Regulatory Consideration on Physical Protection against Sabotage

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1. Introduction

The tragic accident at the Fukushima nuclear power plants in Japan was an eye-opening event even from a security point of view. Security specialists assessed the accident provided some insights on how to accomplish sabotage[1] at a nuclear power plant to terrorist groups. After the accident, NSSC and KINAC have reviewed and revised physical protection regulatory framework to prevent sabotage attack especially at a nuclear power plant.

It is reasonable to direct physical protection regulatory resources to prevent against sabotage at a nuclear power plant. Nuclear material stored and used at a nuclear power plant is typically difficult for unauthorized removal. However, large amount of spent fuel stored in a nuclear power plant is an attractive target for sabotage. Furthermore, over eighty percent of nuclear facilities under physical protection regulation are nuclear power plant in Korea.

In this paper, we would like to share our consideration on how to improve physical protection regulatory framework in order to prevent against sabotage.

2. Sabotage to a nuclear facility

Looking into characteristics of nuclear facilities under physical protection regulation in Korea, it comes clear that sabotage is more serious threat than unauthorized removal.

Nuclear Facility	Number of Facilities	UR[2]	S[3]	Remarks
Power Plant	27	O	O	Kori(6), Saeul(2), Wolsung(6), Hanbit(6), Hanul(7)
Research Reactor	1	O	O	
Fuel Fabrication	1	O	X	Only fresh fuel
Irradiation Facility	2	X	O	Without nuclear material
Total	31			

[1] In the nuclear security world, sabotage should come with radiological consequences, exposure to radiation or release of radioactive substance.
[2] UR: Unauthorized Removal
[3] S: Sabotage

Majority of nuclear facilities are nuclear power plants. Those power plants are located in relatively populated areas, as presented in Figure 1. This means large population might be exposed to radiological consequence by sabotage. This characteristic increases risk[4] of sabotage by increasing consequence

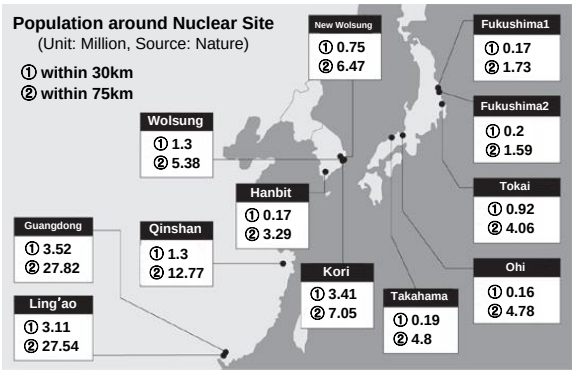


Figure 1. Population around Nuclear Site

From an adversary point of view nuclear material used or stored at a Korean nuclear power plant is more attractive for sabotage rather than unauthorized removal[5]. Nuclear material at a power plant is either fresh fuel or spent fuel. Those fuels are in the form of fuel assemblies, not in bulk form. This makes an adversary difficult to accomplish unauthorized removal because of its heavy weight or delayed time for breaking down fuel assemblies.

From response forces point of view, sabotage to a nuclear power plant is much more difficult to protect against. Timeline analysis for physical protection system shows that response time for sabotage is much shorter than unauthorized removal. Moreover, the number of target sets for sabotage is bigger than that for unauthorized removal. Protection against sabotage requires to protect safety systems. On the other hand, protection against unauthorized removal requires to protect just the small number of areas where nuclear material is used or stored.

3. Regulatory Consideration against Sabotage

In this section, we would like to share our analysis on current regulatory framework and consideration for

[4] Risk can be evaluated by considering its frequency and consequences.
[5] Please be aware that we are not saying that unauthorized removal is not possible in a nuclear power plant.

regulatory improvement. Those analysis and consideration are mainly done by looking into the legal framework.

3.1 Graded Approach against Sabotage

Graded approach, one of the fundamental principles, is to take protective measures considering the current evaluation of threat, the relative attractiveness, the nature of the nuclear material and potential consequences associated with unauthorized removal and with sabotage. For example, regulatory framework against unauthorized removal is according to the categorization of nuclear material. The categorization is based on the feasibility of nuclear material diversion. Protective measures in regulatory requirements are well defined according to the categorization.

In general, regulatory framework against sabotage consists of two parts: protective measures for stored and used nuclear material (at a fixed site) and measures for nuclear material in transport.

Regulatory framework for a fixed site states protective measures according to unacceptable and high radiological consequences as shown in Figure 2. However, those level of radiological consequences are not defined.

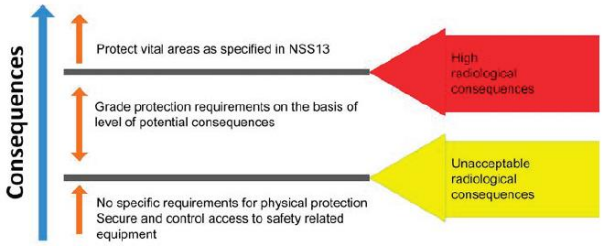


Figure 2. Relationship between unacceptable radiological consequences and high radiological consequences and graded levels of protection in NSS 13.

In case of regulatory framework for nuclear material in transport, the protective requirements are ridiculously stated according to the categorization of nuclear material, which is regulatory criteria against unauthorized removal. We will discuss on this in detail in the next section.

3.2 Protective Requirements against Sabotage according to the Categorization of Nuclear Material

Korean regulatory frameworks against sabotage and unauthorized removal are somewhat mixed up. This is mainly because protective requirements against sabotage are defined according to the categorization of nuclear material. As it is already discussed, the categorization is regulatory criteria against unauthorized removal.

First of all, protective requirements against sabotage to nuclear material in transport are stated according to the categorization. The problem is that there is a provision in the categorization regulation regarding self-protection of nuclear material. This means that nuclear material whose radiation level exceeding 1Gy/h at 1m unshielded could be reduced one category level. This goes against graded approach against sabotage. The basic principle for graded approach against sabotage is that the greater radiological consequences the more reinforced protective measures.

Another mixed-up point is the definition of the areas such as limited access area and protected area. In Korean regulatory framework, those areas are defined according to the categorization of nuclear material. For instance, “Category III Protective area”, which is equivalent to limited access area in NSS 13, is defined as the area to protect category III material. On the other hand, areas to protected against sabotage are only defined as “Protective area” and vital area.

As we have already discussed, sabotage to a nuclear power plant is what we have to more focus on protecting against rather than unauthorized removal. However, the regulatory framework that we have is opposite. Also, this is different from what is stated in IAEA NSS 13.

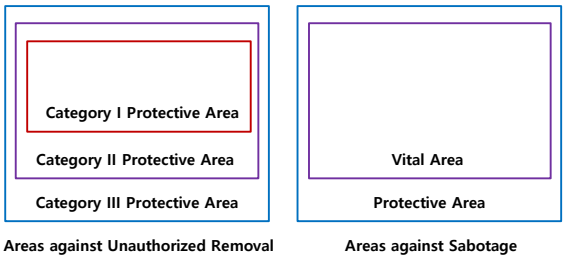


Figure 3. Areas for Protection

3.3 Vital Area and Target Set

A vital area[6] is another important concept that we have to look into. It is important to protect nuclear facilities with potential high radiological consequence by identifying vital areas and taking protective measures.

One of the biggest issues is that we do not have clearly defined criterial on what high radiological consequence is. As well, the legal framework does not have any provision on how to identify vital areas.

Currently, NSSC and KINAC is struggling for re-identifying vital areas on nuclear power plants by adapting U.S. criteria. KINAC published a regulatory guide on identification of vital areas in order to make up for those gaps in the legal framework.

We could have some insights how to improve our regulatory framework by taking a close look at U.S. framework. In 10CFR, there are more provisions on

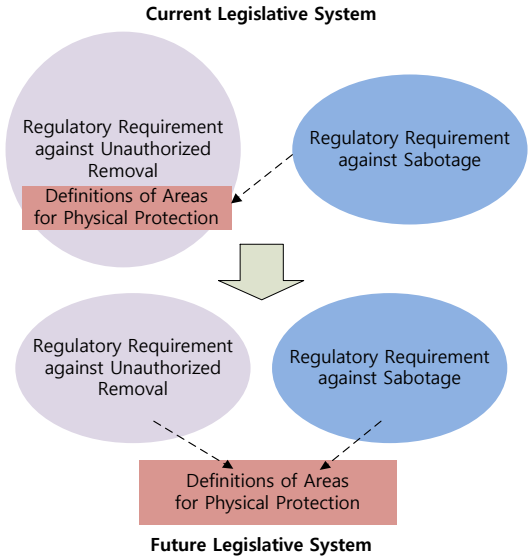
6 Area inside a protected area containing equipment, systems, or devices, or nuclear material, the sabotage of which could directly or indirectly lead to high radiological consequences

how nuclear operators protect target sets[7]. Target sets are what an adversary attack for high radiological consequence, so that U.S. regulatory framework states provisions on how to identify target sets and how to develop protective strategy for them. Especially, U.S. regulatory framework has a regulatory guide on how to install missile barriers on target sets.

4. Future works

In this paper, we would like to point out the fact that legislative revision is required on regulatory requirements against sabotage to nuclear facilities. We would like to suggest to start from simple ones.

The simplest one is to redefine definition of areas for physical protection. In the current legislative system, the definitions of areas are closed related to unauthorized removal. This seems to be one of the main reasons why the regulatory requirements to designate areas against sabotage becomes so different from international recommendations. It is required to define the kinds of areas for physical protection independently from threats.



Then, we need to introduce the concept of target sets in the current legislative system. In order for this, we need to state regulatory requirements for two things. The first is to state requirements on the procedure to identify vital areas from facility (safety) analysis to target set identification and finally to vital area identification. The second is to state requirements on preparing protective measures for target sets not only for vital areas.

At last, we need to specify the levels of two radiological consequences (unacceptable and high). Specifying the levels of radiological consequence has influence on not only physical protection but also other fields. For this, collaborative research is required with experts in the field of radiological emergency preparedness and public health.

7 Target sets are list of areas that can be leaded to high radiological consequences by having disabled due to adversary's attack.

5. Conclusions

We have discussed rationales of focusing on preventing from sabotage rather than unauthorized removal based on characteristics of nuclear facilities and threats in Korea. We have looked into our regulatory framework, and then pointed out that it put higher standards on unauthorized removal rather than sabotage. Also, we have provided what to improve our regulatory framework such as setting criteria for radiological consequences, resolving tangled regulatory requirements between unauthorized removal and sabotage, and reinforcing regulatory requirements including target sets.

REFERENCES

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[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Physical Protection of Nuclear Material and Nuclear Facilities (Implementation of INFCIRC/225/Revision 5), IAEA Nuclear Security Series No. 27-G, IAEA, Vienna (2018).
[3] 원자력시설 등의 방호 및 방사능 방재 대책법. 동법 시행령 및 시행규칙.
[4] 10CFR 73.55 Requirements for physical protection of licensed activities in nuclear power reactors against radiological sabotage.
[5] Regulatory Guide 5.65, Vital Area Access Controls, Protection of Physical Security Equipment, and Key and Lock Control
[6] APR-1400 Design Control Document Tier 2, Chapter 3. Design of Structures, Systems, Components, and Equipment