Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 10-11, 2007

Vulnerability Analysis for Physical Protection System at Hypothetical Facility of a Different Type Reactor

Won Moog Jung, Jung-Soo Kim, Jae Kwang Kim, Ho sik Yoo, Sung-Ho KwaK, Sung Soon Jang
KINAC Physical Protection dept. 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 increased 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[1].

Detection, delay, and response elements are all important to PPS. They are used for 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 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 of a different type using SAVI code that the basic input parameters are from PPS of a different type.

For analysis, first, the site-specific Adversary Sequence Diagrams(ASDs) of the PPS is designed. 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 compare with the most vulnerable paths at a different type.

2. Analysis Methods

2.1 SAVI computer code

The SAVI computer code is used to evaluate PPS effectiveness. SAVI determines the most vulnerable path of an ASD as a measure of effectiveness[2].

The SAVI code is composed of two module; one is facility module and another is outside module.

The formor module is defined a common description of a facility that can be used for outsider 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[3].

The latter module uses the information from a facility description file created in the facility module and supplied it with additional information about the adversary and facility response to adversary.

The calculation steps of the SAVI code are as bellows;[3][4]

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

2.2 Description of PPS at Hypothetical Facility

The PPS of Hypothetical facility was selected and analyzed.

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

2.3 Analysis of PPS using the SAVI code

The used input data in 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 and Figure 2 show ASD that the PPS in hypothetical facility of type Ⅰ and type Ⅱ using ASD. Shown in the figure, each protection layers consist of several specific protection elements. Adversaries intrude from offside to target and attempt to sequentially defeat elements in each protection layer by force and stealth

Figure 3 and Figure 4 show a vulnerable path of type Ⅰ and type Ⅱ. Based on the analysis, the red color shows the most vulnerable path from offsite to target area. Adversaries intrude along the most vulnerable path in red.

Figure 5 and Figure 6 show sensitivity of most vulnerable path to RFT of type Ⅰ and type Ⅱ. Figure 5 shows that probability of interruption calculated high. Response force will interrupt the adversaries before they can

complete their task. Figure 6 shows when RFT is 133seconds, probability of interruption is calculated high. RFT is more than 133second, probability of interruption is calculated very lower. That means is that RFT is less than 133 seconds, adversaries failed their tact

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

Figure 2. Site-specific ASDs of PPS at Hypothetical Facility of type Ⅱ

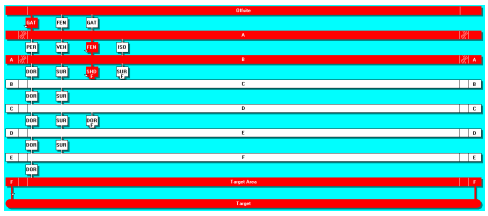

Figure 3. Intrusion path diagram at Hypothetical Facility of type Ⅰ in RFT= 300 seconds

Figure 4. Intrusion path diagram at Hypothetical Facility of type Ⅱ in RFT= 300 seconds

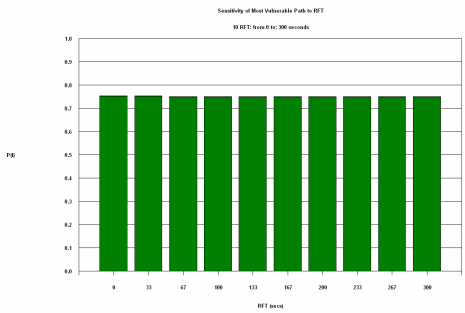

Figure 5. Sensitivity of most vulnerable path to RFT for type Ⅰ

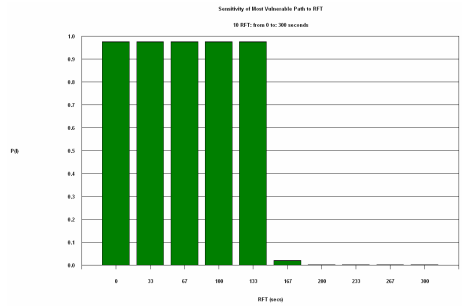

Figure 6. Sensitivity of most vulnerable path to RFT for type Ⅱ

3. Conclusion

This paper presented the vulnerability analysis of the PPS at hypothetical facility of type Ⅰ and type Ⅱ using the SAVI code.

The site-specific ASD was designed for the PPS at hypothetical facility of type Ⅰ and type Ⅱ. Then, the most vulnerable path of an ASD was determined for a measure of effectiveness.

The most vulnerable path of type Ⅰ shows the intrusion through the gate and the most vulnerable path of type Ⅱ shows the intrusion through the sea.

Probability of interruption of type Ⅰ was calculated high. and probability of interruption of type Ⅱ was calculated high when the RFT was less than 133 seconds. This means that most of intrusion would be interrupted with the PPS of type Ⅱ when a response force is ready to react against the intrusion within 133 seconds.

The results could not be directly applied to the real situation in the domestic NPP because the input data used in the analysis were obtained from the appropriate code which generated from the assigned country. But, the analysis would be helpful to understand the functions of the existing PPS and improve the possible performance upgrade for the system like a different type reactor.

REFERENCES

[1] Won Moog Jung, Ho Jin Lee, Donghan Yu, Gyungsik Min, "Vulnerability Analysis of Physical Protection System at Wolsung Nuclear Power Plant" Transaction of the Korea Nuclear Society Spring Meeting, 2006.

[2] SAVI 4.0 User's Manual

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

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