TRANSPORT OF RADIOACTIVE MATERIALS

CHAPTER 11

1 GENERAL INTRODUCTION

1 | 1 Annual traffic

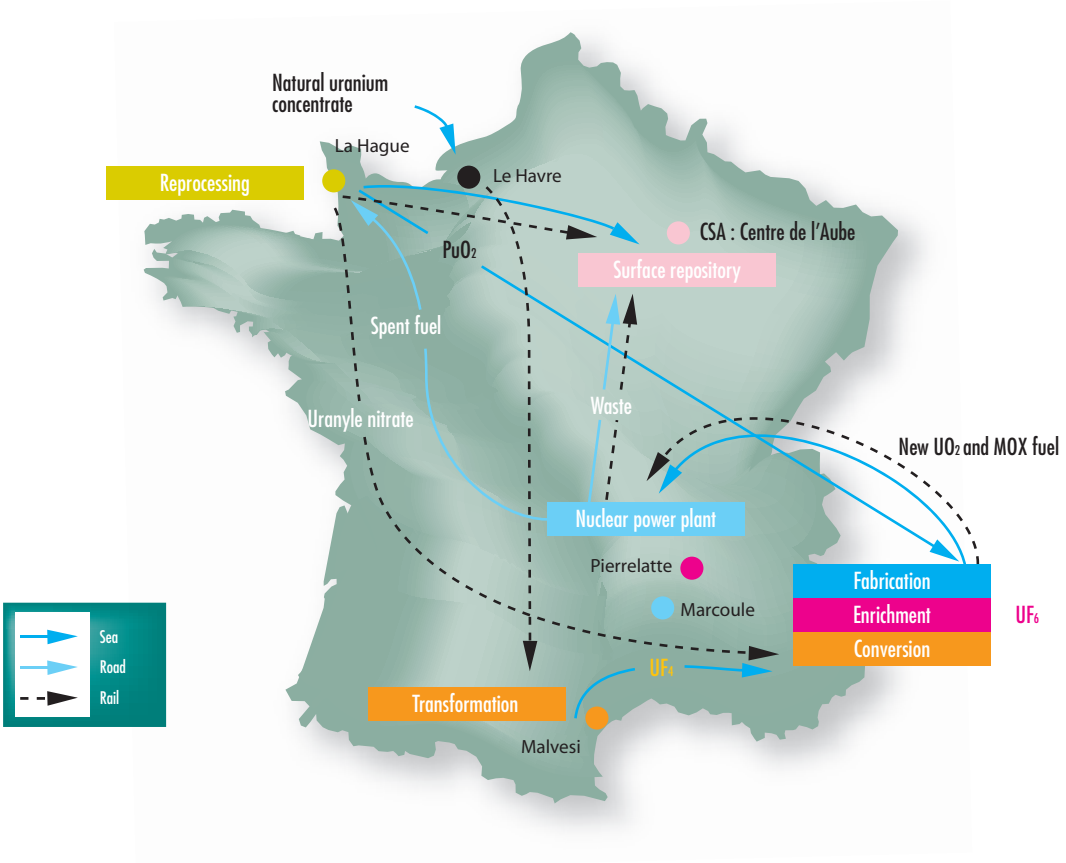
About 900,000 packages of radioactive materials circulate in France every year, representing a few percent of the dangerous goods traffic. Two thirds of these packages are intended for medical or industrial uses (lead analysis, gamma radiography, etc.). The diversity of these packages is considerable. Their radioactivity varies by more than twelve orders of magnitude, or from a few thousand becquerels (pharmaceutical packages) to millions of billions of becquerels (spent fuel), and their weight from a few kilograms to about a hundred tons.

The sectors using these packages are also extremely diverse. There is obviously the nuclear sector, but also the medical field, conventional industry and research. These latter sectors account for more than 85% of radioactive material package traffic.

The nuclear power cycle industry generates transport of a variety of radioactive materials: uranium concentrates, uranium tetrafluoride (UF_4), uranium hexafluoride (UF_6), depleted, natural or enriched uranium, new or spent fuel assemblies, based on uranium or mixed uranium and plutonium oxide (MOX), plutonium oxide, waste from the NPPs, from reprocessing, from the CEA Centres, etc. The most frequent shipments include 300 of new fuel, 250 of spent fuel, about thirty of MOX fuels and about sixty of plutonium oxide powder.

Since transport provisions are international, France is also a transit country for some of these shipments, for instance for spent fuel packages from Switzerland or Germany, bound for Sellafield in Great Britain, which are taken on board ship at Dunkirk.

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.



Transport associated with the fuel cycle in France

1 | 2 Industrial participants

The two main participants in transport arrangements are the consignor and the carrier. The consignor is responsible for package safety and accepts its 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 container must be designed and sized in accordance with conditions of use and current regulations. In most cases, a prototype is needed to carry out the tests prescribed by the regulations. Following this phase, the safety documents are prepared and submitted to the competent authority, to back up 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 transport. 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 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 transport 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.

1 | 3 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, virtually all the spent fuel intended for reprocessing is sent by train to the rail terminal at Valognes, and then by road 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 specific general or local 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 to carry spent nuclear fuel, plutonium and high-level waste must comply with the

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 of 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, temperature control in the cargo hold, stowage and securing of packages in the holds, backup electrical power, radiological protection, and the shipboard emergency and personnel training plan.

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 is widely used for small, urgent packages over long distances, for example short-lived radiopharmaceutical products.

Transit storage
The regulations for the transport of radioactive materials apply to all modes of transport, whether by land, sea, air or river. 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.

2 ROLES OF THE PUBLIC AUTHORITIES

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 regulations pertaining to the safe transport of radioactive and fissile materials for civil use and for monitoring its enforcement. Its responsibilities role in this field 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.

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, first of all by modulating the content limitations of the packages and means of transport, along with the performance standards applied to the package models, according to the risk inherent in the radioactive contents; secondly by setting requirements for the design and operation of the packages and for container maintenance, taking account of the nature of the radioactive contents and, finally, by stipulating administrative checks, including approval by ASN if necessary.

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 (materials of use for weapons). The authority responsible is the Defence and Security High Official (HFDS) at the Ministry for Ecology, Energy, Sustainable Development and the Sea (MEEDDM).

Finally, a number of other administrations intervene in areas other than safety but which interface with it. So that regulation is as coherent as possible, ASN works with them regularly. The breakdown of the various responsibilities is summarised in table 1.

2|2 Specific intervention for the different package types

Although the regulations apply to all radioactive material packages[1], 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 radioisotope and are calculated on the basis of a model, called the Q-system.

1. The term package designates the container with its radioactive contents ready for transport.

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

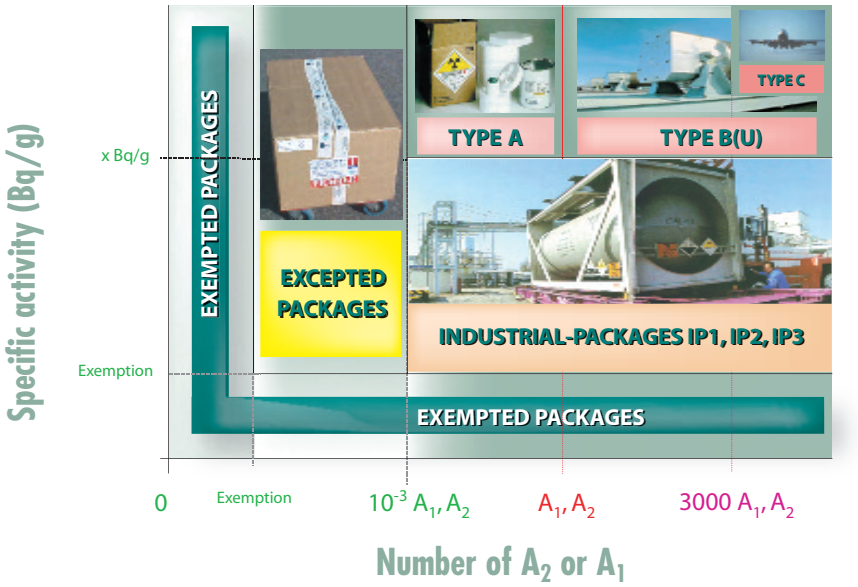
Mode of transport	Regulation of mode of transport	Package regulation
Sea	General Directorate for Infrastructure, Transport and the Sea (DGITM) at the MEEDDM. ASN assists it with monitoring compliance with the requirements of the international code for the safe carriage transport of irradiated nuclear fuels, plutonium and high level radioactive waste on-board ships (INF code)	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 safety and road traffic delegation of the MEEDDM	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	General Directorate for Civil Aviation (DGAC) of the MEEDDM	The DGAC is competent to regulate packages of dangerous goods in general and in close coordination with ASN for packages of radioactive materials

For a given radioisotope, these thresholds (referred to as A2 or A1 depending on whether or not there is a risk of source dispersal) represent the activity level which, in the event of an accident, would lead to an effective dose of 50 mSv in 30 minutes at a distance of 1 metre, considering all 5 exposure modes (external due to photons, external due to beta emitters, internal dose by inhalation, dose by immersion, dose at the skin and ingestion after transfer of contamination).

The Q-system thus defines a reference activity level which is all the lower, the more harmful 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 definition of the scope of intervention by the public authorities and the acceptable level of transport risk. 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;
– slightly dispersible radioactive materials;
– type B and C packages and all fissile material packages;

Type of package according to total and specific activity



Example of a type A packaging – Technetium 99m generator

Example of a type B packaging – Gamma radiography appliance containing an iridium source

– 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);
– packages containing more than 100 g of UF_6.

For the other types of packages, ASN carries out checks on samples to ensure compliance with the regulations.

Furthermore, each type of package undergoes a number of strength tests representative of the risks to which the shipment can be exposed, while at the same time taking account of 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.

These technical and operational requirements applicable to the transport of radioactive materials are drafted under the supervision of IAEA and collated in a document called TS-R-1.

2|3 ASN responsibilities regarding regulation of the safe transport of radioactive materials

In the context of 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.

2|4 Administrative authorisations

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

After technical review of the documents by IRSN, ASN approves the package models complying with the regulations and validates approvals issued by the competent authorities in other countries for transport in France.

These approvals are usually issued for a period of a few years. At the present time, about 100 applications for approval are submitted annually by the manufacturers to ASN (new package design, extension of the term of validity, validation of a certificate issued by a foreign authority, special arrangement, extension of a certificate to cover contents other than those initially defined in the safety documents).

Characteristics of the various types of packages

Excepted packages are subjected to no qualification tests. However, they must 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 certain 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 onto a rock target 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 give rise to no 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 a rock target,
• a 1 m drop onto a spike,
• encircling fire of at least 800 °C for 30 minutes;
– immersion in 15 m deep water (200 m water 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 a rock target,
• a 3 m drop onto a spike,
• encircling fire of at least 800 °C for 60 minutes;
– 90 m/s impact on a rock target;
– immersion in 200 m deep water for 1 hour;
– burial test.

Generally speaking, approval is issued for package models and not package by package. This approval however specifies the manufacturing, operating and maintenance conditions.

This approval 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 High Official at the MEEDDM).

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 appraisal carried out by IRSN at the request of ASN can therefore be supplemented by an Advisory Committee examination. New package concepts are covered by this procedure.

This Advisory Committee thus met in 2009 to discuss the TN 117 package designed by TN International (AREVA group) for transport of Italian spent fuel assemblies to the La Hague site for reprocessing.

In 2010, the R 73 package will be presented to the Advisory Committee for transport by ROBATEL Industrie of waste produced by decommissioning of EDF's first generation of reactors.

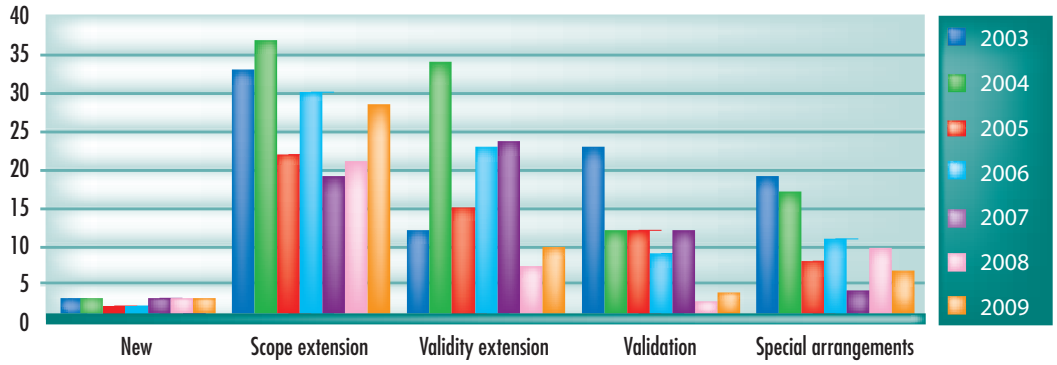
In 2009, ASN issued 65 certificates, broken down according to type (see graph 1).

The breakdown and nature of the transport operations concerned by these certificates in 2009 are shown in graph 2.

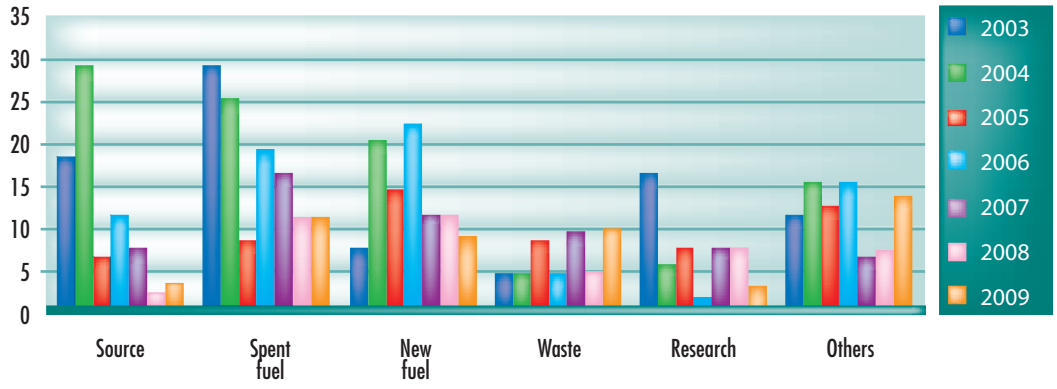
Finally, in May 2009, ASN published an applicant's guide for approval of shipments and package models or

radioactive materials for civil purposes transported on the public highway. The guide presents ASN's recommendations to the applicants, to facilitate review of the package approval applications and of the shipment approvals for the transport of radioactive materials. It also specifies how the safety cases are to be transmitted to ASN and to IRSN, their structure, the contents of the draft approval certificate, the minimum processing times, the operating experience feedback from previous reviews and the requirements to be met if a package model or material is modified.

Graph 1: breakdown of number of approvals according to type



Graph 2: breakdown of number of approvals according to content



3 REGULATING THE TRANSPORT OF RADIOACTIVE MATERIALS

ASN's responsibilities include checks carried out at the various parties involved in the transport of radioactive materials. The consignors and carriers are the subject of constant attention, but the inspections also concern activities related to 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. ASN has therefore either already signed 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), or will soon be signing them. The TSN Act also reinforced the powers of ASN inspectors, in particular with regard to ascertaining violations and imposing penalties.

In 2009, a total of 96 inspections were carried out in the field of radioactive material transport.

In 2009, the radioactive material transport inspection duties, performed by ASN's inspectors, were based around various key topics:
– fluorine 18 surprise inspections;
– BNI field inspections;
– packaging container design and manufacture.

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

The importance of these deviations depends on the nature of the transport operations affected. For example:
– nuclear medicine, brachytherapy or research establishments (consignors and/or consignees) are generally little involved, in that the suppliers or final destinations (ANDRA for example) are responsible for organising the entire transport process. The result of this is their ignorance of the applicable regulations, a lack of a quality assurance organisation and little or no training of the personnel involved. The impact of these deviations can however be limited by a radiation protection culture, contractor support (provision of data sheets, ready-to-use packages and labels) or the very nature of the packages (transport of limited quantities);
– the departments in charge of transport operations within BNIs are generally characterised by an organisation capable of guaranteeing regulatory compliance and the traceability of this compliance. However, when deviations are detected, they are indicative of a breakdown in the self-inspection mechanisms. The nature of the materials transported and the potential risks associated with them justify maintaining rigorous monitoring and strict requirements.

Fluorine-18

Fluorine 18 is used in nuclear medicine for in vivo diagnosis. Owing to the very short half-life of this isotope (110 minutes), it is produced at the last moment and the packages are shipped without delay. Operational constraints such as these are liable to lead to deviations on the part of the various parties involved in transport. In 2009, ASN carried out 17 inspections on this topic.

Teams of inspectors visited the consignor sites to draw up an inventory of carrier practices. The initial results showed that the transport conditions were on the whole in conformity with the requirements of the regulations, although this was offset by a certain lack of concern on the part of the drivers.

The procedures, guides and equipment supplied by the producers of fluorine 18 and by the shipping agents ensure conformity with the basic rules such as radiological monitoring, stowing and securing, vehicle signage and the presence on-board of the required documents and equipment.

However, some drivers were little informed of the contents of the safety instructions, of their own radiological monitoring or of the quality assurance requirements (little or no formal specification of checks to be carried out).

Sea transport inspection – The port of Le Havre (Seine-Maritime *département*) – 2009

ASN carried out inspections during the manufacture of the LR 144 package and during the regulation tests on the TN 833, TN 843 packages and the over-package for SV 34, SV 69 and devices that cannot be disassembled (irradiators). The deviations identified mainly concern quality assurance deficiencies that can be split 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 implementation of the internal quality requirements (official validation, planning and oversight of remedial action).

Finally, in 2008 and in coordination with ASND (Defence Nuclear Safety Authority) ASN decided to strengthen the rules and requirements for the transport of hazardous goods 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.

Inspection of transport packaging manufacture – 2009

These internal transport rules are a set of operational and organisational rules to a large extent inspired by the public highway transport regulations (ADR order and ADR (2[2])) while taking account of certain aspects specific to on-site transport.

In 2008 and 2009, ASN together with ASND, monitored the progress made by the working group, which should lead to an overhaul of these internal transport rules, taking account of initial operating experience feedback.

2. ADR is the European agreement concerning the international carriage of dangerous goods by road. The ADR order aims to make the European agreement applicable in French law.

4 INCIDENTS AND ACCIDENTS

The criteria for ASN notification of transport incidents or accidents are defined by a guide, the currently applicable version of which was sent out by ASN in a letter dated 24 October 2005, to all consignors and carriers (see chapter 4, point 1|2|2). This guide also reuses the incident report template proposed in the ADR and RID orders.

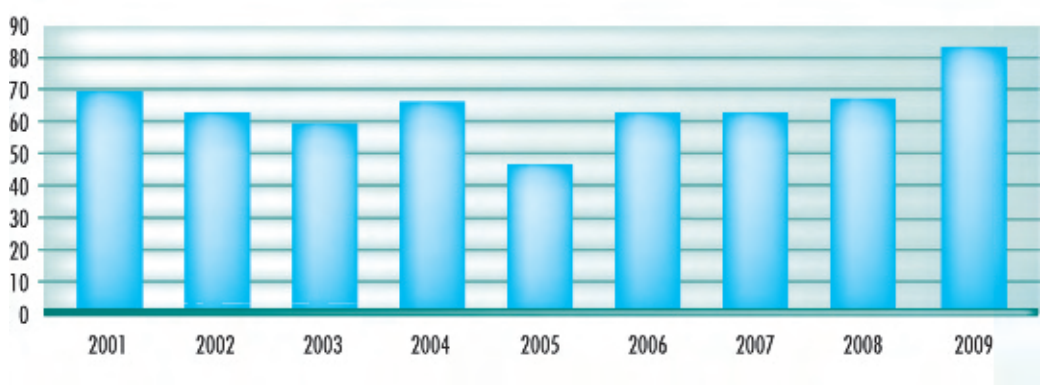
All transport deviations are thus to be declared to ASN. Apart from this declaration, a detailed incident report must be sent to ASN within two months. Events concerning regulatory nonconformities but which do not impair the safety functions are not concerned by this report. In the case of contamination,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

The main events that occurred this year are detailed below according to category. These events may be of several types:
– package handling events;
– incidents or accidents during actual transport, particularly a stowage fault;
– nonconformity with the regulations laid down in the orders concerning each mode and in the package model approval certificates, in particular the checks required prior to departure (deviations concerning labelling, signalling, signage, transport documents and exceeding the contamination thresholds).

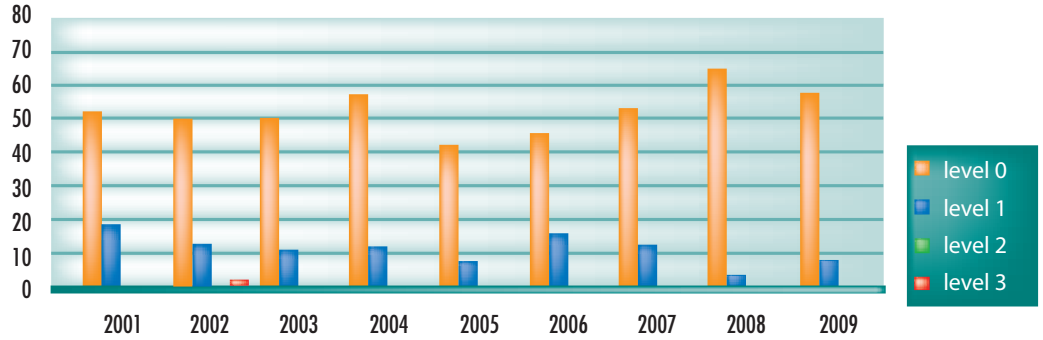
In 2009, 76 incidents were rated at level 0, and 7 at level 1. The following graph shows the trends since 2001.

The medical, conventional industry and research sectors are the origin of about 46% of the transport-related events. However, this number must be treated with precaution. It is in fact striking that most of the deviations notified to ASN in the medical, conventional industry or research sectors are events which cannot be hidden, such as package damage, theft or loss, or even road accidents.

Graph 5: changes in the number of radioactive material transport incidents or accidents notified between 2001 and 2009



Graph 6: trends in the number of events rated on the INES scale since 2001



Sea transport incident of 3 July 2009

On Friday 3 July 2009, ASN was notified by AREVA/TN International of a transport event that had occurred in Danish waters. The accident took place before 3 pm between a container ship (the KAPITAN LUSS) and a ship carrying methanol (the SUNDSTRAUM). The event occurred near the Danish coast, about 5 nautical miles outside the port of Copenhagen.

The "KAPITAN LUSS" was carrying 9 ISO containers (industrial containers requiring no ASN approval) of natural uranium, amounting to 129 tons of uranium. On behalf of AREVA, this ship carries mining concentrates from the KATCO mine in Kazakhstan and intended for processing by COMURHEX Malvési (conversion) via the port of Le Havre.

The accident caused a leak on the container ship, although with no consequences for the cargo. The leak was stopped and the two ships involved were separated and immobilised. The compartment affected by the collision was not that containing the uranium package. The cargo was not therefore damaged.

All the operations were carried out under the control of the Danish maritime authorities, in liaison with the shipping company.

As this shipment came from abroad and had no impact on package safety, this event was not rated on the INES scale by ASN.

Aerial view of the Kapitan Luss after the collision

However, those which concern breaches 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 doubt due to failure to submit notifications by the professionals in the small-scale nuclear activities.

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

4|1 Package handling events

Events during package handling are considered to be transport-related incidents. In the eyes of the regulations, handling is part of transport because transport

Damage to a package containing medical radioactive iodine

On Tuesday 17 June 2009, ASN was informed by the IBA company of an incident that had occurred during air transport of a package containing medical iodine 131. A box loaded with radioactive material was found damaged at Roissy airport. The box had probably been crushed by a handling vehicle.

The package shipped by the IBA company contained a flask of iodine 131. The radioactive material was in liquid form, surrounded by a sponge and placed in a metal can with a crimped lid. This can was placed inside a cardboard box and held in place by cardboard and polystyrene packing.

The flask was undamaged but the lid on the metal can was slightly deformed, such that material containment could no longer be guaranteed.

The radiation protection measurements taken on contact with the package and at one metre from it, revealed no contamination or radiation leak.

Together with ASN, Air France took steps to ensure that such an event could not happen again: reminder of radioactive package transport rules for the handling company staff, improved distribution of greater numbers of "yellow crates" for the transport of radioactive packages. These crates are specially designed for use by handling equipment and the radioactive packages must be firmly secured inside them. They had already been deployed by Air France to facilitate handling of this type of package and prevent them falling.

Owing to the damaged containment of a radioactive material transport package, ASN rated this event level 1 on the INES scale.

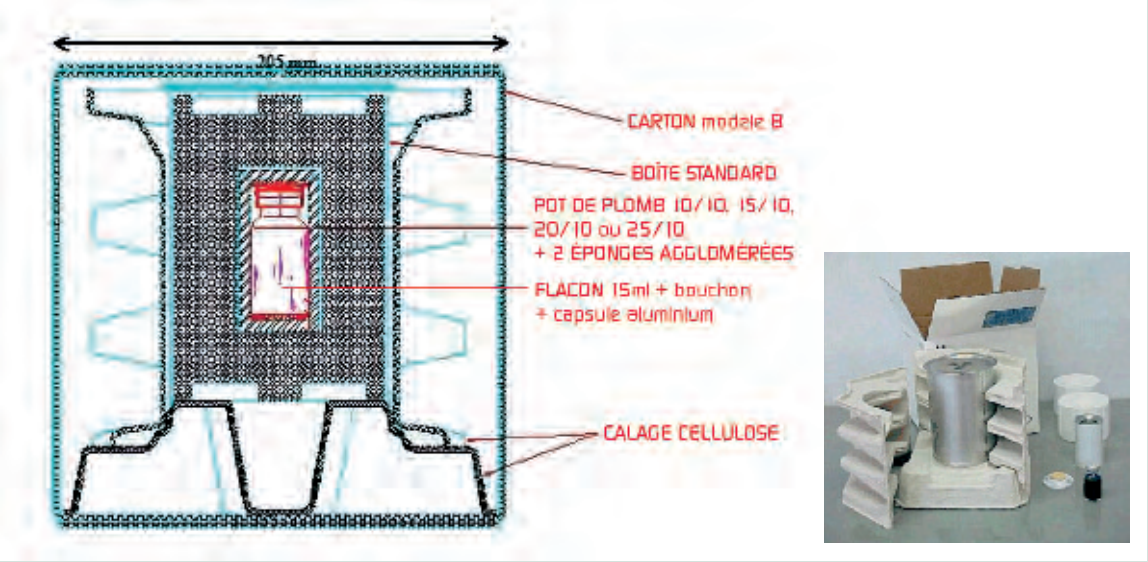


Illustration of the package involved in the incident of 17 June 2009

encompasses 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 shipments of radioactive materials.

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

Events in airports

The events that occur in airports are generally radioactive material package handling incidents.

In 2009, 18 incidents of this type were identified at Roissy-Charles-de-Gaulle, Orly and Marignane (Marseille) airports. These incidents concerned type 1 or excepted

Transport of non-leaktight rods between the EDF NPPs and La Hague

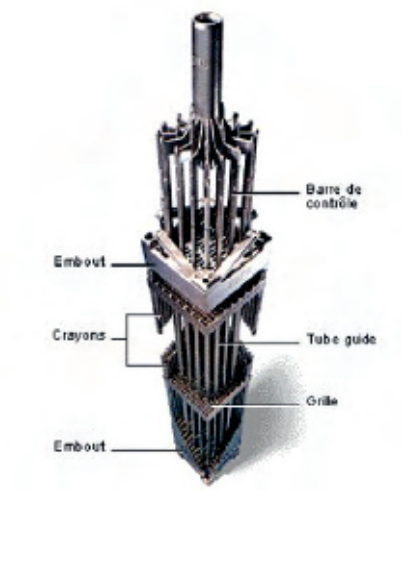
On 31 March 2009, ASN decided to revise the six approval certificates for spent fuel transport containers TN 12/2, TN 13/2, TN 17/2 and TN 106.

These packages are loaded under water. The load power and maximum transport time are set in the approval certificates in order to minimise the consequences of radiolysis and thus the production of hydrogen under the effect of radiation.

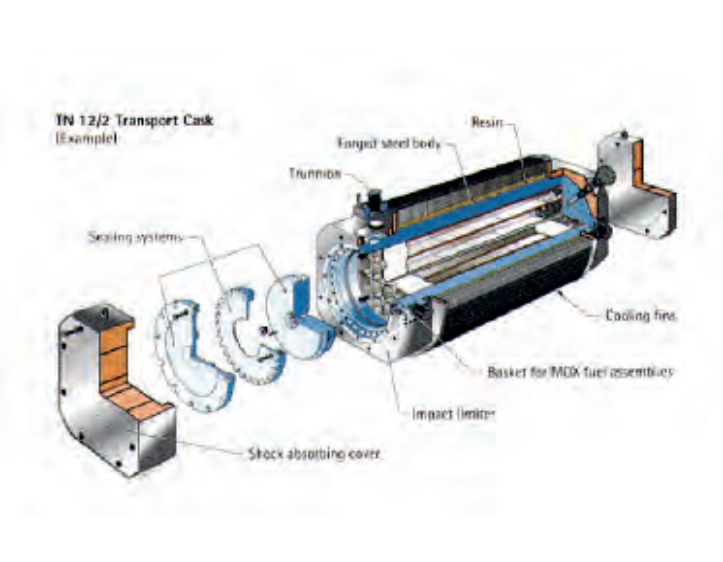
These containers are likely to transport fuel rods with cracks and which are therefore referred to as "non-leaktight". On 23 January 2009 and 6 March 2009, the TN International company submitted additional analyses performed at the request of ASN, revealing hydrogen levels far higher than those anticipated in the safety cases, owing to the presence of these cracks.

To guarantee transport safety, ASN revised the six approval certificates concerned by this problem and now requires systematic hydrogen level measurements before shipment, to determine the maximum duration of each transport operation and guarantee that the hydrogen flammability threshold is not exceeded. The risk created by exceeding the hydrogen flammability threshold is linked to overheating of the gases in the cavity after ignition. This can even lead to an explosion.

The countries through which these shipments pass were informed of this approval modification. Owing to the potential consequences for radioactive material transport packages, ASN rated this event level 1 on the INES scale.



Fuel assembly comprising rods



Cross-section of a spent fuel transport package

packages, which were damaged to varying extents. There was a slight loss of containment in one case, although with no contamination.

In addition, a type A package was lost in 2009. It contained Iodine 131 intended for medical uses and did not reach its destination. It left Charles de Gaulle airport for Istanbul with a stopover in Leipzig (Germany). Its trace was lost at Leipzig airport. This significant event was rated level 1 on the INES Transport scale.

Jointly with the DGAC and the air transport police, ASN carried out a number of air cargo inspections. The carriers were reminded of the need to implement a radiation protection programme appropriate to the transport activities, to correctly secure the packages and 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 type of event, ASN particularly closely examines 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 contamination of spent fuel packages. There are usually no consequences for the workers, the public or the environment as a result of these events, however ASN examines them meticulously given that they can affect the public. About 80% of incidents in this category concern packages that do not require approval (25 of the 31 incidents). Most contamination incidents therefore no longer concern spent fuel shipments, as at the end of the 1990s, but rather non-approved packages.

4 | 4 Transport infrastructures hazard studies

ASN and IRSN were asked to take part in a working group set up by the MEEDDM for the purpose of producing a guide to hazard studies in transport infrastructures. The aim is on the one hand to harmonise the content of the studies and on the other to help managers of this type of infrastructure with carrying out the studies. The managers of the larger infrastructures are required by decree 2007-700 of 3 May 2007 to submit a hazard study concerning their installation to the *préfet** of the *département*** not later than in May 2010.

ASN made an undertaking to 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 production of hazard studies 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 inadvisable. The hazardousness of radioactive materials differs from that of other materials in their stochastic effects. ASN thus proposed a single threshold of 50 mSv, equivalent to the irreversible effects threshold (IET). This threshold is consistent with the thresholds used in the PUI (health thresholds) and with the transport regulations. Finally, it enables account to be taken of the stochastic effects.

4 | 5 "Radioactive Material Transport" emergency plan (PU-TMR)

In 2008, jointly with ASND, ASN decided to organise a working group to define and harmonise 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 consignor's response, jointly with the other parties concerned (carriers, shipping agents, designers, etc.). The plan produced by this working group will be issued for application in national radioactive material transport operations using packages approved by the competent authority (ASN or ASND).

*In a *département*, representative of the State appointed by the President.

**Administrative region headed by a *préfet*.

5 INTERNATIONAL ACTION

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. These regulations were drafted and are implemented as a result of fruitful exchanges between 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 relevant meetings from 29 June to 3 July and from 3 to 9 October 2009 in Vienna.

During these meetings, ASN successfully took a stance against plans to modify the regulations, involving the adoption of surface contamination limits that were different for each radioisotope.

Working groups will be set up in 2010 in preparation for the forthcoming revision of the radioactive material transport regulations (future 2012/2013 edition). The areas covered will include fissile exceptions, acceleration levels to be considered when securing packages, transitional measures and relaxation of the type C package tests.

Creation of a club of European authorities with competence for 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 will work towards more harmonious implementation of the regulations concerning radioactive materials and exchange operating experience feedback with the various member countries. ASN took part in the first and second plenary meetings, which were held in London in December 2008 and then in Berlin in September 2009, respectively. The first subjects discussed by the countries were radiation protection of transport workers, including with regard to the shipping of radiopharmaceuticals, packages not approved by the competent authorities and changes to the regulations.

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 experiences.

Since 2005, an annual exchange meeting is held by ASN and AFCN, in order to take a closer look at the safety cases for the French package models validated in Belgium. The meeting of 14 May 2009 reviewed the various package models used in France and Belgium. A joint inspection was carried out on 27 November 2009 in the Ateliers de La Meuse following a series of manufacturing defects found on the TN24 family of packaging containers.

United Kingdom

France and the United Kingdom use radioactive materials for similar civil applications, such as the nuclear generation of electricity, reprocessing and use of radioactive substances for medical purposes. The two regulators therefore 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 International Atomic Energy Agency, demonstrating the high level of competence of the two authorities with regard to radioactive material transport, thus enhancing their mutual trust and confidence.

Against this backdrop, ASN signed a memorandum of understanding on 24 February 2006, for the mutual recognition of the approval certificates confirming the safety of radioactive material transport. The approval certificates issued by the United Kingdom's competent authority (DfT, Department for Transport) in accordance with the applicable rules are recognised by ASN, 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. This arrangement also increases the level of competence through sharing of know-how and experience.

Having successfully cooperated on the Memorandum of Understanding signed in February 2006, ASN and the DfT extended their cooperation on the following subjects, through an agreement concluded on 27 February 2008:

– licensing procedures;
– inspections;
– emergency procedures;
– guides for domestic and international transport of radioactive materials;

– radioactive material transport standards;
– quality assurance systems.

Since 2008, two discussion meetings are organised annually between ASN and the DfT, to enable them to work more closely together, in particular on reviewing the safety cases for the package models used in Great Britain and France. A discussion meeting was held in February 2009.

Germany

The French and German authorities have decided to meet regularly to discuss certain technical matters and there is indeed no shortage of subjects of common interest because many 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. Two discussion meetings were held in July and September 2009.

United States

Recently, on the occasion of a symposium at the International Conference On Nuclear Engineering, Mr Klein, a Commissioner from the American nuclear regulator (NRC), stated that in his opinion, the transport sector should follow the example of international technical cooperation on reactors. Subsequently, the American authorities (NRC and US Department of Transportation DOT) contacted ASN in order to set up collaboration on subjects of common interest. This also involves examining whether it would eventually be possible to draft MoUs for mutual recognition of approval certificates. A first meeting on this subject is scheduled for early 2010.

6 OUTLOOK

As in 2009, ASN will in 2010 be continuing its inspections at the designers, manufacturers, users, carriers and consignors of radioactive material packages.

The inspections carried out in 2008 and 2009 show that progress has been made, including in the drafting of the radiation protection programmes that have been mandatory since 2001, but that there is still room for improvement. In particular for packages that do not require approval by the competent authority, ASN considers the situation to be unsatisfactory. Whether through regulations conformity demonstrations or checks prior to shipment, the inspections brought a large number of shortcomings to light. This situation is all the more worrying as these packages are the source of a large percentage of the incidents that occurred in 2009.

Consequently, ASN will continue to monitor non-approved packages, 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 therefore continue to carry out reconnaissance to gain a clearer picture of the situation.

As in previous years, ASN will in 2010 continue to test its response organisation designed to deal with an accident involving a transport of radioactive materials. It considers that emergency exercises in the transport field are of particular importance. Given that an accident can take place anywhere, especially in those départements in which there are no basic nuclear installations, the local stakeholders are liable to be inadequately prepared to deal with such an event. These national exercises, in association with local exercises, make a contribution to training and educating the protagonists. In 2010, 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 do this, it will in the next two years be producing supplements to the regulations applicable to nuclear installations on this point.

Finally, 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 will also be aiming to give an increasingly international dimension to its action. ASN intends to intervene as far upstream as possible in the drafting of IAEA's recommendations. As, by their very nature, the regulations concerning the transport of radioactive materials are the subject of international exchanges, harmonised interpretation must be a major objective for ASN. This was the reason for the MoU for mutual recognition of the certificates issued by each of the authorities, signed with the British authority in February 2006, which was extended in 2008. A similar approach could be adopted in the next few years with the German and American authorities.