

## Safeguards Implementation Strategy for Exporting FNPP

Hosik YOO, Seungho JEONG, Seungho, Kwangho JU  
Korea Institute of Nuclear Nonproliferation and Control, Nuclear Nonproliferation Division, 1418,  
Yuseong-Daero, Daejeon, ROK

\*Corresponding author: [hsyoo@kinac.re.kr](mailto:hsyoo@kinac.re.kr)

\***Keywords** : FNPP, Safeguards, CSA, AP

### 1. Introduction

Several countries, including the Republic of Korea (ROK), have been actively developing Floating Nuclear Power Plants (FNPP) due to its significant potential for flexible deployment and cost-effective construction. [1-2] In general, FNPPs can potentially present technical challenges for safeguards implementation if novel reactor concepts are involved. The unique deployment model of an FNPP, however, presents additional challenges that can be either technical or legal in nature, especially during export. Safeguards measures depend on the types of agreement concluding with the IAEA, leading to complexities when supplying and recipient states differ in their safeguards statuses. Nuclear Non-Weapon States (NNWSs) must conclude Comprehensive Safeguards Agreements (CSA) pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). [3-4] The IAEA and States are required to cooperate in the implementation of such agreements. Over 100 NNWSs party to the NPT have very limited quantities of nuclear material and have concluded protocols (referred to as Small Quantity Protocols, SQP) to their CSAs which hold in abeyance many procedures in Part II of a CSA. [4-5] Besides, ratification of the Additional Protocol (AP) and the type of agreement with the IAEA play a crucial role in determining safeguards measures. This study categorizes states based on their safeguards implementation status and discusses relevant tasks in scenarios involving different supplying and recipient countries. The results of this study can be useful to those contemplating FNPP exportation.

### 2. Categorization of Safeguards Status and Tasks

#### 2.1 Categorization of States:

States are categorized into four types based on their agreements with the IAEA: CSA, Voluntary Offer Agreement (VOA), Partial Agreement (PA), and SQP. NNWSs with nuclear materials must conclude CSAs, while those without such materials opt for SQPs. The five Nuclear Weapon States (NWSs) have VOA agreements, and three non-NPT member states have PAs based on INFCIRC/66. The categorization is influenced by whether the states have ratified the AP,

leading to a total of ten possible state types (Table 1). However, as all five NWSs have ratified the AP, the actual categorization reduces to nine types.

#### 2.2 Categorization of Supply-Recipient States

Over 40 countries are developing Small Modular Reactors (SMR), and five countries plan to construct FNPPs.

Table 1. Categorization of the States

NPT	Types		AP	Symbol
Ratified	VOA		Ratified	VOAA
			Non-Ratified	VOAN
	CSA		Ratified	CSAA
			Non-Ratified	CSAN
	SQP	Original	Ratified	SQPOA
			Non-Ratified	SQPON
Modified		Ratified	SQPMA	
		Non-Ratified	SQPMN	
Non-Ratified	PA		Ratified	PAA
			Non-Ratified	PAN

Since any country with SMR technology can produce FNPPs, they can function as supply countries. Most countries planning FNPP or SMR development fall under VOA and CSA categories. However, exporting or importing FNPPs to or from PA countries faces difficulties due to the requirement of the Nuclear Suppliers Group (NSG), allowing nuclear reactor exports or imports only for countries applying full safeguards.

Table 2. Supply and Recipient Countries

Supplier Country	Recipient Country
VOAA CSAA CSAN	VOAA
	CSAA
	CSAN
	SQPOA
	SQPON
	SQPMA
	SQPMN
	PAA
	PAN

On the country, other countries concluding safeguards agreement with the IAEA can import FNPP (Table 2).

### *2.3 Tasks for Exporting FNPP*

FNPPs could present new challenges from a safeguards regulatory perspective as these types of SMRs may be constructed in one State and then deployed in a different State. The safeguards regulatory authority for the nuclear material and activities on a FNPP must be defined, and recognizes that there are open questions about jurisdiction and control for a FNPP operating in territorial and international waters that require solutions. International waters (or the high seas) begin at the edge of the territorial waters, a threshold at which national authority begins to diminish.

#### *2.3.1 Exporting between VOA and CSA countries*

Exporting FNPPs between VOA and CSA countries poses minimal challenges as they have established State Systems for Account and Control (SSAC) and considerable experience with IAEA safeguards. There will need to be cooperation between the State supplying a reactor, the State deploying a reactor, and the IAEA, to ensure that safeguards requirements for the provision of early design information and verification, and initial inventory declaration and verification, are met in conjunction with the reactor transfer. In this regard, a trilateral agreement among the IAEA, supplying country, and recipient country becomes necessary to clarify safeguards responsibilities. For CSAN countries, importing FNPPs may be difficult due to some countries' demand for AP ratification as a prerequisite condition.

#### *2.3.2 Exporting from VOA to SQP countries*

Exporting FNPPs from VOA to SQP countries requires SQP countries to establish a national safeguards framework before importing FNPPs. The IAEA can provide assistance through consulting, training, and capacity building activity. However, VOA countries, having limited experience with full-scope IAEA inspection, may face difficulties in providing safeguards measures if the recipient country requires them. Thus, a trilateral agreement is vital to ensure successful IAEA safeguards implementation. The agreement should specify detailed safeguards measures, considering that VOA countries may manufacture reactors and nuclear fuel on their territory and transport reactor-equipped fuel to recipient countries. The VOA country may hold responsibility for FNPP operation and its safeguards. Additionally, since SQP countries lack experience in handling spent fuel, there is a high likelihood of spent fuel and reactor return to the supplier country, necessitating inclusion in the agreement.

#### *2.3.3 Exporting from CSA to SQP countries*

This scenario is believed to be similar to 2.3.2. However, CSA countries can provide more specific measures for IAEA safeguards due to their extensive experience. Both CSAA and CSAN countries may possess their own legal and institutional frameworks for safeguards, greatly assisting recipient countries in establishing their systems. The trilateral agreement concluded through discussions among the three parties should include detailed safeguard measures.

## **3. Conclusions**

This study categorizes countries based on their IAEA safeguards agreements, yielding nine distinct categories. Safeguarding FNPPs differs from other reactor types due to their mobility, necessitating detailed safeguards measures for each stage, including manufacturing, transportation, operation, and spent fuel disposal. While VOA and CSA countries face fewer challenges when exporting or importing FNPPs between them, SQP countries need adequate preparation due to their insufficient legal and institutional frameworks for implementing IAEA safeguards. Assistance from the IAEA and supplying countries can aid SQP countries in establishing suitable safeguards frameworks. Trilateral discussions among supplying, recipient countries, and the IAEA are essential to reach agreements containing detailed safeguards measures to ensure implementation and prevent potential issues.

## **ACKNOWLEDGEMENTS**

This work was supported by the Nuclear Safety Research Program through the Korea Foundation Of Nuclear Safety (KoFONS) using the financial resource granted by the Nuclear Safety and Security Commission (NSSC) of the Republic of Korea. (No. 2207007)

## **REFERENCES**

- [1] Brian D. Boyer, Understanding the Specific Small Modular Reactors Safeguards Issues, INPRO Dialogues Forum, 2016.
- [2] Nicole Virgili, The Impact of Small Modular Reactors on Nuclear Non-Proliferation and IAEA Safeguards, VCDNP Report, 2020.
- [3] INTERNATIONAL ATOMIC ENERGY AGENCY, Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/140, IAEA, Vienna (1970).
- [4] INTERNATIONAL ATOMIC ENERGY AGENCY, The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153 (Corrected), IAEA, Vienna (1972).

[5] INTERNATIONAL ATOMIC ENERGY AGENCY,  
Standard Text of a Protocol to an Agreement,  
GOV/INF/276/Annex B, IAEA, Vienna (1974).

[6] INTERNATIONAL ATOMIC ENERGY AGENCY,  
Modified Text of the Protocol to an  
Agreement Concluded on the Basis of GOV/INF/276, Annex  
A, GOV/INF/276 Mod 1 and Corr. 1 Annex B, IAEA, Vienna  
(2005).