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Exercise Scenario Development Plan and Method for the Quantitative Assessment of Force-on-Force Exercise

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Abstract: Today, countries around the world are at risk of terrorism, especially after the September 11, 2001 terrorist attacks in the United States. The IAEA revised the INFCIRC/225/Rev.5 in 2011 to establish the nuclear security program and provide recommendations and guidelines for member states to establish, implement and maintain their physical protection systems. INFCIRC/225/Rev.5 recommends that appropriate exercise be conducted, such as a Force-on-Force exercise, to determine whether an unauthorized removal of nuclear material in use and storage and an effective and timely response to sabotage are possible. In practice exercise, it is necessary to simulate various threat situations that may occur and to develop practical exercise scenarios that can improve the response capability of nuclear power operators. After the exercise is completed, it is necessary to develop a systematic exercise evaluation methodology that can quantitatively evaluate the result of exercise and identify the enhancements. In this study, development plan of various exercise scenarios considering the characteristics of each nuclear facility are introduced to improve the efficiency of the Force-on-Force exercise, and we will present an objective and systematic exercise evaluation methodology based on collected data from exercise evaluation system developed by KINAC (Korea Institute of Nonproliferation and Control). The location information of the exercise participants, the engaging information, intrusion pathway and the route of the intruders and response forces from the exercise evaluation system are collected in real time, and the result of the combination of this information is derived. Through this, it is possible to strengthen the protection capability of nuclear facilities by identifying weaknesses of protection in their facilities and reinforcing the protection element and efficiently deploying the security forces.

Key words: force-on-force exercise, quantitative assessment, exercise scenario development plan

1. Background

There are various forms of terrorism occurring all over the world and Korea's nuclear facilities cannot be free from terrorism threats. The IAEA recommends that appropriate exercise, such as a Force-on-Force Exercise, should be provided to determine if guards and response forces can respond effectively and timely to sabotage. In Korea, based on the domestic law[1], physical protection exercise is carried out every year. Physical protection exercise evaluation system which can implement same effect of the actual exercise and collect exercise information is utilized. As a result of physical protection exercise, it draws out excellent items and corrective requirements and uses it to supplement physical protection system. The requirements to make correct are derived from the evaluation results based on the exercise evaluation table. However, there is a possibility that the subjective opinion of the evaluator may be included. Therefore, there is a need for a method to quantitatively evaluate physical protection exercise. And also, development of procedure regarding to physical protection exercise scenario should include identification of exercise scenario factors taking into consideration the characteristics of each nuclear facility.

2. Quantitative Methodology of Exercise Evaluation

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[1] APPRE: Act for Physical Protection and Radiological Emergency.

Quantitative assessment methodology is based on scenarios in which terrorists attempt to sabotage intrudes into critical facilities with protective equipment and response forces. The most important element of the methodology is the location of the terrorist and the distance of the target from which the terrorist will generate the sabotage. The physical protection exercise evaluation system can collect the GPS information of the participants in real time through the individual equipment. It makes to identify the location of the terrorist and measure the distance from the target. As a result, a time-distance graph between terrorist and target can be obtained and the strength and weakness of the protection facility can be derived from the slope of the graph.

2.1 Protected Area

The protected area of the facility where the physical protection exercise was conducted is divided into two categories as shown in Fig. 1. A fence is installed on the outside of each area to prevent intrusion from the outside, and protection facilities such as CCTV, sensor, and trolley are installed according to the characteristics of the facility. Since the location of the protection facility is classified as secret, it is intended to introduce the boundaries only at the level that helps understanding as shown in Fig. 2.

The data used in this study were collected through actual physical protection exercise for nuclear facility in South of Korea. We reviewed vulnerable path of the facility, two random targets that could be targets of

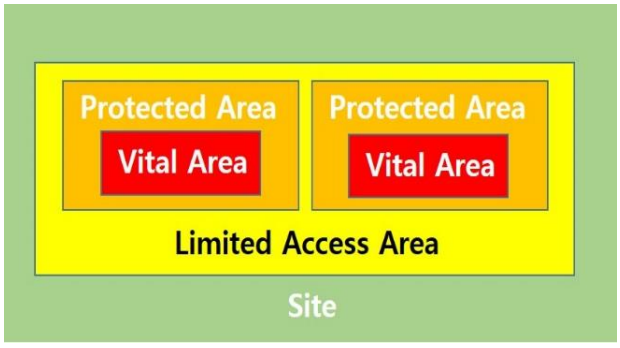

Fig. 1 Location and boundaries for protected, inner, and vital areas.

Fig. 2 Simplified Layout.

sabotage were selected. And then, we constructed virtual terrorists, and collected GPS information through exercise. In this study, we compare two cases. The first one is that terrorists are detected at barrier zone fence of a limited access area and the other is that terrorists are not detected and penetrates secretly. Thus we analyze the results of physical protection exercise from two cases through quantitative evaluation methodology.

2.2 Condition of Exercise

Physical protection exercise starts with the following condition when terrorists penetrate the fences of limited access area without detection. The reason for this is that exercise begins when terrorists approach limit access area fence from a remote area outside the facility, but the outskirts of the facility are generally accessible to the public and generally does not take measures such as detection, delay and response. As a result of measuring the distance between the target and the starting point of exercise I where the response forces did not detect the terrorist in the limit access area fence, was 399 m from the terrorist and the target. On the other hand, for the exercise II, distance to the target from terrorists is 461 m. Starting with this, we measure the straight line distance from the target according to the movement path of the terrorist.

2.3 Analysis of the Exercise

GPS signals were collected and the movement path of terrorists was drawn according to time elapsed as shown in the table below. One point on the exercise I graph corresponds to one minute, and one point on the

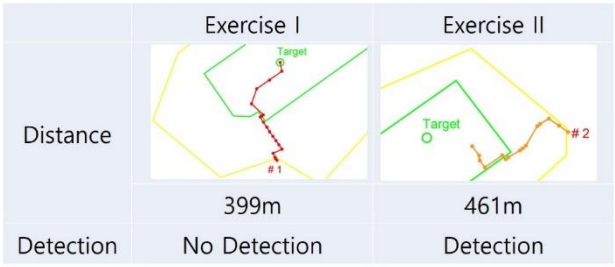

Fig. 3 Condition of Exercise I and II.

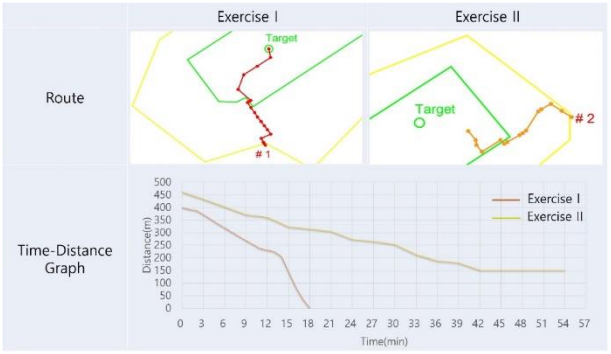

Fig. 4 Time-Distance Graph of Exercise I and II.

exercise II graph corresponds to three minutes. Also, the slope of time-distance graph shows that (undetectable) exercise I is drastically reduced compared to (detectable) exercise II. This resulted in a decrease in terrorist movement speeds in exercise II, as additional efforts were needed to conceal terrorists or search for detour facilities because of blocking critical path from response forces. On the other hand, exercise II detected in limit access area was terminated because all terrorists were killed.

3. Development Procedure for Physical Protection Exercise Scenario

3.1 Guideline of Physical Protection Exercise

The IAEA strongly recommends performance-based regulation and its physical protection exercise through the INFCIRC/225/Rev.5 document, but does not mention how to conduct physical protection exercise. Accordingly, the IAEA is developing the IAEA Physical Protection Training Manual (tentative name) to guide member countries in carrying out physical protection training in the right way. Therefore, we have collected and reviewed international documents to provide directions for the study of development procedures, and developed domestic physical protection training scenario development procedures and example scenarios in accordance with the components and development considerations of the scenarios recommended in the document. The IAEA physical protection exercise guidelines provide a detailed description of the scenarios, including situations and social moods, the invaders' strategy and sequential events, missions of invaders and controller. The components of the scenarios presented in the above IAEA guidelines are to be included in the scenarios at all stages from the preparation of the exercise to the performance of the scenarios. On the other hand, this procedure study is not to develop A to Z for one scenario, but to develop various scenarios up to the main event level.

Therefore, in this study of scenario development procedure, we only deal with "description of strategy" and "sequential occurrence" as the scenario components and the two components were reclassified into the following constituent factors.

3.2 Description of Strategy

Strategy descriptions can be subdivided into factors related to the characteristics and tools of the invaders, such as the purpose, goals, and attack methods. At this time, factors that do not directly affect the exercise scenarios such as motivation, level of training, affiliated organizations are excluded. The list below is an example of the factors that break down the description of the strategy.

- Intrusion purpose: illegal transfer or sabotage
- Intruder target: (illegal) removal target, (sabotage) demolition target
- Means of Intrusion: vehicle, sea, air, fake pass, etc.
- Weapons: pistols, shotguns, rifles, machine guns, etc.
- Explosives: vehicle explosives, aerial explosives, suicide vests, etc.

3.3 Sequential Occurrence

It is appropriate that penetration path for reaching the target (including the escape route in case of illegal transfer) is defined as an argument to specify the sequential occurrence. This is because the sequential occurrence of exercise is mostly determined by the penetration path of the invaders. The corresponding path of response forces can be considered as a factor, but the corresponding path is not defined as an argument because it is dependent on the penetration path as described above.

A total of six factors derived from the above two components were reclassified for the convenience of development. First of all, we dealt with the intrusion purpose which is the first item to be set in the scenario development and considered explosives and weapons as features of threat. And, purpose of intrusion, penetration path, and means of intrusion are considered as penetration path and means of intrusion.

	Purpose of Intrusion	Threat Characteristics	Penetration Path and Means of Intrusion
Argument	Purpose of Intrusion	Weapons, Explosives	Target, Penetration Path, Means of Intrusion

It is possible to create scenarios that are summarized to the main event level through a combination of constituent factors such as purpose of intrusion, threat characteristics, and penetration path and etc. derived from above. However, scenarios created through simple combination are too numerous and logically incompatible, so it is necessary to reduce the number of scenarios in a reasonable way and extract valid scenarios. Such procedures were developed by referring to the "Considerations in developing exercise scenarios" in the IAEA Physical Protection exercise guidelines.

4. Conclusion

To fulfill the obligation of implementing safeguards is a prerequisite for the peaceful use of nuclear energy. In addition, to establish and maintain a well-functioning nuclear material accounting and control system could prevent nuclear security risks. To foster safeguards culture could be one of the effective ways to facilitate the implementation of safeguards, which could provide states with both tangible and intangible benefits.

To promote safeguards culture, an international initiative needs to be set up by creating experts group regarding this topic. For instance, the IAEA could take the lead in studying safeguards culture and disseminating the research results. Considering the relatively low priority that safeguards has been given, to embed safeguards culture in regulation evaluation process could be a solution to raise awareness of the importance of safeguards culture targeting not only facility workers, but also higher management. To this end, development of the methodology to measure safeguards culture also should be taken into account for the next steps.

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