EXPERIENCE FEEDBACK FROM THE TRANSPORTATION OF FRAMATOME FUEL ASSEMBLIES

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SUMMARY

Framatome, the foremost world nuclear fuel manufacturer, has for 25 years been delivering fuel elements from its three (3) factories (Dessel, Romans, Pierrelatte) to the various sites in France and abroad (Germany, Sweden, Belgium, China, Korea, South Africa, Switzerland).

During this period, Framatome has built up experience and expertise in fuel element transportation by road, rail and sea. In this field, the range of constraints is very wide :

- safety and environmental protection constraints,
- constraints arising from the control and protection of nuclear materials,
- contractual and financial constraints,
- media watchdogs.

Through the experience feedback from the transportation of FRAMATOME assemblies, this paper addresses all the phases in the transportation of fresh fuel assemblies.

INTRODUCTION

The shipment of fissile materials is subject to strict regulations, as defined in class 7 of the European Regulation on Road Transportation. The delivery of FRAMATOME fuel elements is accordingly subject to compliance with the requirements of this class.
Compliance with the regulations is combined with contractual constraints (schedular, cost control) which are sometimes difficult to manage given the many parameters to be taken into consideration for shipment organization.
For greater clarity, Figure 1 shows the whole fuel assembly transportation process as it is managed at Framatome. This diagram illustrates the main process phases which will be detailed in the rest of the article.

BACKGROUND

The organization set up by FRAMATOME for programming the deliveries is dependent first of all on the type of fuel assembly to be delivered and the country of destination.

The first actions will differ according to whether it is a delivery in the export market or to EDF.

For EDF, the first exchanges start between 3 and 6 months before the desired shipment dates, depending on the selected transportation mode and the type of fuel assembly.

The ordered assemblies are assigned to the units in response to their outage dates which are only settled 3 months before the outage.

It is during the period 3-5 months before the outage that exchanges between FRAMATOME and the EDF Fuel Delegation begin for determining the F/A delivery programme.

For the EDF NPPs, the Fuel Delegation acts as regulator of the flows of fresh and spent fuels. It centralizes the fuel building unavailability constraints, whether they relate to maintenance, inspection and service activities or to resources.

Based on these data transmitted by the plants, it is possible to find fuel delivery and disposal timings which optimize the use of resources for the whole NPP pool. This optimization is recalculated monthly, at each new outage planning session. For each unit, it determines the slot(s) during which programming of a delivery is possible.

These slots and the desired shipment mode (rail or road) are transmitted for a given site to FRAMATOME by the Fuel Delegation about 3 months before the target delivery date. In return, FRAMATOME establishes a detailed tentative programme mentioning the F/A arrival dates and times. Planning is finalized about 1 month before delivery after validation by the site.

These arrangements are adhered to for MOX assembly deliveries, but in this case the shipment dates are confidential and coded information is exchanged between authorized personnel.

For deliveries in the export market, the delivery schedule is known a long time in advance. The choice of shipment mode is also made very early, generally about 3 months before departure.

Knowledge of the type of fuel assembly and determination of the transport mode make it possible to extract the applicable texts from the various regulations governing the transportation of dangerous materials.

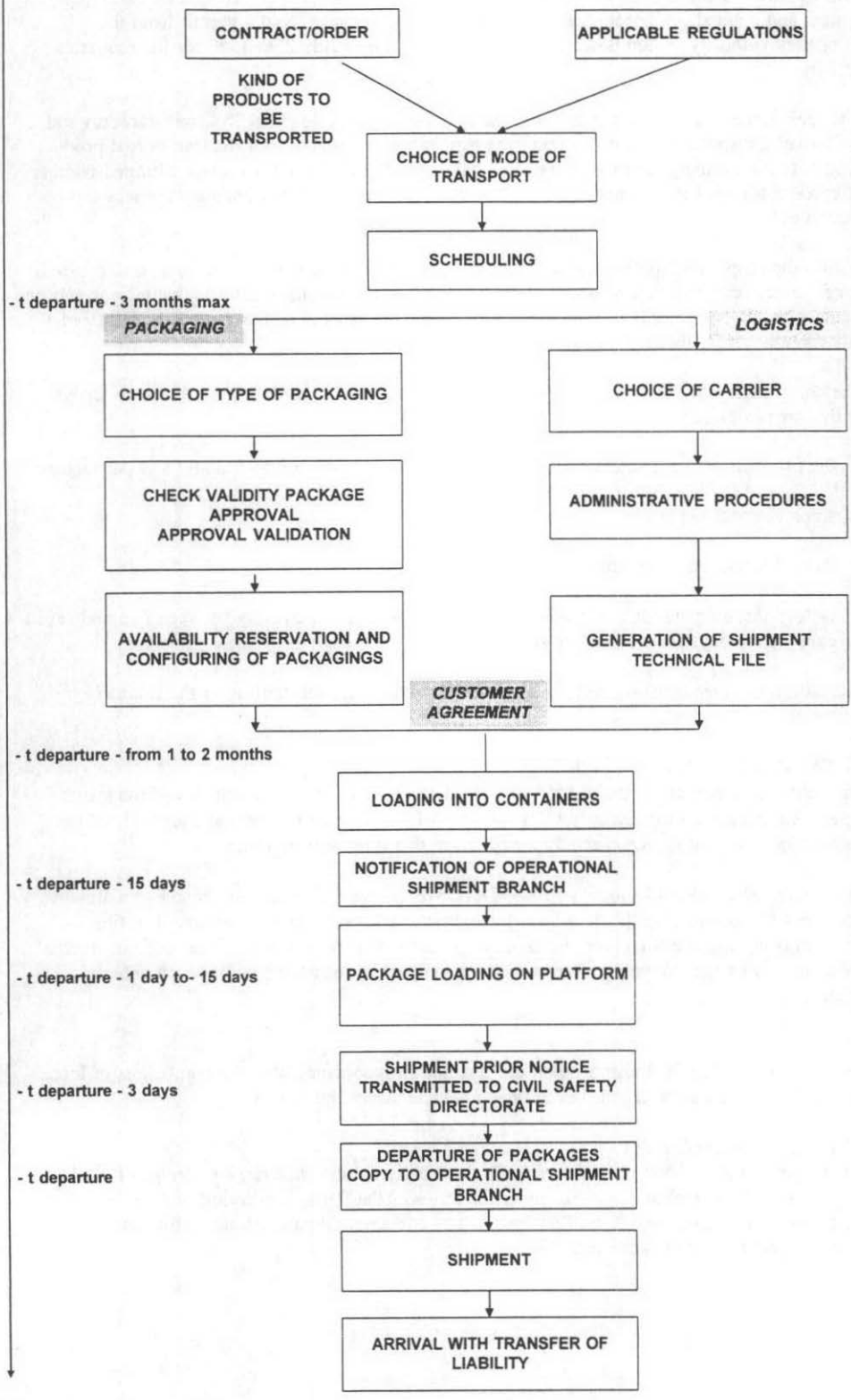
It is on this basis and in full compliance with these regulatory texts that the next shipment phases will unfold.

SHIPMENT PREPARATION

LOGISTICS

The shipment of class 7 products leads FRAMATOME to select carriers or shipping agents who are recognized on the nuclear market for their skill and experience developed both in France and abroad and whose organization guarantees a quality service meeting customer needs with maximum reactivity.

PROCESS FOR SHIPMENT/DELIVERY OF FRAMATOME FRESH FUEL ASSEMBLIES



These firms, evaluated for their technical ability to cater for customer requirements and for their quality system, are approved in accordance with the FRAMATOME quality assurance system and audited. A check is also made that these companies hold a permit from the competent authority as laid down in chapter 2 of the law of July 25th 1980 for the requested activity.

The fuel element shipment market on French territory breaks down as 20% rail transport and 80% road transport. The small scale of the market and the specifics of the transported product subject to increasingly severe requirements have led FRAMATOME to select a limited number of carriers for road transportation of fuel elements. With this formula, quality services are guaranteed.

Within the scope of shipment logistics and independently of the choice of carrier, a five-month tentative delivery programme is established on the basis of the manufacturing campaigns and on changes in customer needs in response to reactor outage dates. The fuel is usually delivered 1 to 2 months before the unit outage.

The confirmation of the final customer delivery programmes is made after a thorough analysis of the various parameters, including :

- the progress of the manufacturing runs and acceptances per product family and per factory,
- shipment package needs,
- factory stocks and their trends,
- factory throughputs for fuel loading into containers, which may vary between five and seven consecutive days for a reload of 40 assemblies.

The customer agreement is generally given one month before the starting of the shipment campaign.

STOWING FILE - ROAD VEHICLES

The delivery of fuel elements by road is performed by up-to-date road vehicles of the trailer type, complying with the European Regulation on Road Transportation and equipped with a halphen rail stowing device specially designed for this type of transport.

The carrier undertakes to submit to FRAMATOME before each shipment campaign a stowing document file comprising the drawings, instructions and justifying calculations. The file documents are made available to the factory operators who ensure, within the scope of internal procedures, that the stowing conforms with the applicable documents before each vehicle departure.

DRIVERS

The drivers selected for transportation are certified in accordance with the regulations in force and their credentials are checked each time a vehicle leaves the factory.

NUCLEAR INSURANCE

The transportation of fuel elements requires third party liability insurance coverage on the part of the responsible nuclear operator, under the terms of the Paris Convention of July 29th 1960 for a coverage amount of 150 million francs. The corresponding certificate of financial security is an integral part of the shipment file.

PACKAGINGS

The choice of packaging depends directly on the type of fuel assembly transported. Bear in mind that FRAMATOME supplies fuel assemblies of various arrays (14 x 14, 15 x 15, 16 x 16, 17 x 17, 18 x 18) and of different lengths.
To cover all of its needs, FRAMATOME manages a pool of 250 packagings which are classified fissile industrial package 3 as per the IAEA guidelines and are subject to regular maintenance inspections.

Each packaging model is covered by a special approval or arrangement indicating all the authorized contents. One of the major parameters is, for a given array, the maximum enrichment rate accepted for the delivery, for which the packaging designer justifies the subcriticality of the package on completion of accident tests defined by the IAEA guidelines.

The primary aim is therefore to check that the content and in particular the U235 content indicated in the contract is indeed authorized by the package approval or special arrangement.

In the export market, parallel applications are made to the Safety Regulators of all the countries crossed for validation of the package model approvals and special arrangements. This administrative stage, indispensable before any departure, lasts about 2 months and takes place well before the overall shipment planning process.

While these administrative procedures are going ahead, the packagings reserved for the shipment are checked and put in the correct configuration when the shipment has specific features.

BEFORE SHIPMENT

The application of regulations on the protection and control of nuclear materials during shipment leads to the issue of a shipment prior notice addressed to the Institute of Nuclear Safety and Protection Operational Shipment Branch and to the Nuclear Safety Directorate, 15 days before the scheduled dispatch date.

A shipment execution notice is forwarded to the competent authority no later than 3 working days before the date of shipment.
By the same deadline, the shipper forwards to the destination NPP a Telex giving the identification of the transported fuel elements and the factory departure and site arrival dates.
For each shipment, the FRAMATOME quality system requires the issue of a factory document certifying that the containers are loaded in accordance with the operating procedures in force and that the loading of the means of transport is in line with the requirements. This document allows a dispatch note to be drawn up, giving the final identification of the F/As with their characteristics (U / UO2 / U235 masses - enrichments - activities) and those of the containers used for the shipment.

The packages are loaded and stowed on the shipment surface in accordance with the applicable drawings.
The radiological inspections (contamination and dose rates) are an integral part of the factory operating procedures and their results, before and after package loading, are entered by the Health Physics Department on the specially provided carrier documents.
A list of the various inspections needed to enforce the regulations (vehicle check - driver and escort documents) is issued before each fuel element shipment and is signed jointly by the shipper and carrier. It attests to the compliance of the shipment with the regulations.

SHIPMENT PHASE

To comply with the regulations on the physical inspections of nuclear materials in transit, the vehicles used are fitted with communication links for getting in contact at any time with the competent authority, the emergency services in case of an incident or accident, the consignee and the shipper. The action to be taken in case of an incident, accident and/or significant delay is outlined in a procedure.

Upon shipment arrival or departure, EDF conducts a sampling inspection to ensure compliance with the regulations (condition of the truck and associated documentation, fire-fighting capability, logbooks, knowledge of action procedures in case of incident...).
On French territory, the Institute of Nuclear Safety and Protection Operational Shipment Branch keeps a permanent watch on any shipment of radioactive materials. For its part, EDF has organized an on-call service for these shipments. The person responsible for this service at the Nuclear Operations Branch of the Fuel Delegation can be reached at any time. His phone number is noted in the logbook documents.

He has the detailed weekly schedule of the radioactive material and product shipments (kind, quantity, departure, arrival, service provider) and the personal details of his contacts in the supplier, service provider and subcontractor organizations.
In the event of an incident, i.e in the presence of any contingency arising during shipment and resulting in failure to comply with the initial programme, his task is to ensure in the shortest possible time that the various players are briefed and to define, in coordination with the suppliers or service providers, NPP operation and the competent security and/or safety organizations where appropriate, the arrangements to be made to cope with the consequences. The emergency capability that may be necessary is determined and implemented by the local authorities ("Préfet" of the Department, Civil Protection). At the request of the latter, the resources of the nearest National Power-Generating Center may be required.

EXPERIENCE FEEDBACK

ROAD SHIPMENT SPECIFICS AND EXPERIENCE FEEDBACK

Over the past few years, FRAMATOME has performed an average of 200 shipments per year of fuel elements by road from its three factories to the various EDF sites.
These shipments went smoothly, without notable incidents. The inspections conducted on the shipments showed that the approved carriers respected the applicable procedures.

RAIL SHIPMENT SPECIFICS AND EXPERIENCE FEEDBACK

The solution of rail transport was defined and qualified jointly by EDF and FRAMATOME in 1993, following the truckers strike which blocked all transportation in France in July 1992.

The 1993 dry run test campaign led to a solution being found: the deliveries were made with a fleet of 5 wagons with bogies (type R30). Each wagon had a special-purpose wedging and stowing set and can accommodate up to 9 RCC containers.

The reload is transported in a special convoy comprising the power car and the fuel wagons. The presence of an escort is required. This type of convoy has a guaranteed twin-track which avoids passing through the marshalling yard. It is permanently monitored by the SNCF (French Rail Network) from the central control station at DIJON. The empty containers can be returned in a general-purpose train.

The first delivery took place end 1993 at CATTENOM according to a generic on-track receiving procedure which provides for receiving and parking of the convoy on site in a protected zone.

To date, more than 1100 assemblies have been delivered to EDF by rail. This mode of transport today accounts for 20% of annual deliveries. In future, EDF would like to extend this mode to all connected sites.

Compared with road transport, the railway mobilizes all the containers of a given reload at the same time. The supplier must therefore size his container pool accordingly. Moreover, the twin-track reserved for the special train limits the possibilities for deferred shipments.

For the NPP, this delivery mode presents operating advantages: the whole reload is available at one time and the plant is not dependent on transport for organizing off-loading.

MARITIME SHIPMENT SPECIFICS AND EXPERIENCE FEEDBACK

Some years ago, FRAMATOME transported fuel by sea to the Uljin (Korea) and Guangdong (China) NPPs, then shipped fuel reloads on a regular basis to the Koeberg plant (South Africa).
Transportation by sea calls for a special organization to be set up in the factory to cater for the large quantities of fuel to be shipped and for the constraints arising from the ship arrival dates.
To meet its contractual commitments, FRAMATOME draws up a schedule of the various tasks to be performed, about three months before the shipment.
The packagings loaded with fuel are shipped in 40 ft flat-rack type ISO maritime containers.
The compliance of these containers with shipment requirements is checked before they are sent to the factory.
The loading of the packagings, their stowing on maritime containers and the respective inspections are checked in accordance with the applicable stowing technical file.
To meet the safety requirements applicable to maritime transport in special arrangements, the RCC type packagings are transported non-stacked to avoid any vertical protrusion.
The maritime containers are transported to the port of destination on flatbed trailers. The fuel remains on the port terminal for the shortest possible time, during which it is guarded by firms accredited by the Port Authority in accordance with the regulatory provisions.
The operations for checking the compliance of the shipment focus on the labelling and the stowing of the packages within the maritime containers which, once loaded in the boat, are placed under close watch.
The same applies to the maritime container handling operations at the port which are performed in line with the loading procedure established by the Port Authority, requiring a visual check that the load is properly locked to the handling tool (spreader).

For purposes of shipment safety, the lifting rigs are checked by an accredited organization.
Maritime transportation is provided by internationally recognized companies, Conference members, offering a regular service to the country of destination. These companies are accredited by the competent authority as subcontractor of the FRAMATOME carrier.
The ships used are large-sized container carriers whose stopovers in foreign ports call for the securing of transit permits and multilateral approval for shipment packagings containing fissile materials.
Fuel offloading at the port of destination takes place under the supervision of FRAMATOME and of the carrier or his agent, in accordance with the procedures in force. The latter informs the French authority of arrival and of fuel transfer conditions to the destination NPP.

CONCLUSION

The field of fissile material transportation is subject to stringent regulations, which ensure that a very high level of security and safety is reached.
FRAMATOME, in collaboration with EDF for delivery to French sites, has complied with these constraints and contractual commitments by setting up reliable, smooth-running organizational structures. It is in full compliance with these parameters (safety, regulation, contractual requirements) that FRAMATOME has been delivering for the past 25 years fresh fuel assemblies in France and in the export market by road, sea and rail.

REFERENCES

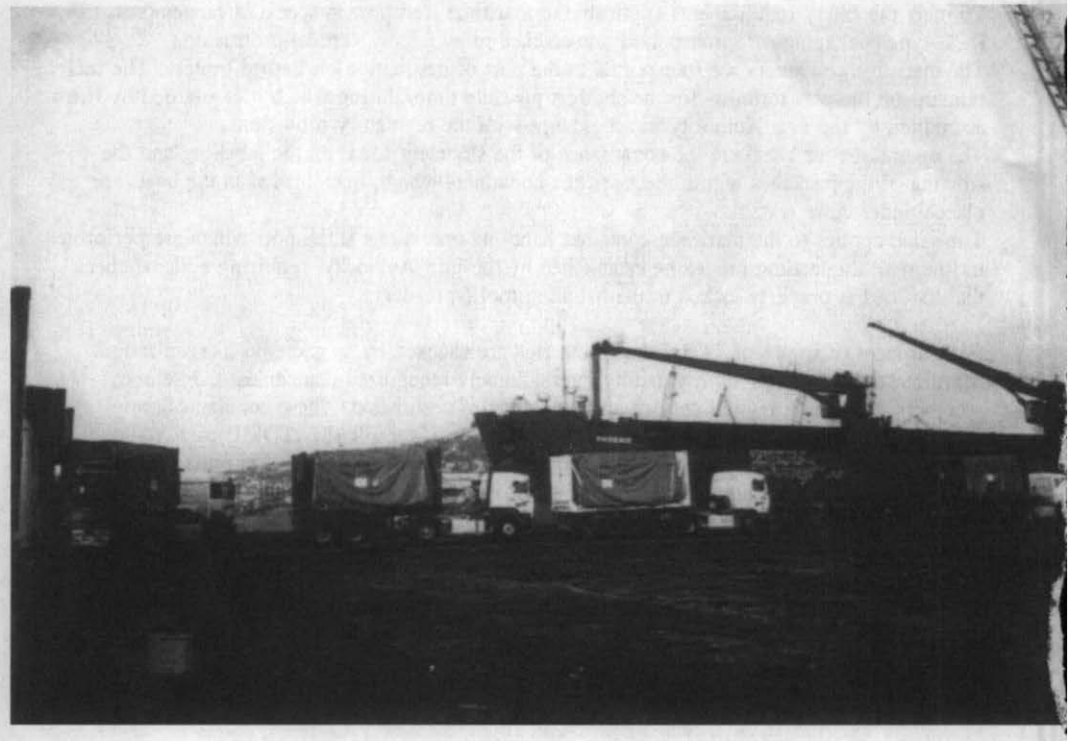
Normes de Sûreté de l'A.I.E.A. - Règlement de transport de matières radioactives - Edition de 1985, supplément 1990.

Arrêté du 5 décembre 1996 relatif au transport des marchandises dangereuses par route (dit "arrêté A.D.R.").

Arrêté du 6 décembre 1996 relatif au transport des marchandises dangereuses par chemin de fer (dit : arrêté RID).

Loi n°80-372 du 25 juillet 1980, décrets et arrêtés d'application sur la protection et le contrôle des matières nucléaires en cours de transport.

Code Maritime International des marchandises dangereuses de l'Organisation Maritime Internationale (code IMDG).



SESSION 8.3

Sea Transport