Vulnerability Analysis of Physical Protection System at Hypothetical Facility

Won Moog Jung, Ho Jin Lee, Donghan Yu, Gyungsik Min

KINAC Technology Development Team. P.O.Box 114 Yuseong, Daejoen, Korea 305-600.wmjung@kinac.re.kr

1. Introduction

Since the 9/11 event in the U.S.A, International terror possibilities has been increasing for nuclear facilities including nuclear power plants(NPPs). It is necessary to evaluate the performance of an existing physical protection system(PPS) at nuclear facilities based on such malevolent acts.

A PPS is a complex configuration of detection, delay, and response elements. Detection, delay, and response elements are all important to the analysis and evaluation of a PPS and its effectiveness. Methodes are available to analyze a PPS and evaluate its effectiveness. Sandia National Laboratory(SNL) in the U.S.A was developed a System Analysis of Vulnerability to Intrusion (SAVI) computer code for evaluating the effectiveness of PPS against outsider threats.

This study presents the vulnerability analysis of the PPS at hypothetical facility using SAVI code that the basic input parameters are from PPS of Hanaro Research Reactor at Korea Atomic Energy Research Institution. It is understand that PPS of research reactor and critical assemblies are deficient that that of NPP and nuclear materials of RRCAS are compact to transport

For analysis, first, the site-specific Adversary Sequence Diagrams(ASDs) of the PPS is constructed. It helps to understand the functions of the existing PPS composed of physical areas and Protection Elements(PEs). Then, the most vulnerable path of an ASD as a measure of effectiveness is determined.

The results in the analysis can used to suggest the possible PPS upgrades to the most vulnerable paths for the system like research reactor.

2. Methods

2.1 SAVI computer code

The SAVI code is composed of facility module and outside module

Facility module is defined a common description of a facility that can be used for outsider evaluation module. The facility information is defined using an Adversary Sequence Diagram.(ASD) An ASD is a schematic representation of a facility and its safeguards components.[1]

The outsider program module uses the information from a facility description file created in the facility module and supplements it with additional information about the adversary and facility response to that adversary.[1]

The calculation steps of the SAVI code are as follows[2][3]

a) Identify targets & Construction a site-specific ASD
b) Define safeguards at each PE in ASD
c) Assign delay and detection values to each safeguard
d) Define adversary characteristic
e) Define response force characteristic
f) Analyze and review results

2.2 Description of PPS at Hypothetical Research Reactor

The PPS of Hypothetical facility was selected and analyzed.

- The perimeters are protected by dual fences with guard posts and established fences with CCTV and intrusion detection sensors.
- Main entrance/exit gate is operated by a control-center with armed persons.
- Security gates monitored by CCTV.

2.3 Analysis of PPS using the SAVI code

The input data for the analysis using the SAVI code are as follows;

- The threat type is a terrorist foot.
- The intrusion is a combination of force and stealth.
- The response strategy is a containment.
- The Response Force Time (RFT) is set to 300 seconds.

Figure 1 shows the PPS in hypothetical facility using ASD. Each protection layer consists of several specific protection systems shown in the figure. Adversaries intrude from offside and they attempt to sequentially defeat an element in each protection layer by force and stealth

Figure 2 shows a vulnerable path. Based on the analysis, the red color shows the most vulnerable path from offsite to target area.

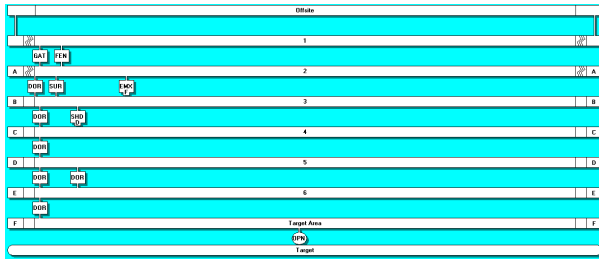The most vulnerable path shows Fen-Dor-Dor-Dor-Dor-Dor-Taget

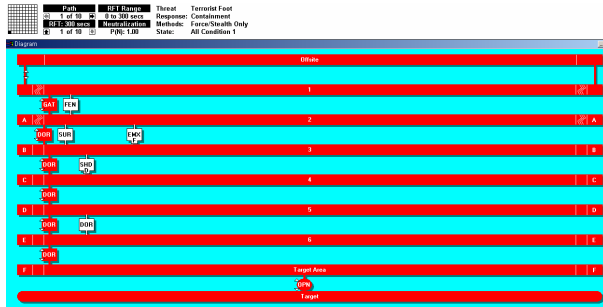Figure 1. Site-specific ASDs of PPS at Hypothetical Facility

Figure 2. Intrusion path diagram of Hypothetical Facility PPS
in RFT= 300 seconds

3. Conclusion

This paper presented the vulnerability analysis of the PPS at hypothetical facility using the SAVI code.

The site-specific ASD was constructed for the PPS. Then, the most vulnerable path of an ASD was determined for a measure of effectiveness.

The results could not be applied directly to the real situation in the domestic NPPs since the input data used in the analysis were obtained from the USA cases However, the analysis would be helpful to understand the functions of the existing physical protection systems and improve the possible performance upgrade for the system like research reactor.

REFERENCES

[1] SAVI 4.0 User's Manual

[2]Ann Bouchard, SAVI Coures South Korea, Cooperative Monitoring Center, p. 25-1-25-10, 2001.

[3]SNL, Physical Protection System Design, Workshop Material on Physical Protection System Methodology, 1996