AUTORITÉ DE SÛRETÉ NUCLÉAIRE

A S N GUIDES

TRANSPORT

Radiation Protection in Radioactive Substance Transport Activities

GUIDE No. 29

Version of 29/03/2018

Preamble

The collection of ASN guides comprises documents intended for professionals interested in the regulations applicable to nuclear safety and radiation protection (licensees, users or carriers of ionising radiation sources, health care professionals).
These guides can also be issued to the various stakeholders, such as the local information committees (CLIs).

Each guide sets out recommendations with the aim of:
- explaining the regulations and the rights and obligations of the persons concerned by the regulations;
- explaining the regulatory objectives and, as applicable, describing the practices considered by ASN to be satisfactory;
- giving practical tips and useful information concerning nuclear safety and radiation protection.

Only the French language version of this guide adopted by the commissioners present at the meeting of the ASN Commission of 29 March 2018 is deemed authentic.

Contents

1. INTRODUCTION

1.1. Context

Nearly one million packages of radioactive substances are transported in France each year. Among these, only 12% are transported for the nuclear industry. The very large majority (88%) therefore concern the non-nuclear industry, health or research sectors (referred to as "*small scale nuclear activities*"), and among these, 30% represent supplies of radiopharmaceuticals and brachytherapy sources for hospitals. These consignments are mainly transported by road.

The workers involved in the transport of radioactive substances are potentially exposed to ionising radiation, due more specifically to their close proximity with the packages. Members of the public situated in the immediate vicinity of the transport vehicles may also be exposed, but to a lesser extent. The regulations therefore make provisions to protect the workers, the general public and the environment against the dangers of ionising radiation. More specifically, the transport regulations provide that companies involved in a radioactive substance transport operations must establish a radiation protection programme. Without prejudice to other applicable regulations, the radiation protection programme presents all the measures taken by a company to ensure radiation protection during the transport operations it carries out.

The inspections conducted by the French nuclear safety authority (ASN) in 2015-2016 revealed that certain carriers do not sufficiently integrate the risk of exposure of workers and general public to ionising radiation in the prevention methods they define and implement, yet transport activities can have significant radiation protection implications, particularly for the workers. The individual dosimetric monitoring of ionising radiation exposure of monitored persons shows that drivers transporting radiopharmaceuticals receive higher doses than the average for workers in other sectors of activity, with annual doses that can reach 14 millisieverts per year (mSv/year), while the regulatory exposure limit is 20 mSv/year.

In terms of radiation protection recommendations for transport operations, the International Atomic Energy Agency (IAEA) has published Guide No. TS-G-1.3 [16], which focuses on the recommended content of a radiation protection programme (see chapter 3). The present document has been drawn up on the basis of this guide, while adapting it to the particularities of the regulations applicable in France.

1.2. Scope of application

This guide is applicable to all modes of transport (road, rail, inland waterways, maritime, air) and to all radioactive substance transport operations during which people (workers or the public) could be exposed to ionisating radiation: preparation of packages, handling, carriage, loading, unloading, etc. It therefore does not address:

- the design and manufacture of the packaging,
- their maintenance and repair, if these operations are performed on packagings decontaminated to below the regulatory thresholds set in article 2.2.7.1.2 of the ADR [5].

For the purpose of simplification, this guide will only make reference to the articles of the order of 29th May 2009 amended relative to the transport of hazardous materials (called the "TMD" order) [8] and of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) [5]. Unless otherwise specified, the recommendations given in this guide are valid for the other modes of transport.

This guide also addresses questions relating to protection of workers and the public against the risks arising from exposure to ionising radiation, under routine or incident transport conditions. It does not however address accident or post-accident situations, which form the subject of ASN Guide No. 17 [18].

1.3. Purpose of the guide

This document is intended for professionals exercising a radioactive substance transport activity. It sets out the regulatory requirements relating to radiation protection of workers and the public and details the links between the various applicable texts. It also presents the ASN recommendations to ensure compliance with these requirements.

1.4. Document status

This document is an ASN guide which underwent a public consultation from 27th October to 27th November 2017.

It will be updated if necessary when the regulatory texts transposing Council Directive 2013/59/Euratom of 5th December 2013 [7] into French law are published.

2. DEFINITIONS AND REGULATORY FRAMEWORK

2.1. Definitions

The transport operations are defined in article 1.7.1.3 of the ADR [5]. They are namely: the design, manufacture, maintenance and repair of packagings, the consigning, loading, carriage, including in-transit storage, unloading and receipt at the final destination of loads of radioactive substances and packages.

As indicated in section 1.2, this guide only concerns transport operations during which there is a risk of the workers of the public being exposed to ionising radiation.

Radiation protection consists in protecting people - whether they are members of the public or workers - and the environment against the harmful effects of ionising radiation.

Article L. 591-1 of the Environment Code

Radiation protection means protection against ionising radiation, in other words all the rules, procedures and means of prevention and monitoring aimed at preventing or mitigating the harmful effects of ionising radiation on people, directly or indirectly, including by their adverse environmental impact.

It is based on three broad principles: justification, optimisation and limitation. These principles are defined in article L. 1333-2 of the Public Health Code.

Article L. 1333-2 of the Public Health Code

Nuclear activities shall satisfy the following principles:

1° **The principle of justification**, whereby a nuclear activity may only be undertaken or exercised if justified by the individual or collective advantages it procures - particularly in health, social, economic or scientific terms - with respect to the risks inherent to the exposure to ionising radiation to which the individuals are likely to be subjected;

2° **The principle of optimisation**, whereby the level of exposure of individuals to ionising radiation resulting from one of these activities, the probability of such exposure occurring and the number of persons exposed must be maintained at a level that is as low as reasonably achievable, in view of the state of technical knowledge, economic and societal factors and, where applicable, the medical research objective;

3° **The principle of limitation**, whereby the exposure of a person to ionising radiation resulting from one of these activities cannot raise the sum of the doses received beyond limits set by regulations, unless this person is exposed for medical purposes or in the context of research work as stipulated in 1° of article L. 1121-1.

2.2. International texts underpinning the French regulatory framework

The following texts underpin the French regulatory framework:

[1] Regulations for the Safe Transport of Radioactive Materials, 2012 Edition, Specific Safety Requirements No. SSR-6, IAEA.

[2] Regulations concerning the International Carriage of Dangerous Goods by Rail (RID).

[3] International Civil Aviation Organisation Technical Instructions (ICAO-TI).

[4] International Maritime Dangerous Goods Code (IMDG Code).

[5] European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR).

[6] European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN).

[7] Council Directive 2013/59/EURATOM of 5th December 2013 laying down basic protection standards against the dangers arising from exposure to ionising radiation.

2.3. French regulatory framework

The transport of radioactive substances is governed by various regulatory requirements, established in particular by the Public Health Code (see section 2.3.1), the Labour Code (see section 2.3.2) and the Transport Code (see section 2.3.3), which apply concomitantly and contribute to achieving common objectives.

2.3.1 Public Health Code

The transport of radioactive substances is a nuclear activity within the meaning of article L. 1333-1 of the Public Health Code therefore, as such, it is subject to the provisions of this code which aim at protecting the public and the environment against the dangers arising from ionising radiation.

Article L. 1333-1 of the Public Health Code

The provisions of this chapter apply to:
1° Activities involving a risk of exposure of individuals to ionising radiation resulting from the use either of an artificial source, whether it is a substance or device, or a natural source, whether naturally occurring radioactive substances or materials containing natural radionuclides, hereinafter referred to as nuclear activities; […]

In application of article R. 1333-44 of the Public Health Code, ASN Resolution 2015-DC-0503 [12] institutes an obligation for companies carrying out the operations specified in article 1 of the resolution to notify ASN if the corresponding transport operation takes place at least in part on French territory.

ASN Resolution 2015-DC-0503 of 12th March 2015 relative to the notification system for companies transporting radioactive substances on French territory.

Article 1

In application of Articles L. 1333-44[1] and R. 7 of the Public Health Code, companies that carry out the radioactive substance transport operations mentioned in this article are subject to a notification system whenever these operations are not totally exempted from the requirements of the regulations applicable to the transport of dangerous goods of class 7 mentioned below:

- Council Regulation (EEC) No. 3922/91 of 16th December 1991 amended on the harmonisation of technical requirements and administrative procedures in the field of civil aviation;
- Order of 29th May 2009 amended on the land transport of dangerous goods (called the "TMD" order);
- Order of 23rd November 1987 amended on the safety of ships;
- Order of 18th July 2000 amended regulating the transport and handling of dangerous goods in seaports;
- Order of 22nd March 2001 on postal dispatches of radioactive materials.

The following operations are concerned:

- the carriage of radioactive substance packages,
- the loading or unloading of radioactive substance packages, including on logistic platforms, in airports and ports,
- the handling of radioactive substance packages after loading a package on the dispatch site and before its unloading on the reception site,

carried out for overland carriage (road, rail, inland waterways), all or part of which take place on French territory, or by sea and including a stop in a French port, or by air and including a stop in a French airport.

The following are not concerned:

- transport operations carried out entirely within a basic nuclear installation defined in Article L. 593-2 of the Environment Code or a defence-related nuclear installation defined in Article L. 1333-15 of the Defence Code;
- transport operations carried out entirely within an installation forming the subject of the authorisation mentioned in article L. 512-1 of the Environment Code or the authorisation mentioned in article L. 162-3 of the Mining Code, if these authorisations take into account the utilisation or the holding of radioactive sources in the installation.

Companies that only transport radioactive substances for which they have a possession or utilisation authorisation or have given notification of their possession or utilisation in application of b) of 1°) of I of article R. 1333-17 of the Public Health Code are exempted from the notification mentioned in the first paragraph.

[1] The legislative part of the Public Health Code has been modified since the resolution came into effect. Article L. 1333-8 takes up the provisions of the former Article L. 1333-4.

In this respect, ASN underlines that:

- the "carriage of radioactive substance packages " includes parking periods during carriage and in-transit storage (that is to say storage of the package during carriage, for example while waiting for a change in means of transport);
- radioactive substance transport operations carried out solely inside a basic nuclear installation (BNI) are considered to be part of the operation of that installation and as such are covered by its authorisation. They are governed by the Order of 7th February 2012 amended setting out the general rules for basic nuclear installations. These operations are also covered by ASN Guide No. 34 relative to the implementation of regulatory requirements applicable to on-site transport operations [19]. Thus, a company that simply loads packages within a BNI is exempted from the notification requirement, even if the packages are subsequently transported outside the installation;
- notification to ASN is not required if the company transporting the radioactive substances already has a license or an existing notification to possess or use these substances under Article L. 1333-8 of the Public Health Code. This can concern:
    - own-account transport, such as the transportation of a gamma ray projector by the industrial radiography contractor;
    - hire or reward transport, such as a radiopharmaceuticals producer which delivers the sources it has produced to a hospital.
- pursuant to II of Article R. 1333-44 of the Public Health Code, licenses for the transport of radioactive substances by air issued in application of Article R. 330-1-1 of the Civil Aviation Code serve as the notification to ASN.

2.3.2 Labour Code

The provisions of the Labour Code concerning prevention of the risks of exposure to ionising radiation, set out in Articles R. 4451-1 et seq., are applied by any employer whose workers, and by any self-employed workers who themselves, could risk exposure to such radiation resulting from nuclear activities coming under one of the administrative regimes provided for under the Public Health Code. These provisions therefore apply to carriers who are required to give notification to ASN on account of ASN Resolution 2015-DC-0503 [12], whether notification has been given or not.

ASN underlines that companies exempted from notification in application of article 1 of this resolution are not exempted from application of the provisions of the Labour Code, such as:

- a company that loads radioactive substance packages within the bounds of a BNI in which the Labour Code applies, is automatically subject to its regulations;
- a company that only carries out transport operations involving radioactive substances for which it has a license to possess or use, or a registration or notification, is subject to the provisions of the Labour Code relative to ionising radiation on account of this license (transportation of a gamma ray projector by an industrial gamma radiography contractor, or a radiopharmaceuticals producer which itself delivers sources it has produced for the treatment of patients to a hospital, etc.).

In addition, the provisions of the Labour Code relative to the prevention of risks associated with certain activities or operations, particularly those relative to loading and unloading operations, set out in Articles R. 4515-1 to R. 4515-11, apply to the loading and unloading of radioactive substance packages. It details the methods of assessing the risks between the carrier and the receiving company, more specifically by drawing up a written security protocol.

Labour Code

Article R. 4515-4.
The loading and unloading operations form the subject of a written document called "security protocol" which replaces the prevention plan.

Article R. 4515-5.
The security protocol contains the relevant information for assessing all types of risks arising from the operation and the prevention and security measures to observe during each phase of the operation.

2.3.3 Transport Code

The TMD order [8] issued in application of Articles L. 1252-1 and R. 1252-8 of the Transport Code renders applicable the international agreements specific to each mode of transport (modal regulations) and clarifies or supplements their provisions. When radioactive substances are transported by road, i.e. the very large majority of cases, the applicable modal regulation is the ADR [5]. It governs the transportation of dangerous goods, which includes radioactive substances.

The ADR [5] contains several provisions for ensuring the protection of workers, the public and the environment against the dangers of ionising radiation. Among these, the need to develop and implement a radiation protection programme must be underlined (see chapter 3).

2.3.4 Environment Code

Article L. 595-1 of the Environment Code stipulates that ASN is the competent authority for taking requisite licensing decisions and for receiving the declarations and notifications concerning the transport of radioactive substances. Articles L. 596-1 et seq. define the conditions of oversight of radioactive substance transport.

2.3.5 Other specific applicable texts

The texts below also set applicable regulatory requirements:

[8] Order of 29th May 2009 amended relative to the land transport of dangerous goods (called the "TMD" order).

[9] Order of 17th July 2013 relative to the medical and dosimetric monitoring card for workers exposed to ionising radiation.

[10] Order of 6th December 2013 amended relative to the training conditions for the Radiation Protection Expert-Officer and the certification of the training organisations.

[11] Order of 15th May 2006 amended relative to the requirements for delimiting and signalling monitored and controlled areas and specially regulated or prohibited areas in view of the exposure to ionising radiation, and the health, safety and maintenance rules imposed in them (called the "zoning" order.

[12] ASN Resolution 2015-DC-0503 of 12th March 2015 relative to the notification system for companies transporting radioactive substances on French territory (approved by the order of 24th July 2015).

[13] ASN Resolution 2010-DC-0175 of 4th February 2010 specifying the technical conditions and the frequencies of the inspections provided for in Articles R4452-12 and R4452-13 of the Labour Code and Articles R.1333-7 and R1333-95 of the Public Health Code (approved by the order of 21st May 2010).

[14] ASN Resolution 2009-DC-0147 of 16th July 2009 establishing the conditions for exercising the functions of Radiation Protection Expert-Officer external to the establishment in application of Article R. 4456-4 of the Labour Code (approved by the order of 24th November 2009.

[15] DGT/ASN Circular No. 4 of 21st April 2010 relative to the prevention measures against the risks of exposure to ionising radiation.

2.4. Guides

The following guides provide good practice recommendations on the subject addressed herein:

[16] IAEA Safety Standards Series n° TS-G-1.3 "Radiation Protection Programmes for the Transport of Radioactive Material".

[17] IAEA Specific Safety Guide SSG-26 "Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)".

[18] ASN Guide No. 17 relative to the content of radioactive substance transport incident and accident management plans.

[19] ASN Guide No. 34 relative to the implementation of the regulatory requirements applicable to on-site transport operations.

3. RADIOLOGICAL PROTECTION PROGRAMME

3.1. Need for a radiation protection programme

The ADR stipulates that all radioactive substance transport operations (preparation of packages, consigning, package handling, loading, unloading, carriage, in-transit storage, unpacking, receipt, etc.) shall be governed by a radiation protection programme (RPP).

To meet this obligation, ASN considers that each company involved in a radioactive substance transport operation must draw up an RPP.

The requirement to put in place an RPP applies whatever the mode of transport (road, rail, inland waterways, air, sea) and whatever the types of substances transported (materials in excepted packages, fissile material , LSA[2] materials and SCO[3], materials in type-A packages, materials in type-B packages, etc.).

[2] *Low Specific Activity*: these are materials whose specific activity is below the thresholds defined in the regulations.
[3] *Surface Contaminated Object*: these are non-radioactive objects with external contamination that does not exceed certain thresholds defined in the regulations.

The RPP defines the radiation protection objectives and the means necessary to achieve these objectives while taking account of the nature and scale of the risks (Article 1.7.2.3 of the ADR). **The graded approach principle applies: the level of detail of the RPP and the extent of the provisions it contains must be proportional to the radiation protection implications of the transport operations performed.**

Whatever the level of risk, even low, it is mandatory for the RPP to indicate (Article 1.7.2.3 of the ADR):

- the individual dose constraints[4] defined below the relevant dose limits for the public and workers, and the measures taken to optimise radiation protection and safety, taking into account the interfaces between carriage and other activities[5] (Article 1.7.2.2 of the ADR: the "relevant dose limits" to which this article makes reference must be taken as being the regulatory dose limits);
- the estimations of predicted individual doses resulting from the transport operations for the workers and the individual monitoring or work place monitoring provisions adopted (Article 1.7.2.4 of ADR);
- the provisions for ensuring worker training (Article 1.7.2.5 of the ADR);
- the measures taken to ensure compliance with the minimum separation distances between the packages of radioactive substances and the workers or the public (Article 7.5.11 CV33 (1.1) of the ADR).

Extracts from the ADR	
1.7.2.1	The carriage of radioactive material shall be subject to a radiation protection program which shall consist of systematic arrangements aimed at providing adequate consideration of radiation protection measures.
1.7.2.2	Doses to persons shall be below the relevant dose limits. Protection and safety shall be optimized in order that the magnitude of individual doses, the number of persons exposed and the likelihood of incurring exposure shall be kept as low as reasonably achievable, economic and social factors being taken into account within the restriction that the doses to individuals be subject to dose constraints. A structured and systematic approach shall be adopted and shall include consideration of the interfaces between carriage and other activities.
1.7.2.3	The nature and extent of the measures to be employed in the programme shall be related to the magnitude and likelihood of radiation exposures. The programme shall incorporate the requirements in 1.7.2.2, 1.7.2.4, 1.7.2.5 and 7.5.11 CV 33 (1.1). Programme documents shall be available, on request, for inspection by the relevant competent authority.
1.7.2.4	For occupational exposures arising from transport activities, where it is assessed that the effective dose either: a) is likely to be between 1 and 6 mSv in a year, a dose assessment programme via work place monitoring or individual monitoring shall be conducted; or b) is likely to exceed 6 mSv in a year, individual monitoring shall be conducted.

[4] see definition in section 3.4.4.
[5] "other activities" means other transport activities

	When individual monitoring or work place monitoring is conducted, appropriate records shall be kept. ***NOTE:*** *For occupational exposures arising from transport activities, where it is assessed that the effective dose is most unlikely to exceed 1 mSv in a year, no special work patterns, detailed monitoring, dose assessment programmes or individual record keeping need be applied.*
1.7.2.5	Workers (see 7.5.11 CV 33 Note 3) shall be appropriately trained in radiation protection including the precautions to be observed in order to restrict their occupational exposure and the exposure of other persons who might be affected by their actions.
7.5.11 CV 33 Note 3	***NOTE 3:*** *"Workers" are any persons who work, whether full time, part-time or temporarily, for an employer and who have recognised rights and duties in relation to occupational radiation protection.*
7.5.11 CV 33 (1.1)	Packages, overpacks, containers and tanks containing radioactive material and unpacked radioactive material shall be segregated during carriage: a) from workers in regularly occupied working areas: i) in accordance with Table A below [see page 27]; or ii) by distances calculated using a dose criterion of 5 mSv in a year and conservative model parameters; ***NOTE:*** *Workers subject to individual monitoring for the purposes of radiation protection shall not be considered for the purposes of segregation* b) members of the public, in areas where the public has regular access: i) in accordance with Table A below [see page 27]; or ii) by distances calculated using a dose criterion of 1 mSv in a year and conservative model parameters;

ASN therefore recommends that an RPP should contain the following chapters:

- **scope of the radiation protection programme;**
- **roles and responsibilities within the company and interfaces, if any, with external players;**
- **dose assessments and optimisation of exposures of the public and workers;**
- **inspection of work environments, packages and vehicles;**
- **separation distances between packages and workers and between packages and the public;**
- **worker training;**
- **applicable management system (quality assurance).**

Chapters 3.2 to 3.8 below detail the expected content of each of these chapters and the associated regulatory requirements.

The RPP shall be kept available for examination by the competent inspection authorities (§ 1.7.2.3 of the ADR).

Under Article R. 4121-1 of the Labour Code, the employer is obliged to inventory all the risks workers are exposed to in a "DUER" (French acronym for "unified risks assessment document"). To avoid having identical content repeated in different documents, the employer may simply reference the RPP in the section of the DUER relating to exposure to ionising radiation. Conversely, the employer may also decide to reference the DUER in the section of the RPP relating to the assessment of occupational exposure. The RPP shall nevertheless cover the other aspects, particularly exposure of the public.

This approach can be adopted in the other sections of the RPP: their content may also be found in other documents, provided that they are referenced in the RPP and kept available for examination by the competent authorities.

3.2. Scope of the radiation protection programme (RPP)

The RPP shall be tailored to the activities of the company. It shall cover all the aspects relating to transport: all the transport activities exercised, all the modes of transport concerned, all types of packages, and all potentially exposed persons (workers and public). It shall take into account the interactions between carriage and other transport activities.

The objective of the "Scope of the programme" chapter of the RPP is therefore to describe the activities of the company with respect to their radiation protection implications. As is emphasised in chapter 3.1, the level of detail shall be proportional to the significance of the risks with regard to radiation protection of the workers and the public.

3.2.1 Company activities

To describe the activities of the company, the RPP should contain:

- a list of the company's transport activities (carriage, loading, unloading, handling, packaging, etc.);
- the modes of transport concerned;
- a general description of the radioactive substances concerned:
  - an estimation of the number of packages transported per year (or the number of packages loaded, unloaded, handled, packaged or not, etc.);
  - the types of packages concerned (by indicating, for example, the UN numbers of the packages or giving a more precise description of the contents), with an estimation of the proportions of the different types;
  - the package categories (labels I-white, II-yellow, III-yellow or without label), with an estimation of the proportions of the different categories;
- the number of workers (employees of the company or subcontractors) who could be exposed to ionising radiation, also indicating those that are involved in the organisation of transport activities;
- any additional information deemed necessary.

3.2.2 Interactions between several companies

Paragraph 1.7.2.2 of the ADR indicates that the RPP shall take into account the interfaces between carriage and other transport activities. Regarding application of this paragraph, ASN considers that if the transport operation involves several companies, each company should have its own radiation protection programme. However, one of the companies can take charge of all the risk assessments in its RPP in

order to ensure better coordination of the radiation protection measures, on condition that the other companies participate and make reference to this RPP in their own RPP or their DUER (see chapter 3.1).

When loading and unloading operations take place on the premises of a facility, this obligation must be interlinked with the obligation imposed on the receiving company and the carrier company to draw up a "security protocol" comprising an assessment of the risks - including but not limited to the radiological risk - and a description of the associated prevention measures under Articles R. 4515-1 et seq. of the Labour Code. To avoid having the same content repeated in several documents, the security protocol can, for the part concerning the risks relating to occupational exposure to ionising radiation and taking into account the interactions between carriage and other transport activities, make reference to the RPP alone. The RPP must however be dated, signed and kept available for the labour inspectorate within the facilities of the receiving company and the carrier company, as must the security protocol.

3.3. Roles and responsibilities within the company and interfaces, if any, with external players;

The RPP should contain a description of the role of each of the players with regard to radiation protection. The responsibilities of each person or entity shall be clearly defined, indicating more specifically the persons responsible for correct application of the RPP, the persons handling the packages, the persons taking dose rate and contamination measurements, the persons performing the inspections (including of documents) to verify compliance with the various requirements, etc. An organisation chart can help to clarify these aspects.

Pursuant to the provisions of Article R. 1333-7 of the Public Health Code, "*the head of the facility or the head of the company is obliged to provide the physical person responsible for a nuclear activity with all the necessary means to achieve and maintain an optimal level of protection of the population against ionising radiation in compliance with the regulatory requirements applicable to it.*" In application of this article, the carrier company shall, within the framework of its management system (see Article 1.7.3 of the ADR and chapter 3.8):

- designate the person(s) responsible for managing and monitoring the RPP. They shall have the necessary skills and authority to fully grasp the radiation protection implications and to check that the RPP is correctly applied within the company. This role could, for example, be assigned to the transport safety advisor (if there is one: see chapter 4.2) or the radiation protection expert-officer appointed under the Labour Code (see chapter 4.1);
- define and make available the means and resources necessary for implementation of the RPP (decision-making authority, qualified personnel, equipment, training, quality assurance, etc.);
- verify that the radiation protection objectives under the applicable regulations (compliance with dose constraints and effectiveness of optimisation measures) have been achieved or, if they have not, identify and analyse the causes of the deviations from the objectives in order to implement the necessary corrective action with a view to continuous improvement.

3.4. Dose assessments and optimisation of exposures

The obligation to assess doses and optimise exposure of workers and the public set by the regulations applicable to transport is also specifically laid down in the Labour Code (for workers) and in the Public Health Code (for the public).
These obligations must therefore be fulfilled, without increasing the number of procedures for as much.

3.4.1 Principle

Assessment of the doses that the workers and public could receive is a key part of the RPP because it allows the radiation protection measures to be adapted to the radiological risks.

The assessment must be carried out prior to any transport activity to ascertain that all the protection measures are, in principle, appropriate.

The dose assessments must be carried out considering the usual work situations and the reasonably foreseeable incidents. It not necessary, however, to consider accident conditions of transport as defined in the ADR.

The ADR defines "normal conditions of carriage" which correspond to the incidents a package can suffer during transport and which can lead to a 20% increase in the dose rate on the surface of the package. ASN considers that an incident corresponding to normal conditions of transport could occur during transportation and go undetected. Consequently, the dose assessment must take into account the possibility of such an incident. In concrete terms this means that the results of the dose assessment carried out using one of the methods described in section 3.4.2 must be increased by 20%.

The dose assessment must be verified periodically and updated if necessary. The verification frequency shall be specified in the RPP. ASN considers it good practice to carry out this verification at least once a year.

The periodic verification obligation applies even if the foreseeable dose for the workers is less than 1 mSv/year. This can more specifically provide confirmation that the initial assessment remains valid, including in cases where the company's activity has undergone changes.

Whatever the case, the dose assessment shall be updated if there is a change in the company's activities that could significantly modify exposure of the workers or the public.

Article R. 4451-11 of the Labour Code

As part of the risk assessment, the employer, in collaboration with the head of the outside company or the self-employed worker where necessary, shall conduct an analysis of the work stations and environments which shall be updated periodically and in the event of any change in conditions that could affect worker health and safety. […]

3.4.2 External dose assessment methods

The external dose is the dose resulting from exposure to radioactive sources situated outside the organism (irradiation). In transport operations, the external dose received results from the dose emitted by the package and the ambient dose in the work area if other sources of ionising radiation are also present.

Several parameters must be taken into account in this assessment, such as: the dose rate at the work station(s), the time spent near the packages, the volume of the shipments, the use of overpacks or containers, in-transit storage, the mode of transport, the arrangement of the packages inside the vehicle, any protections against ionising radiation, etc.

The initial dose assessment can be carried out using various methods:

- by using feedback on the dosimetric results of the workers or work place radiation monitoring;

In compliance with the conditions of utilisation of dosimetric results provided for in the Labour Code, the use of this method more specifically necessitates correct monitoring of the doses received by the workers in the past (wearing of dosimeters) and extrapolation of these data on an annual basis taking into account the ratios reflecting any changes in the activity of the company and covering the uncertainties.

- by means of a calculated estimate;

  The dose assessment can also be carried out by calculation, particularly if the available data are not representative of the planned operations or not directly transposable to them.

  For straightforward exposure situations (for example an operator remaining at a fixed distance from a package), the dose received by the workers or the public can be assessed by simple calculations (see example in appendix 1).

  For more complex exposure situations, the use of calculation codes (such as those mentioned in chapter 6 of the TS-G-1.3 [16]) is also a possibility. These codes enable exposure situations to be modelled with varying levels of detail. The level of detail to adopt depends on the complexity of the situation and the associated radiation protection implications.

  Whatever the case, if the assessment is based on a calculation - whether simple or complex - and concludes that individual or work place radiation monitoring is necessary, a retrospective verification that it is effectively reasonably conservative must be carried out on the basis of a comparison with said monitoring results.

- by using bibliographic data.

  The use of bibliographic studies for the assessment can be envisaged when data are available on exposures for activites of the same type conducted under similar conditions (see example in appendix 2). This method should however only be used for activities presenting minor radiation protection implications.

  Whatever the case, if the dose assessment for the workers or public is based on a bibliographic study, it shall be demonstrated that this study is relevant and conservative for the activities of the company.

For companies that have been carrying out radioactive substance transport activities for several months or even several years, the method to favour is experience feedback, provided that worker dosimetric monitoring and work place radiation monitoring are reliable and representative.

Whatever the case, the chosen method shall be justified with respect to the characteristics of the company's activities.

3.4.3 Internal dose assessment methods

The internal dose results from exposure to radioactive sources situated inside the organism, most often due to the inhalation of radionuclides. Internal exposure can sometimes result from the ingestion of radionuclides or their passage through the skin (via wounds or transcutaneously). In the case of transport, the risk of internal exposure generally arises from residual contamination that may be present on the external surfaces of the packages.

On account of the checks to verify compliance with the regulatory contamination limits, the assessment of internal exposure is generally not necessary, on condition that protection measures are put in place (gloves for handling packages, etc.). The checks to verify compliance with the regulatory contamination limits and the protection measures against internal exposure may be adapted according to the result of

the risk assessment, for example in cases where is its demonstrated that surface contamination is extremely improbable (transportation of sealed radioactive sources for example).

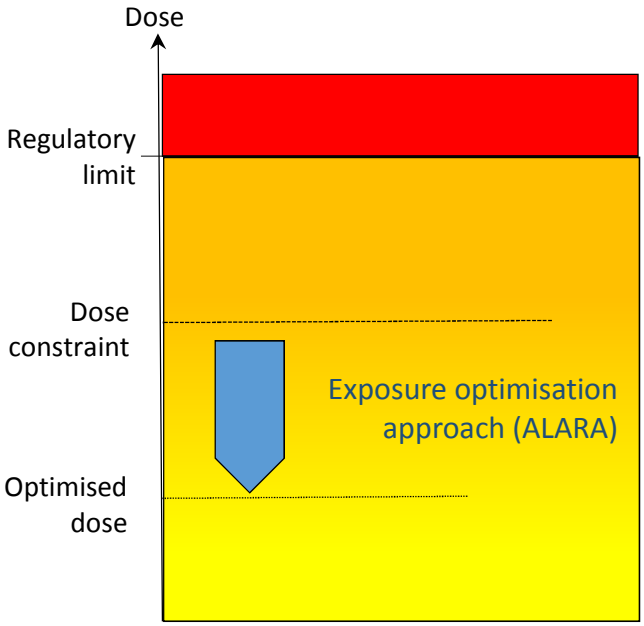
If there is a risk of dispersion of radionuclides into the ambient air, an internal dose assessment based on estimations and then measurements of activity concentration in the air will be necessary.

3.4.4 Dose limits, dose constraints and optimisation

The regulations define the annual effective dose limits for the public (Article R. 1333-8 of the Public Health Code) and over twelve consecutive months for workers (Articles R. 4451-12, 13 and 45, D. 4152-5 and D. 4153-21 of the Labour Code). They also define the annual equivalent dose limits for certain organs. Some of these values are indicated in the table below.

	Whole Body (effective dose)	Hands, forearms, feet, ankles (equivalent dose)	Skin (equivalent dose on any given cm^2)
Public	1 mSv/year	-	50 mSv/year
Workers	20 mSv over twelve consecutive months	500 mSv over twelve consecutive months	500 mSv over twelve consecutive months
Young workers (between 15 and 18 years, provided they are authorised for their training needs)	6 mSv over twelve consecutive months	150 mSv over twelve consecutive months	150 mSv over twelve consecutive months
Working pregnant women	Less than 1 mSv (exposure of the foetus), from notification of pregnancy until childbirth.		
Working nursing mothers	Prohibited to keep them working in, or to assign them to, a job leading to a risk of internal exposure.		

By virtue of the principle of optimisation written into the Labour Code, the Public Health Code and the ADR, radiation protection must be optimised such that the exposure of persons is kept as low as reasonably achievable, taking account of economic and social factors (ALARA[6] approach), without exceeding the regulatory limits. Consequently, reaching the regulatory dose limits cannot be considered satisfactory.



To apply the optimisation principle, the RPP must set dose constraints (Article 1.7.2.2 of the ADR). These dose constraints, as much for the workers as the public, are necessarily below the regulatory dose limits and represent dose values that it should be possible not to exceed in standard operations carried out in accordance with good practices. Exceeding the dose constraints does not constitute a violation, nevertheless the employer or the carrier company must analyse the reasons for the exceedance in order to prevent if from happening again. It is worthwhile defining a dose constraint per operation when the predicted doses are high (see section 3.4.5).

The dose limits for members of the public are applicable for all nuclear activities that can lead to their exposure. ASN recommends setting a dose constraint substantially below the annual regulatory limits because it is unacceptable that the limit be reached on account of a single transport operation. This is because it cannot be excluded that members of the public be otherwise exposed to other nuclear activities.

The RPP must also describe the measures taken to optimise the doses that could be received by workers and the public. Here are a few examples of possible measures:

- apply appropriate separation distances between the packages and the workers or the public (possibly greater than those imposed by the regulations);
- use protective devices, such as lead shields, between the driver's cab and the packages (on condition that this is compatible with the regulations governing the use of road vehicles);
- define specific instructions for the storage, loading, unloading and securing packages with high transport index (TI) numbers;
- restrict the access of workers and the public to package storage areas, particularly those with the highest dose rates;
- prepare the documents as far away from the radioactive substance packages as possible;
- automate the measuring system to limit the time operators spend near packages;
- reduce the loading and unloading times;
- optimise the way in which the packages are arranged in the vehicle so as to maximise the distance between the packages and the driver's cab, and place the packages with the lowest transport index (TI) in front of the packages with high TI to form a shield;

[6] *As Low As Reasonably Achievable.*

- arrange the work schedules to minimise the doses for the personnel, for example by rotating the personnel so that the jobs involving the highest doses are not always carried out by the same operators;
- use equipment to maintain a distance between the personnel and the packages when handling them (handling cart or trolley for example, possibly with lead shields);
- define the itineraries to minimise exposure of workers and the public (bypassing densely populated areas, minimising driving time, parking vehicles in isolated zones, delivering high TI packages in priority, etc.).

Under the management system put in place, experience feedback must be taken into account to assess the effectiveness of the optimisation measures and, if necessary, modify them. This should more specifically lead to deeper reflection on how to optimise the exposure of the company's most exposed workers.

3.4.5 Monitoring doses received by the workers

The ADR [5] sets requirements concerning the monitoring of doses received by workers (article 1.7.2.4). Thus, if the effective dose liable to be received is:

- above 6 mSv/year, individual dosimetric monitoring adapted to the mode of exposure shall be put in place;
- between 1 and 6 mSv/year, individual dosimetric monitoring can be replaced by dosimetric monitoring of the work places (which, within the meaning of the ADR, includes the vehicle cab), with a passive dosimeter for example.

Furthermore, this dose monitoring requirement shall be interlinked with the provisions set by the Labour Code concerning, where applicable, the classification of workers, appropriate radiation monitoring and reinforced individual monitoring of their state of health.

The classification of workers who could be exposed to ionising radiation into category A or B only concerns workers who enter regulated areas (monitored area or controlled area or identified operation area around a source of ionising radiation). When workers enter such areas, they are classified:

- in category A if they could receive an annual effective dose exceeding 6 mSv over twelve consecutive months (or an annual equivalent dose to the organs exceeding 3 tenths of the limits indicated in the table in section 3.4.4);
- in category B if they could receive an annual effective dose exceeding 1 mSv and below 6 mSv/year over twelve consecutive months (or an annual equivalent dose to the organs exceeding the limits for the public).

Classified workers must then undergo individual exposure monitoring through dosimetric monitoring that is appropriate for the mode of exposure (Article R. 4451-62 of the Labour Code) and medical monitoring (Articles R. 4451-82 et seq. and Articles R. 4624-22 et seq. of the Labour Code).

Workers involved in radioactive substance transport operations shall be classified according to the assessment of the dose they could receive when they enter the regulated area. If necessary, radiation monitoring will also be extended to transport operations taking place outside the regulated areas.

However, for workers involved in transport operations and who are not classified in category A or B, only the provisions of the ADR apply for exposure monitoring. ASN nevertheless recommends that non-classified workers who could receive an effective dose of between 1 and 6 mSv/year be subject to individual monitoring even if they do not enter regulated areas, in accordance with the provisions of the European Council Directive 2013/59/Euratom [7].

The additional use of an active dosimeter is a good practice that ASN recommends applying when the predicted doses for an operation are high. Active dosimetry effectively provides real-time measurement and display of the dose received and therefore enables abnormally high exposure to be detected as early as possible, especially by setting alarm thresholds.

The RPP must describe the provisions for monitoring worker exposure and demonstrate that they are appropriate for the type of exposure. As for medical monitoring, this is defined by the occupational physician.

3.5. Checks of work environments, packages and vehicles with regard to radiation protection of workers and the public

3.5.1 Internal checks provided for in the Public Health Code

Article R. 1333-7 of the Public Health Code obliges the company to perform internal checks. The dose rate and contamination checks performed on the packages and the vehicle under the ADR, and the verifications of the RPP effectiveness (see chapter 3.8) satisfy the provisions of this article on condition that the measuring instruments used for these checks are periodically calibrated and subject to verification.

Extract of Article R. 1333-7 of the Public Health Code,

[…] Furthermore, [the head of establishment or company] carries out an internal check to verify compliance with the applicable provisions regarding protection against ionising radiation and checks in particular the effectiveness of the technical arrangements provided for this purpose, receives and periodically calibrates the measuring instruments and checks that they are in good condition and are used correctly. [...]

3.5.2 Checks provided for by the Labour Code

It is considered that the provisions laid down in 1°, 2°, 3°, 4° and 6° of Article R. 4451-29 of the Labour Code are not applicable for transport operations because neither the packages nor the transport vehicles are considered as "sources" within the meaning of this article.

However, 5° of this article is fully applicable in the context of a radioactive substance transport activity.

Article R. 4451-29 of the Labour Code

The employer performs, or has a third party perform, technical radiation protection controls on the sources and devices emitting ionising radiation, on the protection and alarm devices and on the measuring instruments used.
These technical controls include in particular:
1° An inspection on reception in the company;
2° An inspection before the first use;
3° An inspection if the conditions of use are modified;
4° A periodic inspection of the sources and devices emitting ionising radiation;
5° A periodic inspection of the active dosimeters mentioned in Article R. 4451-67 and of the measuring instruments used for the controls provided for in this article and in Article R. 4451-30, which includes a verification that they are in good working order and are used correctly;
6° An inspection of unsealed sources when they are definitively withdrawn from use.

The ambient environment controls provided for by Article R. 4451-30 of the Labour Code are also fully applicable to radioactive substance transport operations.

To check:

- the risk of external exposure within the meaning of 1° of this article, an integrating measuring device that can record the dose over the period in question, such as a passive dosimeter, can be placed in the driver's cab. Good practice for a road transport carrier is to mount the dosimeter on the partition separating the driver's cab from the part of the vehicle that contains the consignment;
- the risk of internal exposure within the meaning of 2° of this article, the verifications carried out under the ADR (vehicle surface contamination measurements) can be combined with those stipulated in the Labour Code.

Article R. 4451-30 of the Labour Code

To allow an assessment of the external and internal exposure of the workers, the employer shall perform, or have a third party perform, technical controls of the ambient environment.
These controls comprise more specifically:
1° In the event of external exposure risks, measurement of the external dose rates indicating the radiation characteristics involved;
2° In the event of internal exposure risks, the measurements of the activity concentration in the air and of surface contamination indicating the characteristics of the radioactive substances present.
If these controls are not carried out on a continuous basis, their frequency is defined in accordance with an ASN resolution issued in application of Article R. 4451-34.

As ASN Resolution 2010-DC-0175 [13] only defines the frequencies of performance of ambient environment technical controls for "installations", this resolution does not apply to vehicles. Thus:

- for the ambient environment controls carried out by the company, the ADR is the only applicable regulatory framework: the frequency of the controls is defined by the company proportionately to the risks;
- for the ambient environment controls carried out by third party organizations (R. 4451-32 of the Labour Code), no regulatory framework sets the frequency of the controls at present. It is therefore considered that they are not to be carried out.

3.5.3 Controls provided for by the radioactive substance transport regulations

In order to verify that the level of contamination and the dose rates do not exceed the limits set by the regulations on the transport of radioactive substances, the ADR provides that controls be carried out on the packages, the vehicle and the equipment used for transport.

Prior to departure of the consignment, it is necessary to check compliance with the contamination and dose rate limits around the packages (see articles 4.1.9.1.2, 4.1.9.1.4, 4.1.9.1.10 to 12 of the ADR) and the vehicles[7] (see article 7.5.11 CV 33 (3.3) and (3.5) of the ADR). The controls performed (radiological measurements or appropriate demonstrations) must be recorded under the management system required by Article 1.7.3. of the ADR (also see chapter **Erreur ! Source du renvoi introuvable.**).

Extracts from the ADR	
2.2.7.2.4.1.2	A package containing radioactive material may be classified as an excepted package provided that the radiation level at any point on its external surface does not exceed 5 μSv/h.
4.1.9.1.2	The non-fixed contamination on the external surfaces of any package shall be kept as low as practicable and, under routine conditions of transport, shall not exceed the following limits: a) 4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters; and b) 0.4 Bq/cm^2 for all other alpha emitters.
4.1.9.1.4	Except as provided in 7.5.11, CV33, the level of non-fixed contamination on the external and internal surfaces of overpacks, containers, tanks, IBCs and vehicles shall not exceed the limits specified in 4.1.9.1.2.
4.1.9.1.10	Except for consignments under exclusive use[8], the TI[9] of any package or overpack shall not exceed 10 […]
4.1.9.1.11	Except for packages and overpacks carried under exclusive use under the conditions specified in 7.5.11, CV33 (3.5) a), the maximum radiation level at any point on any external surface of a package or overpack shall not exceed 2 mSv/h.
4.1.9.1.12	The maximum radiation level at any point on any external surface of a package or overpack under exclusive use shall not exceed 10 mSv/h.
7.5.11 CV 33 (3.3)	Loading of containers and accumulation of packages, overpacks and containers shall be controlled as follows: a) Except under the condition of exclusive use, and for consignments of LSA-I material, the total number of packages, overpacks and containers aboard a single vehicle shall be so limited that the total sum of the transport indexes aboard the vehicle does not exceed the values indicated in Table D below; b) The radiation level under routine conditions of transport shall not exceed 2 mSv/h at any point on the external surface and 0.1 mSv/h at 2 m from the external surface of the vehicle, except for consignments carried under exclusive use, for which the radiation limits around the vehicle are set forth in (3.5) b) and c). ; c) […]

[7] The limits on vehicles indicated in the ADR are not applicable to transport by air or sea. Refer to the technical instructions of the ICAO [3] or to the IMDG code [4] for further information.

[8] Use by a single consignor of a vehicle or of a large container in respect of which all initial, intermediate and final loading and unloading is carried out in accordance with the instructions of the consignor or the consignee, when this required by the ADR.

[9] TI means "transport index". Article 5.1.5.3 of the ADR indicates how it is calculated.

Table D: Transport Index limits for containers and vehicles not under exclusive use

Type of container or vehicle	Limit on total sum of transport indexes in a container or aboard a vehicle
Small container	50
Large container	50
Vehicle	50

7.5.11 CV 33 (3.5) For consignments under exclusive use, the radiation level shall not exceed:

a) 10 mSv/h at any point on the external surface of any package or overpack and may only exceed 2 mSv/h provided that:
   i) the vehicle is equipped with an enclosure which, during routine conditions of carriage, prevents the access of unauthorized persons to the interior of the enclosure;
   ii) provisions are made to secure the package or overpack so that its position within the vehicle enclosure remains fixed during routine conditions of carriage; and
   iii) there is no loading or unloading during the shipment;

b) 2 mSv/h at any point on the external surfaces of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle; and

c) 0.1 mSv/h at any point 2 m from the vertical planes represented by the outer lateral surfaces of the vehicle, or, if the load is carried in an open vehicle, at any point 2 m from the vertical planes projected from the outer edges of the vehicle.

Summary table of regulatory limits on dose rates

	Limits on packages		Limits on vehicles (*valid for land transport only*)		
	In contact	At 1 m	In contact	At 2 m	Maximum transport index of load
Excepted packages	5 µSv/h	-	2 mSv/h	0.1 mSv/h	50
Packages not carried under exclusive use	2 mSv/h	0.1 mSv/h			50
Non-excepted packages carried under exclusive use	10 mSv/h	No limit			No limit

(5.3) of 7.5.11 CV 33 of the ADR provides for a periodic check of the contamination of the equipment and vehicles used regularly for the carriage of radioactive materials. The frequency of these checks is determined by the company according to the probability of contamination and the consignments carried. This frequency shall be indicated in the RPP.

The ADR does not indicate precisely who must perform the checks, but they must be performed by competent persons who have received appropriate training (see section 1.3 and Article 1.7.2.5 of the ADR).

The vehicle contamination checks performed under the ADR can substitute for the ambient environment controls required by 2° of Article R. 4451-30 of the Labour Code to assess the risk of internal exposure. More specifically, for non-fixed contamination, the levels of vehicle surface contamination below which decontamination is not necessary are those given in Article 4.1.9.1.2 of the ADR: 4 Bq/cm^2 for gamma, beta and low toxicity alpha emitters and 0.4 Bq/cm^2 for the other alpha emitters. Furthermore, the radiation level resulting from fixed contamination shall not exceed 5 µSv/h (see Article 7.5.11 CV 33 (5.4) of the ADR).

The routine monitoring of contamination of the means of transport and the equipment is not required for sealed radioactive sources if it can be demonstrated that the risk of contamination is very low, which is the case in particular for radioactive materials in special form (gamma radiography devices, for example). This nevertheless assumes that no risk, incident or accident has arisen that could compromise the integrity of the source.

Lastly, before a vehicle that has been used to transport radioactive substances can be used for other purposes, the carrier must be able to demonstrate that the contamination of the internal surfaces of the vehicle is as low as reasonably achievable under the principle of optimisation imposed by Article L. 1333-2 of the Public Health Code. ASN considers that to achieve this objective, it is necessary at least to check that the internal surfaces of the vehicle are not contaminated (that is to say that the measured contamination levels must be below those set in Article 2.2.7.1.2 of the ADR, i.e. 0.4 Bq/cm^2 for the gamma, beta and low-toxicity alpha emitters and 0.04 Bq/cm^2 for the other alpha emitters).

Extracts from the ADR	
7.5.11 CV 33 (5.3)	A vehicle and equipment used regularly for the carriage of radioactive material shall be periodically checked to determine the level of contamination. The frequency of such checks shall be related to the likelihood of contamination and the extent to which radioactive material is carried".
7.5.11 CV 33 (5.4)	Except as provided in paragraph (5.5), any vehicle, or equipment or part thereof which has become contaminated above the limits specified in 4.1.9.1.2 in the course of carriage of radioactive material, or which shows a radiation level in excess of 5 µSv/h at the surface, shall be decontaminated as soon as possible by a qualified person and shall not be re-used unless the following conditions are fulfilled: a) the non-fixed contamination shall not exceed the limits specified in 4.1.9.1.2; b) the radiation level resulting from the fixed contamination shall not exceed 5 µSv/h at the surface.

3.6. Separation distances between packages and workers and between packages and the public

During transport operations, the minimum separation distances between the packages and workers who are not subject to individual dose monitoring, and between packages and the public, shall be respected (§ 7.5.11 CV 33 (1.1) and associated Table A of the ADR). These separation distances also apply to the work areas and areas normally accessible to the public. The aim to reduce the doses received by segregating the sources of ionising radiation from persons.

Extracts from the ADR

7.5.11 CV 33 (1.1) Packages, overpacks, containers and tanks containing radioactive material and unpacked radioactive material shall be segregated during carriage:

a) from workers in regularly occupied working areas
   i) in accordance with Table A below; or
   ii) by distances calculated using a dose criterion of 5 mSv in a year and conservative model parameters;

[…]

b) members of the public, in areas where the public has regular access:
   i) in accordance with Table A below; or
   ii) by distances calculated using a dose criterion of 1 mSv in a year and conservative model parameters;

c) […]

Table A: **Table A: Minimum distances between packages of category II-YELLOW or of category III-YELLOW and persons**

Exposure time per year (hours)				
Sum of transport indexes not more than	**Areas where members of the public have regular access**		**Regularly occupied working areas**	
	50	**250**	**50**	**250**
	Segregation distance in metres, no shielding material intervening, from			
2	1	3	0,5	1
4	1.5	4	0.5	1.5
8	2.5	6	1.0	2.5
12	3	7.5	1.0	3
20	4	9.5	1.5	4
30	5	12	2	5
40	5.5	13.5	2.5	5.5
50	6.5	15.5	3	6.5

Example: with a load whose transport index equals 1 (and therefore not exceeding 2), the packages of categories II-Yellow and III-Yellow of this load shall be placed at least 1 m from members of the public (considering the minimum exposure hypothesis of table A, namely an area to which the public has regular access but is only exposed for 50 h/year).

The carrier may also choose not to use the values of table A and calculate the minimum applicable distances itself, with a maximum dose criterion of 5 mSv/year for workers who are not subject to individual dosimetric monitoring and 1 mSv/year for the public, and using conservative assumptions (§ 7.5.11 CV 33 (1.1) a) ii) and b) ii) of the ADR). The dose constraints set for the public and workers must also be taken into account (see chapter 3.4.4).

The RPP shall indicate the separation distances to apply (when this is relevant in view of the company's activities).

The regulations require that vehicles transporting radioactive materials:

- be parked in a supervised park;
- or be parked unsupervised in a secure depot or secure factory premises;
- or, failing this, be parked on a site separated from major public highways and dwellings, where the public does not normally pass or assemble (see article 8.4. of the ADR and S21 of article 8.5).

Article 2.6.3 of appendix I of the TMD order limits the parking durations (generally to 72 hours in the general case). These provisions also serve to limit the doses received by the workers and the public. They can in particular help ensure compliance with the separation/segregation distances mentioned above.

Article 2.6.3 of the TMD Order

Limitation of the duration of parking and in-transit storage of radioactive materials

Without prejudice to the requirements of 8.4 and 8.5, the following provisions apply to the parking during carriage of vehicles transporting radioactive materials and the in-transit storage of radioactive materials, off the premises of the consigner and the consignee if they come under one of the regimes mentioned in Article L. 1333-4 of the Public Health Code.

The duration of a parking period in the course of carriage or of an in-transit storage period is limited to 72 consecutive hours. This duration can be extended by 24 hours if a public holiday falls the day before or after a weekend or by 48 hours if the public holiday is separated from a weekend by a single working day.

If the parking or in-transit storage takes place in a loading, unloading and transfer centre, its duration may be extended in the event of constraints associated with the delay of a ship, or the impossibility to board an aircraft, or the formation, separation or inspection of a rail convoy.

If the parking or in-transit storage takes place within a basic nuclear installation defined in Article L. 593-2 of the Environment Code or a defence-related nuclear installation defined in Article L. 1333-15 of the Defence Code, its duration can be extended to one week.

If an event arises that obliges parking during carriage or in-transit storage beyond the above durations, the carrier shall inform the consigner and the consignee as soon as possible in order to determine the measures to take. The duration limits defined above do not start to run until it is once again possible to stop the parking or in-transit storage.

If the duration of a parking period or an in-transit storage period during carriage exceeds 72 hours, the checks stipulated in point c of Article 1.4.2.2.1 of the ADR are carried out every 24 hours, after a period of 72 hours. These operations are recorded for purposes of traceability.

The present paragraph does not apply to:

- excepted packages coming under UN number 2908;
- uncleaned empty tanks coming under UN numbers 2912, 3321 or 3322.

Extracts from the ADR

8.4.1 Vehicles carrying dangerous goods in the quantities shown in special provisionsS1 (6) and S14 to S24 of chapter 8.5 for a given substance according to Column (19) of Table A of Chapter 3.2[10] shall be supervised or alternatively may be parked, unsupervised, in a secure depot or secure factory premises. If such facilities are not available, the vehicle, after having been properly secured, may be parked in an isolated position meeting the requirements of a), b) or c) below:

a) a vehicle park supervised by an attendant who has been notified of the nature of the load and the whereabouts of the driver;

[10] Column (19) of Table A of Chapter 3.2 of the ADR indicates that the special provision S21 of Chapter 8.5 is applicable for all radioactive substances

	b) A public or private vehicle park where the vehicle is not likely to suffer damage from other vehicles; or c) A suitable open space separated from the public highway and from dwellings, where the public does not normally pass or assemble. The parking facilities permitted in b) shall be used only if those described in a) are not available, and those described in c) may be used only if facilities described in a) and b) are not available.
Chapter 8.5 S21	The provisions of Chapter 8.concerning the supervision of vehicles shall apply to all material, in whatever mass. In addition, these goods shall be subject at all times to supervision to prevent any malicious act and to alert the driver and the competent authorities in the event of loss or fire. However, the provisions of Chapter 8.4 need not be applied where: a) The loaded compartment is locked or the packages carried are otherwise protected against illicit unloading; and b) The dose rate does not exceed 5 μSv/h at any accessible point on the outer surface of the vehicle.

3.7. Training

All workers, when they could be exposed to ionising radiation during a transport operation, shall be trained in radiation protection in order to know the characteristics of ionising radiation, the risks it presents, the ways of protecting themselves and other persons against them, and the regulatory provisions (see Article 1.7.2.5 of the ADR). This requirement also enables the radiation protection culture to be promoted within the company, which is a vital factor in keeping exposure levels as low as reasonably achievable.

The level of training must proportionate to the risks and the responsibilities of the worker.

Article 1.7.2.5 of the ADR

Workers (see 7.5.11 CV 33 Note 3) shall be appropriately trained in radiation protection including the precautions to be observed in order to restrict their occupational exposure and the exposure of other persons who might be affected by their actions.

Furthermore, this training obligation shall be interlinked with those set by the Labour Code concerning information and training in general, and more specifically in the event of a risk of exposure to ionising radiation.

Extracts from the Labour Code
Article R. 4451-47.

Workers liable to work in monitored or controlled areas or on the work sites of the facilities mentioned in the second paragraph of Article R. 4451-2 receive radiation protection training organised by the employer.

This training covers:
1° The risks associated with exposure to ionising radiation;
2° The general radiation protection procedures implemented in the facility;
3° The prevention and protection rules set by the provisions of this chapter.
The training is adapted to the particular radiation protection procedures affecting the occupied job position and the rules governing the response in abnormal situations.

Article R. 4451-48.

When workers could be exposed to high-activity sources such as those mentioned in Article R. 1333-33 of the Public Health Code, the training is reinforced, particularly in the aspects relating to safety and the potential consequences of loss of adequate control of the sources.
Article R. 4451-49. For pregnant women and young workers as mentioned in Articles D. 4152-5 and D. 4153-34, the training takes into account the particular prevention rules that apply to them
Article R. 4451-50. Refresher training is provided periodically and at least every three years. Training is refreshed whenever necessary in the cases and under the conditions set out in Articles R. 4141-9 and R. 4141-15.
Article R. 4451-52. Prior to any work in a controlled area, the employer shall give each worker a leaflet indicating the particular risks associated with the position occupied or the work to accomplish, the applicable safety rules, and the instructions to follow if an abnormal situation arises.

It is considered good practice for the training dispensed under the ADR (see Article 1.7.2.5) to follow the training conditions stipulated in the Labour Code for workers entering regulated areas (Articles R. 4451-47 to 50 of the Labour Code), and in particular that the training be refreshed every three years. If this is not the case, the employer must be able to demonstrate that the training it provides is appropriate for the exposure risks.

The regulations also provide that workers must receive training in line with their responsibilities addressing the regulatory requirements that concern them and safety in general. On this account they shall, among other things, be trained in the management of accident situations (see ASN Guide No. 17 [18]), and receive information as provided for in Article R. 4451-52 of the Labour Code if they work in controlled areas.

3.8. Management system (quality assurance)

This chapter of the RPP shall indicate the way in which the requirements of the company's management system are applied to the RPP.

Implementation of the RPP shall meet the formalisation and traceability requirements of the management system that is required for any transport operation (see Article 1.7.3 of the ADR), which can be used to ensure compliance with the regulatory requirements. This applies in particular to the results of the various checks or assessments that must be carried out.

Article 1.7.3 of the ADR

A management system based on international, national or other standards acceptable to the competent authority shall be established and implemented for all activities within the scope of ADR, as identified in 1.7.1.3, to ensure compliance with the relevant provisions of ADR. Certification that the design specification has been fully implemented shall be available to the competent authority. The manufacturer, consignor or user shall be prepared:

a) To provide facilities for inspection during manufacture and use; and
b) To demonstrate compliance with ADR to the competent authority.

Where competent authority approval is required, such approval shall take into account and be contingent upon the adequacy of the management system.

Under the management system, the RPP effectiveness shall be assessed more specifically on the basis of an experience feedback analysis and periodic reviews. The management system shall therefore provide for such reviews and specify their scope such that they cover all the areas addressed in the RPP and are held at appropriate frequencies for the risks and for the particularities of the company. This also helps ensure compliance with the provisions of Article R. 1333-7 of the Public Health Code, which also provides for the implementation of in-house controls to ensure compliance with the radiation protection provisions (see section **Erreur ! Source du renvoi introuvable.**).

The management system shall provide for the RPP:

- to be revised at each major change that could impact the radiation protection of the workers or the public on account of the transport activities (also see section 3.4.1);
- to undergo a periodic review to ascertain that its content remains relevant and up to date, particularly with regard to lessons learned from experience feedback. The frequency of this review is to be determined by the company, but should be consistent with the frequency of the review of received doses (see section 3.4.1).

4. OTHER REGULATORY OBLIGATIONS

4.1. Radiation Protection Expert-Officer (RPE-O)[11]

The employer appoints a Radiation Protection Expert-Officer (RPE-O) after consulting the CHSCT (Committee for Health, Safety and Working Conditions) or, failing this, the employee representatives (Article R. 4451-107 of the Labour Code).

Self-employed workers are also obliged to appoint an RPE-O (Articles R. 4451-103 and 106 of the Labour Code, Order of 6th December 2013 relative to the conditions of training the RPE-O [10] and ASN Resolution 2009-DC-0147 relative to the outsourcing of the RPE-O [14]).

Extracts from the Labour Code

Article R. 4451-103.

The employer shall appoint at least one Radiation Protection Expert-Officer when the presence, the handling, the utilisation or the storage of a sealed or unsealed radioactive source or of an ionising radiation generator leads to a risk of exposure for the employer's workers or those of outside contractors or self-employed workers conducting work in this facility.

Article R. 4451-106.

[11] In France, the Radiation Protection Expert-Officer (RPE-O) [formerly referred to in ASN documents as the PCR (person competent in radiation protection), reflecting the French term and acronym "Personne compétente en radioprotection (PCR)"], is appointed by the employer of persons exposed to ionising radiation in the course of their work. Under the responsibility of the employer, the RPE-O participates in preparing the notification or licensing file and assessing the nature and extent of the risks to which the workers are exposed and in organising radiation protection. The RPE-O carries out internal radiation protection controls and keeps track of third-party radiation protection controls carried out by approved organisations. The RPE-O monitors worker radiation protection. Lastly, the RPE-O is involved in defining and implementing worker safety training for aspects concerning radiation protection and participates in the management of cases where worker exposure limit values are exceeded. These duties correspond to those of both Radiation Protection Expert (RPE) and Radiation Protection Officer (RPO), hence the adoption of the umbrella term Radiation Protection Expert-Officer (RPE-O).

In facilities other than those mentioned in Article R. 4451-105, the employer can appoint a Radiation Protection Expert-Officer external to the facility who exercises the functions under conditions set out, in view of the nature of the activity and the extent of the risk, in an ASN resolution approved by the Ministers responsible for labour and agriculture.

For radioactive material transport activities, the RPE-O shall hold a certificate delivered on completion of training referred to as:

- level 1, "radioactive substances transport" sector, if the transported packages are only of the excepted type[12] ;
- of level 2, radioactive substances transport" sector in all other cases.

The RPE-O is appointed among the company employees. However, as transport activities are subject to the notification system provided for under the Public Health Code, the employer can appoint an external RPE-O (unless the employer exercises an activity that is otherwise subject to licensing). An external RPE-O must have received level-2 training.

In the case of loading or unloading operations, and as specified in the DGT/ASN Circular No. of 21st April 2010 [15], the head of the carrier company can designate the RPE-O of the destination company on the carrier's behalf, if a formalised agreement between the two companies provides for this.

If a company only carries out a few transport operations per year, the obligation to have an RPE-O only applies for the duration of these operations (if there are no other nuclear activities).

The duties of the RPE-O, whether internal or external to the company, are set out in Articles R. 4451-110 to R. 4451-113 of the Labour Code.

Extracts from the Labour Code

Article R. 4451-110.

The Radiation Protection Expert-Officer is consulted with regard to the delimiting of monitored or controlled areas and the defining of the particular rules applicable to them.

Article R. 4451-111.

The Radiation Protection Expert-Officer participates in the defining and implementation of the safety training of exposed workers, organised in application of Article R. 4451-47.

Article R. 4451-112.

Under the responsibility of the employer and in collaboration with the Committee for Health Safety and Working Conditions or, failing this, the employee representatives, the Radiation Protection Expert- Officer:

1° Helps to prepare the notification file or licensing application provided for in Article L. 1333-4 of the Public Health Code;

2° Carries out a preliminary assessment to identify the nature and extent of the risk incurred by the exposed workers. The persons supervising the works or operations assist the RPE-O in this task;

3° Defines, after conducting this assessment, the appropriate protection measures to implement. The RPE-O checks their appropriateness in the light of the results of the technical controls and active dosimetry, and the effective doses received;

[12] Excepted packages are those corresponding to the lowest radiological risk level (see definition in 2.2.7.2.4.1 of the ADR).

4° Lists the work situations or modes that could justify exposure, subject to the delivery of the special license required in application of Article R. 4451-15, defines the collective and individual dose targets for each operation and checks their implementation;
5° Defines the necessary means required in abnormal situations.

Article R. 4451-113.

When an operation involves a risk of exposure to ionising radiation for the workers of outside contractors or for self-employed workers, the head of the user company involves the Radiation Protection Expert-Officer in defining and implementing the overall coordination of prevention measures provided for in Article R. 4451-8.
On this account the Radiation Protection Expert-Officer appointed by the head of the user company makes all necessary contacts with the Radiation Protection Expert-Officers that the heads of outside contractor companies are obliged to appoint.

4.2. The Transport Safety Advisor (TSA)

In application of Article 1.8.3.1 of the ADR, of the RID and of the ADN, companies involved in land transport (by road, rail or inland waterways) as packer, loader, carrier or unloader, must also appoint a Transport Safety Advisor (TSA).

Article 1.8.3.1 of the ADR

Each undertaking, the activities of which include the carriage, or the related packing, loading, filling or unloading, of dangerous goods by road shall appoint one or more safety advisers for the carriage of dangerous goods, responsible for helping to prevent the risks inherent in such activities with regard to persons, property and the environment.

Article 6 of the "TMD" order indicates the exemptions. Companies that only carry out transport operations by air or sea[13] are not subject to this obligation.

The TSA must hold a certificate covering class 7 (radioactive materials) and the modes of land transport used (road, rail and inland waterways), delivered by an approved body. The function of TSA can be fulfilled by any person in the company (including the head of the company) or by a person external to the company, provided that the person is effectively capable of fulfilling the tasks of advisor.

The TSA - the company's expert in the safety of transport operations, and the RPE-O - the expert in occupational radiation protection reporting to the employer, have specific and separate skills. Their training and their appointment meet different requirements. Consequently, one cannot substitute for the other. Collaboration between the RPE-O and the TSA is nevertheless essential. Furthermore, the two functions can be fulfilled by the same person.

[13] Air transport is taken as meaning any transport operation on an airport platform and any carriage operation by air. Sea transport is taken as meaning only the carriage operation that actually takes place by sea.

4.3. Medical monitoring

The workers involved in transport operations are subject to reinforced individual health monitoring, baptised "SIR" in French (Articles R. 4624-22 et seq. of the Labour Code), if they are classified in category A or B.

The SIR comprises a medical examination of fitness for the job, carried out by the occupational physician before the worker is assigned to the post. The SIR is carried out annually for workers in category A (Article R. 4451-84 of the Labour Code), while for category B workers the frequency is determined by the occupational physician with a minimum frequency of once every four years and with an intermediate check-up by a health professional no later than two years after the examination by the occupational physician.

For workers who are not classified, only the "VIP" (French acronym for "information and prevention check-up") (Articles R. 4624-10 to R. 4624-21[14] of the Labour Code) applies.

In accordance with Article R. 4451-9 of the Labour Code, self-employed workers shall take the necessary measures to ensure they receive appropriate medical monitoring.

The provisions of the order of 17th July 2013 relative to the medical and dosimetric monitoring card for workers exposed to ionising radiation [9] are applicable.

4.4. Delimitation of regulated areas with respect to the risk of exposure to ionising radiation (zoning)

In the context of a radioactive substance transport operation, the "zoning" order [11] applies only to the operations upstream and downstream[15] of the carriage of radioactive substances on road or rail (see III of its article 17).

During the phase of carriage on the public highway, only the "transport" regulations (ADR and "TMD" order) are applicable, and in particular the provisions concerning the minimum distances between the packages and the public and the parking requirements (see chapter 3.6).

Where air freight zones are involved, the air transport regulations are applicable.

During the carriage phase of a transport operation on the public highway, in-transit storage or parking phases whose durations exceed those authorised by Article 2.6.3 of Appendix I of the TMD Order (72 hours in the general case, see chapter **Erreur ! Source du renvoi introuvable.**) are no longer governed by the transport regulations but by the "zoning" order [11].

When the "zoning" order [11] is applicable, zones should be defined in accordance with the rules set for the installations (Articles 3 to 11 of the Order).

[14] Taken from Decree 2016-1908 of 27th December 2016 relative to the modernisation of occupational medicine

[15] The terms:

- upstream operations means: package preparation and loading of the vehicle;
- downstream operations means: reception and unloading of the vehicle.

GLOSSARY

ADN	European agreement concerning the international carriage of dangerous goods by inland waterways
ADR	European agreement concerning the international carriage of dangerous goods by road
ALARA	As low as reasonably achievable
ASN	*Autorité de sûreté nucléaire* - French nuclear safety authority
BNI	Basic Nuclear Installation
DUER	*Document Unique d'Évaluation des Risques* - Unified risks assessment document
IAEA	International Atomic Energy Agency
IMDG	International Maritime Dangerous Goods Code
LSA	Low specific activity
ICAO	International Civil Aviation Organisation
RPE-O	Radiation Protection Expert-Officer
RPP	Radiation Protection Programme
RID	Regulations governing the international carriage of dangerous goods by rail
SCO	Surface contaminated object
TI	Transport Index
TSA	Transport Safety Advisor

APPENDIX I: Examples of simple calculations for assessing the dose received by workers or the public

Application of the inverse square law which states that the intensity of radiation is inversely proportional to the square of the distance from the source

In simple cases, the dose can for example be assessed using the law whereby intensity is inversely proportional to the square of the distance from the source:

$$I = I_0 \left(\frac{D_0}{D}\right)^2$$

I: dose rate at D metres from the source

I_0: dose rate at D_0 metres from the source

This formula is valid for small-sized packages which can be likened to point sources (a source can considered a point source if the distance D between the source and the point in question is at least 5 times greater than the largest dimension of the source).

The dose rate at D0 meters from the source can be obtained using the package transport index (a TI of 10 signifies that the dose rate I0 equals 0.1 mSv/h at D0= 1 m from the package).

Example 1: Administrative personnel in a freight transport company

Situation envisaged

The storage area of a freight transport company is situated 10 metres from an office occupied by the administrative personnel. The office has 20-cm thick concrete walls. This thickness reduces the dose rate by a factor of 1/50 (this is an arbitrary value taken as an example; in an RPP, this value would have to be substantiated).The packages are stored for 3 hours per day at the most and have a total transport index of 10, which corresponds to a dose rate of 0.1 mSv/h at 1 metre from the package.

Exposure calculation

Considering that this is a point source (approximation that is acceptable for small packages, given the low risks), the attenuation factor due to the distance between the dose rate at d0 = 1 m (the transport index) and the dose rate at d = 10 m (distance between the workers and the packages) can be considered to be the inversely proportional to the square of the distances, that is to say:

$$\left(\frac{\mathrm{d_0}}{\mathrm{d}}\right)^2 = \frac{1^2}{10^2} = \frac{1}{100}$$

Given the distance between the packages and the workers, and the thickness of the wall, the total reduction factor with respect to the dose rate at 1 m is:

$$1/100 \times 1/50 = 1/5000.$$

The dose rate in the office is therefore 100/5000 = 0,02 µSv/h when the packages are present, which - given the maximum duration of package presence of 3 hours per day - corresponds to 0.06 µSv/day. If we assume a working year of 230 days, the effective dose will be 230 × 0.06 = 13.8 µSv.

Example 2: Driver transporting radiopharmaceuticals

Situation envisaged

A driver transports two category III-Yellow packages at the most per journey.

The packages are loaded at the last minute in order to minimise the time they spend near the driver. Furthermore, they are loaded by another handler, not by the driver. The packages are positioned as far as possible from the driver's cab, which, given the type of vehicle, maintains a distance of 2 metres between the packages and the driver during the journey.

The carriage is not under exclusive use therefore the dose rate at 1 metre from each package is less than 0.1 mSv/h. However, to ensure a conservative approach, it is assumed that the dose rate of each package is maximal, that is to say 0.1 mSv/h at 1 m.

Exposure calculation

Considering a point source and applying the inverse square law, we obtain an attenuation factor between the dose rates at 1 m and 2 m of
$\frac{1^2}{2^2} = \frac{1}{4}$.

The driver is therefore exposed to a dose of 0.1/4 = 0.025 mSv/h for each package, that is to say 2 × 0.025 = 0.05 mSv/h for the two packages together.

Assuming that the driver makes a journey of one hour per day, 230 days per year, the predicted annual dose received is 230 × 0.05 = 11.5 mSv.

Remark: In view of the predicted calculated exposure, the RPP should provide for technical or organisational means of reducing the driver's exposure. For example, placing a 3-mm thick lead shielding plate behind the driver's cab would reduce the dose by about 30% (in the case of packages containing fluorine 18), which would reduce the driver's predicted annual dose to 8 mSv.

Example 3: Dose received by a member of the public, exposure of a motorway toll attendant

Situation envisaged

A carrier carries out weekly transport operations on the same given motorway section (to make deliveries to a hospital situated near that motorway, to gain access to an airport, etc.). The passage of the vehicle at the toll lasts 2 minutes on average. The toll attendant is situated 2 m from the load. It is considered that there is no shielding screen between the toll attendant and the load.
The dose rate at 2 m from the vehicle is the maximum authorised by the regulations in Article 7.5.11 CV33 (3.3) b) of ADR (0.1 mSv/h at 2 m).

Exposure calculation

The employee is therefore exposed to 0.1 mSv/h x 2 min = 3.3 µSv at each passage of the vehicle.

Over one year, that employee, assuming conservatively that it is always the same person, is exposed to 174 µSv solely on account of this practice.

Remark: In view of the predicted exposure, the RPP should envisage optimising the dose received by this member of the public. Technical and organisational means for reducing the exposure of the toll attendant can still be envisaged (limitation of the activity of the packages, additional vehicle shielding, positioning the packages away from the wall of the vehicle to reduce the contact dose rate, etc.), or even using the electronic payment toll lanes to avoid exposing the toll attendant.

APPENDIX II

Example of bibliographic study

Table 3 of the IAEA Safety Guide TS-G-1.3 [16] gives the results of a study linking the doses received by the workers to the transport indexes of the packages handled.

Table 3 of IAEA Safety Guide TS-G-1.3[16]

Category of packages	Maximum number of packages handled annually resulting in an individual occupational dose not exceeding 1 mSv/year	
	Scenario: for each package, worker is located at 1 m for 30 min	Scenario: for each package, worker is located at contact for 5 min and at 1 m for 25 min
Category I-WHITE	4000	1600
Category II-YELLOW	200	40[a]
Category III-YELLOW	20	6[b]
Category III + exclusive use	0	0
[a] Forty packages with an average dose rate of 0.25 mSv/h at contact and TI = 1 [b] Six packages with an average dose rate of 1.25 mSv/h at contact and TI = 10		

[16] This table is reproduced with the kind permission of the International Atomic Energy Agency.

THE COLLECTION OF ASN GUIDES

No. 1 Disposal of radioactive waste in deep geological formations

No. 2 Transport of radioactive materials in airports

No. 3 Recommendations for the preparation of annual public information reports concerning BNIs

No. 4 Self-assessment of risks for external-beam radiotherapy patients

No. 5 Management of safety and quality of care in radiotherapy

No. 6 Final shutdown, decommissioning and delicensing of BNIs in France

No. 7 Civil transport of radioactive packages or substances on the public highway *(3 volumes: shipments, packages requiring and not requiring approval)*

No. 8 Conformity assessment of nuclear pressure equipment

No. 9 Determining the perimeters of a basic nuclear installation (BNI)

No. 10 Local involvement of CLIs in the 3rd ten-yearly outages of the 900 MWe reactors

No. 11 Notification and codification of criteria related to significant radiation protection events (*excluding BNIs and radioactive material transport operations*)

No. 12 Notification and codification of criteria related to significant safety, radiation protection or environmental events applicable to BNIs

No. 13 Protection of BNIs against external flooding

No. 14 Remediation of structures in BNIs in France

No. 15 Control of activities in the vicinity of BNIs

No. 16 Significant patient radiation protection event in radiotherapy: notification and classification on the ASN-SFRO scale

No. 17 Content of radioactive substance transport incident and accident management plans

No. 18 Disposal of effluents and waste contaminated by radionuclides, produced in facilities licensed under the Public Health Code

No. 19 Application of the order of 12/12/2005 relating to nuclear pressure equipment

No. 20 Drafting of the medical physics organisation plan (POPM)

No. 21 Processing conformity deviations with respect to a specified requirement for an EIP PWR - Radiological accident risks

No. 22 Design of pressurised water reactors

No. 23 Definition and modification of the waste zoning plan for BNIs

No. 24 Management of soils polluted by BNI activities

No. 25 Preparation of an ASN regulation or an ASN guide: procedures for consultation with stakeholders and the public

No. 27 Stowage of radioactive packages, materials or objects for transportation

No. 28 Qualification of scientific computing tools used in the nuclear safety case

No. 29 Radiation protection in radioactive substance transport activities

No. 31 Notification procedures for events relating to the transport of radioactive substances

No. 32 In-vivo nuclear medicine facilities - Minimum technical rules for design, operation and maintenance

No. 34 Implementation of regulatory requirements applicable to on-site transport operations

15, rue Louis Lejeune
92120 Montrouge
Centre d'information du public : 01 46 16 40 16 · info@asn.fr

Coordonnées des divisions de l'ASN :
www.asn.fr/Contact

www.asn.fr/Professionnels