International Journal of Nuclear Security

Volume 7 | Number 1 Article 14

2022

Effort and Prospective on Nuclear Security in ROK

Jung Soo Kim
Korea Institute Nonproliferation And Control

Myung-Tak Jung
Korea Institute of Nuclear Nonproliferation and Control (KINAC)

Kookheui Kwon
Korea Institute of Nuclear Nonproliferation and Control (KINAC)

YoungWook Lee
Korea Institute of Nuclear Nonproliferation and Control (KINAC)

International Journal of Nuclear Security, Vol.7, No.1, 2022

Effort and Prospective on Nuclear Security in ROK

Jung Soo Kim, Myung-Tak Jung, Kookheui Kwon, and YoungWook Lee
Nuclear Security and Cyber Security Division, Korea Institute of Nuclear Nonproliferation and Control (KINAC)

Abstract

As of July 2013, the Republic of Korea (ROK) has been operating a total of 23 nuclear power reactors at four sites with five new reactors under construction. In addition, the country has planned to construct two more units at two candidate sites, but due to a change in the energy policy, only one candidate site has been constructed while the other was decommissioned. The ROK has also been exporting nuclear power plants to the United Arab Emirates (UAE) and building a research reactor in Jordan. These actions have made the nation's nuclear industry by far the fastest growing industry in the world. While Korea has focused on improvements in the field of nuclear safety (especially after the Fukushima accident), it continues to strengthen nuclear security as well. This was demonstrated both when the country hosted the 2012 Nuclear Security Summit and when the nation's president made a speech emphasizing the need for nuclear and cyber security during the 2014 Nuclear Security Summit (NSS). This paper examines the approaches leading to the establishment of the physical protection systems and their application at nuclear facilities in the ROK based on the Convention on the Physical Protection and Nuclear Materials (CPPNM). The paper also recommends further steps to improve the ROK's existing nuclear security apparatus.

Keywords: Nuclear Security, Cyber security, Nuclear Security Summit (NSS), Physical Protection

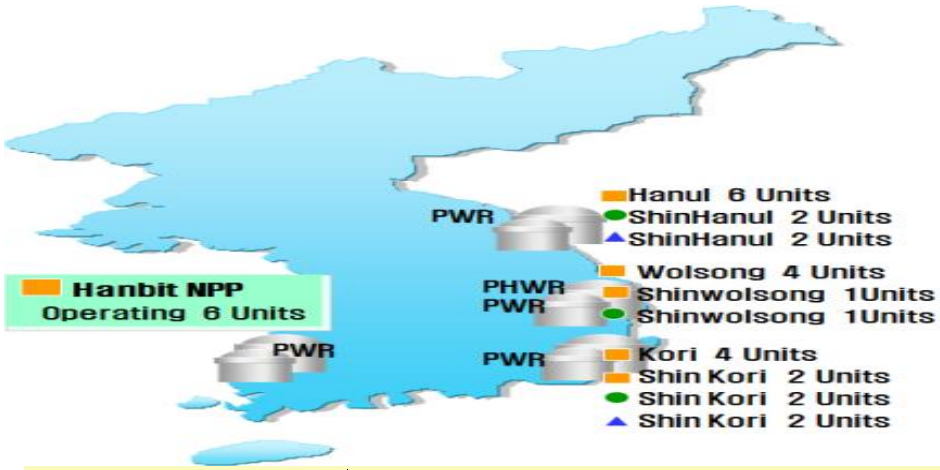
I. Introduction

Since 2013, the Republic of Korea (ROK) has had 23 reactors in operation, which accounts for more than 20 to 30% of ROK's electricity generation. During the 2010 Washington Nuclear Security Summit (NSS), President Lee announced, "To enforce nuclear security, it is necessary to develop the HRD (Human Resource Development) and in order to achieve the goal, the ROK will establish the education center for Security before the next meeting" ***[1]***. At the next meeting, the Seoul Nuclear Summit 2012, President Lee reported the establishment of INSA (International Nuclear Security Center), the COE

doi: 10.7290/ijns07c1uw

(Center of Excellence) in the ROK, and announced the IPPAS (International Physical Protection Advisory Service) mission in the ROK **[*2*]**. Due to the Seoul Nuclear Summit in 2012, INSA was opened in 2014 and has been run in nuclear security curriculums with many students in Asian countries participating **[*2*]**. Also, during the 2014 Hague Nuclear Security Summit (NSS), the ROK's President Park underscored her nation's strong relationship with regional countries in the field of nuclear security. She went on to highlight the issue of cyber threats to nuclear facilities as well as the leading role of the ROK in preventing terrorist attacks **[*3*]**. At the end of 2012, the ROK added cyber threats to the revised Design Basis Threat (DBT) based on the threat assessment. Currently, the Korea Institute of Nuclear Nonproliferation and Control (KINAC) acts as the regulatory body entrusted by the NSSC to inspect in nuclear facilities, and licensees are now implementing a seven-step cyber security phase in accordance with the cyber security plan that was approved in April 2015. Additionally, various efforts have been made to ensure adequate implementation of each step through technical meetings with KINAC and licensees. KINAC has been reviewing the Cyber Security Plan (CSP) of new reactors since 2016.

As of July 2013, ROK operates a total of 23 nuclear power reactors at four sites, with five nuclear power reactors under construction at the Hanul and Kori sites. Figure 1 shows four nuclear power sites on the east and west coasts. There are 19 light water reactors, with four heavy water reactors at the Wolsong site.



Status		Number of units
■	In operation	23 units
●	Under construction	5 units
▲	Planned	4 units

Figure 1. Four nuclear power sites on the east and west coasts [*4*]

II. The ROK Nuclear Security Policies and Regulation

The goal of the ROK's physical protection policy is to establish a national physical protection regime which ensures that nuclear material and facilities are used only for peaceful purposes. This policy was also designed to protect against internal and external threats in advance, deter unauthorized acts, and minimize radiological consequences. With this basic national physical protection regime, the Nuclear Safety & Security Commission (NSSC) set up a national physical protection regime reflecting the

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

regulations of INFCIRC/225/rev.5. Since its establishment in 2011, the NSSC has been responsible for setting up and implementing national policies related to physical protection. The national physical protection regime is comprised of a legal and institutional framework; a threat assessment base; regulations, prevention, and response measures against radiological terrorism; and international cooperation. The ROK entered the Act on Physical Protection and Radiological Emergency (APPRE) into law in 2003 to set up a legal and institutional framework for physical protection **[*5*]**. The government formulated the national DBT in 2009 to establish a threat assessment base. It was updated to reflect domestic and international threats in 2012 and 2015. It requires every nuclear facility to complete an attack and response scenario. To implement these regulations, the government conducts reviews and inspections of nuclear facilities. By developing technology and using objective technical standards to assess their requirements for physical protection, the government can ensure that facilities follow international rules.

The ROK has been committed to international efforts in strengthening its physical protection regime. Regarding the prevention of radiological terrorism, the ROK established its own response measures in 2006. This is the basis for all response systems regulated to each competent authority involved in nuclear energy. The ROK has formulated and carried out a mid- and long-term plan (five years each) to develop technologies for preventing and responding to radiological terrorism. Each nation is fully responsible for its own physical protection. However, with increasing international transportation of nuclear materials, the radiological consequences of a nuclear event could potentially reach neighboring countries. Therefore, international cooperation has become crucial in physical protection. The ROK ratified the CPPNM (Convention on Physical Protection of Nuclear Material) in 1982 and held the 2nd Nuclear Security Summit in 2012. There are 13 international security-related conventions. Among these 2 conventions, the CPPNM and the ICSANT (International Convention for the Suppression of Acts of Nuclear Terrorism) are directly related to the physical protection of nuclear material and facilities. The CPPNM was signed into law in 1980 and officially took effect in 1987. In the ROK, the CPPNM was ratified by the National Assembly in 1982 and has been implemented for the international transport of nuclear material since 1987. The ROK signed the CPPNM and the ICSANT in 2005 and began forcing it at the end of 2014. Besides international conventions, the United Nation Security Council Resolution (UNSCR) is an international rule with strong binding power in physical protection. In particular, UNSCR 1540 was adopted under Chapter VII of the United Nations Charter and took into effect in 2004 to control against general security threats instead of the specific national security threats. It obligates all states to legislate and execute physical protection and export control. The ROK submitted the first report in November 2004 and an additional report in September 2005.

Meanwhile, the most significant turning point for the development in the physical protection regime in the ROK was the establishment of the NSSC as an independent regulatory authority in October 2011. The setup and update of the DBT in 2009 and 2012 has been changed from the prescriptive approach to performance approach in the physical protection. KINAC provides technical support for physical protection while the NSSC takes the initiative in providing interface between nuclear safety and security for policy making. The policy of physical protection in the ROK is emphasized as below **[*6*]**.

First, the ROK is actively committed to meeting international demands in its policy by adopting INFCIRC/225/rev.5, including cyber threat in the DBT, and amending relevant laws and regulations. Second, the ROK has developed the nuclear security culture and kept continuing to require that licensees enhance nuclear security culture. Third, the ROK has been supporting the establishment of a regulatory regime for nuclear security and enforcing international cooperation with new-comer countries, such as the UAE and Jordan. These countries were providing support for the construction of physical protection infrastructure customized to each country, conducted technical cooperation with subject matter experts, and developed the HRD participating in the INSA curriculum. In that regard, the ROK's physical protection policy complies with the "Global Nuclear Security Regime" of the IAEA.

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

III. The ROK's Physical Protection System

The APPRE (Act on Physical Protection and Radiological Emergency) was legislated to prevent radiological disaster and establish the physical protection regime. Before its enactment, the implementation of physical protection was interfaced or integrated with specific nuclear material accountancy regulations under the Atomic Energy Act **[*7*]**. However, since the 9/11 attacks in the U.S., potential threats to nuclear facilities have been more prevalent. Accordingly, the ROK legislated and promulgated the APPRE on May 15, 2013 (implemented on February 16, 2004) to bring legal and institutional improvements to the domestic physical protection system (PPS) and to build an effective national system. The APPRE provided the tools needed to help prevent radiological disasters. The APPRE reflects most of the basic principles of physical protection required by the amended CPPNM and other international recommendations. In particular, the APPRE imposes obligations on the government to carry out a threat assessment based on a DBT, which is an essential element of the national physical protection system.

Other features of this legislation dictate that the country should first conduct a periodic threat assessment at its nuclear facilities. Second, under the NSSC, a physical protection council should be set up to review important national policies. Metropolitan, provincial, city, county, and borough protection councils should be established in regions with nuclear facilities. Third, categorizing nuclear material and requirements for their protection against unauthorized removal and sabotage should be determined under presidential decree. Fourth, a licensee should comply with such presidential decrees. This includes receiving approval from the NSSC for establishing its physical protection systems and equipment for its facility, as well as for implementing its operating systems, physical protection regulations, and contingency plans. Fifth, licensees should be subjected to an initial inspection, followed by periodic inspections, transport inspections, and special inspections to confirm their adherence to the regulations. If a licensee fails an inspection, they could be subject to imprisonment or fines. Sixth, when licensees use or transport nuclear material without due authority, and thereby cause injuries or death, they could be subject to the death penalty or life sentence in prison **[*5*]**. After the APPRE was legislated, the country made several improvements to its physical protection system, such as eliminating vulnerabilities identified from the Fukushima Nuclear Disaster. These improvements also reflected the CPPNM amendment, INFCIRC/225/rev.5, and the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), in addition to the communiqué rendered by the 2012 and 2014 Nuclear Security Summits **[*2, 3*]**.

The NSSC specifies relevant inspections and formulates rules regarding the education and training of people responsible for physical protection. The ROK is responsible for the establishment, implementation, and maintenance of the physical protection regime for nuclear material and facilities in compliance with laws and regulations in the country. Requirements for physical protection of nuclear facilities and material in use, storage, and during transport are specified in the APPRE (enacted in 2003) in addition to the laws and regulations that have been enacted. A graded approach is made to physical protection requirements, based on the category of nuclear material. Table 1 lists the category of nuclear facilities in ROK.

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

Table 1. The category of nuclear facilities in the ROK

Nuclear power plant	Facility capacity (MW)	Commencement of commercial operation
Kori 1	587	April 1978
Kori 2	650	July 1983
Kori 3	950	September 1985
Kori 4	950	April 1986
Shin Kori 1	1,000	February 2011
Shin Kori 2	1,000	July 2012
Wolsong 1	678	April 1983
Wolsong 2	700	July 1997
Wolsong 3	700	July 1998
Wolsong 4	700	October 1999
Shin Wolsung 1	1,000	July 2012
Hanbit 1	950	August 1986
Hanbit 2	950	June 1987
Hanbit 3	1,000	March 1995
Hanbit 4	1,000	January 1996
Hanbit 5	1,000	May 2002
Hanbit 6	1,000	December 2002
Hanul 1	950	September 1988
Hanul 2	950	September 1989
Hanul 3	1,000	August 1998
Hanul 4	1,000	December 1999
Hanul 5	1,000	July 2004
Hanul 6	1,000	April 2005

The requirements for protection against unauthorized removal are classified in two ways. The first pertains to the unauthorized removal of nuclear material in use and storage, and the second pertains to unauthorized removal during transport. The requirements for protection against sabotage are classified in two ways as well. These include requirements for protection against sabotage of nuclear material in use and storage, and, second, for protection against sabotage during transport. To meet such requirements, the ROK drew up the "Technical Standard for Physical Protection Review and Inspection" **[*8*]**.

Under the ROK's legal and regulatory system, regulatory services related to the DBT (Design Basis Threat) are subject to the "Act on Physical Protection and the Radiological Emergency Act" (APPRE) under the jurisdiction of the NSSC. According to article 3 of APPRE, the ROK is required to establish policies for physical protection of nuclear material and nuclear facilities. These policies include protection against unauthorized removal of nuclear material, measures to find and retrieve lost or stolen nuclear material, prevention of sabotage of facilities, and measures with regards to a radiological impact caused by sabotage of a nuclear facility.

To implement these physical protection policies, the government set up a regime and a design basis threat (DBT). The national DBT was first formulated in 2009 to establish a threat assessment. It was updated in 2012 to reflect domestic and international threats, including cyber security. The NSSC prepares a threat assessment and DBT document, cooperates with the relevant central administrative bodies (including the

doi: 10.7290/ijns07c1uw

Intelligence Service) and the associated organizations for reviews, and subsequently finalizes the DBT. The threat assessment is consistently updated with new information on international and domestic threat-related incidents, types of adversaries (both outsider/insiders) as well as environmental threats and geological information on domestic nuclear facilities. Normally, the DBT must be revised and renewed every three years bearing in mind the cause of the threat, the possibility of its occurrence, and the possible consequence. The established DBT is classified and managed as a confidential document and distributed only to those necessary. Each licensee should establish or change a physical protection system pursuant to the established DBT. Currently, the DBT applies to all facilities subject to the review/inspection. Figure 2 shows the development and revision process of DBT in the ROK.

Material	Form	Category I	Category II	Category III
1. Plutonium	Unirradiated[b]	2 kg or more	Under 2 kg but more th an 500 g	500 g or less but more than 15 g
2. Uranium-235	Unirradiated[b] - Uranium enriched to 20% ^{235}U or more	5 kg or more	Under 5 kg but more th an 1 kg	1 kg or less but more t han 15 g
	- Uranium enriched to 10% ^{235}U but below 20% ^{235} U		10 kg or more	Under10 kg but more t han 1 kg
	- Uranium enriched above natural but below 10% ^{235} U			10 kg or more
3. Uranium-233	Unirradiated[b]	2 kg or more	Under 2 kg but more th an 500 g	500 g or less but more than 15 g
4. Irradiated Fuel (The categ orization of irradiated fuel in t he table is based on internati onal *transport* considerations . The State may assign a diff erent category for domestic u se, storage, and *transportatio n* taking all relevant factors in to account.)			Depleted or natural ur anium, thorium or low-enriched fuel (less tha n 10% fissile content)	

[a] All plutonium except that with isotopic concentration exceeding 80% in plutonium-238.
[b] Material not irradiated in a reactor or material irradiated in a reactor but with a radiation level equal to or less than 1 Gy/hr.
[c] Other fuel which by virtue of its original material content is classified as Category II or III before irradiation may be reduced one category level while the radiation level from the fuel exceeds 1 Gy/hr (100rad/hr) at one meter unshielded.

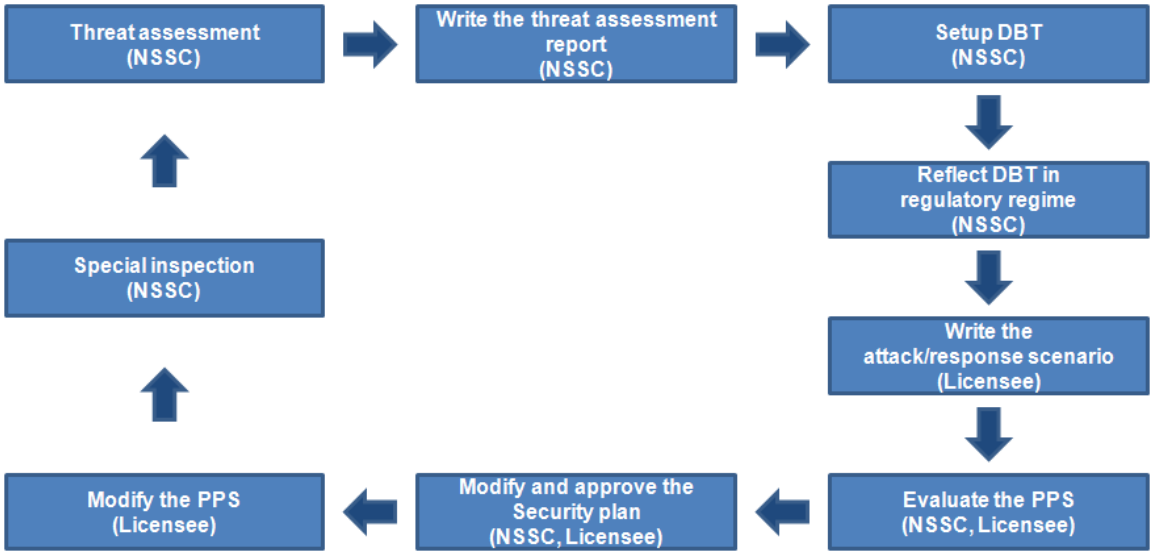


Figure 2. The development and revision process of DBT in the ROK [*4*]

A. Graded Approach

Physical protection requirements are applied in a graded approach. This method takes into consideration the threat evaluation, the relative attractiveness of the target, the nature of the material, and the potential consequences of its unauthorized removal. As seen in Table 1, the APPRE defines the requirements for the classification of nuclear material based on the CPPNM and INFCIRC/225 requirements. Following the grading of nuclear material, a licensee must meet the requirements for physical protection of their

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

facility. Table 2 summarizes these requirements. In case of the vital area, the "two-men rule" was applied for the nuclear facilities even if the facility was Category II.

Table 2. Requirements for nuclear material (refer to INFCIRC 225/rev.5)

Category I	Category II	Category III
Satisfy the req. for Category II	Satisfy the req. for Category III	Access Control
Prohibit entry of private vehicles	Facilities located in protected area	Detection Measures
Two person rule	Detection of unauthorized intrusion	Contingency Plan
Isolated from general road	Minimize entry of vehicles and limit designated parking areas	Annual Training and education
Perform CAS during emergencies	Minimize personal access, escort unauthorized persons in protected areas	Periodic evaluation of security plan
	Search of persons, vehicles and packages	Hand-over reporting procedures
	Provide sufficient lighting and visibility	Movement of nuclear material within same area
	Provide Central Alarm station	Provide computer & information systems
	CAS located in protected area	
	Independent power supply for detection equipment and CAS	
	24-hour guard service, as well as regular and random patrols	
	Periodical exercises by both guards and off-site response forces	

B. Information Security

The NSSC establishes and oversees the implementation of information security regulations at domestic nuclear facilities, including domestic nuclear power plants under the nation's physical protection regime. KINAC provides technical support to facilities for their reviews and inspection of information security. The goal of information security lies in maintaining the confidentiality, integrity, and availability of digital computers and information document and systems. The NSSC obligates licensees to implement document security and information security, as well as to establish electronic security for computers and information systems at their facilities in compliance with APPRE. Licensees are required to establish relevant implementation guidelines in their security plans. When the NSSC inspects a physical protection system (pursuant to Articles 9 and 12 of APPRE), they also evaluate the facility's information and computer security plan. With computer attacks increasing, the national computer security infrastructure has become more significant. Accordingly, stronger security controls against internal and external computer attacks have become necessary for domestic nuclear facilities. The ROK added cyber threats to its periodic threat assessment, based on the INFCIRC/225/rev.5 **[*9*]**. Computer attacks against nuclear facilities, alone or combined with physical attacks, could lead to the unauthorized removal of nuclear material or sabotage as well as damage to nuclear facilities. At the end of 2012, the NSSC added computer attacks to the revised DBT based on threat assessments. In order to evaluate the impact of

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

computer threats on nuclear facilities in the revised DBT, the NSSC requires nuclear facilities to assess their vulnerabilities using response scenarios and correct any shortcomings.

The APPRE enforcement decree outlines requirements for the protection of nuclear material and nuclear facilities by identifying and eliminating vulnerabilities to computer security, minimizing radiological consequences, and establishing a computer security system. Such requirements were established with extensive reference to the INFCIRC/225/rev.5 and technical guidelines outlined by NSS-17 **[*10*]**. These guidelines include regulations on organizations, facilities, equipment used for electronic security measures, electronic security plans for nuclear facilities, security plans against electronic intrusion, and other electronic security plan issues for digital computer and information systems.

C. Enhancing the Nuclear Security Culture

The international community learned important lessons from the September 11, 2001 attacks in the U.S. and the Fukushima nuclear disaster in Japan. From these events, the ROK published the "Implementing Guideline on Nuclear Security Culture" **[*11*]**. This guide is based on No.7 "Nuclear Security Culture" **[*12*]** and "Technology and Institutions for Nuclear Security" **[*13*]**. The guide defines the concept, elements, roles and responsibilities of a nuclear security culture appropriate for the ROK's physical protection regime. The "Implementing Guideline" also outlines how the nation, its organizations, management, and staff can nurture a nuclear security culture.

The ROK's government announced that all organizations involved in the nuclear industry must carry out those regulations outlined in the guide. Based on this operational mechanism, the ROK is committed to creating a nuclear security system by providing education and training on these guidelines, as well as related policies and codes of conduct. Implementing these guidelines will encourage organizational awareness and maintain a nuclear security culture.

D. Sustainability Program

Initiated by a presidential pledge made during the 2010 Nuclear Security Summit (NSS), the ROK established an international training center called INSA (the International Nuclear Nonproliferation and Security Academy). The Korean Centre of Excellence (COE) was opened in February 2014 and was equipped with state-of-the-art security devices and tools. In addition to providing security training, the facility is also used for nuclear security research and development (R&D). The external physical protection training and test facilities are divided into four sectors. The training facilities include a detection equipment room, access control room, table top exercise room, and a state-of-the-art central alarm station (CAS). The training courses began in March 2014. The objective of INSA is to provide practical education and training programs, and to raise awareness of nuclear nonproliferation and security. INSA will help secure an efficient and effective physical protection regime by developing requirements for physical protection in addition to technical standards for the ROK's nuclear facilities. INSA will also help nuclear newcomer countries to establish their own nonproliferation and security regimes. Figure 3 shows the International Nuclear Nonproliferation and Security Academy (INSA).

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

Figure 3. International Nuclear Non-proliferation and Security Academy (INSA) [18]

E. Confidentiality

Article 15 of the APPRE and Table 1 under the enforcement regulation thereof requires the nuclear licensee to not divulge secrets on the physical protection, to use physical protection as intended, and to implement security control on the physical protection documents and information. Under the law and regulations, the relevant technical standard ("The Technical Standard on the Document and Information Management of Nuclear Facilities" **[*14*]**) defines the DBT-related information, the location of nuclear material and major equipment, and the drawing on the interior structure of nuclear facilities and information on the physical protection of nuclear facilities as "Security Information" since such information has a negative impact on the security of a nuclear facility upon leakage. The Technical Standard limits the number of people with access to the Security Information to the minimum number necessary. The Security Information is managed confidentially with four different levels depending on the significance of the subject.

F. Force-On-Force

Due to the Y-12 National Security Complex incident **[*13*]**, the ROK should conduct realistic performance tests at all levels from protesters to terrorist-type adversaries. Therefore, Article 9.3 of the APPRE and enforcement 5.4 related with "Force On Force Exercise" requires the nuclear licensee to conduct the FOF exercise every year. The purpose of FOF exercise is to do in-depth vulnerability assessments and performance tests of the physical protection system. Through FOF, there would be a realistic exercise for responses against threats. The FOF exercise in the ROK has been performed since 2016 and it evaluates the checklist based on the scenario. For FOF exercises, there are many kinds of equipment (Advanced Multiple Integrated Laser Engagement System (MILES) equipment) and evaluation software. MILES is combat equipment that uses laser beams to simulate shooting. Sensors and controllers are attached to the training vests and helmets, which provide the weapon effectiveness of an actual system safely. It is able to analyze the results of the exercise easily by recording the training participant's location, action, combat, and communications. Figure 4 shows the evaluation software for real time indication and tracking during exercise. Through the evaluation checklist, evaluation software, and exercise video results, one can analyze adversary pathways and times, response pathways and times, and the combat outcomes between the invading adversary and the response force. Through this, the ROK can deduce the best practices, as well as findings and recommendations, to improve the physical protection system.

doi: 10.7290/ijns07c1uw

Figure 4. The evaluation software for real-time indication and tracking during exercise [*15*]

G. IPPAS in ROK

The ROK has adopted international standards and guidelines which reflect the country's circumstances. As the demand for energy increased, and as the ROK became a nuclear reactor exporter, the role and importance of nuclear energy has grown extensively. Accordingly, there has been increasing interest and demand for nuclear security in the country. The ROK held the 2012 Nuclear Security Summit where the nation requested that the International Atomic Energy Agency (IAEA) conduct an International Physical Protection Advisory Service (IPPAS) mission in an effort to cope proactively with increasing international demands for strengthened nuclear security on the peninsula. In June 2012, the NSSC set up a preparatory organization to host the IPPAS mission and discussions and began on a preparation plan with related organizations including KINAC. In December 2012, the NSSC reconfirmed the request for the mission and continued its consultations with the IAEA. In July 2013, the IPPAS workshop and a preparatory meeting were held (in Daejeon and Seoul respectively) to finalize the scope and schedule of the IPPAS mission to the ROK.

The objective of the IPPAS mission to South Korea in February 2014 was to assess its national protection regime of nuclear and other radioactive materials. This also included associated nuclear facilities and activities in the country, such as its implementation for the nuclear power plant as well as for related transportation. The mission compared the procedures and practices in the country with the Convention on Physical Protection of Nuclear Material (CPPNM) and its 2005 Amendment, IAEA recommendations (INFCIRC/225/rev.5), and other relevant Nuclear Security Series (NSS) guidelines **[*16*]**. The scope of the IPPAS mission to South Korea was broad and covered all five modules. The state-level review covered the legislative and regulatory framework, regulatory practices, and coordination between organizations involved in physical protection. The facility level review covered the PPS at the Hanbit NPP operated by the Korea Hydro and Nuclear Power Company (KHNP), and the High-flux Advanced Neutron Application Research Reactor (HANARO) operated by the Korea Atomic Energy Research Institute (KAERI). The transport review covered the PPS of nuclear fuel in transit from the Korea Electric Power Company's Nuclear Fuel Fabrication Facility (KEPCO NF). The security of Radioactive Material review covered the legislative and the regulatory framework, as well as the PPS of the Advanced Radiation Technology Institute (ARTI) of KAERI. Computer security was examined at the Hanbit NPP operated by KHNP. In preparing for the mission, the IPPAS's task force team conducted self-assessments and

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

reviewed the physical protection regime of the nation. During this process, a great many activities concerning physical protection in the country were organized by the team. The ROK is the 40th state to receive an IPPAS mission. It is one of the first countries to request that an IPPAS mission be carried out in its country, including a comprehensive review of the national physical protection regime with all five IPPAS modules. As a result, the IPPAS mission to the ROK was a great opportunity not only to review its physical protection regime but also to exchange views on ways to enhance international nuclear security.

IV. Conclusion

The ROK has emerged as a leader in nuclear security for several reasons. Firstly, the ROK established the NSSC as the independent authority (for example, the independence between R&D and Regulation) after the Fukushima accident. Secondly, the ROK hosted the Nuclear Summit in 2012. The President of the ROK was important for determining the role of nuclear security in the country, and the result was the establishment of the INSA as the Centre of Excellence (COE). The INSA focused on the education of nuclear security personnel for Asia and newcomer countries. Thirdly, the ROK has been exporting nuclear power plants to the United Arab Emirates (UAE) and is building a research reactor in Jordan. It has proven that it met the requirements of the International Rule of Nuclear Technology for Safety and Security. Fourthly, even if there were many cyber-attacks recently, the ROK would be well protected from a cyber-attack. Specifically, there is no threat to a nuclear power plant's ICS (Industry Control System). As a leading country in nuclear security, the ROK adopted the mission of IPPAS. An IPPAS member in the ROK stated that the "ROK has Mature and Well-Established Nuclear Security Regime and beyond the International Instrument" in an IPPAS Report. And, establishing the NSSC has changed the nuclear security culture in this nuclear security area. The ROK has been setting up the INSA, and they invited nuclear security persons who joined the 234 persons from South Asia and Eastern Europe in 2017.

The ROK's government would strengthen safety and security even if the nuclear policies were different. To strengthen nuclear security, first, the DBT included insiders (active) and has been changed three times (over a total of nine years), and the Technical Standard for insiders was already developed from an access control perspective. But, until now, the methodology of insider analysis had not been developed. Recently, the IAEA actively discussed (through the INFCIRC-908) that an insider threat would be prevented with physical protection as well as computer security [17]. Following the IAEA Process, the ROK will be developing an implementation document to mitigate or reduce insider threats. Secondly, the "Security by Design" concept was one of the design processes in nuclear power plants by IAEA. IAEA recommended that the Licensing Process reflected the "Security by Design" concept in the designing process of a nuclear power plant. But, the ROK has not fully reflected the "Security by Design" concept in the designing process of a nuclear power plant. NSSC has only been reviewed between the Construction Permit (CP) and Operation Permit (OP) through the security plan. Due to the overall process, it would not fully reflect the change in the security design. The ROK will try to move up the submission period of the security plan to the NSSC before the CP or including Safety Analysis Report. Thirdly, the ROK will enhance its R&D investments into physical protection and implement suggestions and recommendations from the IPPAS mission. For example, in the case of setting up the vital area according to the IPPAS recommendation, the ROK would set up and fix the vital area based on INFCIRC/225/Rev.5. In the case of setting up the HRC (High Radiological Consequence)/URC (Unacceptable Radiological Consequence) level, this is crucial to the graded approach for unauthorized removal or sabotage of nuclear material. If the HRC/URC level was set up properly, it would be effectively protected from potential unauthorized removal or sabotage of the nuclear facility. Lastly is international transportation. As the ROK exported NPPs to UAE, the ROK has provided the nuclear material to UAE according to the overall export schedule. However, the related law (APPRE) and Technical Standard were not specified until now. Therefore, the ROK will modify the law (International Transportation part) and develop the Technical Standard based on the INFCIRC/225/Rev.5.

doi: 10.7290/ijns07c1uw

V. Works Cited

1. National Security Strategy 2010 (2010), (available at https://nssarchive.us/wp-content/uploads/2020/04/2010.pdf).

2. 2012 Seoul Nuclear Security Summit, 100 days away: Preparations for the Agenda (2011), (available at https://www.mofa.go.kr/eng/brd/m_5676/view.do?seq=310758).

3. Foreign Minister Delivers a Keynote Speech at a Symposium concerning the 2014 Hague Nuclear Security Summit View. *Minist. Foreign Aff. Repub. Korea* (2014), (available at https://www.mofa.go.kr/eng/brd/m_5676/view.do?seq=313500).

4. J.-S. Kim, J. Myung-tak, K. Kwon, Y. Lee, Lesson Learned from the IPPAS in ROK (2015).

5. Act on Physical Protection and Radiological Emergency (APPRE) (2003).

6. 원자력안전위원회 원자력안전위원회 운영관련정보 > 원자력안전종합계획. *Nucl. Saf. Secur. Comm. NSSC* (2018), (available at https://www.nssc.go.kr/ko/cms/FR_BBS_CON/BoardView.do?pageNo=1&pagePerCnt=15&MENU_ID=1730&CONTENTS_NO=&SITE_NO=2&BOARD_SEQ=12&BBS_SEQ=44718&USER_NAME=&TEL_NO=&WRITER_DI=&_csrf=&SEARCH_SEQ=11&SEARCH_FLD=&SEARCH=2018%EB%85%84%EB%8F%84_%EC%84%B8%EB%B6%80%EC%82%AC%EC%97%85_%EC%B6%94%EC%A7%84%EA%B3%84%ED%9A%8D.pdf).

7. Atomic Energy Act (2008).

8. Technical Standard for Physical Protection Review and Inspection (2011), (available at www.kinac.re.kr/board?menuID=MENU00491&siteID=SITE00002).

9. *Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5)* (International Atomic Energy Agency, Vienna, 2011; https://www.iaea.org/publications/8629/nuclear-security-recommendations-on-physical-protection-of-nuclear-material-and-nuclear-facilities-infcirc/225/revision-5), *Nuclear Security Series*.

10. *Computer Security Techniques for Nuclear Facilities* (International Atomic Energy Agency, Vienna, 2021; https://www.iaea.org/publications/14729/computer-security-techniques-for-nuclear-facilities), *Nuclear Security Series*.

11. Nuclear Security Culture Implementing Guide (2013).

12. *Nuclear Security Culture* (International Atomic Energy Agency, Vienna, 2008; https://www.iaea.org/publications/7977/nuclear-security-culture), *Nuclear Security Series*.

13. M. Bunn, Nuclear 101: Technology and Institutions for Nuclear Security (2013), (available at https://www.belfercenter.org/publication/nuclear-101-technology-and-institutions-nuclear-security).

14. The Technical Standard on the Document and Information Management of Nuclear Facilities - KINAC/RS-015/2013 (2013), (available at www.kinac.re.kr/board?menuID=MENU00491&siteID=SITE00002).

doi: 10.7290/ijns07c1uw

International Journal of Nuclear Security, Vol.7, No.1, 2022

15. "2017/2018/2019 Annual Report" (Korea Institute of Nuclear Nonproliferation and Control (KINAC), 2019).

16. *International Physical Protection Advisory Service (IPPAS) Guidelines* (International Atomic Energy Agency, Vienna, 2014; https://www.iaea.org/publications/10772/international-physical-protection-advisory-service-ippas-guidelines), *Services Series*.

17. INFCIRC/908: Communication dated 22 December 2016 received from the Permanent Mission of the United States of America concerning a Joint Statement on Mitigating Insider Threats (2017), (available at https://www.iaea.org/sites/default/files/publications/documents/infcircs/2017/infcirc908.pdf).

doi: 10.7290/ijns07c1uw