Development of Risk Assessment Methodology for State's Nuclear Security Regime

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1. Introduction

Threats of nuclear terrorism are increasing after 9/11 terrorist attack. Treats include nuclear explosive device (NED) made by terrorist groups, radiological damage caused by a sabotage aiming nuclear facilities, and radiological dispersion device (RDD), which is also called "dirty bomb". In 9/11, Al Qaeda planed to cause radiological consequences by the crash of a nuclear power plant and the captured airplane. The evidence of a dirty bomb experiment was found in Afganistan by the UK intelligence agency.

Thus, the international communities including the IAEA work substantial efforts. The leaders of 47 nations attended the 2010 nuclear security summit hosted by President Obama, while the next global nuclear summit will be held in Seoul, 2012.

Most states established and are maintaining state's nuclear security regime because of the increasing threat and the international obligations. However, each state's nuclear security regime is different and depends on the state's environment.

The methodology for the assessment of state's nuclear security regime is necessary to design and implement an efficient nuclear security regime, and to figure out weak points. The IAEA's INPRO project suggests a checklist method for State's nuclear security regime. The IAEA is now researching more quantitative methods cooperatively with several countries including Korea.

In this abstract, methodologies to evaluate state's nuclear security regime by risk assessment are addressed.

2. Method

2.1 Nuclear security regime

The *objectives* of nuclear security regime are

- preventing a NED and a RDD,
- preventing a sabotage of nuclear facility which has potential radiological consequences.

Nuclear security regime of a State includes

- legal and regulatory framework
- licensing
- import/export control
- border control
- MC&A,
- response measure,
- design basis threat
- security of nuclear materials and radiological materials in storage and in transport

IAEA's INPRO project assess State's nuclear security regime. In the project, above factors are measured by compliance based approach.

2.2 A success probability of an adversary

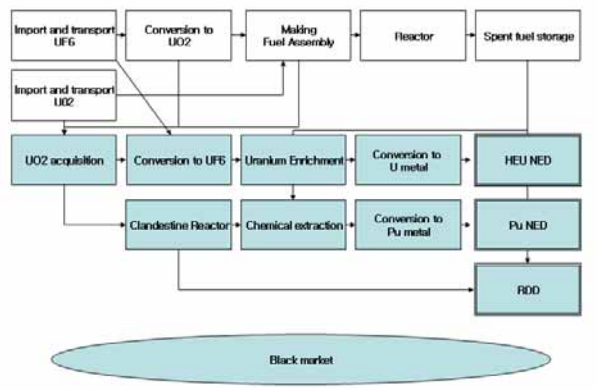

Fig. 1 A success (failure) diagram of an adversary

The idea is that State's national security regime is evaluated according to whether potential adversary would success or not. Thus, if potential adversaries has very little chance to achieve the objectives (NED, RDD, sabotage), a State has a robust nuclear security regime. For convenience, NED case is focused.

A success (failure) diagram shows adversary steps to acquire NED and RDD (Fig. 1). The white box shows nuclear fuel cycle and the colored box shows adversary's steps. The final objectives of an adversary are building NED made of highly enriched uranium or Pu-239, or RDD. This diagram assumes ROK's nuclear fuel cycle. By measuring and combining counter-measures to the diagram, we assesses State's nuclear security regime.

In every step there is possibility that adversary buy the material from or sell it to a black market. Actually, selling materials could be the alternative goal of an adversary.

The evaluation results of adversary's steps (arrows) could be the probability of an adversary success or the amount of material per month. Adversary's steps are depends on an adversary's capability and State's countering measures (prevention, detection and response). Connecting these entire steps gives us the overall evaluation results of nuclear security regime and enables us figure out weak points and over-protected points.

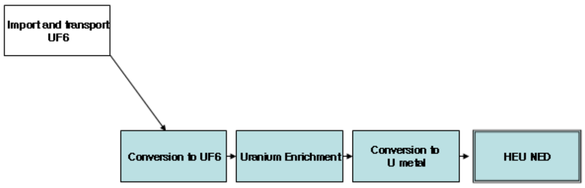

Fig. 2 A success sequence of an adversary to HEU NED

Let's assume evaluated values over steps are probability. The probabilities of success (by adversary) over sequential steps are multiplied, and over parallel are added.

These evaluations give one number between zero and unity, which represents State's nuclear security regime. However the value itself gives little information. By the sensitivity analysis and most successful (weakest) path finding, we can figure out which steps are important or not.

2.3 Other factors of Risk Assessment

Besides the probability of adversary success, some other factors should be considered in nuclear security regime. The adversary diagram shows how to acquire nuclear material and how to build NED, and does not deal with *the formation of an adversary group*, *the transportation to target/detonation*, and *consequences* are not addressed here.

These three factors (terrorist formation, transport and detonation, consequences) should be considered with adversary success to assess risk of nuclear security regime. However, three factors have quite different characteristics and need the help of experts outside of nuclear energy field.

3. Discussion

The success diagram of an adversary could be simple or more specific, which enables us the capability to change the size of model. Thus, this method can be applied to various regimes from simple to very complicated one.

Conclusively, we suggest an idea to evaluate a State's nuclear security regime not by evaluating the success diagram of an adversary. This evaluation method with an appropriate sensitivity analysis will help State's nuclear security regime.

Acknowledgement

This work has been carried out under the Nuclear Research and Development program supported by MEST

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