TRANSPORT OF RADIOACTIVE MATERIALS

CHAPTER 11

Since 1997, the French nuclear safety authority (ASN) has been responsible for monitoring and regulating the safety of packages used for transporting radioactive and fissile materials for civil applications. To guarantee a high level of transport safety, strict rules must be applied. They are based on the implementation of a "Defence in Depth" approach, where the design robustness of the packages is essential. The regulatory requirements relating to the safety functions - namely, containment of the radioactivity, protection from ionising radiation and prevention of criticality risks - must be ensured by the package under both normal transport conditions and accident conditions. The regulatory provisions incorporate the recommendations of the International Atomic Energy Agency (IAEA) to ensure consistency and reliability in the international transport context.

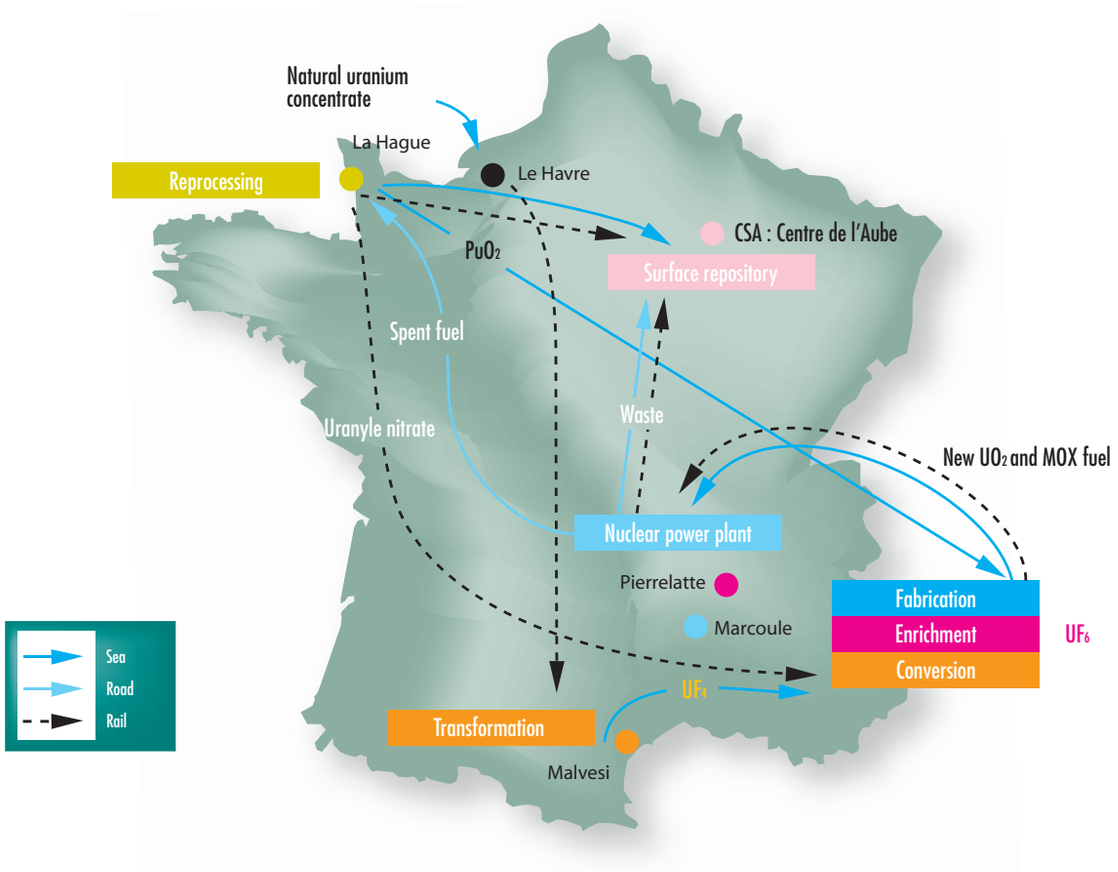
1 GENERAL INTRODUCTION

1|1 The diversity of the radioactive material traffic

Each year, approximately 15 million packages of materials considered as dangerous due to their chemical, explosive or toxic nature, are transported in France. About 900,000 packages of radioactive materials are transported each year, representing a few percent of the dangerous goods traffic. The majority (two-thirds) consists of packages for medical or industrial uses (lead analysers, gamma ray projectors, etc.). Radioactive material packages can be various. Their radioactivity can range over more than twelve orders of magnitude, that is to say from a few thousand becquerels (pharmaceutical packages) to millions of billions of becquerels (irradiated fuels) and their weight can range from a few kilograms to about one hundred tonnes.

The nuclear power cycle industry generates the transport of many sorts of radioactive materials: uranium concentrates, uranium tetrafluoride, depleted, natural or enriched uranium hexafluoride, fresh or spent fuel assemblies containing

Transports related to the fuel cycle in France



UNDERSTAND

Classification of ships carrying an INF cargo

For the purpose of this Code, ships carrying INF cargo (irradiated nuclear fuel, plutonium, or highly radioactive waste) are assigned to the following three classes, depending on the total activity of INF cargo which is carried on board:

Class INF 1 - Ships which are certified to carry INF cargo with an aggregate activity less than 4,000 TBq.

Class INF 2 – Ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes with an aggregate activity less than 2 x 106 TBq and ships which are certified to carry plutonium with an aggregate activity less than 2 x 105 TBq.

Class INF 3 – Ships which are certified to carry irradiated nuclear fuel or high-level radioactive wastes and ships which are certified to carry plutonium with no restriction on the maximum aggregate activity of the materials.

A sliding scale of requirements applies to each of these ship classes in terms of stability, fire extinguishing capability, temperature control in the cargo hold, stowage and securing of packages in the holds, backup electrical power, radiation protection, and the shipboard emergency and personnel training plan.

uranium oxide or mixed uranium and plutonium oxide (MOX), plutonium oxide, waste from power plants, reprocessing plants, CEA research centres, etc. The largest consignments concern about 300 shipments per year for fresh fuel, 250 for spent fuel, about 30 for MOX fuel and about 60 for plutonium oxide powder.

Transport can be international, and France is a transit country for some of those transports.

A large number of international shipments are also due to the presence in the country of plants enriching uranium, fabricating or reprocessing nuclear fuels, along with manufacturers of radioisotopes for medical purposes, all of whom have commercial links with foreign organisations.

1|2 Modes of transport

Rail

Rail transport represents 3% of radioactive material transport operations. This mode of transport is chosen as a priority for heavy or large packages, provided that a rail link is available. For example, almost all the spent fuel intended for reprocessing is sent by train to the rail terminal at Valognes, and then by road for the remaining 20 km to the La Hague plant.

Road

Road transport represents about 90% of all radioactive material transport operations. The transport of radioactive materials by road, in the same way as any other hazardous goods, is subject to general or local specific traffic and parking regulations, to avoid congestion of the road network, especially when traffic is heavy and in residential areas. Most packages of pharmaceutical products and medical sources are delivered to hospitals by road.

Sea

Sea transport represents 4% of all radioactive material transports. The ships used for carrying spent nuclear fuel, plutonium and high-level waste must comply with the requirements of the "International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes on Board Ships" (INF Code). This code divides the ships transporting this type of radioactive material into three classes. These ships are approved by the public authorities.

Air

Air transport, which represents 3% of the traffic, is frequently used for transporting small urgent packages over long distances, such as short-lived radiopharmaceutical products.

ASN inspection of maritime transport – Le Havre Port – 2009

2 THE VARIOUS ROLES IN THE TRANSPORT ORGANISATION

2|1 Fields of competence of the various authorities

Regulation of transport safety and radiation protection

Since 12 June 1997, ASN has been responsible for the regulations relating to the safe transport of radioactive and fissile materials for civil use and for monitoring their application. Its responsibilities in this area were confirmed by Act 2006-686 of 13 June 2006 on Transparency and Security in the Nuclear Field (TSN Act). ASN is also responsible for advising the Government with regard to regulations on this subject.

Ensuring nuclear safety and radiation protection in the transport sector involves managing the risks of irradiation, contamination and criticality and preventing damage caused by the heat of the packages containing radioactive and fissile materials, so that man and the environment do not suffer any prejudicial consequences.

These requirements are met, firstly by modulating the package content limitations and the means of transport, along with the performance standards applied to the package models, according to the risk inherent in to radioactive contents; secondly by setting requirements for the design and operation of the packages and for container maintenance, taking into account the nature of the radioactive contents. In this regard, ASN delivers the approvals for package models and transports that require such approvals. Compliance with these requirements is verified by inspections carried out in both normal and emergency situations.

The responsibility for regulation of the transport of radioactive and fissile materials for national security purposes lies with the Defence Nuclear Safety and Radiation Protection Delegate (DSND).

A distinction must also be made between safety (prevention of accidents), which is the responsibility of ASN and DSND, and security, or physical protection, which consists in preventing the loss, disappearance, theft and misappropriation of nuclear materials (those used for weapons). It is the Defence and Security Executive Officer (HFDS) of the Ministry of Ecology, Sustainable Development, Transport and Housing (MEDTL) who is the competent authority. Further information is provided in chapter 3 of this report.

Finally, a number of other administrations intervene in areas other than safety that interface with it. For the transport of materials displaying a high activity level (more than 3000 times the value of the A2 reference threshold for the radionuclide in question – see point 2|4), the Ministry of the Interior is the competent authority for developing emergency plans. ASN works regularly with these ministries to ensure that inspections are as consistent as possible. The breakdown of the various responsibilities is summarised in table 1.

Table 1: administrations responsible for regulating the mode of transport and the package

Mode of transport	Regulation of mode of transport	Package regulation
Sea	General Directorate for Infrastructure, Transport and the Sea (DGITM) of the Ministry of Ecology, Sustainable Development, Transport and Housing (MEDTL). ASN assists with the monitoring of compliance with the requirements of the international code for the safe carriage transport of irradiated nuclear fuels, plutonium and high level radioactive waste on-board ships (INF code).	The DGITM is competent to regulate packages of dangerous goods in general, and in close coordination with ASN for packages of radioactive materials.
Road, rail, inland waterways	The design rules are defined by the road and traffic safety delegation of the Ministry of Ecology, Sustainable Development, Transport and Housing (MEDTL).	The General Directorate for Risk Prevention (DGPR) is responsible for regulating packages of hazardous goods in general and in close coordination with ASN for radioactive materials.
Air	The General Directorate for Civil Aviation (DGAC) of the Ministry of Ecology, Sustainable Development, Transport and Housing (MEDTL).	The DGAC is competent to regulate packages of dangerous goods in general and in close coordination with ASN for packages of radioactive materials.

2|2 Industrial participants

The main participants in transport arrangements are the consignor and the carrier. The consignor is responsible for package safety and accepts his responsibility by way of the dispatch note accompanying the package remitted to the carrier. Other participants are also involved: the package designer, manufacturer and owner and the carriage commission agent (authorised by the consignor to organise the transport operation).

For a radioactive material shipment to be carried out in good safety conditions, a stringent chain of responsibility has to be set up. So, for major transport operations:

– the consignor must be fully aware of the characteristics of the material to be transported, so that it can select the type of container to be used and specify transport conditions accordingly;
– the corresponding packaging must be designed and sized in accordance with use conditions and current regulations. In most cases, a prototype is needed to carry out the tests prescribed by the regulations. As soon as this phase is completed, the safety analysis report is prepared and submitted to the competent authority to complete the authorisation application;
– in cases where existing containers are used, their conformity with approved models has to be confirmed. In this context, the container owner must set up a maintenance system in conformity with that described in the safety documents and the authorisation certificate;
– the container is sent to the consignor's site, where it will be loaded with the material for transportation. The consignor must carry out the inspections for which it is responsible (leaktightness, dose rate, temperature, contamination) on the loaded container prior to entry on a public road or railway track;
– the transport operation itself is organised by the carriage commission agent, who is responsible for obtaining the requisite permits and complying with advance notice requirements on behalf of the consignor. He also selects the means of transport, the carrier and the itinerary, in compliance with the above-listed requirements;
– the actual transportation is entrusted to specialised firms, having the necessary permits and vehicles. The drivers of road vehicles in particular must be in possession of the training certificate required by the regulations.

The transport of some radioactive materials (including packages containing fissile material) is subject to prior notification to ASN and the Ministry of the Interior by the consignor. The notification indicates the materials transported, the packages used, the transport conditions and the contact details of the persons involved. 1,739 notifications were sent to ASN in 2010.

2|3 Regulations - drafting and objectives

The international nature of radioactive material transport gave rise to regulations, drafted under the supervision of IAEA, ensuring that a very high level of safety is guaranteed.

The international regulations include the following texts:

– the European agreement concerning the international transport of dangerous goods by road (ADR) drafted by the United Nations Economic Commission for Europe (UNECE);
– the Regulations concerning the International Carriage of Dangerous goods by rail (RID) drafted by the Intergovernmental Organisation for International Carriage by Rail (OTIF);
– the International Maritime Dangerous Goods Code (IMDG Code) drafted by the International Maritime Organisation (IMO);
– the Technical Instructions for the Safe Transport of Dangerous Goods by Air, drafted by the International Civil Aviation Organisation (ICAO).

These modal regulations were then entirely transposed into French law and made applicable by government orders, and in particular the amended "TMD" order of 29 May 2009 relative to the transport of dangerous goods by road or rail.

Transit storage

The regulations for the transport of radioactive materials apply to all modes of transport, whether by land, sea, air or inland waterway. For information, transport comprises all operations and conditions associated with the movement of radioactive materials, including transit storage. In 2009, ASN inventoried these transit storage facilities and placed them on the list of topics for inspection in 2010.

Transparency in the transport of radioactive materials

Article 19 of the TSN Act stipulates that the requirements for transparency, introduced by that same Act, from persons responsible for transporting radioactive materials, applies when the quantities transported are higher than thresholds laid down by decree. ASN and the other concerned government departments are currently drafting this decree, which will extend the obligations for transparency incumbent on nuclear licensees to those responsible for transporting radioactive materials and the holders of these materials. An initial draft was submitted to the various stakeholders in 2010.

2|4 Specific intervention for the different package types

Although the regulations apply to all radioactive material packages they define thresholds above which these packages require approval by the public authorities before they can be used. These thresholds are determined so that in the event of an accident, the effective dose received by the public or the parties involved cannot exceed 50 mSv. They are specific to each radionuclide. They are calculated using a model called Q-system.

For a given radionuclide, these thresholds (which are called A2 or A1 depending on whether or not the source presents a risk of dispersion) are taken as the activity which, in the event of an accident, would lead to an effective dose of 50 mSv in 30 minutes at 1 metre, considering all five modes of exposure (external due to photons, external due to beta emitters, internal for exposure by inhalation, immersion or ingestion).

The Q-system thus defines a reference activity level which is inversely proportional to the harmfulness of the product. For

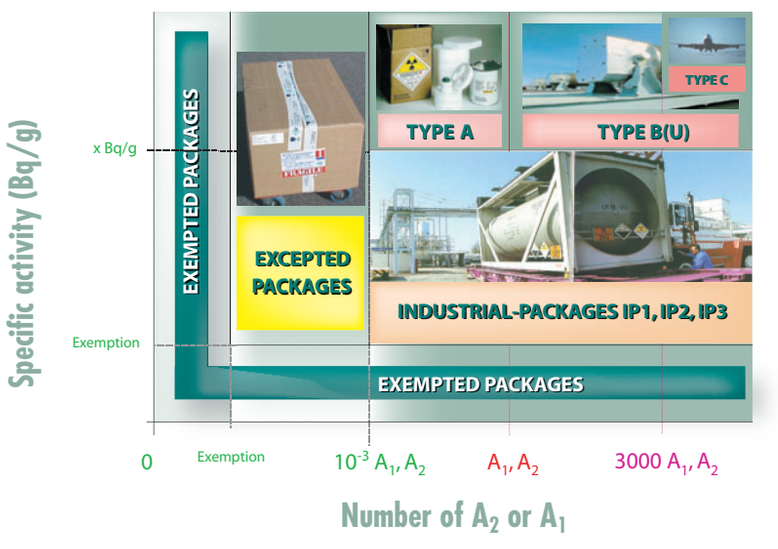
example, for Pu 239, A1 is equal to 10 TBq and A2 is equal to 10^{-3} TBq.

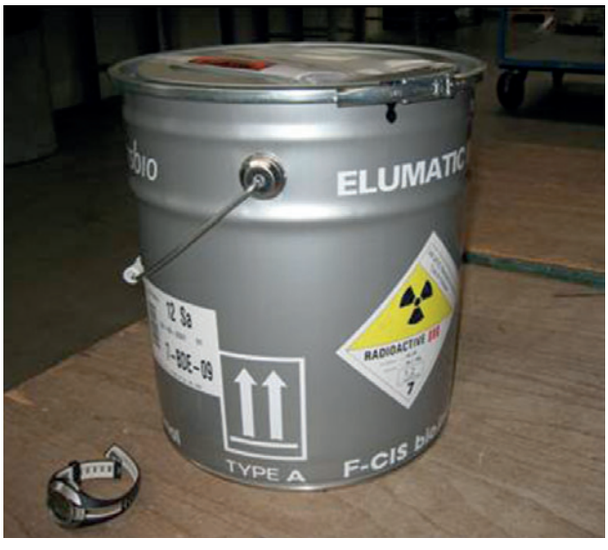
These calculations thus allow the scope of intervention by the public authorities and the acceptable level of transport risk to be defined. They lead to the definition of different types of packages – presented in the following diagram – some of which must be approved by the administration before they can be used. This is the case for:
– radioactive materials in special forms;
– low dispersible radioactive materials;
– Type B and C packages and all fissile material packages;
– special arrangement shipments (the package fails to comply with all the requisite criteria, but compensatory transport measures have been taken to ensure that transport safety is not below that of a transport operation involving an approved package).

Furthermore, each type of package undergoes a number of resistance tests representative of the risks to which the shipment can be exposed, taking into account the risk inherent in the material being transported.

Finally, over and above these design rules, the regulations define rules for the operations concerning the container and those concerning its contents.

Types of package depending on total and specific activity





Example of a Type A package – technetium 99m generator

Example of a Type B packaging – Gammagraph containing an iridium source

Characteristics of the various types of package

Excepted packages are not subjected to qualification tests. They must however comply with a number of general specifications, such as a maximum dose rate at the surface of below 0.005 mSv/h.

Non-fissile industrial or Type A packages are not designed to withstand accident situations. However, they must withstand some kind of incidents which could occur during handling or storage operations. They must consequently withstand the following tests:

– exposure to a severe storm (rainfall reaching 5 cm/h for at least 1 hour);

– drop test onto an unyielding surface from a height varying according to the weight of the package (maximum 1.20 m);

– compression equivalent to 5 times the weight of the package;

– penetration by dropping a standard bar onto the package from a height of 1 m.

These tests should not lead to loss of material and radiation shielding deterioration must remain below 20%.

Fissile or Type B packages must be designed so that they continue to fulfil their containment, sub-criticality and radiation shielding functions under accidental conditions. These accidents are represented by the following tests:

– a series of three consecutive tests:

- *a 9 m drop test onto an unyielding surface,*
- *a 1 m drop onto a spike,*
- *encircling fire of at least 800 °C for 30 minutes;*

– immersion in water at a depth of 15 m (200 m depth for spent fuel) for 8 hours.

Type C packages must be designed so that they continue to fulfil their containment, sub-criticality and radiation shielding functions under representative air transport accident conditions. These accidents are represented by the following tests:

– a series of three consecutive tests:

- *a 9 m drop test onto an unyielding surface,*
- *a 3 m drop onto a spike,*
- *encircling fire of at least 800 °C for 60 minutes;*

– 90 m/s impact on an unyielding surface;

– immersion in water at a depth of 200 m for 1 hour;

– burial test.

2|5 ASN responsibilities regarding regulation of the safe transport of radioactive materials

In the context of the regulation of the safe transport of radioactive and fissile materials, ASN is responsible for:

– proposing technical regulations to the government and monitoring their implementation. It can therefore propose supplements to the rules defined by IAEA;
– completing authorisation procedures (approval of packages and organisations);
– organising and coordinating inspection of packages and materials and their means of transport;
– taking enforcement measures (formal notice, provision of financial guarantees, automatic performance of work, suspension of transport, etc.) and imposing the necessary penalties;
– proposing and organising public information.

In addition, ASN acts within the context of emergency plans defined by the authorities to deal with an accident.

TO BE NOTED IN 2010

Public information

In 2010, ASN organised several information seminars for the various entities involved in the transport of radioactive materials.

These seminars were held:
– on 1 February on the premises of the DGAC (General Directorate of Civil Aviation): seminar for the various concerned airport staff;
– on 4 February in Lyons, organised by the Lyons division;
– on 7 June in Lille, organised by the Douai division for users of gamma ray projectors and gamma density meters;
– on 29 September in Aix-en-Provence, organised by the Marseilles division.

The main purpose of these seminars was to present the important points of the regulations and its evolution, to underline the importance of notifying events that could have affected the safety of the packages, and to answer the participants' questions.

More seminars of this type will be organised in other regions in 2011.

2|6 Administrative authorisations

ASN conducts a critical analysis of the safety analysis reports proposed by the applicants to obtain approval of the package models which so require.

After technical review of the documents by IRSN (French Institute for Radiation Protection and Nuclear Safety), ASN delivers the approvals of the package models stipulated in the regulations and validates approvals issued by the competent authorities in other countries for shipments transiting in France.

These approval certificates are usually issued for a period of a few years. At present, about one hundred applications for approval are submitted annually to ASN by the manufacturers (new package model, approval renewal, validation of a certificate issued by a foreign authority, special arrangement, extension to contents other than those initially defined in the approval certificate).

Generally speaking, approval is given for a package model, and not package by package. The approval certificate nevertheless specifies the manufacturing, operating and maintenance conditions.

The approval certificate is often issued independently of the transport operation, strictly speaking, for which no prior notification of ASN is generally required, but which may involve security checks (physical protection of materials under the control of the Defence and Security Executive Officer at the Ministry for Ecology, Sustainable Development, Transport and Housing).

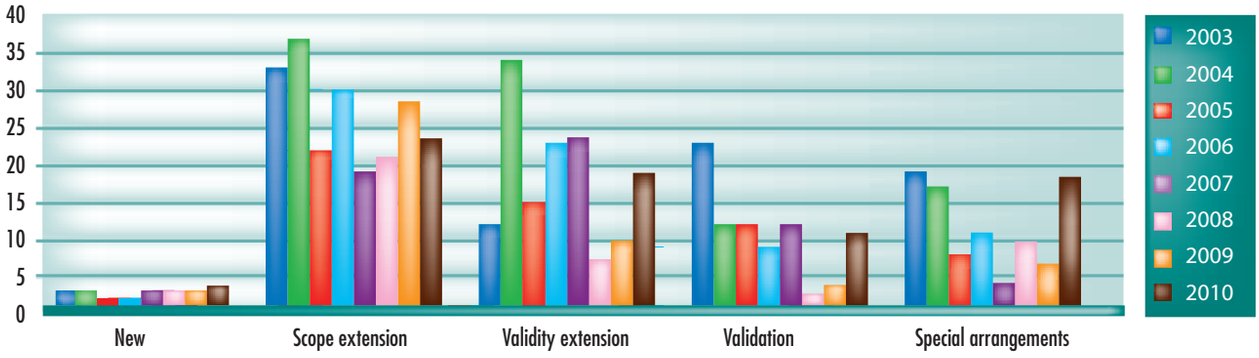
A decision of 1 December 1998 set up an Advisory Committee of Experts (GPE) for radioactive material transport, similar to the other GPEs already in existence for other sectors. The expertise carried out by IRSN at the request of ASN can thus be supplemented by an Advisory Committee examination. This procedure is used for new package concepts, for example.

This GPE thus met in 2010 for the R73 package designed by ROBATEL Industrie for transporting waste from the decommissioning of first-generation reactors of EDF.

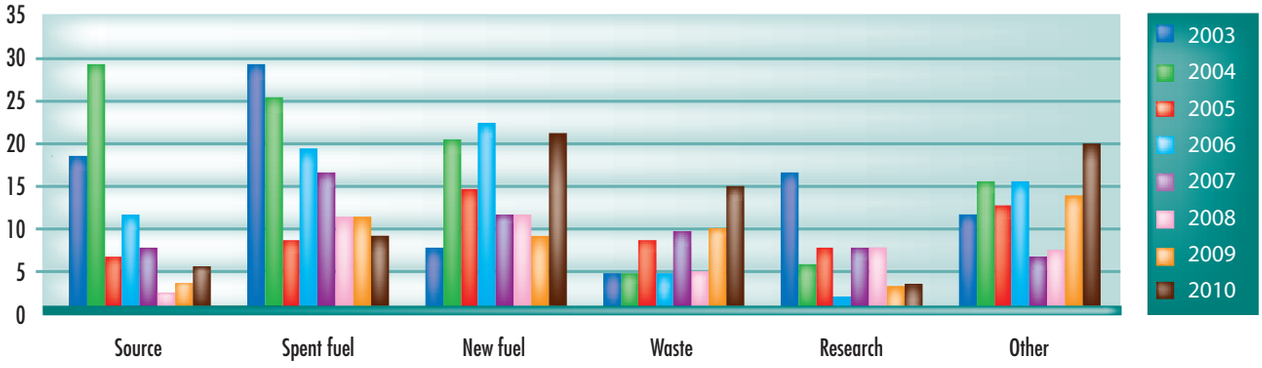
In 2011, packages TN833 and TN843 will be presented to the GPE by the company TN International for the transport of bituminous and compacted wastes coming from the reprocessing of irradiated fuel at La Hague.

ASN delivered 75 certificates in 2010, for which the breakdown by type is shown in graph 1.

Graph 1: Breakdown of the number of approvals according to type



Graph 2: Breakdown of the number of approvals according to their content



The breakdown and nature of the transport operations concerned by these certificates in 2010 are shown in graph 2.

Finally, in May 2009, ASN published an applicant's guide for approval of shipments and package models or radioactive materials for civil purposes transported on the public highway. The guide presents ASN's recommendations to the applicants, to facilitate reviewing of the package approval applications and of the shipment approvals for the transport of radioactive materials. It also specifies how the safety analysis reports are to be transmitted to ASN and to IRSN, their structure, the contents of the draft approval certificate, the minimum processing times, the experience feedback from previous reviews and the requirements to be met if a package model or material is modified. This guide was translated into English in 2010, for distribution to some of the European Union competent authorities for transport issues.

3 REGULATING THE TRANSPORT OF RADIOACTIVE MATERIALS

3|1 Regulation by ASN

As part of its responsibilities, ASN carries out checks on the various parties involved in the transport of radioactive materials. The consignors and carriers are the focus of constant attention, but the inspections also concern peripheral activities associated with transport, such as the manufacture and maintenance of the packaging containers.

From both the regulatory and practical standpoints, it is important to ensure good cohesion with other supervisory authorities responsible, notably, for the inspection of transport vehicles, for conventional safety inspection in the transport sector or for the protection of nuclear materials. For this purpose, ASN has already signed - or will soon signing - protocols with the General Directorate for Infrastructures, Transports and Maritime Affairs (DGITM), the General Directorate for the Prevention of Risks (DGPR) and the General Directorate for Civil Aviation (DGAC). The TSN Act also reinforced the powers of ASN inspectors, in particular with regard to ascertaining violations and imposing penalties.

In 2010, a total of 92 inspections were carried out in the field of radioactive material transport.

In 2010, the radioactive material transport inspection duties performed by ASN inspectors revolved around various priority topics:

– airport handling of radioactive packages;
– BNI field inspections;
– design, manufacture, testing and maintenance of containers;
– manufacture and testing of packages that do not require approval by the competent authority.

Among the observations or findings formulated further to the inspections, the most frequent are about quality assurance, documentation, the responsibilities of the various parties involved, or compliance with procedures and established practices as indicated in the approval certificates, safety cases or, more generally, regulatory texts.

In particular for packages that do not require approval by the competent authority, ASN considers the situation to be unsatisfactory. Whether demonstrations of conformity with the regulations or pre-shipping checks, the inspections revealed a large number of shortcomings. This situation is all the more worrying as these packages are the source of a large proportion of the incidents that occurred in 2010.

On the other hand, the inspections performed in 2009 and 2010 reveal progress in the development of the radiation protection programs, which have been compulsory since 2001.

ASN carried out inspections during the manufacture of the R73 and TN117 containers, and during the regulatory testing of the

DE25 container. The deviations identified mainly concern quality assurance deficiencies that can be divided into the following three types:
– problems with the traceability of correspondence and official validations (nonconformities, hold points) between the packaging designer and manufacturer;
– insufficient traceability of document revisions;
– incomplete application of the internal quality reference system (performance of internal audits, supplier monitoring, verification of device calibration).

3|2 On-site transport rules

In 2008, ASN decided jointly with ASND (Defence Nuclear Safety Authority) to tighten the regulatory framework for dangerous goods transport on nuclear sites.

At the request of ASN, some sites defined technical rules applicable for this type of transport as early as 2003. This is for example the case with the CEA centres or Areva's La Hague or Tricastin sites. On-site transport on the AREVA La Hague site, for example, was optimized in 2010 by adopting protected transport lanes that are preferentially dedicated to the transport of radioactive materials.

These on-site transport rules are a set of operational and organisational rules largely inspired by the current road and rail transport regulations ("TMD" order) while taking into account certain aspects specific to on-site transport.

ASN together with ASND monitored the progress made by the working group which should lead to an overhaul of these on-site transport rules, taking account of initial operating experience feedback.

Measuring radioactivity at Cadarache before a spent fuel convoy departs for the Greifswald centre in Germany – December 2010

Package not requiring approval by the competent authority

Industrial or Type A packages do not require approval, thus ASN does not deliver an approval certificate.

These packages are nevertheless subject to regulations and must, among others, withstand certain tests (see point 2|2).

Through the inspection of various container manufacturers, ASN checks that the packages comply with the regulations: tests performed in accordance with regulations, presence of a complete conformity file and a certificate of conformity for all the package models.

UNDERSTAND

4 INCIDENTS AND ACCIDENTS

The criteria for ASN notification of transport incidents or accidents are defined by a guide. The currently applicable version of this guide was sent out by ASN in a letter dated 24 October 2005 to all consignors and carriers (see chapter 4). This guide also reuses the incident report template proposed in the "TMD" order.

All transport deviations are thus to be declared to ASN. Apart from this notification, a detailed incident report must be sent to ASN within two months. Events concerning regulatory nonconformities but which do not impair the safety functions are not concerned by this report. In case of contamination, an analysis report is to be sent to ASN within two months.

The main events arisen this year are detailed below according to the following categories:

– package handling events;

– incidents and accidents during actual transport;

– nonconformity with the regulatory requirements of the official orders relative to each mode of transport and with the requirements of the package model approval certificates, and notably the pre-shipping verifications (difference concerning marking, labelling and placarding, transport documentation and exceeding of the contamination and dose rates thresholds).

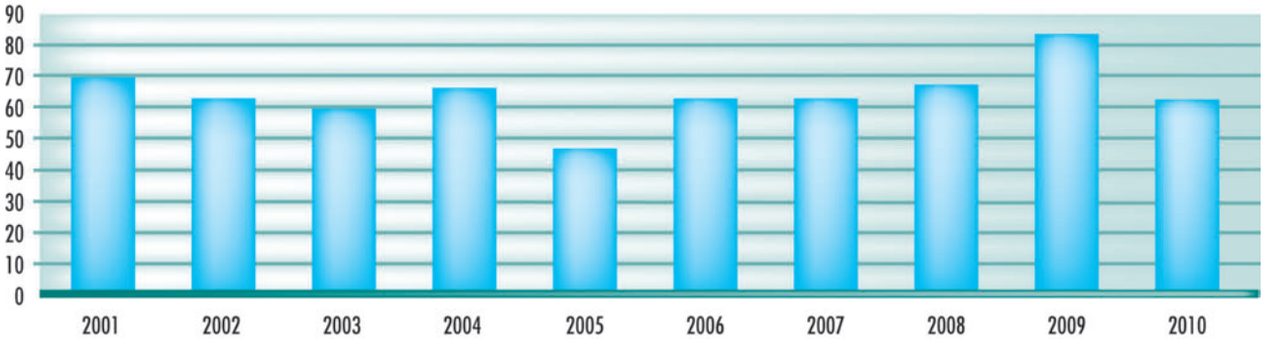
In 2010, 53 incidents were classified as level 0, and 9 as level 1. Graph 4 shows the trends since 2001.

The medical, conventional industry and research sectors account for about 46% of the transport-related events. However, this number must be treated with caution. It is in fact striking that most of the deviations notified to ASN in the medical, conventional industry or research sectors are events that cannot be hidden, such as package damage, theft or loss, or even road accidents. However, those concerning violations of the regulations or for which the direct safety consequences are minor represent a far smaller share than in the nuclear sector. This is without any doubt due to professionals in the small-scale nuclear activities failing to submit notifications.

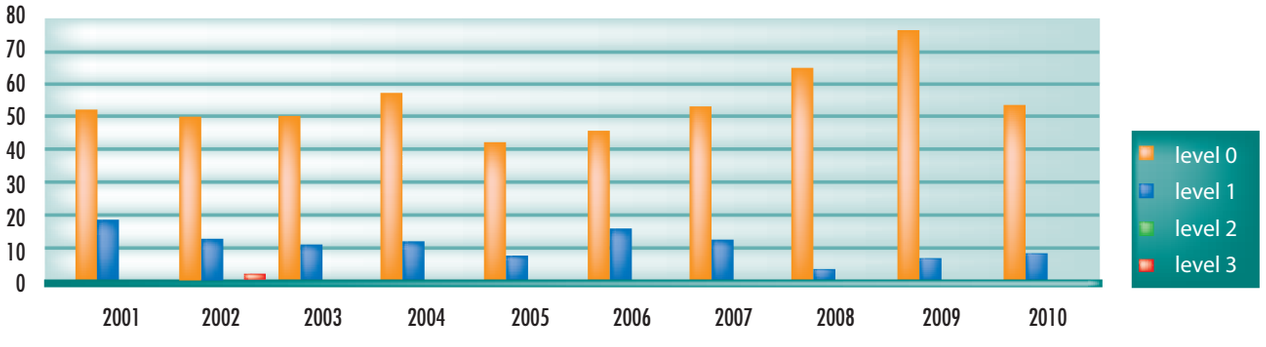
ASN considers this situation to be unsatisfactory, because poor design or incorrect use of these packages can lead workers or the public to receive doses higher than the regulation limits, especially in the event of content leakage.

The obligation and the method of notifying transport events were underlined at the various information seminars (see point 2 | 3).

Graph 3: Trend for the number of radioactive material transport incidents or accidents declared between 2001 and 2010



Graph 4: Trend for the number of events classified on the INES scale since 2001



4|1 Package handling events

Events causing damage during package handling are considered to be transport-related incidents. In the eyes of the regulations, handling is part of transport because transport is defined as including all operations and conditions associated with the movement of radioactive materials, such as container design, manufacture, maintenance and repair, preparation, dispatch, loading, routing (including interim storage in transit), unloading and reception at the final destination of the radioactive material shipments.

These events are among those that ASN follows most closely, because their potential impact on workers, whether radiological or not, requires an extreme vigilance. Among the events that are of the greatest concern to ASN are those occurring in airports.

Events in airports

Events in airports are generally handling incidents where radioactive material packages suffer impacts.

In 2010, twenty-three incidents of this type were recorded at the airports of Roissy-Charles-de-Gaulle, Orly and Marignane (Marseilles). These incidents concerned damages to type A or excepted type packages (damages ranging from simple impacts to package crushing). Two of these incidents led to a slight loss of containment (container torn), but no contamination. These two incidents were classified as level 1 on the INES scale.

In addition, a Type A package was lost in 2010. It contained Iodine 131 intended for medical uses and did not reach its destination. The package was to be sent from Charles-de-Gaulle airport to Denmark, but trace of it was lost at Charles-de-Gaulle airport. This significant event was classified as level 1 on the INES scale.

In cooperation with the DGAC and the air transport police, ASN performed several inspections in the air freight zone of Charles-de-Gaulle airport. The carriers were reminded of the need to implement a radiation protection program appropriate to the transport activities, to correctly secure the packages and to make the personnel aware of the ionising radiation risks.

4|2 Incidents and accidents during actual transport

Transport-related events are generally caused by ordinary road accidents. For this kind of event, ASN examines very closely not only the consequences for workers, but also for the public and the environment.

4|3 Nonconformity of container or content

These events are often rooted in non-compliance with the package approval certificate or the package user's guide. These events include the exceeding of radiation intensity limits or a deviation from the content described in the package approval certificate (presence of cover or omission of a seal in the container). There are usually no consequences for the workers, the public or the environment, however ASN examines them meticulously given that they can affect the public.

4|4 Transport infrastructure hazards assessments

ASN and IRSN were invited to participate in the working group organised by the Minister in charge of the Environment, aiming to publish a guide about the method to carry out hazard assessments relative to transport infrastructures. The primary goal is to standardize the content study, and then to assist infrastructure managers in this task. Decree 2007-700 dated 3 May 2007 effectively compels the largest infrastructure managers to submit a hazard study of their facility to the *préfet*[1] of the *département*[2] by May 2010.

ASN was part of the Hazardous Materials delegation at the ministry, on the one hand to propose radiological dose thresholds equivalent to those used by the other classes of hazardous materials, and on the other to propose a guide for the production of safety reports specific to radioactive materials.

The hazard thresholds used for the other hazardous materials are:
– significant lethal effects threshold (LET 5% LC);
– first lethal effects threshold (LET 1% LC);
– irreversible effects threshold (IET).

ASN considered the production of dose rate thresholds equivalent to the effect thresholds of other hazardous materials to be unwise. In consequence, ASN proposed adopting a single threshold of 50 mSv. This is consistent with the thresholds (health thresholds) in on-site emergency plans ("PUI") and with the transport regulations.

The purpose of the guide, which is not legally binding and of a which ASN issued a draft in 2010, is to provide infrastructure managers with the methodological information and the data required to evaluate the specific risks associated with the transport of radioactive materials that must be handled in their safety reports. The ASN guide is intended for the managers of the following infrastructures, which are specified in the decree of 3 May 2007 on the safety reports of infrastructures for the storage, loading or unloading of hazardous materials, implementing article L. 551-2 of the Environment Code:
– highway parking areas with a capacity exceeding 150 heavy goods vehicles;
– railway marshalling or classification yards where on average more than 50 hazardous materials wagons are present simultaneously;
– sea and river port, beyond a total annual goods traffic volume (hazardous or not) of 4 million metric tonnes per year for the sea port infrastructure and 1 million metric tonnes for the river port;
– the multimodal facilities used by hazardous goods vehicles and means of transport, including radioactive materials.

1. In a *département*, representative of the State appointed by the President
2. Administrative region headed by a *préfet*

4|5 Radioactive material transport emergency plan

In 2008, jointly with ASND, ASN decided to organize a working group to define and harmonize emergency plans applicable to the transport of radioactive materials (PU-TMR) on the public highway or in trans shipment centres. The PU-TMR is an operational document which must describe the response of the consignor, jointly with the other concerned parties (carriers, shipping agents, designers, etc.).

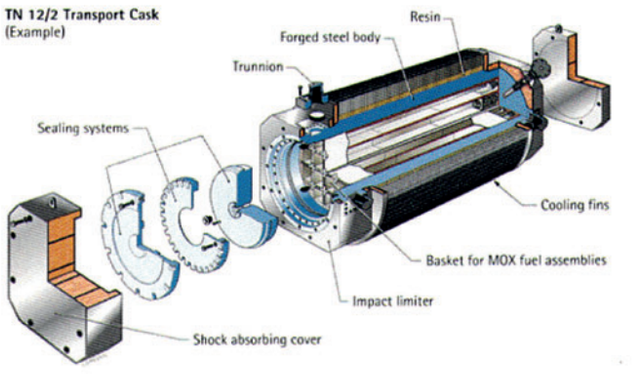
In 2010, the working group agreed on a framework structure that will be issued in 2011 for application for national transport of radioactive materials in packages whose model is approved by the competent authority (ASN or ASND).

UNDERSTAND

Presence of foreign objects in containers

During the maintenance of package models TN12/2, TN13/2 and MX8, foreign objects were found inside the containers. The objects included seals, screws, and pieces of emery cloth used to clean the container. These objects are not authorized by the package approval certificate. Were they to be found in large quantities, the absence of impact of their presence on the safety of the package, particularly in terms of radiolysis would have to be demonstrated.

TN International has implemented several procedures to prevent this type of incident:
– closing the pockets of maintenance staff with adhesive tape,
– checking that seals are in place before shipping.
Particular attention shall be focused on compliance with these procedures during inspections in 2011.



Example of an irradiated fuel transport package in which seals were found

5 INTERNATIONAL ACTION

The international nature of radioactive material transport has given rise to regulations, drafted under the supervision of IAEA, ensuring that a very high level of safety is guaranteed. The drafting and implementation of these regulations give rise to fruitful exchanges between the countries. ASN considers these exchanges to be a contributing factor in the constant improvement in the safety of radioactive material transport.

Regulations

ASN is a member of the Transport Safety Standards Committee (TRANSSC) which, under the supervision of IAEA, comprises experts from all countries in the field of radioactive material transport and drafted the document (TS-R-1) which underpins the regulations applicable to the transport of radioactive materials. ASN took part in the corresponding meetings held from 14 to 18 June and from 29 November to 3 December 2010 in Vienna.

Working groups will be set up in 2011 in preparation for the forthcoming revision of the radioactive material transport regulations (future 2014/2015 edition). They will concern, for example, the acceleration forces to take into account for the securing of packages.

ASN hosted a working group on the foundations of the radioactive materials transport regulations from 11 to 15 October 2010. Organised and supervised by the International Atomic Energy Agency (IAEA), the meeting was attended by 25 participants from eight countries (France, Germany, Argentina, Belgium, Canada, Japan, the Netherlands and Sweden) and international organisations (ISO - International Standards Organisation, and WNTI - World Nuclear Transport Institute)

and involved plenary sessions and workshops. It resulted in the development of methods that will be used to identify and assess the bases of the technical requirements of the radioactive material transport regulations (safety standard referenced TS-R-1).

Creation of a club of European authorities with competence for the inspection of radioactive material transport

A club of European authorities with competence for radioactive material transport was created in December 2008. ASN is a member. Within this framework, it works achieve more harmonious implementation of the regulations concerning radioactive materials and exchange operating experience feedback with the various member countries. ASN took part in the fourth and fifth plenary meetings held respectively in Stockholm in May 2010 and London in October 2010. The countries are working on an inspection guide which should be finalised in 2011.

Bilateral relations

ASN devotes considerable effort to maintaining close ties with the competent authorities of the countries concerned by the numerous shipments to and from France. These in particular include Belgium, the United Kingdom and Germany. Relations with the competent authorities in these two countries are both frequent and fruitful.

Belgium

For its production of electricity from nuclear power, Belgium uses French designed containers for fuel cycle shipment. In order to harmonise practices and achieve progress in the safety of these shipments, ASN and the competent Belgian authority (Belgian Federal Nuclear Regulating Agency – AFCN) regularly exchange know-how and experience feedback.

Since 2005, an annual exchange meeting is held by ASN and AFCN in order to take a closer look at the safety analysis reports for the French package models validated in Belgium. The meeting of 28 May 2010 reviewed the various package models used in France and Belgium. A joint inspection was carried out on 16 September 2010 in the Ateliers de La Meuse after a series of manufacturing defects was found on the TN24 family of packaging containers.

The United Kingdom

France and the United Kingdom use radioactive materials for similar civil applications, such as nuclear generation of electricity, reprocessing and use of radioactive substances for medical purposes, and consequently the two authorities have similar levels of competence. Both France and the United Kingdom also apply the same regulations covering radioactive material transport. Both countries also underwent a review coordinated by the IAEA, demonstrating the high level of competence of the two authorities with regard to radioactive material transport, thus enhancing their mutual trust and confidence.

A bilateral Memorandum of Understanding (MoU) enables ASN to acknowledge the approval certificates issued by the competent UK authority (DfT, Department for Transport) in accordance with the applicable rules, and vice-versa. This MoU eases the procedural burden between the two countries and enables the two authorities to devote more time to important issues. ASN and the DfT also collaborate in the following areas:
– licensing procedures;
– inspections;
– emergency procedures;
– guides for domestic and international transport of radioactive materials;
– radioactive material transport standards;
– quality assurance systems.

Two discussion meetings are organised annually between ASN and the DfT, to enable them to work more closely together, particularly in reviewing the safety analysis reports for the package models used in the UK and France. A consultation meeting was held on 13 April 2010.

Germany

The French and German nuclear authorities have decided to regularly meet to discuss certain technical files. It is true, there is no shortage of subjects of joint interest. Large quantities of shipments cross the Franco-German border. Thought is being given to implementing a Memorandum of Understanding for approval recognition, along the lines of that concluded by ASN with the British regulator. A consultation meeting was held on 21 May 2010.

United States

The American nuclear regulators (NRC and DOT) and ASN have greatly increased their collaborations on subjects of joint interest (discussions on container approvals, for example). Two consultation meetings were held in London in March and October 2010.

PATRAM symposium

ASN/IRSN made two joint presentations at the PATRAM (Packaging and Transport of Radioactive Materials) symposium held from 3 to 8 October 2010. One was on operating experience feedback (REX) from events in France over the last ten years, emphasising the importance of organisational and human factors, while the other addressed the transport infrastructure safety reports.

6 OUTLOOK

In 2011, ASN will continue its inspections of the designers, manufacturers, users, carriers and consignors of radioactive material packages.

Inspecting the manufacture of the containers remains a strong priority for ASN, to ensure that they are well made, in accordance with the requirements specified in their safety analysis report.

ASN will also continue to monitor packages that are not subject to approval, particularly in the medical, conventional industry and research sectors, taking advantage of the radiation protection inspections it already carries out in these fields.

ASN will in 2011 continue to test its response organisation designed to deal with an accident involving the transport of radioactive materials. It considers that emergency exercises in the transport field are of particular importance. Given that an accident can happen anywhere, the local response organisation could be inadequately prepared to deal with it, especially if it occurs in a *département* in which there are no basic nuclear installations. These national exercises, combined with local exercises, contribute to the training of the protagonists. In 2011, ASN will continue its efforts to harmonise and strengthen the emergency plans for dealing with transport accidents through the working group which it set up in 2008, involving representatives from the industrial nuclear world.

ASN is also looking to improve the regulation of the transport of dangerous goods within nuclear sites. To achieve this, in the next two years it will be producing supplements to the regulations applicable to nuclear installations in this respect.

ASN will be continuing the technical background work prior to issue of approval certificates: periodic safety reviews of existing package models and the approval of new models incorporating innovative design features contribute to the overall upgrading of transport safety.

ASN intends to intervene as early as possible in the drafting of IAEA's recommendations. Harmonising safety and radiation protection practices in the transport field also remains a strong priority for ASN.