TRANSPORT OF RADIOACTIVE MATERIALS

CHAPTER 11

The transport of radioactive materials is a specific sector of dangerous goods transport. It involves transporting materials with specific hazardous properties due to their radioactivity, and whose safety must be ensured.

The scope of regulation of the safety of radioactive material transport covers many sectors: Industrial medical and research sector. It is based on stringent and restrictive international regulations.

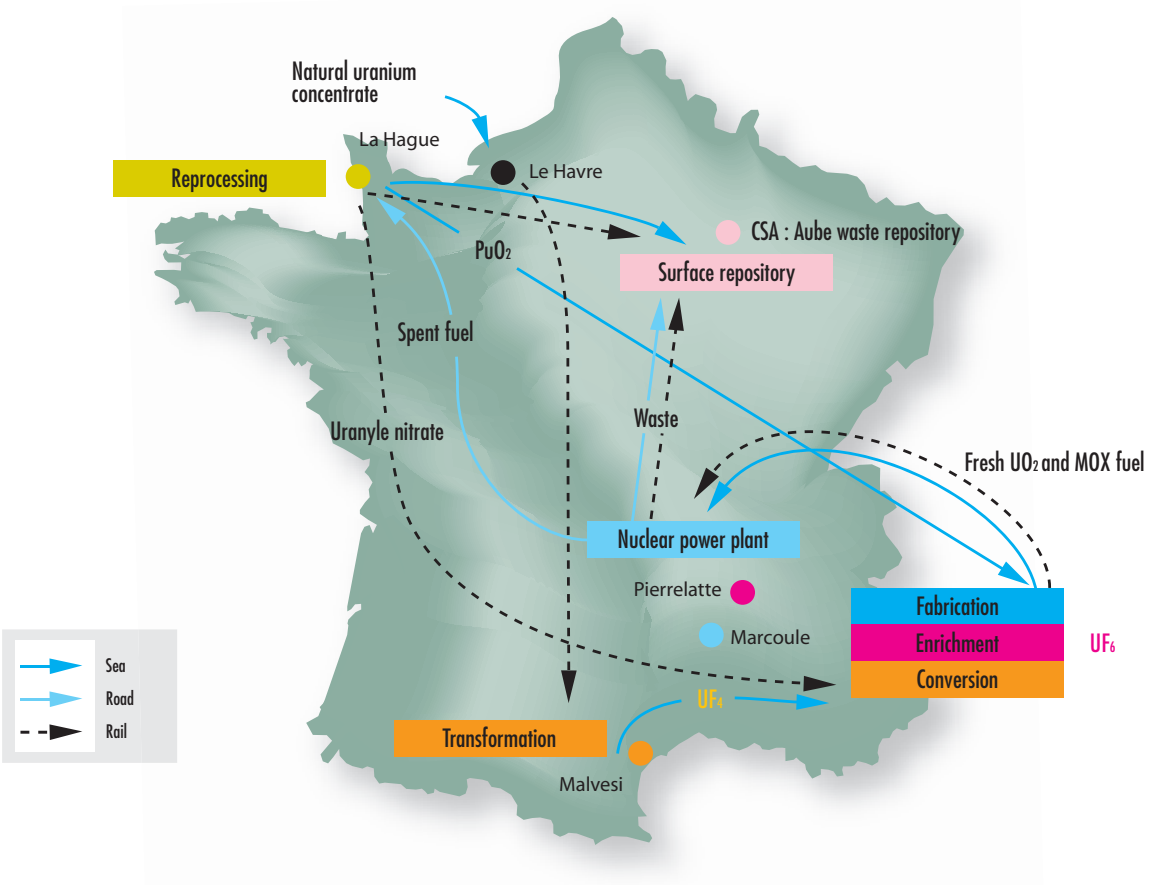
1 MOVEMENTS AND RISKS IN THE TRANSPORT SECTOR

1|1 The diversity of radioactive material[1] transport movements

Fifteen million dangerous goods packages are transported each year in France. The regulations place these packages in different risk classes. Class 1, for example, corresponds to explosive materials and objects, class 3 to flammable liquids, and class 6 to toxic and infectious materials. Class 7 corresponds to hazardous radioactive material. About 900,000 packages of radioactive materials are transported each year, which represents just a small percentage of the total number of dangerous goods packages transported each year in France.

The nuclear industry only represents about 15% of the annual transport movements of radioactive materials: 85% of the transported packages are intended for the medical, non-nuclear industries or research sectors, referred to as small-scale nuclear activities, of which about 30% is accounted for by the medical sector alone.

Transport operations relating to the fuel cycle in France



1. The statistical data provided in this chapter are taken from data collected in 2002. A new study is scheduled for 2012 to update these data.

Table 1 : breakdown of shipments by mode of transport

Approximate number of packages and shipments		Rail	Sea	Sea and rail	Road	Road and air	Road and rail	Road and sea	Total (approx.)
Packages approved by ASN	Number of packages	20		50	90,000	150	130	1,000	90,000
	Number of shipments	20		415	58,000	70	110	20	60,000
Packages not requiring approval by ASN	Number of packages	3,900	20	21,300	760,000	45,000	1,400	14,200	850,000
	Number of shipments	30	20	100	542,000	14,000	460	280	560,000
Approximate number of packages		3,920	20	21,350	850,000	45,150	1,530	15,200	900,000
Approximate number of shipments		50	20	515	600,000	14,070	570	300	600,000

The fuel cycle necessitates an estimated annual total of 11,000 shipments involving 141,000 packages. These include approximately:
– 1,000 shipments from or to foreign countries or transiting via France, representing about 50,000 packages;
– 300 shipments of new uranium-based fuel and some 30 shipments of new uranium and plutonium-based "MOX" fuel;
– 200 shipments transporting spent fuel from the nuclear power plants operated by EDF to the La Hague reprocessing plant operated by AREVA;
– about 60 shipments of plutonium in oxide form transported from the La Hague reprocessing plant to the MELOX fuel production plant in the Gard *département*[2];
– 250 shipments of uranium hexafluoride necessary for the fuel manufacturing cycle.

The field of nuclear industry research, which essentially concerns the CEA, accounts for a little less than 3,000 shipments per year transporting about 8,000 packages.

1|2 Risks associated with the transport of radioactive materials

The content of the packages varies greatly: their radioactivity varies over more than twelve orders of size, that is to say from a few thousand becquerels for low-activity pharmaceutical packages, to trillions of becquerels for irradiated fuel. Their weight also varies from a few kilogrammes to about a hundred tonnes.

The major risks involved in the transport of radioactive materials are:
– the risk of external irradiation of persons in the event of damage to the "biological protection" of the packages, a technical material that reduces the radiation received through contact with the package;
– the risk of inhalation or ingestion of radioactive particles in the event of release of radioactive materials;
– contamination of the environment in the event of release of radioactive materials;
– the starting of an uncontrolled nuclear chain reaction ("criticality safety" risk) that can cause serious irradiation of persons if water is present and the safety of fissile radioactive materials is not controlled.

Moreover, the radioactive materials can also be toxic and corrosive. This, for example, is the case with shipments of natural uranium with low radioactivity, for which the major risk for man is the chemical risk if it is ingested. Similary, uranium hexafluoride (UF_6), used in the manufacture of fuels for nuclear power plants can, in the case of release and contact with water, form hydrofluoric acid, a powerful corrosive and decalcifying agent.

Catering for these risks implies having full control over the behaviour of the packages to avoid any release of material and deterioration in the package protection in the event of:
– fire;
– physical impact further to a transport accident;
– ingress of water into the packaging, as water facilitates chain nuclear reactions in the presence of fissile materials;
– chemical interaction between the various constituents of the package;
– substantial release of heat from the transported materials, to avoid possible heat damage to the package constituent materials.

This approach means that safety principles must be defined for the transport of radioactive materials:
– safety is based first and foremost on the package: regulatory tests and safety demonstrations are required by the regulations to prove that the packages can withstand reference accidents;
– the required level, particularly with regard to the reference accidents that the package must withstand, depends on the level of risk presented by the package.

2. Administrative region headed by a *préfet*.

2 REGULATION DUTIES AND RESPONSIBILITIES IN THE TRANSPORT OF RADIOACTIVE MATERIALS

2|1 Regulation of nuclear safety and radiation protection

The objective of ensuring the safety of shipments of radioactive materials is to prevent nuclear accidents and their radiological consequences for people, by implementing organisational and technical measures.

In France, ASN has been responsible since 1997 for regulating the safety of transport of shipments for civil uses, while ASND (the defence nuclear safety authority) fulfils this role for the shipments relating to national defence. ASN's action in the field of transport comprises:
– hecking, from the safety aspect, all the stages in the life of a package, from design and manufacture through to maintenance;
– checking compliance with the safety regulations during the shipment and transportation of the packages.

Section 4 of this chapter gives more details on these inspections.

2|2 Protection against malicious acts

The prevention of malicious acts consists in preventing sabotage, losses, disappearances, theft and misappropriation of nuclear materials that could be used to manufacture weapons. In the regulatory framework, the defence and security high officials (HFDS), under the ministers responsible for energy and defence, are the Authority responsible for preventing malicious acts targeting nuclear materials. In practice, it is the HFDS of the ministry in charge of ecology who is delegated this role by the two abovementioned HFDS's.

2|3 Regulation of the other classes of dangerous goods

Regulation of the transport of dangerous goods is monitored by the MTMD (hazardous materials transport mission) of the ministry in charge of ecology and transport. This entity is tasked with ensuring the measures relative to the security of transport of dangerous goods other than class 7 (radioactive) by road, rail and inland waterways. It has a consultative body (CITMD – Interministerial hazardous materials transport committee) that is consulted for its opinion on any draft regulations relative to the transport of dangerous goods by rail, road or inland waterway.

Inspections on the ground are ensured by land transport inspectors attached to the DREALs (Regional directorates for the environment, planning and housing).

For the regulation action to be as consistent as possible, ASN collaborates regularly with the administrations responsible for applying the regulations in their particular sector of activity. The breakdown of ASN's various missions is summarized in the table below.

Table 2: 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 (MEDDTL). 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).	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 (MEDDTL).	The General Directorate for Risk Prevention (DGPR) is responsible for regulating packages of dangerous 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 (MEDDTL).	The DGAC is competent to regulate packages of dangerous goods in general and in close coordination with ASN for packages of radioactive materials.

3 DEVELOPMENT OF THE INTERNATIONAL AND EUROPEAN REGULATIONS RELATIVE TO THE TRANSPORT OF RADIOACTIVE MATERIALS

The international nature of radioactive material transport has given rise to regulations, drafted under the supervision of IAEA (International Atomic Energy Agency), that ensure a high level of safety.

3|1 The different types of package

The degree of safety of the packages of radioactive materials is adapted to the potential danger of the material transported. There are five broad types of packages: excepted packages, industrial packages, type A packages, type B packages and type C packages. These package types are determined according to the characteristics of the transported material, such as the total radiological activity, the specific activity - which corresponds to the level of concentration of the material, its physical-chemical form or the possible presence of fissile radioactive materials that could cause a nuclear chain reaction.

3|1|1 Excepted packages

Excepted packages are used to transport very small quantities of radioactive materials, such as very low activity radiopharmaceuticals. These packages are not subject to any qualification tests. They must nevertheless comply with a number of general specifications, notably with regard to radiation protection, to guarantee that the radiation around the excepted packages remains very low.

3|1|2 Non-fissile industrial or type A packages

Industrial packages are used to transport material with low radioactivity per unit mass. Uranium-containing materials extracted from foreign uranium mines are, for example, transported in France in industrial drums with a capacity of 200 litres loaded into 20-foot containers or conventional rail wagons.

Type A packages are used to transport radioactive materials with low total activity. Type A packages can, for example, be used to transport radioisotopes for medical purposes commonly used in nuclear medicine departments, such as technetium generators.

3|1|3 Fissile and type B packages

Type B packages allow the transport of large quantities of some of the most radioactive materials such as spent fuels, vitrified high-activity long-lived nuclear waste and fresh fuels. Given the level of risk associated with these packages, they are subject to an approval delivered by ASN based on the examination of a safety file. Approximately 60,000 type B packages are transported each year in France, essentially for the nuclear industry and for industrial technical controls, including industrial radiology.

Type A packages and industrial packages containing fissile radioactive materials are also subject to ASN approval.

3|1|4 Type C packages

Type C packages are designed for transporting highly radioactive materials by air. In France there is no approval for type C packages for civil uses.

3|2 Requirements applicable to each type of package

The regulations define safety requirements for each type of package, including tests to assess their robustness.

The regulations thus require that type A packages that contain no fissile materials (such as enriched uranium), be designed to withstand incidents that can occur during handling or storage operations. They must therefore be subjected to the following tests:
– exposure to a severe storm (rainfall reaching 5 cm/hour for at least 1 hour);
– drop test onto an unyielding surface from a height varying according to the mass 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.

Additional tests are required if the content of the package is in liquid or gaseous form.

Type A packages are not subject to ASN approval: the package design and performance of the tests are the responsibility of the manufacturer. These packages and their safety demonstration files are inspected by the ASN inspectors.

Type B packages, which are used to transport the most dangerous materials, must be designed such that safety is guaranteed, including in the event of transport accident. These accidents are represented by the following tests:
– 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 15 m deep water for 8 h (200 m water depth for spent fuel).

These tests, which are comparable with automotive industry “crash tests”, have been recommended by the International Atomic Energy Agency (IAEA). They have been designed, firstly to cover 95% of the most severe accidents, and secondly with the aim of being readily reproducible from one country to another. These tests are thus recognized and applied very widely by the IAEA member countries. Their performance is obligatory within the European Union.

Drop test of a packaging intended for the transport of spent fuel

Packaging mock-up undergoing a fire test

3|3 Defining responsibilities in the transport of radioactive materials

The 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. The carrier is responsible for carriage of the shipment to its destination. 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 satisfactory conditions of safety, a stringent chain of responsibility has to be set up. So, for major transport operations:

– the corresponding packaging must be designed and sized in accordance with conditions of use and the current regulations. The designer must have lodged an ASN-approval application and obtained it;
– the manufacturer must produce packaging in accordance with the description given in the approval;
– the consigner must check that the material is authorised for transport and only use approved, correctly maintained packagings that are suitable for the goods in question, and comply with requirements concerning the mode of transport and the shipment restrictions. The consignor must more particularly carry out the inspections of leak-tightness, dose rate, temperature, contamination, and mark and label the packages. It must also provide the carrier with all the required documents and information;
– the actual transport is organised by the carriage commission agent. The carriage commission agent is responsible for obtaining all the necessary authorisations on behalf of the consignor, and for sending the various notices. He also selects the means of transport, the carrier and the itinerary, in compliance with the regulatory requirements;
– the carrier, usually a specialised company with the necessary authorisations, appropriate vehicles and duly trained drivers, must verify the completeness and availability of the information provided by the consigner, and the good overall condition and correct labelling of the vehicles and packages. It must also verify that the materials to be transported are authorised for transport;
– the consignee, for its part, is under the obligation not to postpone, without vital reason, acceptance of the goods and to verify, after unloading, that the requirements of the corresponding ADR have been satisfied;
– finally, the container owner must set up a maintenance system in conformity with that described in the safety documents and the authorisation certificate.

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. 1,426 notifications were sent to ASN in 2011.

3|4 Monitoring radiation protection around shipments of radioactive materials

The radiation protection of workers and the public around shipments of radioactive materials must be a constant concern.

The general regulations relative to radiation protection provided for by the public health code and by the labour code also apply to the transport of radioactive materials as a nuclear activity in its own right: the public and non-specialised workers must not be exposed to a dose exceeding 1 millisievert (mSv) per year. However, this limit is not intended to be an authorisation to expose the public to up to 1 millisievert (mSv): the regulations provide that any exposure, even low, must be both justified and optimised. These principles, applicable to any nuclear activity, apply particularly to the transport of radioactive materials.

Radiation protection forms the subject of specific requirements in the regulations applicable to the transport of radioactive materials. Thus, for transport by road, the regulations[3] stipulate that the radiation at the surface of the package must not exceed 2 mSv/h (this limit can be increased to 10 mSv/h in the case of exclusive use, where actions near the package are limited). The radiation at the surface of the vehicle must not exceed 2 mSv/h, and must be less than 0.1 mSv/h at a distance of 2 metres from the vehicle. In the case of exclusive use, these limits can be increased to 10 mSv/h on contact with the vehicles, on condition that the vehicle is equipped with an enclosure preventing the access of unauthorised persons, and that operations near the package are restricted (loading and unloading operations between the start and end of shipment are prohibited).

Assuming that a transport vehicle reaches the limit of 0.1 mSv/h at 2 metres, a person would have to spend 10 hours without interruption at a distance of 2 metres from the vehicle for the radiation dose received to reach the annual public exposure limit.

These limits are supplemented by requirements relative to the organisation of radiation protection within companies. The transport stakeholders must establish a radiological protection programme that integrates the measures taken to optimise human exposure. Training is a key factor in the radiological protection programmes.

This training is also required by the regulations. All the stakeholders in the transport chain must thus be trained and made aware of the nature of the risks associated with radiation so that they can protect themselves and others against them.

3|5 Regulation of the safety of transport operations within the bounds of nuclear facilities

Dangerous goods transport operations can take place on the private roads of nuclear sites, in what are referred to as "on-site transport operations". Such operations are not subject to the regulations governing the transport of dangerous goods, which only apply on public highways.

On-site radioactive material transport operations are currently governed on nuclear sites by "internal transport rules" specific to each site.

ASN thus plans reinforcing, in the framework of the "BNI" order published on 7 February 2012 (see chapter 3), the legal basis of these rule by demanding their integration in the baseline safety standard of the basic nuclear installations. The on-site transport of dangerous goods presents the same risks and inconveniences as the transport of dangerous goods on the public highway. The safety of transport must be overseen with the same rigour as for any other risk or inconvenience present within the bounds of the BNI.

3|6 Public information in the field of transport

Order no.2012-6 of 5 January 2012 which codifies Act no.2006-686 of 13 June 2006 relative to the security and transparency in the nuclear field, extends the public information obligations to those in charge of nuclear activities. It is Article L. 125-10 that sets the threshold beyond which the person responsible for transport must communicate the information requested by a citizen, by reclassification of the provisions of decree 2011-1844 of 9 December 2011.

The thresholds are defined as being those *"above which, in application of the international conventions and regulations governing the transport of dangerous goods, of the code of transport and of the texts taken for their application, the transport of radioactive materials is subject to the delivery – by ASN or by a foreign Authority competent in the field of radioactive material transport – of an approval of the transport package design or a shipment approval, including under special arrangement"*. Any citizen can therefore now ask the persons in charge of transport for information on the risks presented by the transport operations referred to in the decree.

A person to whom a nuclear licensee or transport supervisor has refused to communicate information, can refer the matter to the CADA (Committee of access to administrative documents), instituted by Article 20 of the Act of 1978, for its opinion. The matter must be referred to the CADA prior to any legal action. Disputes relative to communication refusals can then be brought before the administrative jurisdictions, even if they are between two private individuals.

2. ADR: European Agreement concerning the International Carriage of Dangerous Goods by Road, concluded in Geneva on 30 September 1957, including the amendments in force on 1 January 2011.

4 ASN ACTION IN THE TRANSPORT OF RADIOACTIVE MATERIALS

4|1 Delivery of approval certificates and shipment approvals

To verify that type B packages and packages containing fissile materials satisfy all the regulatory requirements, ASN calls upon the IRSN (Institute of Radiation Protection and Nuclear Safety) to appraise the file demonstrating the safety of the package provided by the manufacturer. ASN takes the decision to deliver an approval certificate on the basis of this technical examination, possibly combined with requests for further information to be brought to the safety file before the next approval renewal deadline.

In some cases the IRSN appraisal is supplemented by a meeting of the Advisory committee of experts in the transport of radioactive materials (GPT). The opinions of the Advisory committees are always published on the ASN website. The GPT, for example, met twice in 2011 to examine new package concepts (TN833 and TN843 designed by the company TN International).

These approval certificates are usually issued for a period of a few years. At present, about a hundred approval applications per year are lodged with ASN by the manufacturers. The approval certificate specifies the package manufacturing, operating and maintenance conditions.

The approval certificate is often issued for a package design 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).

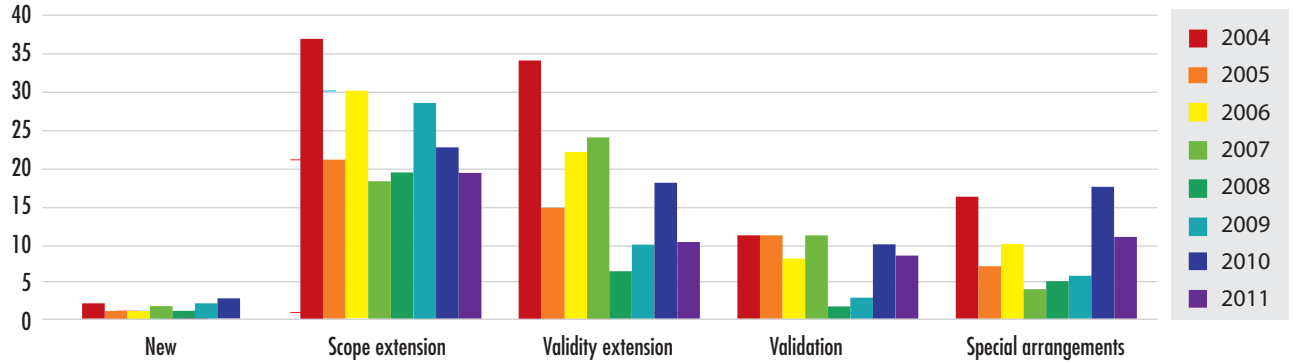
When the conditions required by the regulations for the consignment of radioactive materials with regard to the content, the package design or its shipment are not satisfied in full, the shipment can exceptionally be approved under special arrangement. The application must demonstrate at least equivalent conditions of safety in transport to compensate for the noncompliance with certain "standard" requirements.

In the case of certificates issued abroad, the international regulations provide for their recognition (validation). Validation can be indicated by endorsement on the original certificate or by the delivery of a separate approval by the competent Authority of the country in which shipment takes place.

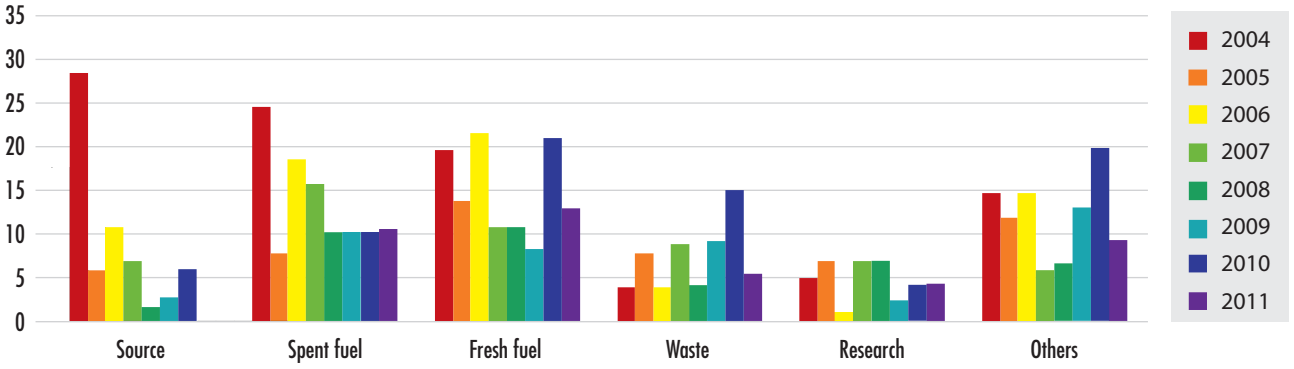
ASN delivered 50 approval certificates in 2011, for which the breakdown by type is shown in graph 1.

The breakdown and nature of the transport operations concerned by these certificates in 2011 are shown in graph 2.

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



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



Finally, in May 2009, ASN published an applicant's guide for approval of shipments and package designs 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 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 design 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. An update of this guide is planned for the beginning of 2012.

4|2 Monitoring all the stages in the life of a package and its shipment conditions

4|2|1 Packaging manufacturing inspections

The manufacture of transport packaging is subject to the regulations for the transport of radioactive materials. In accordance with the regulatory requirements, each manufacturer of an approved package design must be able to provide ASN with all the elements for ensuring the conformity of packaging manufacture with the package design specifications approved by ASN. These specifications are defined in the safety file specific to each packaging, which represents the demonstration of safety for the package design. The safety file sets the objectives in terms of packaging design. It contains all the elements relative firstly to the requirements concerning the packaging and its content, and secondly to the tests that can be required to demonstrate the safety of the package design.

The role of ASN is to check that the manufacturing specifications and the inspection procedures match up to the design requirements defined in the safety file.

The quality assurance system is applied and conformity with the safety file specifications is ensured in all the operations from procurement through to final inspection.

ASN inspected the manufacture of three package designs in 2011:

– CTB: used for the transport of sources,
– TN 112 : used for the transport of spent fuel,
– 30B cylinders: used with an overpack for the transport of uranium hexafluoride.

The follow-up letters to these inspections are available on the ASN web site.

During these inspections, ASN checks the quality assurance system implemented for the production of a package from the design data, and for tracing in-process inspections and any deviations.

It also visits the manufacturing shops to check the package component storage conditions and the conformity of the various manufacturing operations (welding, assembly, etc.).

ASN inspects the in-process inspection of a 30B cylinder on 28 July 2011 (Socorom site in Romania)

Thermal test on a transport packaging

When subcontractors are used, ASN checks the monitoring of manufacturing by the manufacturer in charge and intervenes directly on the manufacturing sites, which are sometimes located in foreign countries. Thus, for the inspection of the manufacture of the 30B cylinders, ASN inspected a production factory in Romania.

In parallel with these package manufacturing inspections, ASN inspects the manufacture of the specimens used for the regulatory drop tests and fire tests. The objectives are the same as for the series production model, because the specimens must be representative and comply with the minimum requirements indicated in the mock-up manufacturing file, which will determine the minimum characteristics of the actual packaging to be manufactured.

ASN thus inspected the manufacture of two specimens in 2011:
– Marianne: used for the transport of irradiated targets,
– DN30: overpack for the transport of 30B cylinders filled with uranium hexafluoride.

4|2|2 Type B package maintenance inspections

The consigner or user of a package filled with radioactive material must be ready to prove to ASN that this package is periodically inspected and, if necessary, repaired and maintained in good condition such that it continues to satisfy all the relevant requirements and specifications of its safety file and approval certificate, even after repeated use. For type B packages, the ASN inspections concern the following maintenance activities, for example:
– the periodic inspections of the components of the containment envelope (screws, bolts, welds, seals, etc.) ;
– the periodic inspections of the securing and handling components;
– the frequency of replacement of the package components which must take account of any reduction in performance due to wear, corrosion, aging, etc.

In 2011, ASN carried out three targeted inspections on the maintenance of gamma ray projectors, the maintenance of packages intended for the transport of fuel and waste from research activities, and the maintenance of the cylinders intended for the transport of uranium hexafluoride. This latter inspection was carried out further to three events concerning the package closing system.

4|2|3 Oversight of packages not requiring approval

For the packages that do not require ASN approval (see chapter 3), the consigner must be able, at the request of ASN, to provide the documents proving that the package design complies with the applicable requirements. A certificate attesting full compliance with the design specifications for each package must be held at the disposal of ASN.

The various inspections performed reveal that these elements are often unavailable or incomplete on the sites of the entities concerned (designer, manufacturer, distributor, owner, consigner, companies performing the regulatory drop tests, package maintenance, etc.). The areas for improvement concern the following points in particular:
– the description of the authorised contents per type of package;
– demonstration that there has been no loss or dispersion of the radioactive content under normal transport conditions;

UNDERSTAND

Feedback from reactive inspection of the UX-30 packaging on 20 April 2011

The UX-30 overpack is an American designed packaging for the transport of uranium hexafluoride contained in a 30B cylinder.

It is made up of two half-shells joined together by a ball-lock closing system.

Further to the notification of three events involving disengagement of the ball-locks, ASN conducted a UX-30 shell maintenance inspection. It visited a packaging maintenance workshop belonging to the AREVA group to verify the conditions of performance of the maintenance operations and the conformity of the shop procedures with the maintenance manual provided in the safety file of the UX-30 overpack. ASN also visited two consignors to check how the periodicity of maintenance is managed.

These inspections and the three incidents revealed deficiencies in AREVA's organisation with regard to:
– *the tracking of changes in the requirements of the UX-30 safety file;*
– *management of event notifications between the different entities of the group;*
– *management of maintenance dates of packagings currently in carriage;*
– *taking incidents into account in the maintenance operations.*

Further to these findings, ASN asked the AREVA group to implement a plan of action. ASN is currently assessing the results on site.

ASN inspection prior to maritime shipment of empty packagings for the transport of radioactive waste – Port of Cherbourg 2011

– compliance with the regulatory radiation protection requirements;
– the representativeness of the tests performed.

ASN's website (*www.asn.fr*) thus provides a guide to the structure and minimum content of the safety files to demonstrate that packages not subject to approval do comply with all applicable requirements, and indicating the minimum content of a certificate attesting conformity of package design with the regulations.

4|2|4 Oversight of the shipment of packages of radioactive materials

ASN devotes more than half of its transport inspections to the checking of shipments and carriers, at both regional and national level.

During these inspections, the checks concern all the regulatory requirements incumbent upon each stakeholder in the transport process, grouped around two topics: the organisation of the company and the procedures or measures implemented to verify conformity of the transport process with the regulations.

In 2011, ASN carried out 100 inspections in radioactive material transport (all sectors considered).

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

ASN's inspections reveal deficiencies in the knowledge of the regulations and responsibilities on the part of the transport stakeholders in small-scale nuclear activities. To remedy this shortcoming, ASN organised information seminars in 2010 and 2011. Control of subcontracting is a constant difficulty, insofar as the consignors tend too often to rely on the carrier, whereas the main responsibilities in the transport operation are those of the consignor.

4|2|5 Analysis of the incidents

By listing and analysing the various transport incidents, ASN can identify the problems faced by the transport operators and the possible safety risks, in order to improve current practices and identify any needs for changes in the regulations.

Any deviation from the regulations or the safety files relative to the transport of radioactive materials must be notified to ASN in accordance with the events notification guide, as required by Article 7 of the TMD[3] order. This events notification guide was communicated by letter to the various stakeholders in the transport of radioactive materials on 24 October 2005 and can be consulted on the ASN web site (*www.asn.fr*). It defines the various conditions of notification and classification of transport events on the INES scale. Apart from the notification, a detailed incident report must be sent to ASN within two months.

Events declared in 2011

In 2011, 40 events rated level 0, and 3 events rated level 1 on the INES scale were notified to ASN in 2011. These figures are lower than for 2010. Graph 3 shows the trend for the number of events notified since 2001.

The drop in the number of events observed in 2011 can essentially be explained by a change in the recording of events concerning impacts on radiopharmaceutical packages in airports . To facilitate incident analysis, the corresponding notification criterion was adjusted so that only significant impacts that could affect the safety of the package are taken into account. Minor impacts having no consequences must now simply be traced, and no longer notified to ASN.

Areas of activity concerned by these events

More than half of the events are notified by the industrial stakeholders in the nuclear cycle (EDF and AREVA in particular). About 20% of the events concern the radioactive pharmaceutical products shipped by Cis Bio.

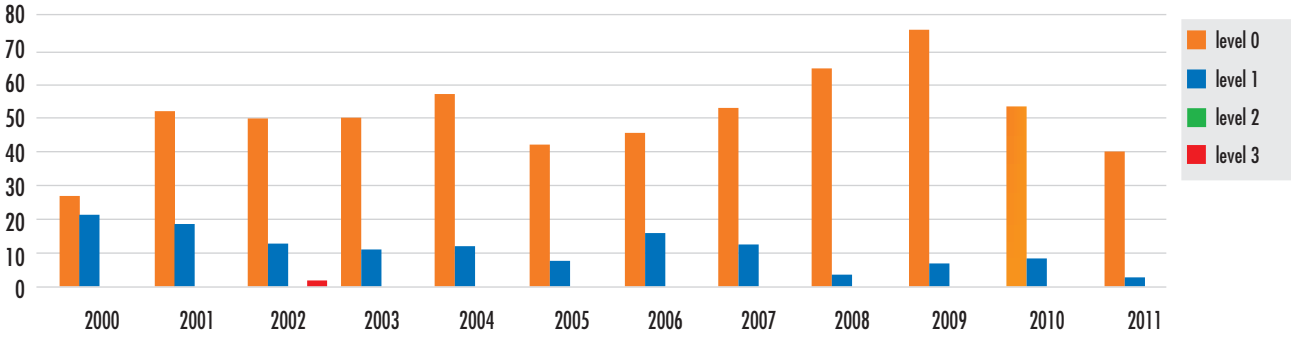
Very few transport-related event notifications are made by the conventional industry and research sectors. Analysis of the statistics nevertheless shows that this low notification level is probably due to small-scale nuclear activity professionals failing to notify events, usually due to a lack of knowledge of the events notification process.

The package contents concerned by the events notifications are extremely varied: radionuclides for medical uses, contaminated material, fuel, empty packaging, etc. Graph 4 shows the breakdown of notified transport events by content and mode of transport. It can be seen that few events concern the transport of nuclear fuel or waste.

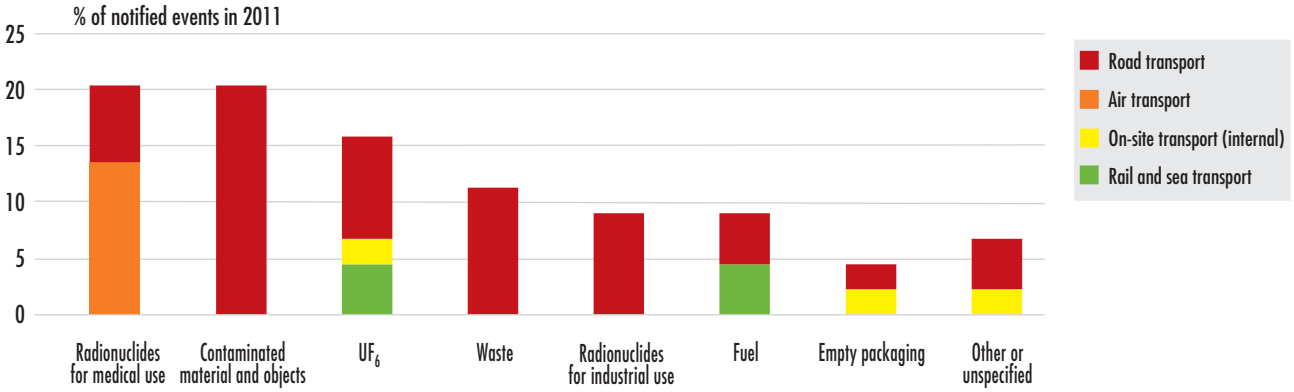
Road transport accounts for the majority of the notified events. The proportion of events concerning air transport, about 15%

3. Order of 29 May 2009 concerning the transport of dangerous goods by land, known as the "TMD order".

Graph 3: trend for the number of radioactive material transport incidents or accidents declared between 2000 and 2011



Graph 4: breakdown of notified transport events by content and mode of transport



in 2011, reflects greater awareness of the airport companies that detect deviations and are more familiar with the notification process. These events essentially involve package impacts or falls during handling, or temporary or definitive losses in transit. Few events involve rail or maritime transport. These figures are in agreement with transport movements in France.

ASN inspection of transport package maintenance instructions

Causes of events

The events notified in 2011 chiefly concern:
- losses of medical packages during transits in airports (temporary or definitive loss);
- insufficient or deficient securing of packages of material transported for EDF;
- falls or impacts during the handling of medical packages in airports;
- noncompliance with the package design approval certificates or noncompliance with the packaging maintenance manuals declared by the BNI licensees;
- exceeding the contamination and radiation intensity limits;
- noncompliance with the regulatory requirements of the applicable orders (e.g. the TMD order for land transport).

The distribution of transport events per domain is illustrated in the above figure.

In 2011 one can see an increase in the events associated with deviations in application of the requirements of the approval certificates and the utilisation or maintenance manuals. Particular attention will be focused on this point in the ASN inspections concerning the transport of radioactive materials in 2012.

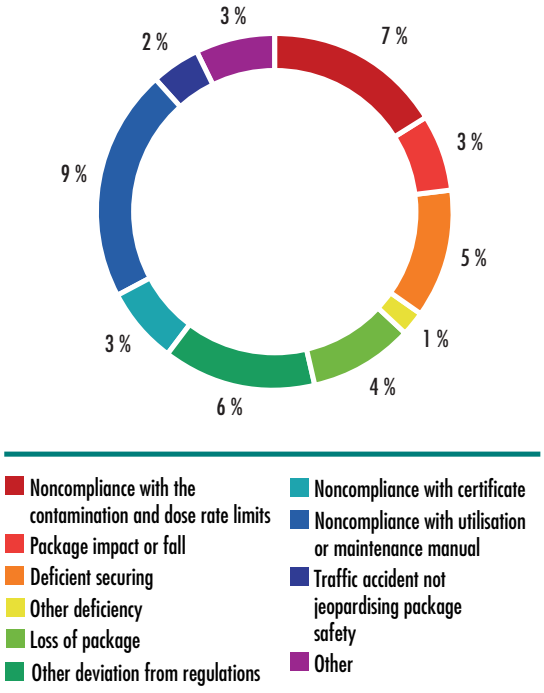
UNDERSTAND

Deviations: noncompliance with certificates or utilisation manuals

The deviations in application of the approval certificates, utilisation or maintenance manuals observed in 2011 were analysed in depth by ASN. ASN considers that any deviation of this type, whatever the associated implications for safety, must not be trivialised. The persons responsible for transport operations must remain in control of all the safety requirements relating to transport. Furthermore, experience feedback should enable the recurrence of such deviations to be prevented. By way of example, in 2011 ASN noted:

- *insufficient drying during packaging maintenance, resulting in water remaining in the packaging. This was detected before filling the packaging, which was intended to accommodate fuel. Ensuring the absence of water in fuel packaging is an important factor in demonstrating safety relative to the criticality risk (checking there is no onset of spontaneous nuclear reactions) and relative to the absence of production of hydrogenated gas by radiolysis. Unauthorised water in a contaminated tooling container could lead to dissemination of the contamination of the transported objects or corrosion of the equipment.*
- *one event relating to noncompliance with the scheduled maintenance date for a package. The packagings must undergo periodic maintenance with obligatory replacement of seal, verification of the condition of certain parts, etc. Failure to perform the packaging periodic maintenance inspections means that the design-basis behaviour cannot be guaranteed, in the event of an accident situation for example. ASN was particularly attentive to the monitoring of utilisation and maintenance manuals in its inspections in 2011, and will continue to focus on this topic in 2012.*

Graph 5: distribution of significant events notified in 2011



4|3 Participation in international relations in the transport sector

The international regulations were drafted and are implemented as a result of fruitful exchanges between countries. ASN places these exchanges in a process of continuous progress in the level of safety of radioactive material shipments, and encourages exchanges with its counterparts in other countries.

4|3|1 Participation in the work of the IAEA

ASN represents France on 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. 2011 saw the conclusion of the revising of regulation TS-R-1, which began in 2008. The new edition, planned for 2012, integrates modifications in the objective of harmonising practices with the UNO recommendations for the transport of dangerous goods. The most important changes concern criticality safety, with the modification of the configurations of materials classified as excepted fissile materials, materials for which no demonstration of criticality safety is required at present, subject to compliance with the weight limits per package and per consignment. These modifications could more particularly have an impact on the transport of waste containing fissile radionuclides, which will become subject to safety demonstration requirements

4|3|2 Participation in the work of the European Association of Competent Authorities on transport

The European Association of Competent Authorities in the transport of radioactive materials (EACA) was created in December 2008. Its purpose is to promote the harmonisation of practices in the regulation of the safety of transport of radioactive materials, and to encourage exchanges and

experience feedback between the various Authorities. The plenary meeting of May 2011, for example, provided the opportunity to work on the finalising of the content of a European inspection guide, which can be used by the inspectors of all the European Authorities. It also led to discussions on the regulations implemented by the member countries regarding the detection of radioactivity in consumer goods during their transport, a subject that turned out to be highly topical after March 2011 and the Fukushima disaster. These discussions concluded that is was necessary to rapidly develop a harmonised approach to the development of a regulation policy and the installation of detection devices at borders. Further to this, a letter setting forth a joint position of the EACA members was sent to the European Commission.

4|3|3 Bilateral relations with ASN's foreign counterparts

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 include Belgium, the United Kingdom, Germany and the USA in particular.

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 Belgium 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 analysis reports for the French package designs validated in Belgium. The AFCN added to these exchanges in 2011 by presenting its policy of disciplinary action for transport offenses and the results of the audits conducted with the French manufacturers of packages used in Belgium.

The United Kingdom

France and the United Kingdom use radioactive materials for the same civil applications, such as the nuclear generation of electricity, reprocessing, and for medical purposes. Consequently, ASN and the competent British authority (Department for transport – DfT) 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.

Against this backdrop, ASN and the DfT signed a memorandum of understanding on 24 February 2006, for the mutual recognition of the approval certificates confirming the safety of radioactive material transport.

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 files relative to the package designs used in the United Kingdom and France.

Germany

The French and German nuclear authorities have decided to regularly meet to discuss certain technical files. 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. During the investigation of the safety file relative to package DN 30 for the transport of uranium hexafluoride, the drop tests of the package were carried out in Germany in August 2011 in the presence of both the French and German Authorities.

United States

Recently, on the occasion of a symposium at the International Conference On Nuclear Engineering, the American nuclear regulator (Nuclear Regulatory Commission - 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 to set up collaboration on subjects of common interest. Without waiting for this to be formalised, a close collaboration between the French and American Authorities was initiated to draw the lessons from the transport events observed on the UX-30 packaging used in the USA and Europe, which are mentioned in paragraph 4|2|2. The failures observed with this package design had effectively already been detected in the USA.

5 ASN'S OPINION ON THE SAFETY OF TRANSPORT OF RADIOACTIVE MATERIALS AND PROSPECTS

Transport safety management within the AREVA group

Experience feedback from certain inspections, and the analysis of significant events occurring in the AREVA group, has evidenced deficiencies in the overall system of transport safety management within the group (see box in paragraph 4|2|2). It has been observed more specifically that the regulatory responsibilities (shipment, transport, etc.), the mutual obligations in the case of internal contracting, especially with regard to packaging maintenance and the tracking of packaging design modifications, are poorly defined in the group's procedures. This situation often leads to a dilution of responsibilities (role of the designer, manufacturer, consignor, maintenance organisation). In this respect, ASN considers that the AREVA group entities must take corrective action and ensure better mutual coordination in applying a quality assurance system to transport operations as required by the regulations.

The AREVA group undertook to implement corrective actions during 2011 in response to these various ASN findings.

The AREVA group will be subject to inspections in the area of transport organisation in 2012, and subcontracted activities in particular.

The increase in safety requirements relating to on-site transport operations performed within the bounds of the BNIs

As part of the revision of the technical regulations for BNIs, ASN has planned to tighten the regulatory framework and the requirements concerning on-site transport operations

TO BE NOTED IN 2011

ASN gears itself to meet the public information demands concerning the last shipment of vitrified waste to Germany

The last convoy returning vitrified waste was to Germany made its journey at the end of 2011, in compliance with the intergovernmental agreement signed between France and Germany in October 2008. The convoy comprised eleven CASTOR HAW 28M packages approved by the German competent authority and validated by ASN.

ASN performed an inspection to verify compliance with the certificate of approval, the safety file and the regulatory requirements concerning the consignment, and an inspection to verify compliance with the radiation protection limits around the transport units as provided for by the regulations governing the transport of radioactive materials by rail (RID) and by road (ADR).

During the inspection at the Valognes rail terminal, equivalent dose rate measurements were taken around nine packages by experts from the IRSN and ACRO (Association for the Control of Radioactivity in the West of France), both mandated by ASN. All the gamma radiation and neutron measurements gave values below 0.2 millisievert per hour (0.2 mSv/h) in contact with the canopy, and therefore below the regulatory limit of 2 mSv/h in contact with the wagon. The equivalent dose rates measured by IRSN and ACRO at a distance of 2 metres from the wagon were below 0.073 mSv/h, and therefore below the regulatory limit of 0.1 mSv/h at a distance of 2 metres from the wagon.

In its role as consignor, AREVA NC was inspected to ensure it fulfilled its obligations with regard to material-package compatibility, the quality assurance system implemented, operator training, and pre-shipment checks.

Dose rate measurements made by IRSN and ACRO in the presence of the "STOP EPR, ni à Penly ni ailleurs" group

performed within the bounds of the BNIs. The nuclear sites concerned must take prompt action to plan the necessary forthcoming modifications to the existing baseline safety standards. The requirements will be specified in regulatory decisions in 2012, and an ASN guide should help clarify the regulatory requirements.

Monitoring the projects to develop European regulations concerning radioactive material carriers

With regard to regulatory matters, 2011 saw the European Commission adopt a draft regulation aiming at instituting a system for registering radioactive material carriers. This unique registration system, if ratified, will replace the national notification and licensing procedures stemming from application of the Euratom 96/29 directive and transcribed in France by Article R.1333-44 of the public health code. The Council of European Ministers has not yet given its decision on this regulation. In 2012, ASN will contribute to the European discussions in this area and the development of a French stance on the draft regulation.

Continuation of inspections of packages that are not subject to ASN approval

Compliance with regulatory requirements with regard to the transport of packages that are not subject to approval (see point 3) is still insufficient in ASN's opinion. Back in 2007 ASN asked for them to be brought into compliance with the regulations before the end of 2010. ASN's inspections reveal shortcomings in the content of the package design conformity justification file, and sometimes its complete absence. These inspections must still be continued, and in 2012 ASN will focus on an additional inspection of the organisations that assist the packaging suppliers in preparing the package conformity files and the certificates.

Continuation of inspections in the manufacture and maintenance of transport packages subject to ASN approval

The design of transport packages requiring ASN approval is inspected in depth during the examination of the approval request. Once ascertained that the package design complies with the regulatory requirements, its manufacture and subsequent routine maintenance in accordance with the requirements of its safety file must be verified. ASN has planned to maintain a large number if inspections in this area in 2012, particularly with regard to the maintenance of the oldest packagings.

Improvement in emergency situation preparedness and experience feedback from the Fukushima accident in the field of transport

ASN has led an initiative to draw up a guide to the drafting of emergency plans intended for the entities responsible for transport. The aim of this guide, which could be published in 2012, is to harmonise and improve the practices of those responsible for transport in this area.

The Ministry of the Interior and the major stakeholders of the French nuclear industry are moreover looking into the management of emergency situations resulting from a transport accident to improve the national response should such an event arise.

ASN also wishes to draw all the possible lessons that the Fukushima accident can bring in the field of transport. The question of how to better evaluate the margins existing in the design of transport packagings will be addressed in 2012, with a view to preventing the consequences of any type of event, even highly improbable, that could affect them, whether on the public highway or within the BNIs.

Transparency in the area of transport

Growing public and media interest in the transport of radioactive materials was observed for several international shipments organised in 2011. Consequently, ASN has made it a priority to develop the information made available to the public concerning the regulating of the safety of transport of radioactive materials. An educational file was posted on ASN's web site *www.asn.fr* at the end of 2011. At the end of the first quarter of 2012, ASN will also be publishing a new issue of its review *Contrôle*, addressing the subject of transport safety.

ASN will ensure that article L.125-10 of the Order 2012-6 of 5 January 2012, which codifies Act 2006-686 of 13 June 2006 relative to security and transparency in the nuclear field, which reclassifies the provisions of Decree 2011-1844 of 9 December 2011, is applied.