Development of Integrated Code for Risk Assessment (INCORIA) for Physical Protection System

Sung Soon Jang, Hyung-Min Seo and Hosik Yoo
Korea Institute of Nuclear Non-proliferation and Control
Exporo 573, Yuseong, Daejeon, Korea 305-348

1. Motivation

A physical protection system (PPS) [1] integrates people, procedures and equipments for the protection of assets or facilities against theft, sabotage or other malevolent human attacks. Among critical facilities, nuclear facilities and nuclear weapon sites require the highest level of PPS. After the September 11, 2001 terrorist attacks, international communities, including the IAEA, have made substantial efforts to protect nuclear material and nuclear facilities.

The international flow on nuclear security is using the concept or risk assessment. The concept of risk assessment is firstly devised by nuclear safety people. They considered nuclear safety including its possible risk, which is the frequency of failure and possible consequence. Nuclear security people also considers security risk, which is the frequency of threat action, vulnerability, and consequences. The concept means that we should protect more when the credible threat exists and the possible radiological consequence is high.

Even if there are several risk assessment methods of nuclear security, the application needs the help of tools because of a lot of calculation. It's also hard to find tools for whole phase of risk assessment. Several codes exist for the part of risk assessment. SAVI are used for vulnerability of PPS. Vital area identification code is used for consequence analysis.

We are developing Integrated Code for Risk Assessment (INCORIA) to apply risk assessment methods for nuclear facilities. INCORIA evaluates PP-KINAC measures and generation tools for threat scenario. PP-KINAC is risk assessment measures for physical protection system developed by Hosik Yoo[2] and is easy to apply. A threat scenario tool is used to generate threat scenario, which is used as one of input value to PP-KINAC measures.

2. Threat scenario generation

A threat scenario is a detailed plan by which adversaries perform malicious actions on nuclear material or nuclear facilities. A scenario includes path, strategy, and the number of attacker, target, intension, weapons, and retreat methods. It is developed based on design basis threat (DBT) and used for physical protection evaluation or training. Operators should develop many scenarios to assess most part of physical protection. Also scenario gives employees the concrete image so that emergency response is enhanced.

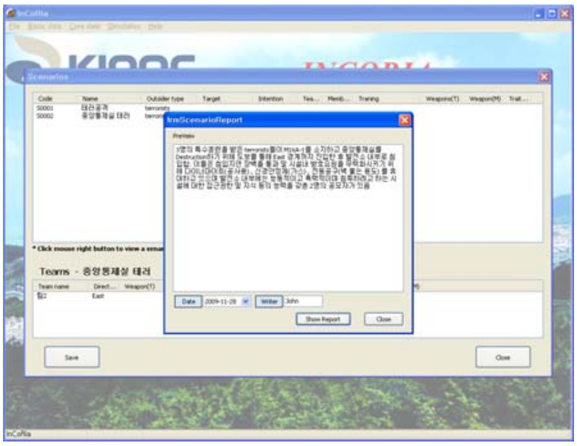

Fig. 1 Threat scenario

A scenario generator provides lists of each scenario factor and generates the following sentence.

- Three specially trained terrorists armed with M16A-1 intrude to eastern border of the facility on foot to destruct main control room. They have dynamite, electric equipments (for penetrating wall). There is two insiders in the facility who is active and violent and has an access and knowledge of the facility.

3. PP-KINAC measure

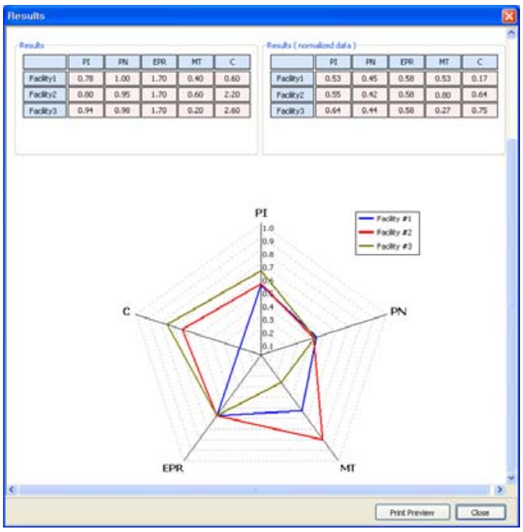

Fig. 2 Polygonal diagram of PP-KINAC

Many factors should be considered when performing a risk assessment. Hosik Yoo[2] had reviewed all the factors that can influence the evaluation of risk, and developed five new measure: the probability of interruption, the probability of neutralization, material type, effectiveness of physical protection resources and consequence.

- *Probability of interruption (PI)*
  Whether an adversary can complete an attack successfully or not depends on how quickly and adversary is detected and how long the delay action can be maintained until an off-site response force can arrive. The likelihood that an adversary will be detected an interrupted is defined as the probability of interruption; and it is determined by the performance of the detection system and the on-site response force.
  Numerous models were studied in order to calculate the probability of interruption and several codes were developed based on them. SAVI and ASSESS[3] are the more well known codes. We have developed a new code called SAPE[4] and the PI value was calculated in the study itself.

- *Probability of neutralization (PN)*
  The interruption of an adversary should not be confused with neutralization. Neutralization in this situation means that an adversarial force has been killed captured, or it has abandoned its attack.

- *Fissile material type (MT)*
  The attractiveness of fissile material to an adversary is dependent upon such factors as its physical and chemical forms, as well as the difficulty in process it and the concentration of the material.

- *Effectiveness of physical protection resources(EPR)*
  The EPR is focused on software such as staff, education and material counting and accountability activity.

- *Consequence (C)*
  Consequences are radiological, economical, and social damages resulting from the successful completion of a potential adversary's intended action.

4. INCORIA code development

The concept of threat scenario and PP-KINAC are complementary because the former describes against what you protect nuclear material and nuclear facilities, and the letter describes how to protect them (PI, PN, EPR) and other factors including possible consequences (C). By considering both, we can evaluate all aspect related to the security of the designated material or facilities.

We have been developing threat scenario generator and risk assessment code, called Integrated Code for Risk Assessment (INCORIA). The one of reasons of INCORIA development is that threat scenario and PP-KINAC factors needs a lot of calculation. It is also developed for the visualization of facility risk.

Fig. 3 Main screen of INCORIA

IAEA showed their interest to INCORIA for international use. Also domestic operators and policy makers are responding positively in particular to the systematic approach to physical protection evaluation.

5. Conclusion

We are under developing Integrated Code for Risk Assessment (INCORIA), which evaluates PP-KINAC measures. PP-KINAC evaluates based on many factors and threat scenario. Thus, we also developed threat scenario generator. INCORIA assesses all aspect of nuclear security, i.e. threat, effectiveness, and consequences. It integrates all related factors and visualizes it. Policy maker and high-level system designer shows much interest. This tool will help physical protection system designers, operators, policy makers, and regulators for an efficient physical protection system.

Acknowledgement

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