Vulnerability Assessment using Modelling and Simulation

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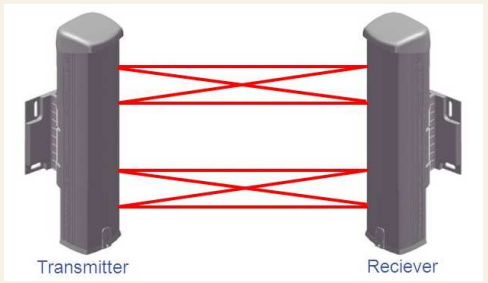
1. Introduction

Physical Protection System (PPS)

- Integrated security measures to protect nuclear materials and facilities against theft, sabotage or other malicious activities.
- Detection, delay, and response



Vulnerability Assessment

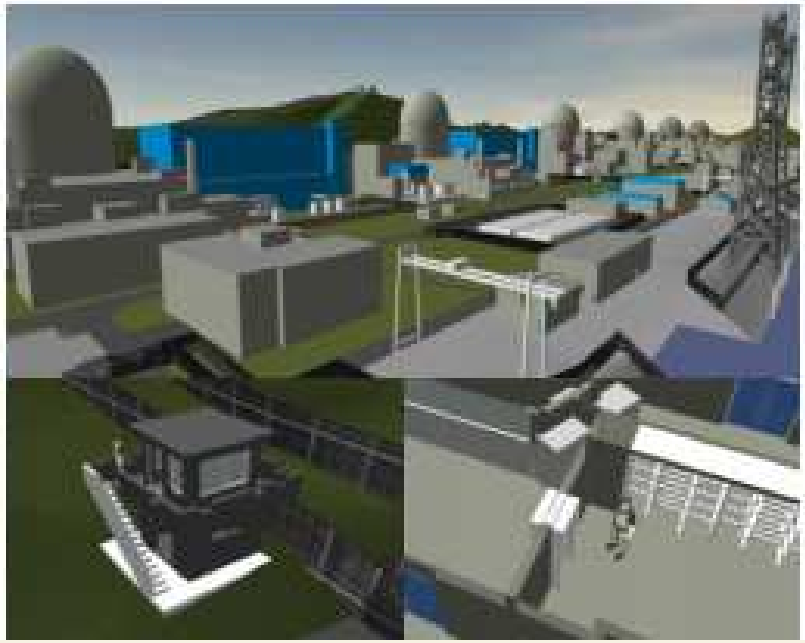
- **PPS Evaluation Methods**
  - ***Expert Opinion:*** Performs PPS design and evaluation activities relying on personal knowledge and experience
  - ***Features Approach:*** PPS design and evaluation based on specification and implementation of a required set of features
  - ***Subsystem Criteria Approach:*** standards approach to PPS design and evaluation that uses performance criteria for some security features
  - ***System Performance Approach:*** A systems engineering approach to the design and evaluation of PPS based on specifying and achieving an overall system effectiveness against the Design Basis Threat (DBT) for theft and sabotage

- **Vulnerability Assessment is performance-based methodology to measure the overall effectiveness of PPS, and is also called as System Effectiveness Evaluation (SEE)**

Vulnerability Assessment with Simulation

- Resources (People, Budget, and Time)
- Similarity to real attacks
- Applicability

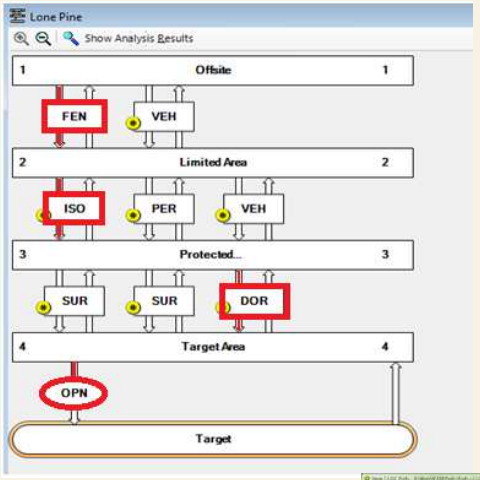
Force on Force

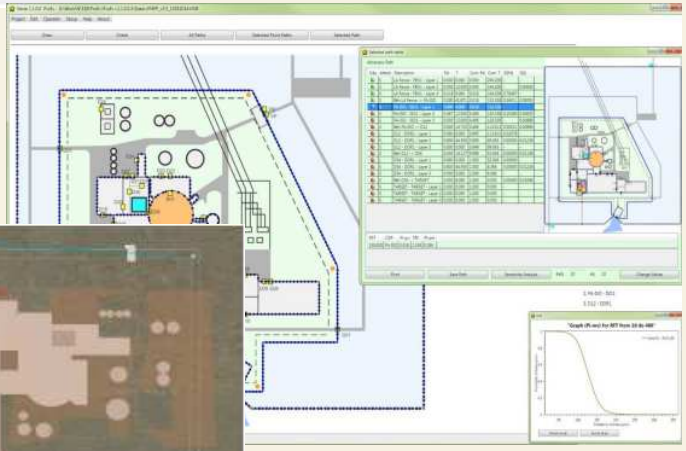


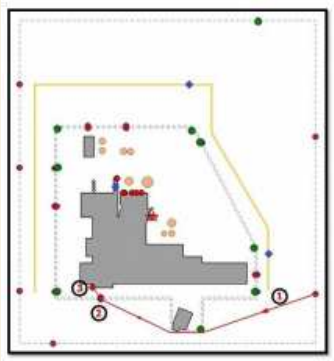
Simulation

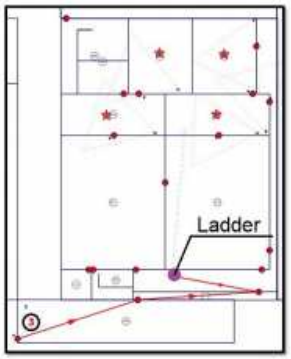
Vulnerability Assessment Software

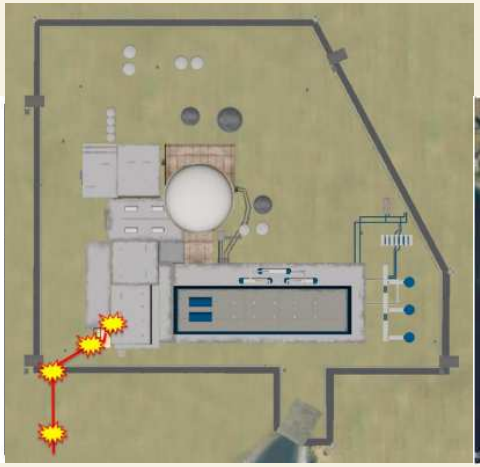
- ***SAVI*** : USA, 1980s
- ***ProEv*** : Check Republic
- ***STAGE*** : Canada
- ***VEGA-2*** : Russia
- ***Simajin/Vanguard*** : USA
- ***AVERT*** : USA
- ***TESS*** : Korea

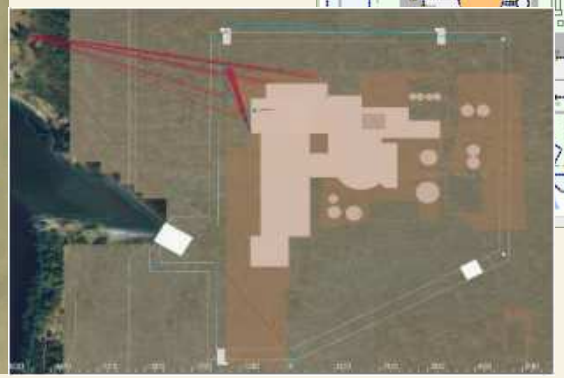










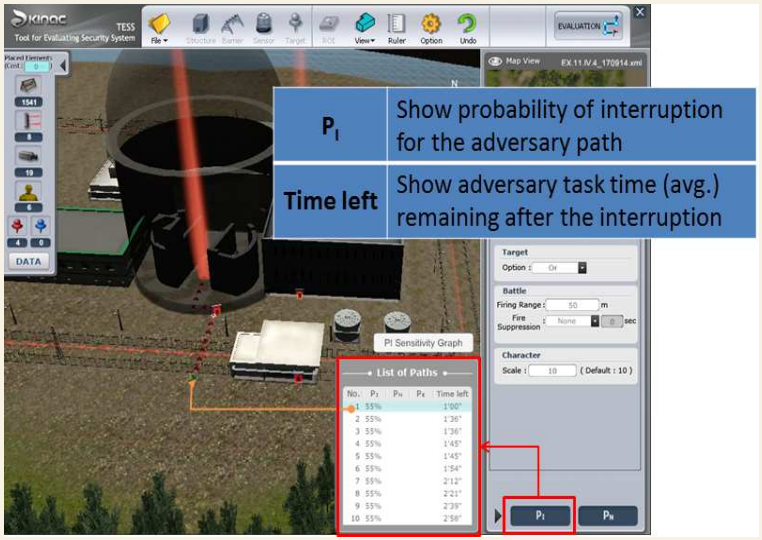


2. Methods

Methods

- KINAC had completed to model all nuclear facilities include five NPP sites with M&S tools, 2014~2019.

- Software Tools AVERT and TESS was used



Geometry Modelling

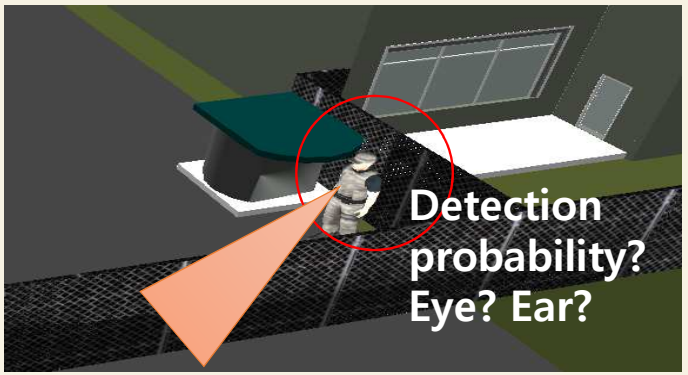
- **Data collection (written, photo, field visits)**
  - Public info(terrain, road, building, miniature*, satellite picture)

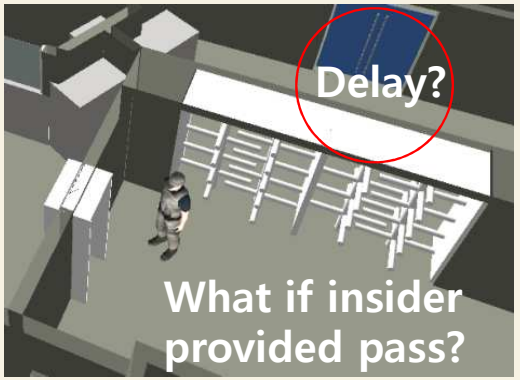
- **Modeling**
  - Reflecting appearance such as building and fence arrange
  - Based on data collection(should be as similar as possible)

<*miniature>

- **Lessens**
  - Layout of Old Nuclear facilities is not present
  - Substantial work is required
  - 3D model error : unexpected hole(path) under building due to interference between meshes

Geometry Modelling – Results



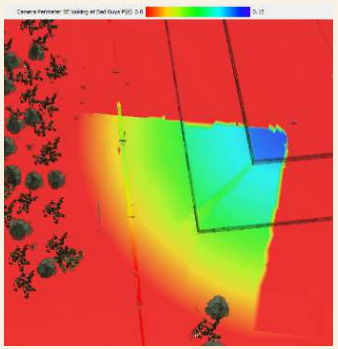


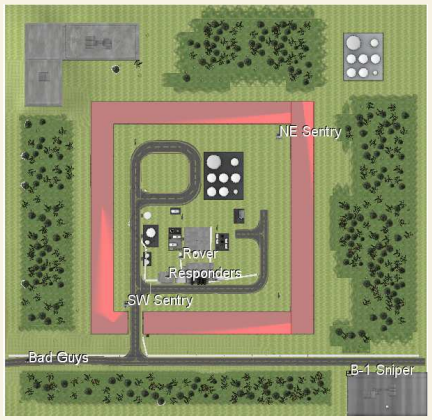
Assign Characteristic Attributes

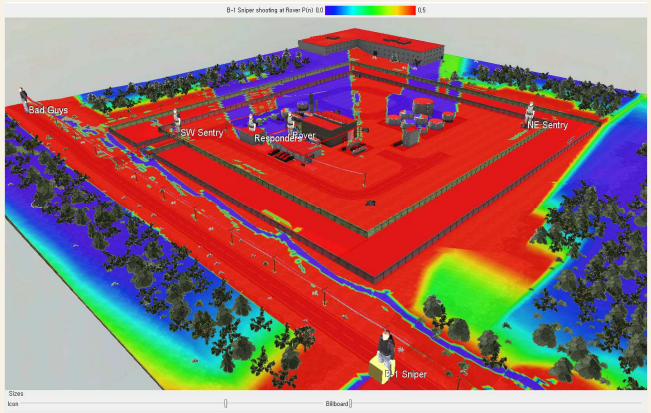
- **Modelled object should have PPS attributes and its interact each other.**
  - Terrain : Speed of adversary
  - Fence : Delay time varies with penetration methods and tools
  - Sensor : Detection probabilities varies with time and distance
  - Weapons : PH/PK varies with body armor, and vehicles

- **Data collection**
  - Confidential info
    - Detection(sensor, CCTV)
    - Delay(fence, gate, barrier, security door)
    - Response(guard, weapon, patrol, external force, protection strategy)
  - Relationship with protection targets
  - DBT(sea, air)
  - Other Limitations and Constraint

Assign Characteristic Attributes







Performance Testing

- Attributes and Characteristics of PPS object is controlled because it could reveal its weakness.
- KINAC used its Test-Facility for performance Testing and Data Building
- Security rEsearch Training and Test (SETT) Facility was built in 2014 as the ROK commitment of Nuclear Security Summit in 2010.

Performance testing

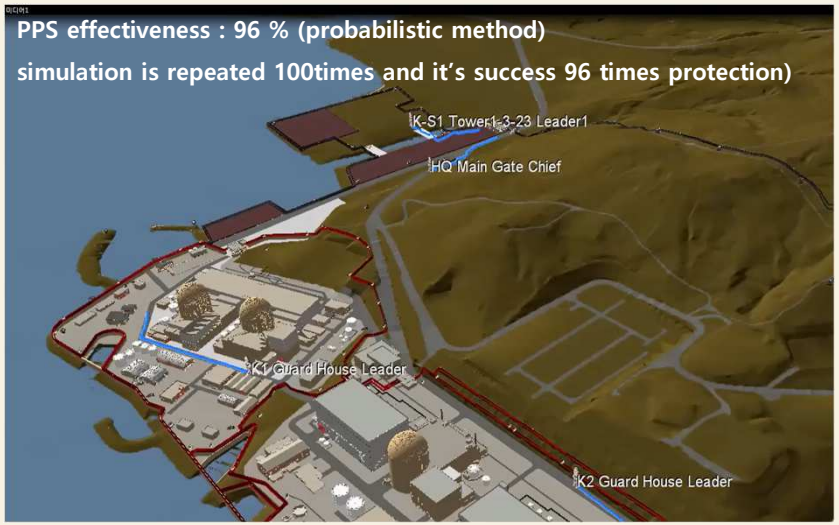
Simulation and Verification

- Thinking (This car should not go through a mountain, why?)
- Compared to FoF results(recommended)

<FoF>

<Simulation Result>

Verification

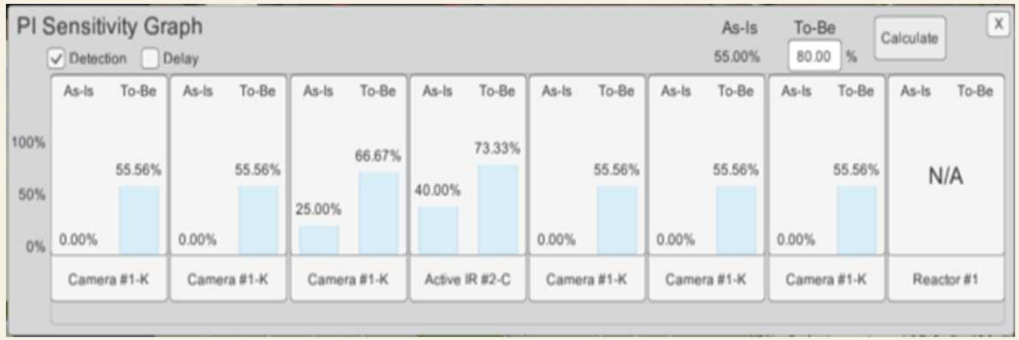


<AVERT>

<TESS>

Applications

- **Simulation Results**
  - Detection cause and location
  - Neutralization cause and location
  - Vulnerable attack path analysis
  - Identify critical detection points
  - Physical protection effectiveness



[Simulator provides an upgrade plan(but limited)]

- **Application**
  - Add or change detection equipment
  - Add or change delayed equipment
  - Change response Strategy

Applications

- **TESS as training tools**
  - Install TESS
  - Open Model Facility
  - Navigate and Find Vulnerability
  - List the Vulnerability and Improvements
  - Run Simulation and Compare

<Training Exercise for a M&S tool, TESS>

- **Results Sharing to Nuclear Operators**

- **Use for regulatory activities**
  - Build attack plan for FOF exercise
  - Review of the first security plan

감사합니다.

Question & Answer