

# Fundamental International Regulatory Framework for Physical Protection of Spent Fuel in Transit

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## 1. Introduction

International transport of nuclear material and its physical protection should consider a variety of issues, from technical matters related to the sealing and other systems for transport of nuclear material, to the security of the transport route, and personnel security and protection capabilities. At present, Korea has no experience in transporting spent nuclear fuel, and domestic laws and physical protection regulations are not fully maintained. Hence, it is necessary to refer to previous experiences in other countries and international norms/conventions and regulatory standards. In this paper, using the US Federal Law 10 CFR 73 and NUREG-0561 in the regulatory guides of the NRC and No. 26-G in the IAEA nuclear security series as the main reference, the essential requirements for the international maritime transport of spent nuclear fuel and its physical protection are discussed. We will review and discuss what needs to be considered when implementing physical protection regulations.

## 2. U.S. Legislative and Regulatory Framework

### 2.1 10 CFR 73

NRC Regulations Title 10, Code of Federal Regulations deals with the requirements binding on all persons and organization who receive a license from NRC to use nuclear materials or operate nuclear facilities. Especially, part 73 of 10 CFR is about Physical Protection of Plants and Materials. Amongst them, 73.25-28 and 74.35-38 deal with the Physical Protection of Special Nuclear Material in Transit, and also contain information on the essential requirements for the transport of spent nuclear fuel. In section 35, 37, 38, requirements for physical protection of irradiated fuel in transit were delivered in detail.

Table I: 10 CFR 73 Parts for Physical Protection of Special Nuclear Material in Transit

	Contents
73.25	• Performance Capabilities for physical protection of strategic special nuclear material in transit
73.26	• Transportation physical protection systems, subsystems, components, and procedures
73.27	• Notification requirements
73.28	• Security background checks for secure transfer of nuclear materials
73.35	• Requirements for physical protection of irradiated reactor fuel in transit (100 grams or less)
73.37	• Requirements for physical protection of irradiated reactor fuel in transit
73.38	• Personnel access authorization requirements for irradiated reactor fuel in transit

### 2.2 NUREG-0561

NUREG is the regulatory guidelines as the sub-enforcement of 10 CFR (Energy) under the NRC's jurisdiction in federal law. NUREG-0561 is related to 10 CFR 73.37 "Requirements for physical protection of irradiated reactor fuel in transit" and 73.38 "Personnel access authorization requirements for irradiated reactor fuel in transit" and delivers the details of physical protection of spent fuel transport. For ROK, it is worth referencing, who has not experienced international transportation of spent nuclear fuel yet.

In NUREG-0561, the general requirements related to the transport of spent nuclear fuel and the general requirements, which include approval of transport routes, advance coordination of shipments, advance notification, communication systems, armed protection, transport records, information management and training, as well as means of transport, the personnel security and information protection, reliability investigation and prohibitions.

## 3. IAEA Documents for Spent Fuel in Transit

### 3.1 Nuclear Security Series No.26-G

NSS No.26-G "Security of Nuclear Material in Transport" and 27-G are implementation guidelines related to INFCIRC/225/Rev.5. NSS 27-G comprehensively covers physical protection of nuclear material and nuclear facilities, and 26-G gives a full description of the security of nuclear material in transit, such as state's responsibilities for physical protection, categorization of nuclear materials for application of security level during transportation, state and carrier's responsibility for lost or stolen nuclear materials, sabotage response during transportation, etc. Since these documents deliver various events that can occur during the transport of nuclear material, it would be an essential reference for who prepares transport of nuclear material.

### 3.2 TECDOC-967

Among the IAEA technical document series TECDOC-967 and Nuclear Security Series No.27-G, some parts give a description for classification of nuclear materials. Since the transport system and standards for protection will be differentiated depending on the categorization of nuclear material, the amount of nuclear material to be transported and the amount of radiation emitted from it will be the subject of consideration. These documents deliver general material about categorization, and more detailed calculation methods and examples are covered in NSS 26-G, which will be described above.

## 4. Domestic Concerns for Spent Fuel Transport

### 4.1 Transport Security Plan

The main content of the revision of the domestic law related to the transport of nuclear material, which is being promoted based on the international standards and the regulatory system of other countries and precedent cases, is that the submission and approval of a Transport Security Plan(TSP) should be required to commence international transport of nuclear material. As covered by the IAEA's NSS 26-G, TSP must describe all means and methods of physical protection, including security requirements, and who is responsible for transport. Also, TSP must include all information such as transport routes, by means, stops and temporary storage locations.

### 4.2 Categorization of Nuclear Materials

The classification of nuclear material being transported is also subject to discussion. The irradiated fuel is classified as Class II, which refers to depleted uranium, natural uranium, thorium or low-enriched fuels with less than 10% fissile material. The IAEA's categorization table for nuclear material is recommended for international transport, but it is open for states to decide categorization of material depending on their specific circumstances. States may assign a different level of physical protection to the abovementioned irradiated fuels while in domestic use, storage and transport. TSP submission and approval are not mentioned for nuclear materials below grade II, but the TSP submission and approval may vary depending on a state's independent interpretation and categorization of nuclear materials.

Material	Form	Category I	Category II	Category III
1. Plutonium	Unirradiated	2kg or more	Less than 2kg But more than 500g	500g or less but more than 15g
2. Uranium-235	Unirradiated - U enriched to 20% <sup>235</sup> U or more	- 5kg or more	- Less than 5kg but more than 1kg	- 1kg or less but more than 15g
	- U enriched to 10% <sup>235</sup> U but less than 20% <sup>235</sup> U - U enriched above natural but less than 10% <sup>235</sup> U	- N/A - N/A	- 10kg or more - N/A	- Less than 10kg but more than 1kg - 10kg or more
3. Uranium-233	Unirradiated	2kg or more	Less than 2kg but more than 500g	500g or less but more than 15g
4. Irradiated Fuel			Depleted or natural uranium, thorium or low enriched fuel (less than 10% fissile content) <sup>e,f</sup>	

<sup>e</sup> Although this level of protection is recommended, it would be open to States, upon evaluation of the specific circumstances, to assign a different category of physical protection.

<sup>f</sup> Other fuel which by virtue of its original fissile material content is classified as Category I or II before irradiation may be reduced one category level, while the radiation level from the fuel exceeds 1 Gy/h (100rad/h) at 1m unshielded.

Table II: Categorization of Nuclear Material (NSS No.26-G)

## 5. Conclusion

For the approval of international maritime transport of nuclear materials, various international norms must be considered, and a corresponding transport security plan must be prepared. This transport security plan should contain detailed response measures and information to implement physical protection measures in response to various possible emergencies, but some cannot be described or verified further. Such loose areas between complicated international conventions should be supported by the continuous problem indication and systematic complement for more secure physical protection measures of international transportation for nuclear material.

International transport of spent nuclear fuel and its physical protection must meet various requirements as well as technical factors, and a corresponding TSP must be prepared and approved by the competent authorities. Under the current domestic law, the international transport of nuclear material can only be initiated only after submission and approval of TSP, regardless of the grade of nuclear material, which requires a stricter system than international standards or previous cases of nuclear material transport. Considering that the uncertainty of international sea/air transportation security may be greater than that of in-land transportation where the control of armed protection or communication systems is relatively easy, the establishment of such a regulatory system can be interpreted with the intention to reduce the potential risk, even a little. By referring to cases of other countries with more experience in transporting spent nuclear fuel, international standards, guidelines, etc., it is necessary to make continuous efforts to set up a firmer regulatory system in Korea to make full efforts for international transport of nuclear materials.