- Sensor : User Input
- Adversary: Delay First
- Tool : Power Tool
- Detection : 0 %
- Delay : 10 sec ☐ Infinite
- Response Force
- Delay : 10 sec ☐ Infinite

- **Double Fence**



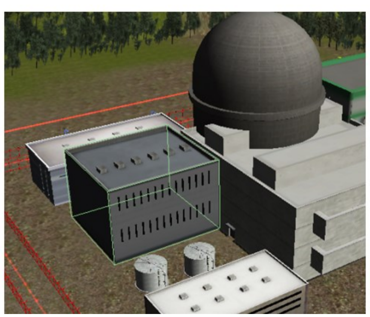
Attributes Cost : 0
- Sensor : Taut Wire
- Adversary: Delay First
- Tool : Power Tool
- Detection : 25 %
- Delay : 10 sec ☐ Infinite
- Response Force
- Delay : 10 sec ☐ Infinite

- **Active IR**

Attributes Cost : 0
- Type : Active Infrared
- Adversary: Delay First
- Tool : Power Tool
- Detection : 40 %
- Delay : 0 sec ☐ Infinite
- Response Force
- Delay : 0 sec ☐ Infinite

- **Wall**

Attributes Cost : 0
- Material : 20cm reinforced conc.
- Adversary: Delay First
- Tool : Power Tool
- Detection : 50 %
- Delay : 600 sec ☐ Infinite
- Response Force
- Delay : 600 sec ☐ Infinite



- **Gate**

Attributes Cost : 0
- Material : 30cm wood & metal
- Adversary: Delay First
- Tool : Power Tool
- Detection : 50 %
- Delay : 530 sec ☐ Infinite
- Response Force
- Delay : 0 sec ☐ Infinite

- **Adversary**

Common | **Adversary** | Response

- List

Intention	Number	Speed (km/h)	Weight (kg)
Sabotage	2	2	7

- Basic
- Intention : ◉ Sabotage ○ Theft
- Number : 2 (1~30)
- Speed : Walk 2 km/h
- Tool : Power Tool 2 kg
- Skill : Medium(Competence 100%)

- Battle
- Tactic : ◉ Defense ○ Assault
- Weapon : Semi-Automatic Rifle 3 kg
- Magazine # : 4 2 kg
- Firing Exposure : Kneel(0.5) 50 %
- Reloading Exposure : Kneel(0.5) 50 %
- Firing Time Delay: 50 %
- Firing Accuracy Degradation due to Illumination : 0 %
- Departure from Average Firing Proficiency : 0 % Better

- **Response**

Common | Adversary | **Response**

- List

#	Number	PPS RT (sec)	Tactic	Weight (kg)
1	4	600	Defense	5

- Basic
- Number : 4 (1~30)

PPS Response Time : 600 sec
- Alarm Comm. Time : 1 sec
- Alarm Assess. Time : 30 sec
- Guard-RF Comm. Time : 20 sec
- RF Prep. Time : 180 sec
- RF Travel. Time : 339 sec
- RF Deploy. Time : 30 sec

- Battle
- Tactic : ◉ Defense ○ Assault
- Weapon : Semi-Automatic Rifle 3 kg
- Magazine # : 4 2 kg
- Firing Exposure : Kneel(0.5) 50 %
- Reloading Exposure : Kneel(0.5) 50 %
- Firing Time Delay: 50 %
- Firing Accuracy Degradation due to Illumination : 0 %
- Departure from Average Firing Proficiency : 0 % Better

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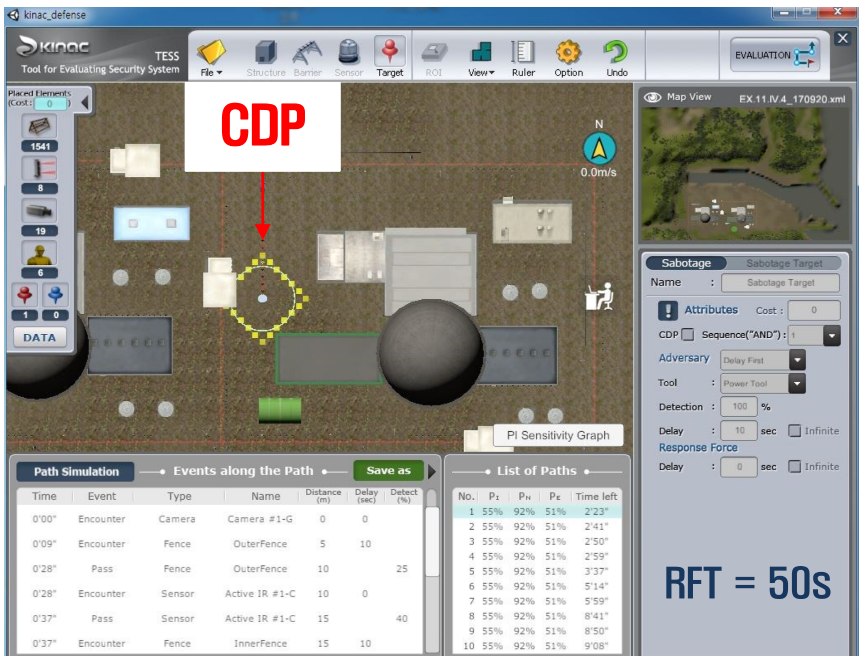
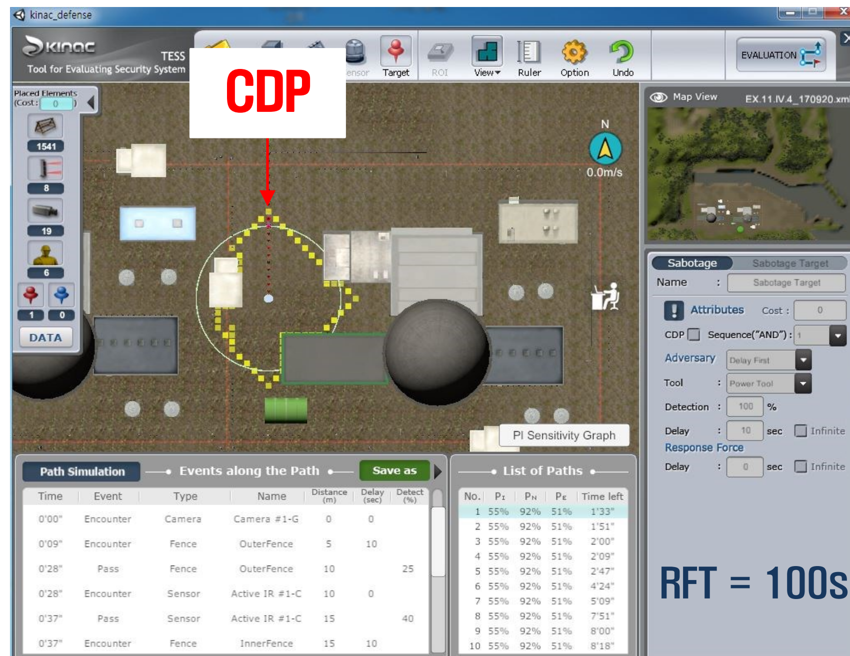
Implementation results (3)

- Evaluation Mode
  - CDP calculation : From target to outside until 〈RFT = delay time〉
  - Path Finding : From CDP to outside 〈minimum detection probability〉
  - Neutralization : Using BATTELLE code from U.S DOE
  - Result : P_E and time after interruption

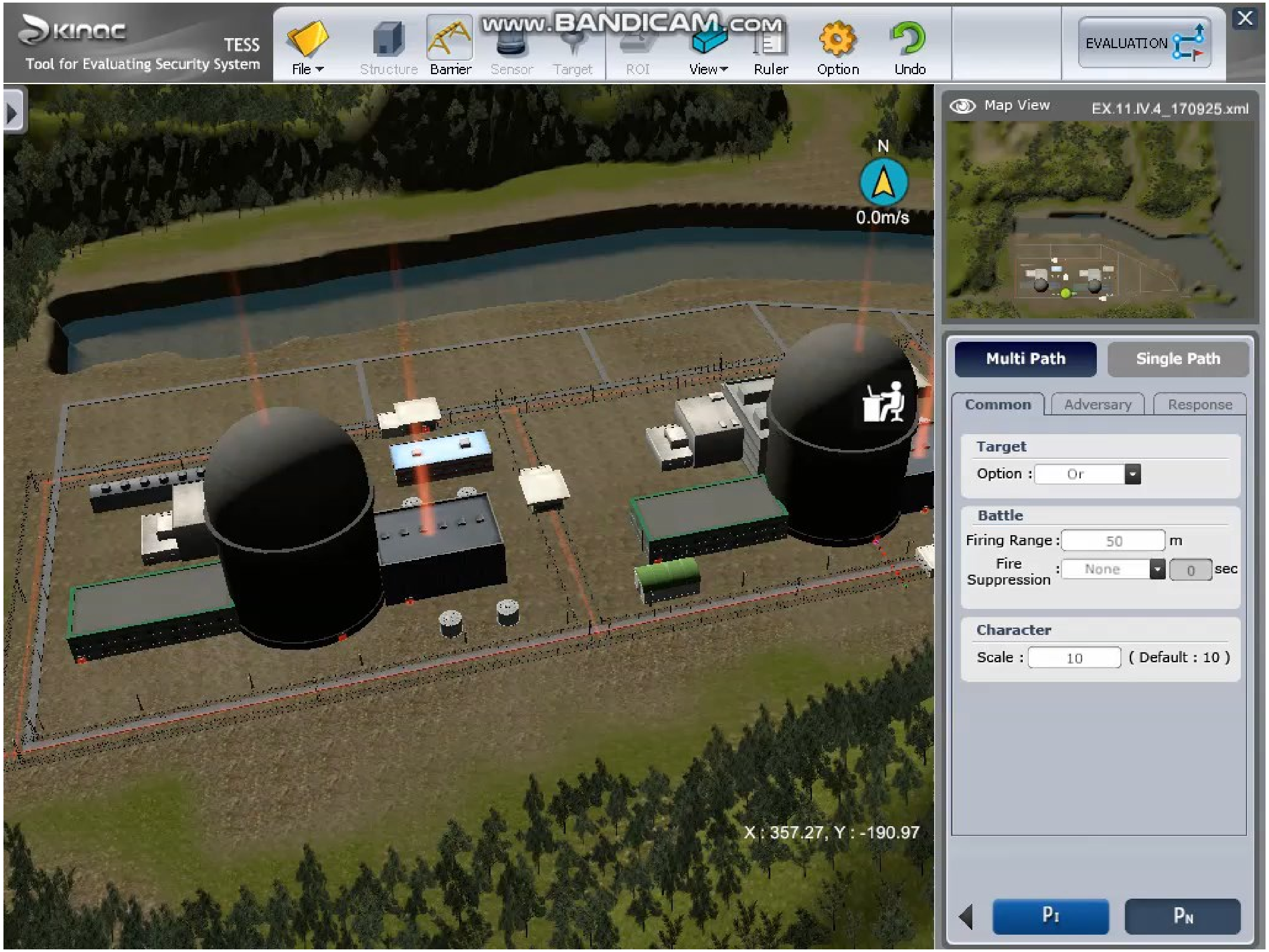




→ CDP depends on RFT and delay elements

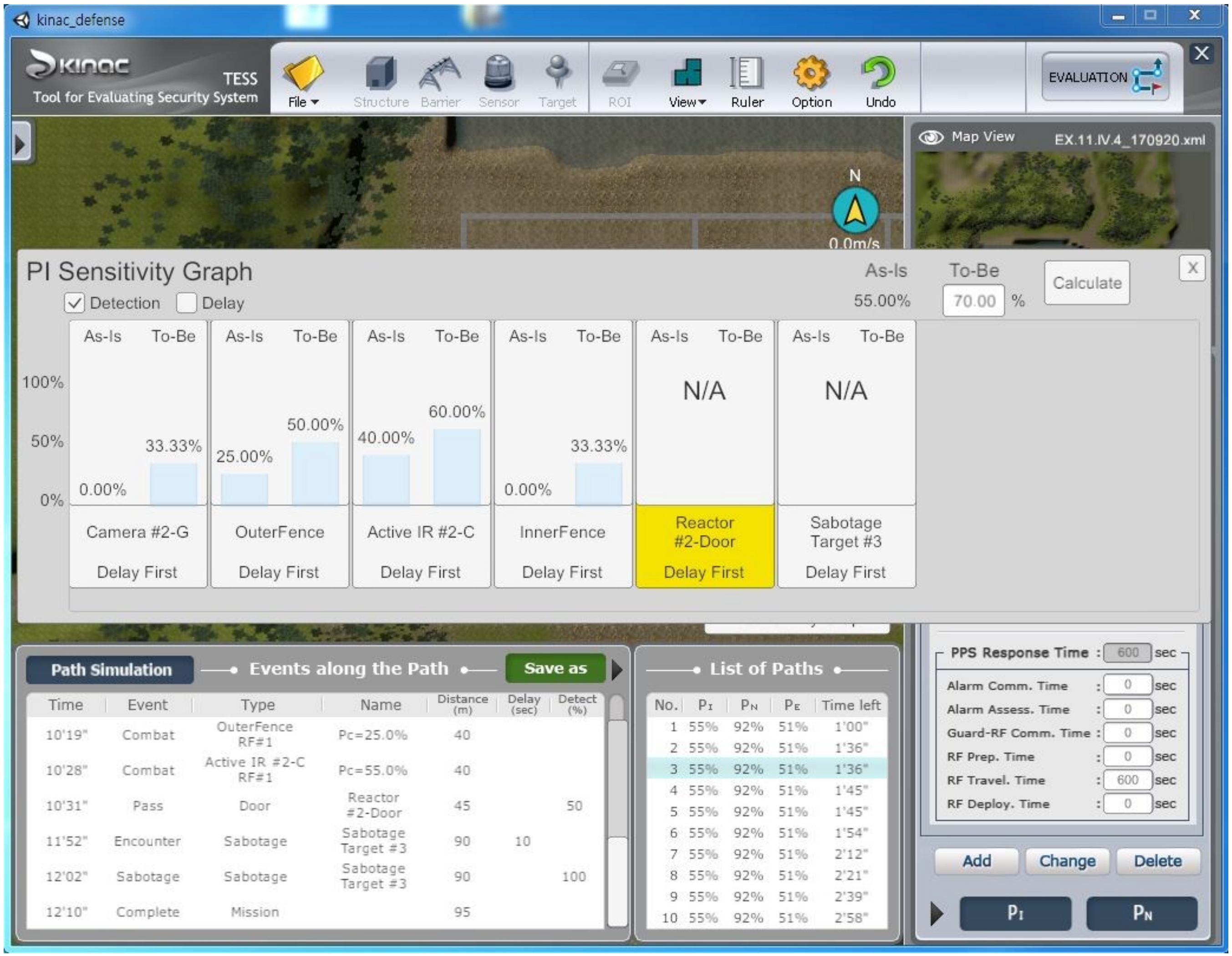
Implementation results (4)

■ Demo video



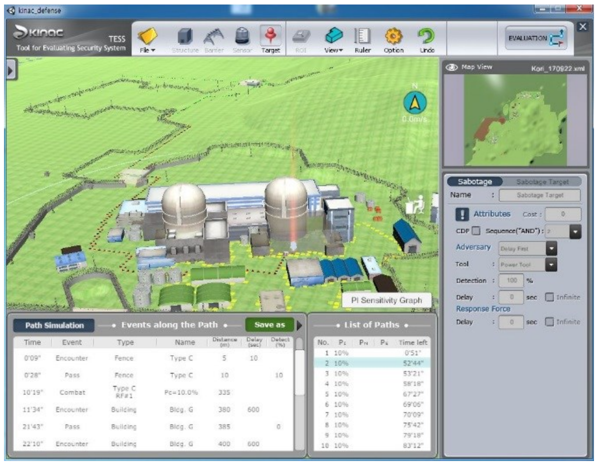
Implementation results (5)

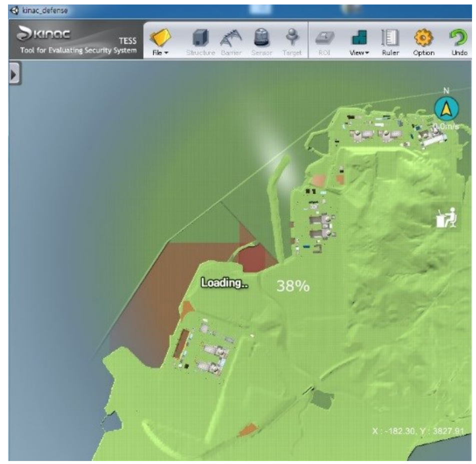
■ Upgrade plan (detection and delay)



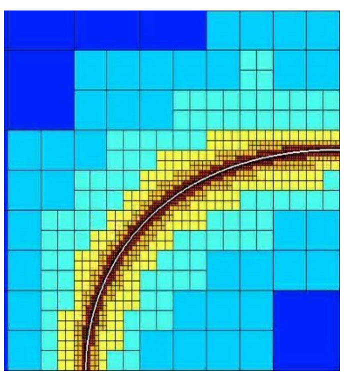
Future plans

■ Application of large-scale nuclear facilities (2017~2019)

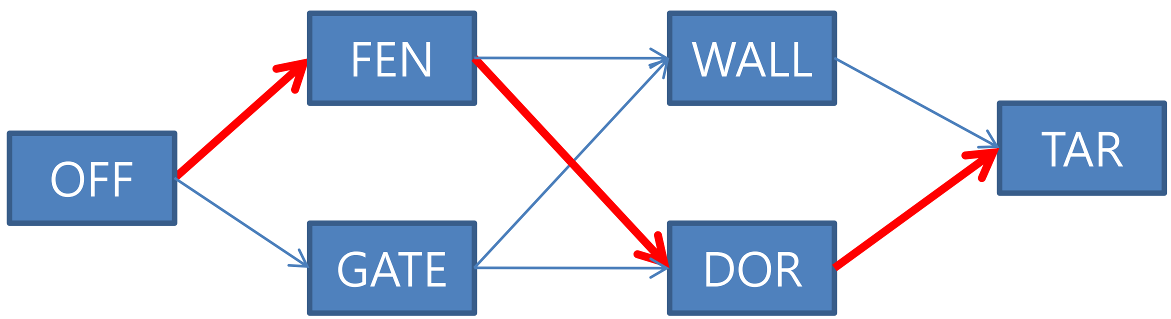




■ Algorithm improvements (2017~2019)



Adaptive mesh



Path pattern

Thank You.

Q&A