

Suggestion of Applying Physical Protection Regulations on Nuclear Materials out of Category

Jounghoon Lee^{a*}

^a Korea Institute of Nuclear Nonproliferation and Control, 1418 Yuseong-Daero, Yuseong-Gu Daejeon, Korea

*Corresponding author: jhlee@kinac.re.kr

1. Introduction

There have been many efforts to strengthen physical protection measures for nuclear material and nuclear facilities. These efforts are reflected and recognized in the establishment of international resolutions and technical documents on nuclear security such as the Convention on the Physical Protection of Nuclear Material (CPPNM), IAEA nuclear security series, etc.

The potential of a malicious acts involving nuclear or other radioactive materials continues to be a threat throughout the world. And when nuclear or other radioactive materials are left uncontrolled or in unauthorized circulation, they become vulnerable to theft. Therefore, nuclear material is categorized in terms of element, isotope, quantity and irradiation to determine its physical protection measures against unauthorized removal [1]. And the requirement of physical protection against unauthorized removal is also classified in line with the categorization. However, nuclear materials excluded from the category, referred to as ‘nuclear materials out of category’ in this paper, is not properly regulated. It is necessary to identify the status of implementation of physical protection of nuclear materials out of category and to seek ways to strengthen their physical protection regulation.

This paper reviews the implementation of physical protection regulations for nuclear materials out of category and proposes its improvements.

2. Physical Protection measures for Nuclear Materials out of Category

There are many international legal instruments related to nuclear security such as the CPPNM and its 2005 Amendment, the International Convention for the Suppression of Acts of Nuclear Terrorism, United Nations Security Council resolution 1540, etc. And many technical documents have been developed to assist in their implementation, among which IAEA nuclear security series are representative. In particular, IAEA nuclear security series No. 13 (NSS No.13) describes recommendations on physical protection of nuclear material against unauthorized removal with the intent to construct a nuclear explosive device, and to the physical protection of nuclear facilities and nuclear material, including during transport, against sabotage [2].

According to the NSS No. 13, the primary factor in determining the physical protection measures against

unauthorized removal is the nuclear material itself. So the nuclear materials are categorized according to element, isotope, quantity, and irradiation, as shown in Table 1. This categorization is the basis for a graded approach for protection against unauthorized removal of nuclear material that could be used in a nuclear explosive device, which itself depends on the type of nuclear material, isotopic composition, physical and chemical form, degree of dilution, radiation level, and quantity [2].

Table 1. Categorization of Nuclear Material

Material	Form	Cat I	Cat II	Cat III
Pu	Unirradiated	2kg or more	Less than 2kg but more than 500g	500g or less but more than 15g
U-235	Unirradiated	5kg or more	Less than 5kg but more than 1kg 10kg or more	1kg or less but more than 15g Less than 10Kg but more than 1kg 10kg or more
	- ²³⁵ U enriched to 20% or more			
	- ²³⁵ U enriched to 10% but less than 20%			
	- ²³⁵ U enriched above natural, but less than 10%			
U-233	Unirradiated	2kg or more	Less than 2kg but more than 500g	500g or less but more than 15g
Irradiated Fuel			Depleted or natural uranium, thorium or low enriched fuel	

These categorization and physical protection measures are equally reflected in national law, the Act on Physical Protection and Radiological Emergency (APPRE). The APPRE also includes physical protection requirements for nuclear materials from the CAT I to CAT III, categorized as in the IAEA NSS No. 13. And due to this categorization of nuclear materials, it is recognized that nuclear materials excluded from the category do not need to apply physical protection measures. (The nuclear materials excluded from the category is referred to as ‘nuclear materials out of category’ in this paper.)

However, NSS No. 13 additionally mentions on physical protection measures for nuclear materials out of category, as follows:

- Quantities not falling in Category III and natural uranium, depleted uranium and thorium should be protected at least in accordance with prudent management practice.

- Nuclear material, which is in a form that is no longer usable for any nuclear activity, minimizes environmental dispersal and is practicably irrecoverable, may be protected against unauthorized removal in accordance with prudent management practice.
- Nuclear material that is required to be protected in accordance with prudent management practice should be secured against unauthorized removal and unauthorized access.
- If the potential radiological consequences of sabotage are less severe than the unacceptable radiological consequences defined by the State, then the operator should still protect safety related equipment and devices by controlling access to them and securing them.

Nevertheless, there is still a lack of detailed description of physical protection measures.

3. Current Status of Nuclear Materials out of Category in the ROK

It is difficult to identify the current status of using nuclear materials out of category from the physical protection and safety regulations point of view. Because some nuclear materials are exempt from these regulations. For example, less than 300 grams of U235 and less than 900 grams of thorium do not need to get a license to use nuclear material from the safety related regulation. On the other hand, basically all nuclear materials should be controlled to implement IAEA CSA and AP in accordance with safeguards regulation. And in terms of safeguards purposes, nuclear materials of less than 1 effective kilogram are defined and managed separately as small quantity of nuclear material (SQNM). Thus, the current status of the using nuclear materials out of category may be investigated through the SQNM status under safeguards regulation.

There are 235 facilities which is using SQNM in ROK and they are consisted of 77 industries and 158 universities and research institutes. The status of using SQNM is shown in the following Table 2.

Table 2. Use status of SQNM in the ROK(2020.2.19)

Element	Number of SQNM	Amount of SQNM
Depleted Uranium	2,205	51,934.981 Kg
Enriched Uranium	34	18,358.440 g
Natural Uranium	129	3.562 Kg
Plutonium	39	1.506 g
Thorium	56	0.683 Kg
Uranium, unified	27	0.012 Kg

To control the SQNM, KINAC uses the National LOF Management System, which is a web-based national SQNM management system, and it helps SQNM users to declare their information of nuclear materials. And KINAC also conducts outreach activities,

such as facility visits, hosting information sharing workshops, etc., to assist SQNM users fulfill their obligations. It is possible to carry out inspections based on the Nuclear Safety Act (NSA), but in practice they are limited to conducting for the IAEA inspections or other special cases.

4. Suggestion of Appropriate Physical Protection Measures for Nuclear Materials out of Category

There are no physical protection requirements for nuclear materials out of category in ROK's legal framework, and very limited and general requirements are described in IAEA NSS No. 13. However, all nuclear materials including out of category should be applied physical protection measures as mentioned in IAEA NSS No. 13. For now, practically, physical protection measures could be applied to nuclear materials which are managed by SQNM under control of safeguards regulation. And such measures should begin to be applied in the form of recommendations, not mandatory, taking into account regulatory resistance.

There is a public notice that mentions security measures for radioactive isotopes. This is not for nuclear material, but only for certain radioactive isotopes above the radioactivity defined in the public notice [3]. However, this public notice may help to set requirements for nuclear materials out of category. Accordingly, the physical protection requirements for nuclear materials out of category are proposed with consideration of this public notification, the current management status of SQNM, and IAEA NSS No. 13, as follows:

- Access to areas for the use and storage of nuclear material should be controlled.
- Inventory of nuclear material should be established, maintained and verified on a regular basis. And it should be reported to the NSSC every year.
- All nuclear security-related events should be appropriately responded and immediately reported to the police and NSSC.

The above requirements reflect the physical protection elements of detection, delay and response, and some of which specifically describe what is mentioned in the Nuclear Security Act and the Act on Physical Protection and Radiological Emergency. Moreover, 'the Security Management Plan' and 'Security Managed Area', which are prescribed by the public notice, are not needed to introduce for the SQNM because the radioactivity of SQNM is generally less than the radioactivity defined in the public notice.

In the future, SQNM will need to be further subdivided to apply graded approach of physical protection requirements. For example, there are some SQNMs needed to obtain license for the use or possess from the Nuclear Safety and Security Commission, and

they may require security plans and designated security areas. Further research is needed for establishing more detailed implementation measures.

5. Conclusions

According to international norms, especially IAEA NSS No. 13, the reason why it is necessary to conduct physical protection measures for nuclear materials out of category are discussed. In addition, the status of using SQNM and its regulation in the ROK was investigated to know the status of using nuclear materials out of category. Based on this, physical protection requirements for nuclear materials out of category are proposed, which reflect similar regulations, national and international norms.

In the future, it may be necessary to modify these physical protection requirements to reflect foreign cases and field opinions. Through this, overall control, management and regulation of national nuclear material out of category should be established.

REFERENCES

- [1] Amendment to the Convention on the Physical Protection of Nuclear Material, IAEA, 2005.
- [2] IAEA Nuclear Security Series No. 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Rev.5), 2011.
- [3] Regulation on Security Measures for Radioactive Isotopes, Nuclear Laws of the Republic of Korea, Public Notice of NSSC no. 2017-55, 2017.