Transport by Road in Europe of Plutonium and MOX Fuel Assemblies

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1. INTRODUCTION

For obvious reasons related to the sensitive nature of plutonium, its transport is a delicate activity in which safety and security aspects must be examined carefully.

Plutonium transports have started with the beginning of nuclear energy, but with the extension of LA HAGUE reprocessing plant and the quick development of recycling programs in Belgium, Germany, Japan, Switzerland and France, these transports have recently reached an industrial stage.

This has only been made possible by :

- developing new equipments (packagings and transport vehicles) specifically designed to carry out these transports,

- mastering problems connected to physical protection in agreement with the instructions issued by the Competent Authorities of the countries involved with a view to ensure the material's protection against any attack or attempts of diversion,

- setting-up elaborate procedures according to which these transports must be carried out, with a view to ensure the utmost control over the movements of fissile materials, to provide confidentiality, and to allow the fastest reaction time in emergency.

This paper deals with the transport of plutonium extracted from the spent fuel reprocessed in the COGEMA La Hague and Marcoule plants, and assigned for the recycling programs decided by the European utilities in their light water reactors (MOX fuel assemblies), or in the fast breeder reactors.

2 - TRANSPORT SYSTEMS :

The increase in plutonium transports made it necessary to set up new specific transport systems composed of 3 basic elements :

- packagings
- security container
- vehicle

2.1 - PACKAGINGS :

Resolving the transportation issues firstly requires to design and to put in operation packagings licensed in conformity with the radioactive material transport regulations (IAEA 1985).

These B(U) type packagings - fissile class II - are designed not only to meet the IAEA recommendations and the requirements of International Regulations, but also with a view to :

. decrease to the maximum extent the radiological exposure of the technicians in charge of loading and unloading operations,

. dissipate the heat generated by the plutonium (in the range of 12 to 15 W per kg of fissile material) in order to maintain the lowest possible temperature for the containers holding the plutonium oxide powder and on the pads on which the MOX fuel assemblies are resting,

. maintain subcriticality in all conditions, including in the event of immersion, while offering a large payload,

. ensure the integrity of the transported fuel rods, or fuel assemblies, and to detect any shock or vibration likely to prevent their use in the reactors,

. allow, to various degrees, the automation of loading and unloading operations. For instance, the packagings assigned to the transport of plutonium oxide powder are loaded by totally automated equipment in LA HAGUE.

. be as standardized as possible in order to reduce manufacturing, operation and maintenance costs.

2.2 - SECURITY CONTAINER :

For transports on public roads, the physical protection of the materials is ensured by armored security containers in which the packagings are placed. These security containers are licensed by the Competent Authorities of each of the countries where they are used, in conformity with the national regulations in force. They have been designed to provide during transport the best static protection, while retaining a high degree of operational flexibility. Overall dimensions, devices for stowing on the vehicle and handling equipment have been standardized.
The packagings also contribute to ensure static protection. They are carefully tied-down in the security containers. The packagings are sealed by the

Authorities in charge of fissile material safeguards (EURATOM - IAEA - National Authorities).
The security containers are dedicated to a given type of packaging.
Packagings and security container make up a transport system.

Currently, 3 types of transport systems are being used for :

. plutonium oxide produced by the reprocessing plants,

. MOX fuel assemblies for light water reactors,

. fast breeder reactor fuel assemblies.

2.2.1. The transport system set up for the plutonium oxide produced by LA HAGUE is composed of a security container holding 10 FS-47 packagings placed in a rack designed to load easily the security container.

Licensed as type B (U)F in FRANCE, GERMANY, BELGIUM, this packaging has a payload of up to 17 kg of fissile plutonium.

2.2.2. The packaging known as FS69 is used for the transportation of fresh MOX fuel assemblies from the manufacturing plant to the reactors of the 900 MW series. It has been designed for 2 PWR assemblies.

The security container used for fresh MOX fuel assemblies has a capacity of 4 FS-69 packagings.

2.2.3. For the delivery of fresh fuel assemblies to PHENIX and SUPER-PHENIX fast breeder reactors, are used the packagings respectively known as FS-33 and FS-41.
For transportation, they are protected by a security container which can accommodate 6 packagings.

2.3 - TRANSPORT VEHICLES :

Most of the facilities between which plutonium must be transported do not have a rail connection and this naturally lead to road transportation . As far as the type of vehicle is concerned, an articulated unit has been selected, with a tractor and a semi-trailer on which the security container is tied-down.
This solution offers various advantages :

. standardization of the transport system, the semi-trailer being designed to receive several types of security containers,

. better operational flexibility of the equipment : interchangeability of tractors and semi-trailers, and availability of the tractor while loading and unloading operations of the security container take place,

. optimization of the vehicle's payload (approximately 25 metric tons) because the axle load accepted by European regulations is more advantageous for articulated vehicles,

. plain appearance of the vehicle and of its security container preventing them to be easily noticeable.

Numerous studies and tests bearing both on vehicle and transport system have been performed in order to meet the most recent requirements of the various Competent Authorities (French, German and Belgian) concerning physical protection.

The means of conveyance have therefore been designed with a view to :

- provide, thanks to the security container an efficient protection against any act of hostility aiming at taking hold of the material secured in the packagings,

- protect the crew on board the vehicle against any attack,

- stop quickly the vehicle in the event of unquestionable aggression,

- track, automatically and continuously the vehicle in order to call out security forces if necessary,

- remain constantly linked to a protected operations center in order to be always in contact with the Authorities in charge of transport follow-up.

It goes without saying that the special devices used to meet these requirements are confidential.
Every necessary measures have been taken to ensure their protection and they have only been disclosed to a limited number of classified individuals.
Special procedures have also been set-up for the maintenance and storage of this equipment during operation.

For several years now, COGEMA and the TRANSNUCLEAIRE Group have been operating specialized equipment for the transportation of plutonium. This equipment has over the years been adapted and upgraded with a view to meet more stringent physical protection requirements.

Its development has been based on a wide variety of studies and testing performed in close collaboration and with the involvement of the French and German Competent Authorities. Now, complete units for the transportation of plutonium oxide are in operation and licensed in compliance with updated physical protection requirements.

3 - SECURITY ASPECTS OF TRANSPORTS :

Physical protection does not only require elaborate equipment, but the following impositions also play a major role :

- armed escort continuously in communication with the vehicle and with the operations center from which the transport is monitored,

- permanent tracking of the vehicle from the operations center. This base is in communication with emergency forces which could be called out in the event of accident or aggression,

- transfer control system for fissile material meeting the requirements of International Agreements.

The task is made more complex by the involvement of several organizations in each country.

On one hand, the organizations, or Government Authorities in charge of :

- licensing the equipment,
- approving the transport organization,
- accepting the proposed routes,
- granting the clearance of personnel and companies involved.

On the other hand, National Authorities and International Organizations such as EURATOM responsible for supervising :

- transport monitoring and means of action of emergencies forces,
- shippers, who guarantee the conformity of the contents and of loading operations,
- consignees who must hold the storage authorizations,
- the licensed transport company, which submits for approval its physical protection scheme, and which must carry it out according to mandatory procedures,
- fissile material safeguards.

Before the actual departure of a truck, many documents must be exchanged : authorizations, programs, prior notifications and notificatins of transport, customs documents, etc... The major part of this information is confidential, and is transmitted in coded form.

A transport file remains with the vehicle, justifying the conformity of the contents, of loading operations, of the packagings, of the preparation of the truck and of the document authorizing the transfer of the material.

Also, a Quality Assurance system has gradually been set-up, to guarantee the conformity with the safety and security requirements of the equipment used and of the operational procedures.

4 - TRANSPORT EXPERIENCE :

COGEMA and the TRANSNUCLEAIRE Group have for the last 25 years gained a wide experience in the field of plutonium transport. This activity took place in countries as diversified in their regulations as France, Germany, Canada, Switzerland, Italy, Holland, Sweden and the United States.

Since 1983, when the FS-47 transport system has been put in operation, more than 80 shipments have been performed from LA HAGUE, corresponding to approximately 8 metric tons of plutonium.

In 1988, 37 transports were carried out, and we are planning 50 transports per year after 1990.

The first transports of fresh MOX fuel assemblies started in 1987 with deliveries to the SENA power plant, at the French-Belgian border. Since that date, approximately 60 fuel assemblies have been delivered to the BEZNAU power plant in Switzerland, and to E.D.F. reactors in France. The rate will gradually raise to 25 transports per year, equivalent to 200 fuel assemblies.

As far as fast breeder reactors are concerned, more than 175 deliveries were made to fuel the PHENIX and SUPER PHENIX reactors.

5 - CONCLUSION :

Transporting plutonium under different forms (oxide and fuel assemblies) can only be undertaken after technical problems have been solved. But stringent national and international regulations must also be met, in particular with a view to ensure the best physical protection. With numerous improvements in these two areas, plutonium transport has now reached an industrial stage, while retaining a high level of safety and security.

This has been achieved thanks to the cooperation of all the organizations involved, and thanks to the agreements negociated between the national and international Authorities responsible for supervising these transports of a particularly sensitive nature.