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ASN REPORT

on the state of nuclear safety and radiation protection in France in 2014

AUTORITÉ
DE SÛRETÉ
NUCLÉAIRE

The ASN (Nuclear Safety Authority) Report on the state of nuclear safety and radiation protection in France in 2014.

This report is specified in Article L. 592-31 of the Environment Code.

It was submitted to the President of the Republic, the Prime Minister and the Presidents of the Senate and the National Assembly, pursuant to the above-mentioned Article.

SUMMARY

Appendix

ASN actions

Activities regulated by ASN

IMPROVING NUCLEAR SAFETY AND RADIATION PROTECTION: A DUTY AS IMPORTANT AS EVER

FROM LEFT TO RIGHT:
Philippe JAMET - Commissioner
Margot TIRMARCHE - Commissioner
Pierre-Franck CHEVET - Chairman
Jean-Jacques DUMONT - Commissioner
Philippe CHAUMET-RIFFAUD - Commissioner

Montrouge, 3rd March 2015

2014 was generally in line with previous years in terms of nuclear safety and radiation protection.

The situation is on the whole relatively satisfactory, but we cannot afford to rest on our laurels. The scale of the challenges and the expectations of society mean that the nuclear safety and radiation protection requirements must be gradually tightened, in the light of accident analysis, increasing scientific knowledge and technological developments.

> *“This principle of reinforced safety and radiation protection applies to all facilities, including those which have been in service for many decades.”*

This concern is apparent internationally. In this respect, 2014 was a significant year:
- the European directives on nuclear safety and radiation protection were significantly reinforced;
- a coordinated approach to the management of emergency situations was proposed by all the European safety and radiation protection regulators.

This principle of reinforced nuclear safety and radiation protection applies to all facilities, including those which have been in service for many decades. The problems encountered in certain facilities in 2014 (CIS bio international, Osiris, FBFC, etc.) illustrate the problems involved in implementing this principle. Similarly, the possible continued operation of the nuclear power plants (NPPs) beyond forty years and the numerous periodic safety reviews initiated on research and fuel cycle facilities means that major and complex work will be required as of 2015.

This year 2015 will also be marked by:
- the beginning of examination of the Flamanville EPR NPP commissioning file;
- continued work to limit the doses resulting from public exposure to radon;
- continued work to ensure improved management of the exposure of patients and health care professionals, particularly in diagnostic radiology and during interventional procedures.

REINFORCED SAFETY REQUIREMENTS

In accordance with the European Nuclear Safety Directive and the recommendations of WENRA (Western European Nuclear Regulators Association), ASN is demanding continuous progress in the safety of the nuclear facilities, whether new-build or existing installations, the safety of which is periodically reassessed.

Learning the lessons of the Fukushima Daiichi disaster is part of this process. Following the stress tests, ASN required that the nuclear facilities be made more resistant to extreme natural hazards and that additional safety structures and equipment (hardened safety core) be installed. In early 2015, ASN completed the definition of all the requirements concerning this hardened safety core. A first series of material and organisational improvements have already been made. Considerable work still has to be done however. It will extend beyond 2020.

The major challenges for the coming years will be to analyse the proposals from the licensees concerning this work and to monitor its performance.

The nuclear facilities are subject to periodic safety reviews every ten years. Their continued operation depends on a demonstration of their conformity with the safety requirements applicable to them and on the implementation of improvements in line with the level of safety of the most recent facilities. This approach has already been used for the EDF reactors and for some facilities of the French Alternative Energies and Atomic Energy Commission (CEA) and Areva. The next few years will be marked by a significant increase in the number of fuel cycle and research facilities to be examined. These facilities are often ageing and some of them will be undergoing their first review. Difficult safety issues will need to be addressed.

ASN will also continue to assess the possibility of the EDF reactors continuing to operate beyond their fourth periodic safety review. As things currently stand, this is not a foregone conclusion. The first periodic safety review concerned will take place in 2020. The schedule is thus a very tight one, given the complexity of the questions to be dealt with and the importance and scale of the corresponding challenges.

Examination of the Flamanville 3 EPR NPP commissioning application will begin in 2015. As this is the first third-generation reactor to be built in France, this commissioning process is of particular importance. The commissioning is scheduled by EDF for 2017 and will entail the deployment of considerable human and financial resources by ASN and by the French Institute for Radiation Protection and Nuclear Safety (IRSN).

Difficulties were once again observed in 2014 in the field of nuclear pressure equipment, both for the manufacturing and assembly operations and in the implementation of the new applicable regulatory provisions. These in particular concern the primary and secondary systems of the EPR reactor and the replacement steam generators, notably those of Le Blayais NPP reactor 3. Some of these deviations entailed large-scale repairs and the development of more effective inspection methods. ASN thus asked Areva and EDF for more extensive safety justifications prior to installation of the steam generators and the restart of reactor 3 at the Le Blayais NPP. More generally, long-term solutions must be implemented to ensure compliance with the regulations in this field.

MEDICAL RADIATION PROTECTION NEEDS TO BE MORE EFFECTIVE

Medical radiation protection remains a priority for ASN. Its work in this field will follow on from that performed in previous years. The main challenges will be to manage the doses delivered to patients in imaging and radiotherapy, and the exposure of health professionals in the operating theatres.

In France, medical imaging for diagnostic purposes is the second most important source of exposure of the population to ionising radiation after naturally occurring radiation. This exposure is continuing to rise as a result of the increased utilisation of certain radiological examinations. The largest contribution by far is from computed tomography. Optimum management of exposure entails strict application of the justification principle: the use of ionising radiation must be reserved for those cases in which non-irradiating techniques such as magnetic resonance imaging (MRI) or ultrasonography are unsuitable. The optimisation principle must also be used to obtain the necessary diagnostic image quality, while minimising patient exposure as far as possible. The main priorities in this field are to reinforce medical physics resources and facilitate access to MRI techniques.

In the field of radiotherapy, four incidents rated level 2 on the ASN-SFRO scale concerning excessive irradiation or doses erroneously delivered to patients were recorded by ASN in 2014. This field requires compliance with particularly rigorous quality assurance procedures, owing to the scale of the doses delivered and the precision of the areas to be irradiated during treatment. The technologies used are also changing extremely fast and if they are to be correctly assimilated by the staff, then sufficient numbers of medical physicists and dosimetrists are required.

Two incidents concerning doses received by physicians during imaging interventions were rated level 2 on the INES scale by ASN in 2014. More generally, and in particular when fluoroscopy-guided procedures are carried out in the operating theatres, interventional radiology inspections show the need to draft and follow operating procedures, ensure a higher level of initial and on-going training of all those involved, increase the involvement by medical physicists and persons competent in radiation protection and, finally, create a true radiation protection culture that is shared by all the personnel.

GROWING EUROPEAN HARMONISATION

ASN continues to play an important role in the European organisations, in particular WENRA, HERCA (Heads of the European Radiological protection Competent Authorities) and ENSREG (European Nuclear Safety Regulators Group). The goals are to harmonise nuclear safety and radiation protection requirements, to promote the independence of the regulators and to act transparently, while communicating with all aspects of society.

Significant European radiation protection and nuclear safety directives have been published or revised since 2013 and their implementation in the coming years implies considerable work:

- in 2015, ASN will continue to coordinate the work to transpose directive 2013/59 /Euratom of 5th December 2013 into French law, specifying the basic radiation protection standards. The first texts will primarily concern: extension of the scope of regulatory oversight to industrial activities using naturally radioactive materials, the implementation of specific management of exposure resulting from an accident, special measures for chronic exposure situations (contaminated sites, exposure to radon, etc.), and reinforcement of the notion of a graduated approach to regulatory oversight according to the stakes involved;
- for several years now, ASN has been involved in the radon action plan in France and in 2014 organised an international seminar on management of the radon risk, in particular in the home;
- a revision of the "nuclear safety" directive was adopted by the Council of Ministers in July 2014. It explains the general safety objectives to be met by nuclear facilities. It introduces a mandatory periodic safety review of each facility at least every ten years and the performance of coordinated Europe-wide examinations on specific safety topics, similar to the post-Fukushima Daiichi stress tests. The obligations to inform the public and the stakeholders are also reinforced.

These improvements to the European safety approach are to be compared with the difficulties being experienced with advancing the situation internationally in these fields.

The radioactive releases from a severe nuclear accident in a European country could affect several other countries in Europe. In a situation such as this, harmonisation of emergency situation management would be essential for effective population protection measures. A significant milestone was reached on this subject in 2014. The European radiation protection and nuclear safety authorities, grouped together within HERCA and WENRA, adopted recommendations for harmonising immediate population protection measures and the associated perimeters in the various European countries affected by radioactive releases. A wide range of accidents is considered, including the most severe, comparable to that at Fukushima Daiichi nuclear power plant. In each State, dialogue is now required with the authorities in charge of civil protection so that these recommendations can be implemented. This approach, which is vital to protecting the populations in the event of a severe nuclear accident, is a priority for ASN.

At the request of the Prime Minister, ASN will in 2015 continue to coordinate the work of the Steering Committee for managing the post-accident phase of a nuclear accident or radiological emergency situation (CODIRPA) on the management of post-accident situations. It will share the results with its European partners, with a view to eventual harmonisation.

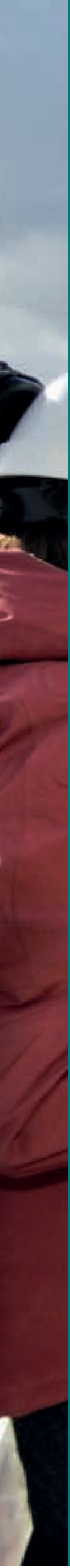
REINFORCED SAFETY OVERSIGHT

In 2014, the ASN Commission issued two opinions underlining the need to reinforce the State's oversight system to deal with unprecedented nuclear safety and radiation protection issues, such as the aftermath of the Fukushima Daiichi disaster, the generalised adoption of safety reassessments for all nuclear facilities, the possible continued operation of EDF reactors beyond their fourth periodic safety review, monitoring the commissioning of the Flamanville EPR NPP and the safety assessment of the radioactive waste disposal projects.

The need for this reinforcement was confirmed by the audit of the French nuclear safety and radiation protection oversight system in 2014, carried out by an international team of experts under the supervision of the International Atomic Energy Agency.

The green growth energy transition bill also provides for an expansion of the roles and prerogatives of ASN concerning stakeholder information and participation in decisions and the orientation of research into nuclear safety and radiation protection. It also makes provision for the possibility of giving ASN additional powers of sanction.

ASN and IRSN benefited from relatively favourable budget decisions for the period 2015-2017. ASN appreciates the efforts made by the Government in a particularly difficult context. It would however point out that these temporary, limited measures cannot guarantee the long-term financing required for performance of its duties. Reform is therefore required if ASN and IRSN are to be given appropriate financing suitable for the challenges involved, derived both from the State budget and from an annual contribution by the nuclear licensees, to be set by Parliament. The 2015 Budget act opens the door to this possibility.



THE NUCLEAR SAFETY AUTHORITY (ASN)

ASN was created by the 13th June 2006 Nuclear Security and Transparency Act.
It is an independent administrative Authority responsible for regulating civil nuclear activities in France. It also contributes towards informing the citizens.

ASN is tasked, on behalf of the State, with regulating nuclear safety and radiation protection in order to protect workers, patients, the public and the environment from the hazards involved in nuclear activities.

ASN aims to provide efficient, impartial, legitimate and credible nuclear regulation, recognised by the citizens and regarded internationally as a benchmark for good practice.

Competence
Independence
Rigour
Transparency


0 HFA 216 PD
SOUDE
ACIDE
MORPHOLINE
Station
déminéralisation
Local Lits Mélangés
0 SDA 107 DE
0 SDB 107 DE
0 SDC 107 DE

ASN

ITS ROLES

REGULATING

ASN contributes to drafting regulations, by giving the Government its opinion on draft decrees and Ministerial Orders, or by issuing statutory resolutions of a technical nature.

AUTHORISING

ASN examines all individual authorisation applications for nuclear facilities. It can grant all authorisations, with the exception of major authorisations for basic nuclear installations, such as creation and decommissioning. ASN also issues the licenses provided for in the Public Health Code concerning small-scale nuclear activities and issues authorisations or approvals for radioactive substances transport operations.

MONITORING

ASN is responsible for ensuring compliance with the rules and requirements applicable to the facilities or activities within its field of competence. Inspection is one of ASN's main means of monitoring, although it also has appropriate powers of enforcement and sanction.

INFORMING

Primarily through its website *www.asn.fr* and its *Contrôle* magazine, ASN informs the public and the stakeholders (local information committees, environmental protection associations, etc.) of its activities and the state of nuclear safety and radiation protection in France.

IN EMERGENCY SITUATIONS

ASN monitors the steps taken by the licensee to make the facility safe. It informs the public of the situation. ASN assists the Government. It in particular sends the competent Authorities its recommendations concerning the civil security measures to be taken.

REGULATION AND MONITORING OF DIVERSE ACTIVITIES AND FACILITIES

Nuclear power plants, radioactive waste management, nuclear fuel shipments, packages of radioactive substances, medical facilities, research laboratories, industrial activities, etc. ASN monitors and regulates an extremely varied range of activities and installations. This regulation covers:
- 58 nuclear reactors producing nearly 80% of the electricity consumed in France, along with the EPR reactor currently under construction;
- all French fuel cycle facilities, from fuel enrichment to reprocessing;
- several thousand facilities or activities which use sources of ionising radiation for medical, industrial or research purposes;
- several hundred thousand shipments of radioactive substances nationwide, every year.

THE HELP OF EXPERTS

When taking certain decisions, ASN calls on the expertise of technical support bodies. This is primarily the case with the Institute for Radiation Protection and Nuclear Safety (IRSN). The ASN Chairman is a member of the IRSN Board. ASN also requests opinions and recommendations from scientific and technical Advisory Committees of Experts (GPE).

KEY FIGURES

474	staff members
82 %	management
273	inspectors
2,170	inspections of nuclear facilities, of shipments of radioactive substances, of the medical, industrial and research sectors, of approved organisations
14,850	inspection follow-up letters available on *www.asn.fr* as at 31st December 2014
448	technical opinions sent to ASN by IRSN
23	Advisory Committee meetings
3,170	licenses
21	press conferences
90	information notices
26	press releases
7	accident simulation exercises
79.95	million euros total budget for ASN
84	million euros IRSN budget devoted to expert appraisal work on behalf of ASN

ASN organisation chart - March 2015

COMMISSION

Commissioners
Philippe CHAUMET-RIFFAUD
Jean-Jacques DUMONT
Philippe JAMET
Margot TIRMARCHE

Head of Private Office
Laurent FELBER

Chairman
Pierre-Franck CHEVET

DIRECTORY-GENERAL OFFICE

Deputy directors-general
Julien COLLET
Alain DELMESTRE
Jean-Luc LACHAUME

Adviser
Henri LEGRAND

Head of Staff
Ambroise PASCAL

Director-general
Jean-Christophe NIEL

Office of administration (SG)
Luc CHANIAL

Director for the Director-general
Anne-Cécile RIGAIL

Management and expertise office (MEA)
N...

DEPARTMENTS

- Nuclear power plant department (DCN)
  Thomas HOUDRÉ
- Nuclear pressure equipment department (DEP)
  Rémy CATTEAU
- Transport and sources department (DTS)
  Vivien TRAN-THIEN
- Waste, research facilities and fuel cycle facilities department (DRC)
  Fabien SCHILZ
- Ionising radiation and health department (DIS)
  Jean-Luc GODET
- Environment and emergency department (DEU)
  Bénédicte GENTHON
- International relations department (DRI)
  Stéphane PAILLER
- Communication and public information department (DCI)
  Alain DELMESTRE

DIVISIONS

1 - Bordeaux division
Regional representative: **Emmanuelle BAUDOIN**
Regional head: **Paul BOUGON**

2 - Caen division
Regional representative: **Caroline GUILLAUME**
Regional head: **Guillaume BOUYT**

3 - Châlons-en-Champagne division
Regional representative: **Jean-Christophe VILLEMAUD**
Regional head: **Jean-Michel FÉRAT**

4 - Dijon division
Regional representative: **Corinne ETAIX**
Regional head: **Alain RIVIÈRE**

5 - Lille division
Regional representative: **Vincent MOTYKA**
Regional head: **François GODIN**

6 - Lyon division
Regional representative: **Françoise NOARS**
Regional head: **Matthieu MANGION**

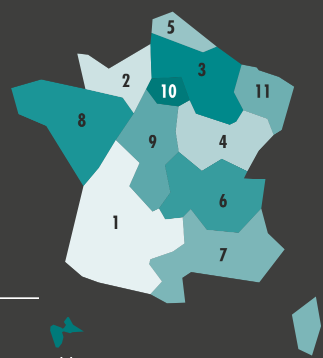
7 - Marseille division
Regional representative: **Anne-France DIDIER**
Regional head: **Laurent DEPROIT**

8 - Nantes division
Regional representative: **Annick BONNEVILLE**
Regional head: **Pierre SIEFRIDT**

9 - Orléans division
Regional representative: **Christophe CHASSANDE**
Regional head: **Pierre BOQUEL**

10 - Paris division
Regional representative: **Alain VALLET**
Regional head: **Delphine RUEL**

11 - Strasbourg division
Regional representative: **Marc HOELTZEL**
Regional head: **Sophie LETOURNEL**



DROM-COM

Division Caen and Orleans respectively involved in the Bretagne region and Ile-de-France region for control of the only BNIs. The Overseas *départements* and regions and the Overseas communities (DROM-COM) are under the responsibility of the Paris division.

ITS ORGANISATION

The Commission

The Commission defines ASN general policy regarding nuclear safety and radiation protection. It consists of five Commissioners, including the Chairman.

Pierre-Franck CHEVET Chairman	Philippe CHAUMET-RIFFAUD Commissioner	Jean-Jacques DUMONT Commissioner	Philippe JAMET Commissioner	Margot TIRMARCHE Commissioner
DATE APPOINTED				
12 November 2012 for 6 years	10 December 2014 for 6 years	15 December 2010 for 6 years	15 December 2010 for 6 years	12 November 2012 for 6 years
APPOINTED BY				
President of the Republic			President of the Senate	President of the National Assembly

IMPARTIALITY

The Commissioners perform their duties in complete impartiality and receive no instructions either from the Government or from any other person or institution.

INDEPENDENCE

The Commissioners perform their duties on a full-time basis. Their mandate is for a six-year term. It is not renewable. The duties of a Commissioner can only be terminated in the case of impediment or resignation duly confirmed by a majority of the Commissioners. The President of the Republic may terminate the duties of a member of the Commission in the event of a serious breach of his or her obligations.

COMPETENCIES

The Commission issues resolutions and publishes opinions in ASN's Official Bulletin. The Commission defines ASN external relations policy both nationally and internationally. The Commission defines ASN regulatory policy. The Chairman appoints the nuclear safety inspectors, the radiation protection inspectors, the health and safety inspectors for the nuclear power plants and the staff responsible for verifying compliance with the requirements applicable to pressure vessels. The Commission decides whether to open an inquiry following an incident or accident. Every year, it presents the ASN report on the state of nuclear safety and radiation protection in France to Parliament. Its Chairman reports on ASN activities to the relevant commissions of the French Parliament's National Assembly and Senate as well as to the Parliamentary Office for the Evaluation of Scientific and Technological Choices. The Commission drafts ASN internal regulations and appoints its representatives to the High Committee for Transparency and Information on Nuclear Security.

Commission figures in 2014

| 71 | sessions | 27 | opinions | 85 | resolutions

Headquarters and the regional divisions

ASN comprises a headquarters and eleven regional divisions with competence for one or more administrative regions. This organisation enables ASN to carry out its regulation and monitoring duties over the entire country and in the overseas territories of France. The headquarters are organised thematically and are responsible at a national level for their fields of activity. The ASN regional divisions operate under the authority of the regional representatives, appointed by the ASN Chairman. They are ASN's representatives in the regions and contribute locally to ASN's public information role. The divisions carry out most of the direct inspections on nuclear facilities, radioactive substances transport operations and small-scale nuclear activities. In emergency situations, the divisions assist the Prefect of the *département*[1], who is in charge of protecting the general public, and supervise the operations carried out to safeguard the facility on the site.

1. Administrative region headed by a Prefect

ASN'S MAJOR ACHIEVEMENTS IN 2014

Jean-Christophe NIEL
Director-general

Montrouge, 3rd March 2015

In the editorial of its 2013 report, the Commission underlined that the regulation and monitoring of nuclear safety and radiation protection is a major responsibility for ASN, which it strives to carry out in complete independence, with stringency, competence and transparency.

A few figures illustrate the density of our activity during the course of 2014 in dealing with this issue and meeting the particularly high expectations of society in this field:
- 2,170 inspections, including the first in-depth inspection of a medical establishment, the Pitié-Salpêtrière Hospital;
- 4 level 2 events and 136 level 1 events on the INES scale applicable to nuclear activities;
- 4 level 2 events and 117 level 1 events on the ASN-SFRO scale applicable to radiation protection of patients;
- 24 violation reports;

- 71 sessions by the Commission, 85 resolutions issued and 27 opinions delivered;
- 6 draft regulatory resolutions and 151 draft individual decisions, with an influence on the environment, submitted to the public for consultation;
- 23 Advisory Committee of Experts meetings;
- 90 information notices and 26 press releases;
- 7 national level nuclear emergency exercises.

As of 31st December 2014, the ASN workforce stood at 474 .

Over and above these figures, let us take a look at the main events which marked this year.

THE STRESS TESTS INITIATED IN THE WAKE OF THE FUKUSHIMA DAIICHI ACCIDENT

ASN regularly mentioned that complete analysis of the lessons learned from the Fukushima Daiichi accident would take many years. This feedback would lead to a significant tightening of the requirements applying to nuclear facilities and to major changes in the management of radiological emergency situations.

Following the Fukushima Daiichi accident, ASN thus asked the licensees to identify the equipment enabling the nuclear facilities to withstand extreme situations. This equipment constitutes the "hardened safety core". On 21st January 2014, it determined the level of seismic hazard the EDF NPPs should be able to withstand. On this same occasion, it also indicated that in the management of such a situation, reactor cooling and heat removal should preferably be by means of the steam generators and that the tightness of the containment should be preserved for as long as possible. In late 2014, as a result of ASN prescriptions, the Nuclear Rapid Intervention Force (FARN) was in a position to intervene simultaneously on four damaged reactors on a given site.

From 22nd October to 21st November 2014, ASN submitted draft resolutions to the public for consultation concerning the additional prescriptions applicable to the "hardened safety core" for the Areva and CEA facilities. These prescriptions more specifically define the hazards to be considered for this "hardened safety core" as well as the associated design requirements. The corresponding resolutions were approved in January 2015.

REVISION OF THE EUROPEAN "NUCLEAR SAFETY" DIRECTIVE

From a regulatory viewpoint, the significant event in 2014 was the approval of the revision of the European "nuclear safety" directive. ASN considers that this revision, initiated following the Fukushima Daiichi accident, represents substantial improvements by comparison with the previous version. The revised directive in particular highlights the principles of "defence in depth" and "safety culture" and the safety objectives for the nuclear facilities promoted by WENRA (Western European Nuclear Regulators Association). It makes a safety reassessment of each nuclear facility mandatory at least every ten years, and requires examination by the European counterparts on specific safety topics every six years, along the same lines as the stress tests. Finally, it reinforces stakeholder information.

At a national level, ASN continued to develop the regulations applicable to nuclear facilities, in particular by taking decisions concerning management of the criticality risk in BNIs or the shutdown and restart of PWR reactors.

> *"In 2014, ASN was particularly attentive to the situation of certain nuclear facilities."*

PERIODIC SAFETY REVIEWS OF NUCLEAR FACILITIES

In accordance with the Environment Code, all French nuclear facilities must undergo a ten-yearly periodic safety review. On this occasion, the facility's conformity with its baseline safety requirements is checked. Improvements must be made to bring it closer into line with the best safety standards. This approach was recognised as being best practice by the European countries following the Fukushima Daiichi accident and was integrated into the revised European nuclear safety directive, approved in June 2014.

In 2014, ASN issued prescriptions concerning the continued operation of Dampierre-en-Burly reactor 1 beyond its third periodic safety review and Nogent-sur-Seine reactors 1 and 2, Cattenom 2 and 3, Saint-Alban/Saint-Maurice 1 and 2 and Penly 1 beyond their second periodic safety reviews. The 900 MWe reactors will for their part be entering the period of their fourth periodic safety review. Detailed technical exchanges were held between EDF, IRSN and ASN, through four seminars concerning the conformity of the facilities, their ageing and their obsolescence, the safety of fuel storage, internal and external hazards and the prevention and mitigation of severe accidents.

Finally, in 2014, ASN also issued prescriptions concerning the operation beyond their periodic safety review of several Areva facilities (Mélox – Mox fuel fabrication plant at Marcoule and IARU – Tricastin site clean-up and uranium recovery facility) and CEA facilities (Eole and Minerve reactors in Cadarache). This was the first periodic safety review for these facilities, which were not subject to this process prior to the TSN act of 2006.

In 2014, ASN was particularly attentive to the situation of certain nuclear facilities.

This was more specifically the case of the Le Blayais NPP, where EDF will replace the three steam generators for reactor 3, owing to the degree of wear on their tube bundles. After examination of the design and manufacture of the new steam generators built by Areva, ASN observed that Areva had not provided all the necessary safety justifications. Accordingly, prior to the installation and then commissioning of the new steam generators in November 2014, the ASN Chairman asked Areva and EDF to provide these safety justifications, in particular with regard to the mechanical stresses for the design of the equipment, the mechanical properties of certain materials, the representativeness of the calculation methods for verifying the mechanical strength of the equipment, or the ability of the inspection methods to detect potential defects.

ASN also placed Areva's FBFC facility under close surveillance. This decision was taken further to the worrying observations regarding safety management, operational rigorousness, in particular concerning management of the criticality risk, and project management. The ASN Commission summoned the senior management of the facility in February 2014 and a meeting was organised with all the management on the site in May. ASN will issue a position statement following analysis of the action plan drawn up by FBFC and the in-depth inspection performed in November 2014.

In 2008, given the risks presented by the Osiris experimental reactor which entered into service 50 years ago in Saclay in the Paris area, and on the basis of the undertakings made by CEA, ASN prescribed shutdown of this reactor in 2015. In accordance with ASN's position, published in the summer of 2014, the Government confirmed that the reactor would be shut down in late 2015. ASN notified the various parties concerned as of 2009 about the international and national issues associated with the production of radiopharmaceuticals by experimental reactors.

The CIS bio international radiopharmaceuticals manufacturing facility, located in the Paris area, was also the subject of particularly close attention. The safety analysis of the facility and the detection of serious fire risk shortcomings, led ASN in 2013 to require that the licensee install automatic fire extinguishing systems. Faced with its tardiness in performing this work, despite formal notice to comply with its prescriptions, ASN initiated a process to require the deposit of a sum corresponding to the required work in September 2014. Notwithstanding the nuclear safety implications, the licensee nonetheless intends to challenge this ASN resolution before the Council of State.

Finally, the ASN Commission reminded the Chairman of Areva of the importance of recovering and packaging the legacy waste at La Hague as rapidly as possible. A draft ASN resolution outlining and prioritising the recovery of legacy waste based on the safety implications of the storage facilities was presented for public consultation in August and September 2014. The resolution was published in January 2015.

THE ISSUES AND IMPLICATIONS OF SMALL-SCALE NUCLEAR ACTIVITIES

Even if no level 2 incident was recorded in 2014 on nuclear installations, this was not the case with small scale nuclear activities, in which four level 2 incidents were identified during the course of the year. Even if no pertinent conclusions can be drawn from the fluctuations in a small number of annual events, ASN nonetheless remains attentive to ensuring that the most serious events are the subject of detailed analysis, so that the necessary lessons can be learned, although without neglecting to analyse medium-term trends.

Thus an analysis of the significant radiation protection events (SRE) notified between 2007 and 2013 led ASN to alert the interventional radiology players to several points in 2014. It in particular pointed out the need to conduct an assessment of the risks for patients and professionals, to identify the procedures entailing a risk and to define the procedures for monitoring the patients at risk. It also recalled the need for medical physicists and persons competent in radiation protection, the importance of training personnel in the radiation protection of both workers and patients and in the use of equipment and, finally, the need to anticipate technical and organisational changes. Over the coming years, ASN will be maintaining interventional radiology as one of its inspection priorities.

In 2014, ASN published the summary of the inspections carried out in the 217 nuclear medicine units in France between 2009 and 2011. Although the state of radiation protection is considered to be satisfactory on the whole, progress is still required concerning personnel training in the radiation protection of patients and workers, the performance of workplace studies for all the personnel, internal quality checks and the exhaustiveness of the waste and effluents management plans.

With regard to the regulations, the new directive setting basic radiation protection standards was published on 5th December 2013. France has four years in which to transpose this new directive into national law. Even if the French regulations had already anticipated the tightening of certain prescriptions, in particular in the field of radiotherapy and the management of unsealed radioactive sources, changes to the legislation (system of qualification of medical physicists) or to the regulations (twelve month dose limit for the lens of the eye reduced to 20 millisieverts per year, modification of the persons competent in radiation protection (PCR) system, reduction in the radon reference level from 400 Bq/m^3 to 300 Bq/m^3) are nonetheless required. ASN has been and will remain involved in this process.

2014 saw the signing of a framework collaboration agreement between ASN and the French national cancer institute (INCa). This agreement more particularly concerns the medical uses of ionising radiation, the cancerous pathologies actually or potentially attributable to nuclear activities, whether medical or industrial in origin, or exposure of the population to ionising radiation of natural origin, more specifically that linked to radon.

In 2014, ASN published a summary of the inspections carried out by its inspectors in 2012 in 47 “equine” veterinary radiology structures. This branch of veterinary medicine has the most significant potential implications for radiation protection, notably owing to the power and conditions of use of the equipment designed for large sized animals. Although the practices in the field were on the whole found to be good (presence of in-house PCR, optimisation of the diagnostic performance conditions), several areas for improvement were identified (operational dosimetry of workers, internal radiation protection checks, radiological zoning, etc.).

In 2014, it also updated and published information on the radioactive substance transport traffic. A public consultation was opened concerning draft guidelines to clarify what should be included in the management plans for radioactive substance transport incidents and accidents drawn up by those involved in this sector (carriers, consignors, etc.).

ASN also reminded those in possession of ionisation chamber smoke detectors that they must be registered by 31st December 2014. In 2011, two resolutions were issued to deal with the withdrawal from service of the seven million detectors installed nationwide in France. These detectors containing radioactive sources can no longer be justified in terms of radiation protection, given that alternatives exist. This system plans, guides and organises the removal, maintenance or recovery operations.

Finally, in autumn 2014, ASN and the Norwegian radiation protection authority jointly organised a seminar on national strategies to reduce radon exposure of the population and the associated risks of lung cancer. Twenty European countries, the World Health Organisation, the International Atomic Energy Agency (IAEA), the United States, Canada and Russia were present. Radon is a public health problem which requires coordinated management, involving all sectors of society and a broad range of tools (regulations, incentives, information, etc.). Although national strategies may differ from one country to another, owing to the specific conditions linked in particular to the local geological conditions or the number of people living in the areas with a high risk of radon exposure, all are based on a shared goal of reducing average radon concentrations.

THE WORKING OF THE FRENCH SYSTEM FOR THE OVERSIGHT OF NUCLEAR SAFETY AND RADIATION PROTECTION

In November 2014, the French system for the oversight of nuclear safety and radiation protection was assessed by a team of twenty-nine international experts under the supervision of IAEA. In 2006, ASN hosted the first IRRS (Integrated Regulatory Review Service) mission concerning all the activities of a safety regulator. This audit is the result of the European nuclear safety directive which requires a peer review mission every ten years. The team identified best practices such as stakeholder involvement, the independence of the ASN commissioners and personnel, the coordination between the oversight organisations involved in emergency planning. The mission also identified a number of points worthy of particular attention or improvement, in particular the regulatory framework for monitoring medical exposure, the system used by ASN for assessing and modifying its regulatory framework, or the human and financial means available to ASN for the performance of its duties. IAEA’s final report was transmitted to France in the first quarter of 2015 and posted on the ASN website.

In order to issue its resolutions, ASN relies on the technical services of IRSN and on the opinions and recommendations of its seven Advisory Committees of Experts (GPE), five of which concern nuclear safety and two radiation protection. They comprise members from various expert organisations (including IRSN), university research laboratories, associations or licensees. Foreign experts from the safety regulators of other countries input their international experience. In 2014, ASN decided to reinforce the independence of the expertise on which it relies and the transparency of the process of drafting its resolutions and decisions.

To do this, new procedures for the selection and nomination of the members of the Advisory Committees of Experts were adopted in order to open them up more broadly to civil society.

To conclude, I would like to underline the commitment and professionalism of the ASN personnel, whose everyday efforts in the field are advancing nuclear safety and radiation protection. The quality of our resolutions and our actions is built on their commitment and on the unfailing assistance of IRSN and our Advisory Committees.

SIGNIFICANT EVENTS IN 2014

ASN actions

Activities regulated by ASN

01 NUCLEAR ACTIVITIES: IONISING RADIATION AND HEALTH AND ENVIRONMENTAL RISKS

Ionising radiation may be of natural origin or caused by human activities, referred to as nuclear activities.

The exposure of the population to naturally occurring ionising radiation is the result of the presence of radionuclides of terrestrial origin in the environment, radon emanations from the ground and exposure to cosmic radiation.

Nuclear activities are activities entailing a risk of exposure to ionising radiation, emanating either from an artificial source or from natural radionuclides processed for their radioactive, fissile or fertile properties, as well as interventions in the event of a radiological risk following an accident or a contamination event. These nuclear activities include those conducted in Basic Nuclear Installations (BNIs) and the transport of radioactive substances, as well as in all medical, veterinary, industrial and research facilities where ionising radiation is used.

Ionising radiation is defined as radiation that is capable of producing ions - directly or indirectly - when it passes through matter. It includes X-rays, alpha, beta and gamma rays, and neutron radiation, all of which have different energies and penetration powers.

The effects of ionising radiation on living beings can be "deterministic" (health effects such as erythema, radiodermatitis, radionecrosis and cataracts, which are certain to appear when the dose of radiation received exceeds a certain threshold) or "probabilistic" (probability of occurrence of cancers in an individual, but no certainty). The protective measures against ionising radiation aim to avoid deterministic effects, but also to reduce the probability of occurrence

of radiation-induced cancers, which constitute the main risk.

Understanding the risks linked to ionising radiation is based on health monitoring (cancer registers), epidemiological investigation and risk assessment via extrapolation to low doses of the risks observed at high doses. Many uncertainties and unknown factors nonetheless persist, in particular with regard to high-dose radiopathologies, the effects of low doses or the effects on non-human species.

EXPOSURE TO IONISING RADIATION IN FRANCE

The entire French population is potentially exposed to ionising radiation, but to differing extents, depending on whether the ionising radiation is of natural origin or the result of human activities.

On average, the exposure of an individual in France was estimated by the French Institute for Radiation Protection and Nuclear Safety (IRSN) at 3.7 millisieverts (mSv) per year in 2010, varying by a factor of 2 to 5 depending on the location.

The sources of this exposure are as follows:

- for about 1 mSv/year, naturally occurring radioactivity excluding radon, including 0.5 mSv/year for radiation of telluric origin, 0.3 mSv/year for cosmic radiation and 0.2 mSv/year for internal exposure from food;
- for about 1.4 mSv/year, radon, with considerable variation related to the geological characteristics of the land (a new map of the country was produced in 2011 according to the radon exhalation potential) and to the buildings themselves; in zones defined as high-priority, periodic measurements must be taken in places open to the public and in the workplace. A 2011-2015 national action plan is currently being drawn up. In 2014, ASN organised a European seminar on national radon risk management programmes;
- for about 1.6 mSv/year (estimation for 2012), radiological diagnostic examinations were up by comparison with 2007 (1.3 mSv/year in 2007) owing to an increase in the number of computed tomography procedures and improved awareness of practices. Particular attention must therefore be given

to management of the doses delivered to the patients;
- representing 0.03 mSv/year, the other artificial sources of exposure: past airborne nuclear tests, accidents affecting facilities, releases from nuclear installations.

Workers in nuclear activities undergo specific monitoring (more than 350,000 individuals in 2013); the annual dose remained lower than 1 mSv (annual effective dose limit for the public) for more than 96% of the workforce monitored; the number of times the limit of 20 mSv (regulatory limit for nuclear workers) was exceeded dropped significantly (9 cases in 2013); the same applies to the collective dose (drop of about 43% since 1996) whereas the population monitored has increased by about 50%. For workers in activity sectors entailing technological enhancement of naturally occurring radioactive materials, the doses received in 85% of cases are less than 1 mSv/year. In a number of known industrial sectors however, it is quite probable that this value will be occasionally exceeded.

Finally, aircrews are subject to particularly close monitoring owing to their exposure to cosmic radiation at high altitude. Of the recorded doses, 85% are between 1 mSv per year and 5 mSv per year, while 15% are below 1 mSv per year.

OUTLOOK

ASN will be particularly attentive to following up the recommendations expected in 2015 from a pluralistic working group on individual monitoring of the exposure of workers to ionising radiation.

With regard to radon, the third national plan, to be adopted in 2015, should compensate for the shortcomings of the previous plan regarding strategic management, which led to a lack of visibility of priority areas on the new map, but also regarding information of the public and elected officials and the radon screening strategy in existing homes.

With regard to the regular increase in doses delivered to patients through medical imaging procedures, ASN will reinforce the steps it initiated in 2011 to maintain the mobilisation of the health authorities and health professionals at all levels. The deployment of strategic management involving the health authorities, to support the intended actions of the Cancer 3 plan, would appear to be essential.

02 THE PRINCIPLES AND PLAYERS IN REGULATING NUCLEAR SAFETY, RADIATION PROTECTION AND ENVIRONMENTAL PROTECTION

Nuclear activities must be carried out in compliance with the eight fundamental principles of the Environment charter, the Environment Code and the Public Health Code.

The principles involved are the prevention principle (anticipation of any environmental threat through rules and measures taking account of the “best available techniques at an economically acceptable cost”), the “polluter-pays” principle (the polluter responsible for the environmental damage bears the cost of pollution prevention and remediation), the precautionary principle (the lack of certainty, in the light of current scientific and technical knowledge, must not delay the adoption of proportionate preventive measures), the participation principle (the populations must take part in determining public decisions), the justification principle (a nuclear activity can only be carried out if justified by the advantages it offers by comparison with its inherent exposure risks), the optimisation principle (exposure to ionising radiation must be kept as low as is reasonably achievable), the limitation principle (the regulations set limits for an individual's exposure to ionising radiation resulting from a nuclear activity except for medical or biomedical research purposes) and the principle of the nuclear licensee's responsibility for the safety of its installation.

THE NUCLEAR ACTIVITY REGULATORS

The current French organisation for the regulation of nuclear safety and radiation protection was established by the 13th June 2006 act on transparency and security in the nuclear field (TSN act) codified in the Environment Code; this regulation is primarily the responsibility of the Government and ASN, within the legislative framework defined by and under the control of Parliament.

Parliament regularly monitors the regulation of nuclear safety and radiation protection, in particular through its special commissions, which conduct hearings, or the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST), which has issued a number of reports on this subject and to which ASN presents its annual report on nuclear safety and radiation protection in France.

On the advice of ASN, the Government defines the general regulations for nuclear safety and radiation protection. Also on the advice of ASN, it takes key individual decisions concerning BNIs (creation or decommissioning authorisation, closure in the event of an unacceptable risk, etc.). It is responsible for civil protection in an emergency.

In the current governmental organisation, the Minister for Ecology, Sustainable Development and Energy is responsible for nuclear safety and, together with the Minister for Social Affairs and Health, for radiation protection.

In the *départements*, the Prefects, as representatives of the State, are the guarantors of public order and have a particular role to play in the event of an emergency, given that they are in charge of population protection measures. The Prefect also takes part in the various procedures concerning the nuclear installations in his *département*, overseeing local consultations and providing the Ministers or ASN with his recommendations as applicable.

ASN is an independent administrative Authority created by the TSN act. It is responsible for regulating nuclear safety and radiation protection and contributes to informing the populations on these subjects. It sends the Government proposals for regulatory texts and is consulted on the texts prepared by the Ministers. It clarifies the regulations by issuing statutory resolutions which are then sent to the competent Ministers for approval. It issues certain individual authorisations and proposes others to the Government. Nuclear activities are monitored and inspected by the ASN staff and by organisations duly authorised by ASN. ASN contributes to France's European and international actions. It alerts and informs the Authorities of third-party States in the event of a radiological emergency and in turn receives alerts and information from them. Finally, it provides its assistance for management of radiological emergencies.

In technical matters, ASN relies on the expertise provided by IRSN and by the Advisory Committees of Experts (GPE) that it has set up, the composition of which was renewed in 2014 with the aim of achieving diversification.

It also convenes pluralistic working groups enabling all the stakeholders to contribute to drafting doctrines and action plans and monitor their implementation. These groups look more specifically at social, organisational and human factors, the management of post-accident situations or the management of waste and radioactive materials (group set up with the Ministry in charge of these questions).

ASN has made a commitment to research, to identify areas of knowledge essential for medium and long-term expertise. It has set up a scientific committee.

ASN is run by a Commission of five full-time, irrevocable Commissioners, nominated for a non-renewable 6-year mandate by the President of the Republic (who nominates the Chairman and two Commissioners) and by the President of the Senate and the President of the National Assembly (who each nominate one Commissioner).

ASN has headquarters and eleven regional divisions around the country. On 31st December 2014, its total workforce stood at 474 employees. In 2014, the ASN budget stood at €79.95 million. In addition, IRSN receives €84 million for the technical support it provides to ASN; these credits include a State subsidy and the revenue from a tax paid by the licensees of the large nuclear facilities.

In total, the State's budget for transparency and the regulation of nuclear safety and radiation protection amounted to €174.7 million in 2014.

These credits are at present divided among five budget programmes, which obscures the overall clarity of the cost of regulation and also leads to problems with budgetary preparation, the settling of budget allocation conflicts and execution.

ASN has a multi-year strategic plan. The current plan covers the period 2013-2015.

CONSULTATIVE BODIES

The organisation of nuclear security and transparency also involves a number of consultative bodies, in particular the High Committee for Transparency and Information on Nuclear Security, an information, consultation and debating body for the risks related to nuclear activities and the impact of these activities on human health, the environment and nuclear security. One could also mention the High Council for public health, a scientific and technical consultative body reporting to the Minister for Health, which contributes to defining the multi-year public health objectives, evaluates the attainment of national public health objectives and contributes to their annual monitoring, along with various commissions tasked with giving an opinion on draft regulatory texts (High Council for the prevention of technological risks concerning certain texts applicable to BNIs, Central Committee for pressure equipment for those concerning pressure equipment and so on).

Faced with a number of unprecedented challenges ("post-Fukushima Daiichi" measures, ageing of facilities and application for extended NPP operation, EPR commissioning, initial periodic safety reviews for about fifty facilities, continuous rise in radiation doses delivered to patients, etc.), ASN considered that it was essential to effect a significant increase in the human and financial resources of both itself and IRSN. It recognises the efforts made by the Government in 2014 in an extremely difficult budgetary context (addition of thirty staff over three years), but it considers that this is insufficient to meet the needs and thus requests a reform of the financing of the regulation and monitoring of nuclear safety and radiation protection, expert appraisal and information concerning nuclear safety and radiation protection, by means of an annual contribution from the nuclear licensees to be determined by Parliament.

03 REGULATIONS

The legal framework for radiation protection is based on international norms, standards and recommendations issued by various organisations, more specifically the International Commission on Radiological Protection (ICRP), an NGO which publishes recommendations about protection against ionising radiation (the latest recommendations appear in the 2007 ICRP publication 103), the International Atomic Energy Agency (IAEA) which regularly publishes and revises nuclear safety and radiation protection standards, and the International Organisation for Standardisation (ISO) which publishes international technical standards.

At a European level, under the Euratom Treaty, various directives set basic rules for radiation protection, nuclear safety and the management of radioactive waste and spent fuel; these directives are binding on all the member States.

With regard to radiation protection, a process to merge and revise the directives led on 5th December 2013 to the adoption of Council directive 2013/59/Euratom, which sets out basic standards for health protection against the dangers resulting from exposure to ionising radiation, published on 17th January 2014.

With regard to nuclear safety, the European Council of Ministers on 8th July 2014 adopted a revision of Council Directive 2009/71/Euratom of 25th June 2009 establishing a Community framework for the nuclear safety of nuclear installations.

ASN actively contributed to the adoption of these two directives.

Nationally, the legal framework for nuclear activities has been extensively overhauled in recent years. The main texts are contained in the Public Health Code and the Environment Code. Other texts are more specialised, such as the Labour Code, which deals with radiation protection of workers, or the Defence Code, which contains provisions regarding defence-related nuclear activities or the prevention of malicious acts. Finally, various texts apply to certain nuclear activities but without being specific to them.

The activities or situations regulated by ASN include a number of different categories presented below, along with the relevant regulations.

Small-scale nuclear activities: this category covers the many fields that use ionising radiation, including medicine (radiology, radiotherapy, nuclear medicine), human biology, research, industry and certain veterinarian, forensic or foodstuff conservation applications.

The Public Health Code created a system of authorisation or notification for the manufacture, possession, distribution (including import and export), and utilisation of radionuclides or products or devices containing them. Licences are issued by ASN and notifications are filed with the ASN regional divisions.

The general rules applicable to small-scale nuclear facilities are the subject of ASN statutory resolutions. On 23rd October 2014, ASN thus adopted resolution 2014-DC-0463 concerning minimum technical rules for the design, operation and maintenance of in vivo nuclear medicine facilities.

Exposure of individuals to radon: human protection is based primarily on the obligation of monitoring in geographical areas where the concentration of naturally occurring radon can be high. This monitoring is mandatory in certain premises open to the public and in the workplace. A strategy to reduce this exposure is necessary, should the measurements taken exceed the action levels laid down in the regulations.

Activities leading to increased ionising radiation of natural origin materials: certain professional activities which cannot be defined as "nuclear activities" can lead to a significant increase in the exposure to ionising radiation on the part of the workers and, to a lesser extent, the neighbouring populations. This in particular concerns activities which utilise raw materials, construction materials or industrial residues containing natural radionuclides not used for their radioactive, fissile or fertile properties (phosphate extraction and phosphate-based fertiliser manufacturing industries, dye industries, in particular those using titanium oxide and those utilising rare earth ores such as monazite). The radiation protection measures required in this field are based on a precise identification of the activities, an estimation of the impact of exposure for the persons concerned, the implementation of corrective measures to reduce this exposure, if necessary, and to monitor it. They are regulated by the Labour Code and the Public Health Code.

Basic Nuclear Installations (BNIs): these are the most important nuclear facilities; they are the facilities of the nuclear electricity generating sector (nuclear power plants, main facilities of the "fuel cycle"), the large storage and disposal facilities for radioactive substances, certain research facilities and the large accelerators or irradiators. There are nearly 150 of them, spread over about 40 sites.

The legal regime for the BNIs is defined by section IX of book V of the Environment Code and its implementing decrees. This regime is said to be "integrated" because it aims to prevent or manage all risks and detrimental effects that a BNI is liable to create for man and the environment, whether or not radioactive in nature. It in particular requires that the creation or decommissioning of a BNI be authorised by a decree issued on the advice of ASN and that ASN authorise start-up of the installation and stipulate requirements regarding its design and operation with respect to protection of the population and the environment.

ASN is carrying out work to overhaul the general technical regulations for BNIs, together with the Ministry responsible for the environment; this led to the publication of the Order of 7th February 2012 setting the general rules for BNIs. Most of the provisions of this order entered into force on 1st July 2013. In the next few years it will be supplemented by about fifteen ASN statutory resolutions. In 2014, ASN thus adopted four resolutions concerning the management of fire risks, physical modifications to BNIs, NPP PWR shutdown and restart and management of the criticality risks. This system is supplemented by ASN guides, which are not legally binding and which present ASN policy; seventeen guides have so far been published.

The transport of radioactive substances: the safe transport of radioactive substances is based on the "defence in depth" principle involving on the one hand the packaging and its content, which must withstand the foreseeable transport conditions, and on the other the means of transport and its reliability, plus the response measures deployed in the event of an incident or accident. The consignor is responsible for implementing these lines of defence.

The regulations concerning the transport of radioactive materials have a particularly international flavour. They are based on the IAEA recommendations integrated into the international agreements covering the various modes of dangerous goods transport. At a European level, the regulations are grouped into a single 24th September 2008 directive, transposed into French law by an amended Order dated 29th May 2009, known as the "TMD Order".

Within this legal framework, ASN is responsible for approving package models for the most hazardous shipments.

Contaminated sites and soils: management of sites contaminated by residual radioactivity resulting either from a past nuclear activity, or an activity which generated deposits of natural radionuclides, warrants specific radiation protection actions, in particular if remediation is envisaged. Depending on the current and future uses of the site, decontamination objectives must be set and the removal of the waste produced during post-operation clean-out of the contaminated premises and remediation of soil must be managed, from the site up to storage or disposal.

In 2012, ASN published its doctrine for the management of sites contaminated by radioactive substances.

OUTLOOK

The green growth energy transition bill, which should be adopted in the first half of 2015, will lead to significant progress in the regulation and monitoring of nuclear safety and radiation protection. ASN will contribute to finalising the texts (ordinances and decrees) implementing this act.

04 REGULATION OF NUCLEAR ACTIVITIES AND EXPOSURE TO IONISING RADIATION

In France, the party responsible for a nuclear activity is first in line for ensuring the safety of that activity. They cannot delegate this responsibility, and must ensure permanent surveillance of their installations. On behalf of the State, ASN is responsible for regulating nuclear activities.

Regulation and monitoring of nuclear activities is a fundamental duty of ASN. The aim is to verify that all parties responsible for a nuclear activity, in particular the licensees of nuclear facilities, fully assume their responsibility and comply with the requirements of the regulations relative to radiation protection and nuclear safety, in order to protect workers, patients, the public and the environment against the risks associated with nuclear activities.

Inspection is the key means of monitoring available to ASN. It involves an ASN inspector travelling to a site being inspected. The inspection is proportionate to the level of risk presented by the installation or the activity and the way in which the licensee assumes its responsibilities. It consists in performing spot checks on the conformity of a given situation with regulatory or technical baseline requirements. After the inspection, a follow-up letter is sent to the head of the inspected site and published on *www.asn.fr*. Any deviations found during the inspection can lead to administrative or penal sanctions.

ASN has a broad vision of monitoring and regulation, encompassing material, organisational and human aspects. Its actions take the tangible form of resolutions, prescriptions, inspection follow-up documents and assessments of nuclear safety and radiation protection in each sector of activity.

SIGNIFICANT EVENTS

2,170 inspections were carried out in 2014 by the 273 ASN inspectors.

In 2014, ASN was notified of:
- 1,114 significant events concerning nuclear safety, radiation protection and the environment in BNIs; 971 of these events were rated on the INES scale (872 events rated level 0 and 99 events rated level 1). Ten significant events were rated as "generic events" including 3 at level 1 on the INES scale;
- 63 significant events concerning the transport of radioactive substances, including 3 events rated level 1 on the INES scale;
- 650 significant events concerning radiation protection in small-scale nuclear activities, including 195 rated on the INES scale (of which 34 were level 1 events and 4 were level 2 events).

In 2014, as a result of violations observed, the ASN inspectors (nuclear safety inspectors, labour inspectors and radiation protection inspectors) transmitted 24 violation reports to the public prosecutor's offices, nine of which were related to labour inspections in the NPPs.

ASN took administrative action (formal notice, suspension, etc.) against 18 licensees and managers of nuclear activities. In 2014, for the first time, ASN in particular initiated two procedures requiring the deposit of funds to cover the performance of work, against the Cis bio international company.

OUTLOOK

In 2015, ASN scheduled 1,850 inspections on BNIs, radioactive substances transport operations, activities employing ionising radiation, organisations and laboratories it has approved and activities involving pressure equipment. Continuing the approach used in 2014, ASN will as a priority inspect the high-stake activities, taking account of experience feedback.

At the same time, ASN will continue to revise the procedures for notification of significant events, taking into account the experimentation of the events notification guide in small-scale nuclear activities and the changes in regulations in the BNI sector.

It will propose changes to the sanctions policy, pursuant to the provisions of the green growth energy transition bill.

In the field of pollution prevention and mitigation of impacts and detrimental effects, after finalising the regulatory overhaul of the BNI system, with the publication of ASN resolution 2013-DC-0360 of 16th July 2013 concerning the control of nuisances and the health and environmental impact of BNIs, which supplements Title IV of the ministerial order of 7th February 2012 setting the general rules applicable to BNIs, ASN will ensure the effective implementation of the new provisions by the licensees and will analyse the initial feedback obtained. ASN will publish the resolution modifying the approval process for environmental radioactivity monitoring laboratories, currently defined by ASN resolution 2008-DC-0099 of 29th April 2008. Work will be started on updating the website of the national environmental radioactivity monitoring network and work on self-monitoring by the licensees will be continued.

05 RADIOLOGICAL EMERGENCY AND POST-ACCIDENT SITUATIONS

Nuclear activities are carried out with the two-fold aim of preventing accidents and mitigating any consequences should they occur. An accident can never be completely ruled out and the necessary provisions for dealing with and managing a radiological emergency situation must be planned, tested and regularly revised.

ASN has four main duties in the management of these situations, with the support of IRSN:
- to ensure and verify the soundness of the steps taken by the licensee;
- to advise the Government and its local representatives;
- to take part in information of the public and the media;
- to act as competent Authority within the framework of the international conventions.

The emergency plans relative to accidents occurring at a BNI define the measures necessary to protect the site personnel, the general public and the environment, and to control the accident.

The ASN emergency response organisation set up for an accident or incident in a BNI more specifically comprises:
- at the national level, an emergency centre in Montrouge, consisting of three Command Posts (PC):
  - a "Strategy" Command Post, consisting of the ASN Commission, which, in an emergency situation, could be called on to issue resolutions and impose prescriptions on the licensee of the installation concerned;
  - a technical Command Post in constant contact with IRSN, whose task is to issue position statements to advise the Prefect, who is director of the emergency response operations;
  - a communications Command Post. The ASN Chairman or his representative acts as spokesperson, a role which is distinct from that of the head of the Technical Command Post.
- at the local level:
  - ASN representatives working with and advising the Prefect in his decisions and communications;
  - ASN inspectors present on the site affected by the accident.

ASN is supported by IRSN's emergency technical centre.

In the event of a severe accident, an interministerial crisis committee is set up with the participation of ASN.

SIGNIFICANT EVENTS

The "Major nuclear or radiological accident" national response plan

This was published in February 2014 and covers all types of emergency situations, supplementing the existing local planning arrangements (PUI – on-site emergency plan and PPI – off-site emergency plan). It clarifies the organisation of the national response in the event of a nuclear accident.

This plan anticipates the possible consequences of an accident so that they can be mitigated and more rapidly assessed. It also includes elements of post-accident policy established by the CODIRPA, the international nature of emergency situations and the mutual assistance possibilities in the case of an event.

CODIRPA

Pursuant to the interministerial directive of 7th April 2005, ASN set up the CODIRPA in June 2005. Post-accident management of a nuclear accident is a complex subject involving numerous aspects and many players. The assessment must benefit from a pluralistic structure which in particular involves all the stakeholders.

CODIRPA policy covering the exit from the emergency phase and the transition and long-term phases was transmitted by ASN to the Prime Minister in November 2012, accompanied by an opinion from the ASN Commission, published on *www.asn.fr* and widely distributed locally, nationally and internationally.

In 2014, the CODIRPA continued its work concerning the lessons learned from post-accident management in the aftermath of the Fukushima Daiichi disaster. The studies carried out hitherto on accidents of a moderate scale should more specifically be extended to the management of severe accidents.

In this context, three areas for focus were proposed:
- test and supplement the policy elements with respect to the different accident situations;
- assist with regional implementation of the elements of post-accident management;
- take part in international work carried out on the post-accident theme, share and integrate its results.

The new duties of the CODIRPA were officially laid out in a letter from the Prime Minister on 29th October 2014, giving ASN a new mandate for a five-year period.

The cost of the nuclear risk

Following on from the work done by the CODIRPA, ASN organised a pluralistic study seminar on the cost of the nuclear risk, on 24th October 2014.

HERCA/WENRA approach

HERCA (Heads of the European Radiological protection Competent Authorities) and WENRA (Western European Nuclear Regulators Association) adopted a joint position on 22nd October 2014 concerning the management of emergency situations and their transboundary coordination, in particular the rapid transmission of information between the countries concerned and consistency between the recommendations issued for protection of the populations. The principle is to align the population protection measures in neighbouring countries with those decided on by the country in which the accident occurred.

In Europe:
- evacuation should be prepared up to 5 km around nuclear power plants, and sheltering and ingestion of iodine thyroid blocking (ITB) up to 20 km;
- a general strategy should be defined in order to be able to extend evacuation up to 20 km, and sheltering and ingestion ITB up to 100 km.

Each of the European nuclear safety and radiation protection authorities will be initiating discussions with their respective national civil protection authorities with a view to implementing the recommended measures.

National nuclear and radiological emergency exercises

ASN, together with the General Secretariat for Defence and National Security, the General Directorate for civil security and emergency management and the Defence Nuclear Safety Authority, took part in implementing the 2014 programme of national nuclear and radiological emergency exercises concerning BNIs and radioactive substance transport operations.

These exercises enable the highest-level decision-making circles to be tested, along with the ability of the leading players to communicate, sometimes with simulated media pressure on them. In addition to the national exercises, the Prefects are asked to conduct local exercises with the sites in their *département*, in order to improve preparedness for radiological emergency situations, more specifically testing the time needed to mobilise all the parties concerned.

OUTLOOK

ASN is actively contributing to the review process currently being carried out by the public authorities following the Fukushima Daiichi accident, concerning the national radiological emergency response organisation. ASN will actively participate in the work to implement the "Major nuclear or radiological accident" national response plan and will in particular call on the assistance of the Ministry of the Interior and the offices of the Prefects on the occasion of the publication of the regional implementation guide.

In 2015, ASN will continue with the European initiatives taken with a view to transboundary harmonisation of actions to protect populations in an emergency situation and to develop a coordinated response by the safety and radiation protection Authorities in the event of a near or remote accident, more specifically as part of the HERCA/WENRA approach.

In 2015, ASN will ensure that these emergency exercises also have an educational and informative dimension by extensively involving the populations in their preparation and implementing international relations aspects.

In 2015, ASN will oversee the preparation of the campaign to inform the populations living around the NPPs with regard to the protection measures and the distribution of stable iodine tablets which will take place in early 2016.

06 FROM INFORMATION TO TRANSPARENCY AND PUBLIC PARTICIPATION

"Transparency in the nuclear field consists in the set of provisions adopted to ensure the public's right to reliable and accessible information on nuclear security" (Article L.125-12 of the Environment Code which codifies Article 1 of the TSN act).

ASN is responsible for the correct implementation of the requirements of the TSN act, particularly those concerning transparency. ASN considers that nuclear subjects are everyone's business and that all citizens should be able to reach their own opinions.

ASN oversees application of the TSN act by the stakeholders and is particularly attentive to verifying that the nuclear licensees meet their obligations regarding transparency. The licensees are required to release to anyone who so requests the information in their possession concerning the risks involved in their activities and the safety or radiation protection measures taken by them to prevent or mitigate these risks.

ASN also focuses on ensuring participation by civil society in subjects related to nuclear safety and radiation protection, in the spirit of the Aarhus Convention which encourages consultation of the public and the stakeholders and the transparency of information. It supports steps in favour of transparency by the Local Information Committees (CLI) and the HCTISN.

Each year ASN presents its Report on the state of nuclear safety and radiation protection in France to Parliament and develops its relations with the members of parliament and the local elected officials.

SIGNIFICANT EVENTS

The ASN *Report on the State of Nuclear Safety and Radiation Protection in France in 2013* was presented to Parliament on 15th April. It led to more than twenty national and regional press conferences.

The new format of *Contrôle* magazine was launched in March 2014 with number 197 concerning the new BNI regulations. It was an opportunity for those concerned by their implementation to give their opinions. Number 198 deals with continued reactor operations beyond 40 years, the radon risk and the fire risk. *Contrôle* magazine is a technical review and is now divided into three separate sections: *"Analyse"* (analysis), *"Retour d'expérience"* (feedback) and *"En question"* (focus).

The *www.asn.fr* website is the main source of information for the general public. This year, the *www.asn.fr.* website attracted nearly 540,000 visitors. In 2014, ASN reorganised the content of the site to make it even easier for the various audiences to find the information they were looking for.

On 21st March 2014, ASN organised a seminar for the nuclear licensees, with the presence of CLI members (300 participants) to present the new regulations applicable to BNIs. This national seminar was followed by a first regional discussion seminar in Caen with the nuclear licensees of Normandy and Brittany.

In 2014, ASN was regularly summoned to attend Parliamentary hearings on its activities and on the various bills concerning nuclear safety and radiation protection. For the second year, ASN took part in the Mayors and Local Authorities Exhibition in November 2014, where it received nearly 300 visitors on a variety of topics, notably the operating lifetime of the nuclear power plants and their monitoring, the management of emergency situations, the radon risk in the home and the means of preventing it, radiation protection of the population and of patients.

In 2014, ASN and IRSN completed their preparation of a travelling educational exhibition designed to inform the general public about the risks linked to ionising radiation. The exhibition was presented to the public in about fifteen high schools and in the ASN information centre. The aim of the exhibition is to be presented primarily in communities within off-site emergency plans (PPI) zones, in the regions concerned by the radon risk, in schools, medical facilities, etc.

ASN's public information centre received nearly 300 visitors during the exhibition entitled *"La sûreté nucléaire? Question centrale!"* (Nuclear Safety? The core of the matter) designed by ASN and IRSN, to present the principles and effects of radioactivity and understand how a nuclear power plant functions and is monitored.

In partnership with the National Association of local information committees and commissions (Anccli), ASN organised the 26th CLI conference, which attracted about 200 participants on 10th December 2014 in Paris. After the "topical questions", with presentations by ASN and the Anccli, two round-table sessions addressed the topics of "Continued operation of the nuclear reactors beyond their 4th periodic safety review" and "Population protection measures in the event of a nuclear accident: towards European harmonisation?".

In October 2014, ASN and the Drôme *département* General Council organised the first inter-CLI discussion seminar, bringing together 150 participants from all the CLIs in the Rhone valley.

OUTLOOK

For 2015, ASN will actively contribute to implementing steps to reinforce nuclear transparency in accordance with the requirements of the green growth energy transition bill.

It will reinforce transparency on the subjects under its responsibility, together with the other players and stakeholders.

ASN will develop its general public information measures, in order to make the technical subjects presented to them clearer and more accessible. ASN will continue to suggest that the public contribute to draft regulatory texts, by submitting their opinion on *www.asn.fr.*

ASN will coordinate preparations for the 2016 information and iodine tablets distribution campaign intended for the populations living around the nuclear power plants.

ASN will continue its exchanges with the elected officials and stakeholders. An inter-CLI meeting for the Val de Loire area is thus planned for 2015.

ASN will continue to support CLI activities. It will continue its actions with respect to the Government and Parliament, to ensure that the CLIs are given the resources they need.

ASN considers that the HCTISN plays an important consultation role at the national level. It regretted the interruption of its work in 2014 and hopes that the HCTISN will rapidly resume working in 2015.

07 INTERNATIONAL RELATIONS

ASN devotes considerable resources to international cooperation, enabling it to contribute to reinforcing nuclear safety and radiation protection worldwide, while consolidating its competence and its independence.

SIGNIFICANT EVENTS

Europe is a priority area for ASN's international actions, in which it aims to contribute to the construction of two areas, one dealing with the topic of nuclear safety and the safe management of waste and spent fuels and the other with the topic of radiation protection.

ASN actively contributed to the revision of the European nuclear safety directive. This was adopted on 8th July 2014 and makes provision for greater powers and independence on the part of the national safety regulators, sets ambitious safety objectives and establishes a European system of peer reviews. It also sets up national periodic safety assessments and provisions concerning preparedness for emergency response interventions. It also reinforces transparency and improves education and training. ASN considers that these new measures significantly strengthen the

European community framework for oversight of the safety of nuclear installations.

The European associations of nuclear regulatory authorities (WENRA) and radiation protection authorities (HERCA) created a joint working group in January 2014, which proposed "reflex" response measures to be taken in the event of a severe accident in which the authorities have very little information about the condition of the facility affected, as was the case for the accident in the Fukushima Daiichi NPP.

In the field of radiation protection, ASN coordinated the work involved in transposing the revision of the directive concerning basic radiation protection standards of 5th December 2013.

Outside Europe, numerous international initiatives on the harmonisation of regulations and practices have been made, more specifically under the supervision of IAEA and the OECD Nuclear Energy Agency (NEA). ASN actively participates in the work of the IAEA Commission of Safety Standards (CSS) which draws up international standards for nuclear safety and radiation protection. It was the originator of a scale for rating radiation protection events involving patients, ASN-SFRO scale which was presented to all countries in October 2014. ASN also takes part in the cooperative MDEP (Multinational Design Evaluation Programme) for new reactors, in particular in the work of the group dedicated to the EPR.

As in previous years, 2014 was marked by intense activity by the international organisations regarding the implications of the accident which struck the Fukushima Daiichi NPP in 2011. ASN played a major role in this work and recalled that it is essential to learn all possible lessons, both regarding technical and organisational and human aspects. At a European level, the safety regulators updated their action plans established following the stress tests.

ASN considers that the peer reviews of the nuclear safety and radiation protection regulators are an essential lever in achieving improvement and international harmonisation. Since 2009, the member states of the European Union have been required to undergo this periodic peer review of their organisation regarding nuclear safety. After receiving the first IRRS (Integrated Regulatory Review Service) mission concerning all the activities of a safety regulator in 2006, ASN hosted a second mission in November 2014. On this occasion, twenty-nine foreign auditors examined the French nuclear safety regulation and monitoring system.

ASN has signed bilateral cooperation agreements with many countries. It thus maintains close relations with the main countries equipped with nuclear reactors or looking to acquire them and with countries interested in radiation protection and emergency situation management issues. It pays particularly close attention to relations with France's neighbours. For many years, ASN has also been promoting personnel exchanges with its foreign counterparts and opens up its Advisory Committees of Experts to foreign representatives.

In 2014, ASN continued to be approached by countries wishing to benefit from its assistance in the regulation of nuclear safety and radiation protection. The purpose of this assistance is to enable the countries concerned to acquire the safety and transparency culture that is essential for a national system of nuclear safety and radiation protection regulation. ASN replies to these approaches through bilateral programmes with the safety regulator of the country concerned, or through international instruments such as the Instrument for Nuclear Safety Cooperation (INSC) – with projects under way in China and Vietnam for example – or IAEA's Regulatory Cooperation Forum (RCF).

Finally, France is a contracting party to four international agreements aimed at preventing accidents linked to the use of nuclear energy and at mitigating their consequences. In 2014, the sixth review meeting of the Convention on Nuclear Safety was held in Vienna and was chaired by André-Claude Lacoste, the former Chairman of ASN.

OUTLOOK

In 2015, ASN will be aiming to promote a high level of safety internationally for new and existing reactors, making full use of the lessons learned from the Fukushima Daiichi accident. It will continue its work to reinforce the safety objectives of reactors worldwide. ASN will take part in the second peer review of the national plans resulting from the reactor stress tests carried out in 2012, concluding with a seminar organised by ENSREG (European Nuclear Safety Regulators Group) in April 2015.

The collaboration between HERCA and WENRA on the management of emergency situations will continue in 2015 and will involve national emergency preparedness authorities, so that a European approach to preparedness for emergency situations can be defined.

ASN will continue its work to develop the European approach to radiation protection. ASN will continue its involvement in radiation protection and will continue to put across its message concerning the need to limit patient doses in medical imaging and to optimise doses in general. It will remain active on the subject of radon and will discuss its practices in this respect with its counterparts.

Finally, ASN will maintain its policy of cooperation, by continuing the various forms of exchanges with its foreign counterparts.

08 REGIONAL OVERVIEW OF NUCLEAR SAFETY AND RADIATION PROTECTION

This chapter sets out the nuclear safety and radiation protection situation observed locally by ASN's eleven regional divisions.

Summary sheets present the BNIs and small-scale nuclear facilities (medical, industrial and research) and the local actions particularly representative of ASN's work in the regions.

09 MEDICAL USES OF IONISING RADIATION

For more than a century, medicine has made use of sources of ionising radiation, both for diagnostic purposes and for therapy. While their benefits and usefulness have long been medically proven, these techniques contribute significantly to the exposure of the population to ionising radiation.

Behind exposure to natural ionising radiation, medical exposure represents the second source of exposure for the population and the leading source of artificial exposure. According to IRSN, 222,975 people working in the medical and veterinary fields were the subject of dosimetric exposure monitoring in 2013. Medical radiology concerns about 52% of the medical personnel exposed. More than 98% of the health professionals monitored in 2013 received an annual effective dose below 1 mSv. The annual effective dose limit of 20 mSv was exceeded on six occasions.

In France, there are several thousand conventional or dental radiology devices, just over a thousand computed tomography facilities, more than a thousand facilities carrying out out interventional radiology and fluoroscopy-guided procedures, 217 nuclear medicine units using unsealed sources for in vivo or in vitro diagnostics and for internal radiotherapy, plus 175 external radiotherapy centres equipped with 452 treatment devices, handling some 175,000 patients every year.

The activities presenting the highest risk from the radiation protection standpoint require authorisation. In 2014, ASN issued 681 authorisations, including 363 in computed tomography, 163 in nuclear medicine, 110 in external radiotherapy, 36 in brachytherapy and 9 for blood product irradiators.

In 2014, ASN produced a situation report on computed tomography radiation protection, on the basis of the inspections performed in 2013, along with a report of external radiotherapy on the basis of the inspections performed in 2012 and 2013.

SIGNIFICANT RADIATION PROTECTION EVENTS (SRE)

In 2014, the number of SRE notified to ASN in the medical field is close to that of 2013 and stands at 557. However, there is a downward trend in the number of SRE notified in radiotherapy, with a drop of about 23% in external radiotherapy. For workers, the 40 SRE concern all activity sectors. For patients, 55% of the 302 SRE notified come from radiotherapy units. These events, which have no serious consequences for the health of the patients, were rated level 1 (117) and 2 (3) on the ASN-SFRO scale. 134 events concerned nuclear medicine. 133 concerned the medical exposure of women unaware of their pregnancy. The number of events concerning radioactive effluent leaks from nuclear medicine units rose in 2014.

The incident notices are published on *www.asn.fr*.

The events notified to ASN in 2014 show that the consequences with the most significance in radiation protection terms concern:
- for workers, primarily interventional radiology;
- for patients, interventional radiology during complex and lengthy procedures, but also nuclear medicine, with errors in the administration of radiopharmaceuticals;
- for the public and the environment, leaks from effluent containment devices in nuclear medicine.

For interventional radiology, the experience feedback from the SRE notified to ASN underlines the need to make greater use of and give greater resources to persons with competence for radiation protection and medical physicists, to develop the training of professionals who are not specialists in ionising radiation and to adopt approaches to manage the quality, safety and evaluation of professional practices.

So that information about a significant event notified to ASN is rapidly available, the Feedback information sheet, a new feedback tool intended for the professionals, was produced by ASN in 2014.

THE RADIATION PROTECTION SITUATION IN RADIOTHERAPY

Since 2012, radiotherapy centres are inspected every two years. An inspection frequency of one year is however maintained for centres showing potential signs of vulnerability or in which major changes have occurred in terms of human resources or organisation, or which adopt new techniques.

At the request of ASN, at the end of 2014, the Advisory Committee of Experts for radiation protection for the medical and forensic applications of ionising radiation worked on the conditions for implementing high-precision irradiation techniques in radiotherapy. ASN will adopt a position on this subject in 2015, on the basis of its opinion.

The ASN inspections performed in 2013 confirm the positive trend with regard to the increase in human resources for medical radiation physics. All the centres now have more than one equivalent full time medical physicist.

All the centres have implemented a patient treatment safety and quality management system, although the progress of this implementation varies greatly from one centre to another.

To encourage the use of risk analysis by the departments, ASN identified the difficulties encountered and in 2015 will be issuing recommendations on this subject.

THE RADIATION PROTECTION SITUATION IN NUCLEAR MEDICINE

In 2014, ASN continued to inspect nuclear medicine units and updated the rules applicable to their layout. Compliance with the regulatory obligations was considered to be on the whole satisfactory, in particular with respect to the designation and definition of the duties of the person competent in radiation protection (PCR), the implementation of appropriate dosimetry and the performance of external radiation protection checks. Efforts are still required concerning risk assessment, radiation protection training of the personnel and the performance of internal inspections. Radiation protection training of the patients remains a weak point.

In 2015, ASN will issue recommendations on the conditions for discharge of radionuclide-contaminated effluents into the public sewerage system.

THE RADIATION PROTECTION SITUATION IN CONVENTIONAL RADIOLOGY AND COMPUTED TOMOGRAPHY

In 2012, computed tomography procedures accounted for 71% of the mean effective dose received by the population, although they only represent 10% of the volume. It should be noted that for a sample of about 600,000 individuals covered by health insurance, analysis of the effective doses for this population shows that 70% of them received less than 1 mSv, 18% between 1 and 10 mSv, 11% between 10 and 50 mSv and 1% more than 50 mSv. In 2013 and 2014, this field remains an inspection priority.

In 2013, the inspection of the 96 computed tomography facilities (10% of the total) confirmed a better assimilation of worker radiation protection than patient radiation protection along with the persistence of the shortcomings previously identified with regard to application of the optimisation principle, analysis of the workstations, radiation protection training refresher courses and monitoring by operational dosimetry

In 2014, ASN contributed to ensuring that the guide to medical imaging best practices was available on smartphone and tablet to enable those referring patients for radiological examinations (general practitioners, specialists and emergency doctors) to better apply the justification principle.

At a European level, within HERCA, ASN met scanner manufacturers in order to improve the equipment optimisation tools and European medical societies and international organisations to look at the justification of imaging examinations utilising ionising radiation.

THE RADIATION PROTECTION SITUATION IN INTERVENTIONAL RADIOLOGY

The monitoring and regulation of radiation protection in interventional radiology is also a national priority for ASN.

In 2015, ASN will be publishing a national summary of the inspections performed over the period 2010 to 2012. The 2013 inspections have already confirmed that the radiation protection of professionals is better assured in fixed installations than in operating theatres and that workplace environment studies, in particular concerning the doses at the extremities and lens of the eye, dosimetric monitoring and professional training must be reinforced.

At the initiative of ASN, the French National Authority for Health (HAS) published recommendations in 2014 for monitoring patients having undergone interventional radiology procedures that could lead to effects on tissues.

Finally, ASN considers that devices for estimating the dose of radiation delivered should be installed on all the radiology equipment in service.

Even if ASN notes improvements in the units and awareness on the part of the professionals, it nonetheless considers that, as in 2013, the urgent measures it has been recommending for several years (more medical physicists, user training, quality assurance, auditing of professional practices, PCR resources, training of professionals in the radiation protection of patients, publication of guides of best practice by learned societies) are not always adequately implemented.

10 INDUSTRIAL, RESEARCH AND VETERINARY USES AND SOURCE SECURITY

Small-scale nuclear activities stand out through their extreme heterogeneity and the very large number of licensees concerned. ASN must therefore adapt its efforts to their radiation protection issues if it is to regulate them effectively. ASN is in particular attentive to overseeing the management of ionising radiation sources, monitoring their conditions of possession, utilisation and disposal and ensuring the accountability and monitoring of source manufacturers and suppliers.

REGULATION

In 2014, the list of installations classified on environmental protection grounds (ICPE) was changed, which meant that some facilities previously authorised by the Environment Code to possess and utilise radioactive substances are now regulated by ASN under the Public Health Code. Henceforth, only facilities holding radioactive substances in an unsealed form in quantities exceeding 10m^3 are subject to the ICPE system (excluding the medical sector and particle accelerators).

In accordance with the simplification process and the graduated approach to radiological risks and potential consequences, ASN has drawn up and implemented licensing application forms specific to each activity and available on *www.asn.fr*.

With regard to the application of the ban on the intentional addition of radionuclides in consumer goods and construction products, two ministerial decisions were the subject of an order in 2014: a waiver on the ban on the addition of radionuclides for the use of ampoules and refusal of a waiver for the addition of radionuclides in watches. ASN issued a favourable opinion on the draft orders and recalled the principle of the justification of activities comprising a risk of human exposure to ionising radiation.

With regard to the design of the facilities, ASN resolution 2013-DC-0349 of 4th June 2013, setting the minimum technical rules for the design of facilities in which X-rays are present, entered into force on 1st January 2014.

Finally, although the subject of monitoring the protection of radioactive sources against malicious acts has been the subject of interministerial discussions since 2008, France has not yet defined the obligations to be implemented to protect sources against malicious acts nor has it designated an authority with the legal capacity to carry out this regulation. In 2014, ASN brought this subject to the attention of Parliament through the review of the green growth energy transition bill. At the same time, ASN continued its preparations for rapid and efficient performance of this new mission.

AUTHORISATION

In 2014, 60 licensing or license renewal applications from suppliers of sources or devices containing sources were examined by ASN and 58 inspections were performed at these suppliers'. With regard to the users of sources, ASN examined and notified 225 new licenses, 1,015 license renewals or updates and revoked 398 licenses. Finally, with regard to the users of electrical generators of ionising radiation, ASN granted 206 licenses and 229 license renewals in 2014 and issued 500 notification certificates.

CONTROL

Two incidents rated level 2 on the INES scale occurred in 2014: an employee working on a defective gamma radiography device at the Latresne welding institute was irradiated and received a single dose higher than the annual regulation limit, and non-compliance with zone entry rules led to significant exposure of a worker during an X-ray inspection in the Nantes centre of the DCNS industrial group.

In 2014, the ASN radiation protection inspectors sent the public prosecutors three violation reports concerning veterinary surgeons, three concerning lead detection devices and three concerning industrial radiology. ASN also adopted three resolutions for formal notification in the industrial field.

ASN also noted several incidents linked to failure of the shutter on certain devices. Analysis of these particular incidents enabled the origin of the failure of this part to be identified and ASN asked the supplier to take preventive measures as part of the annual maintenance of the devices.

Most source blockage incidents were correctly managed. However, poor practices led ASN to send further reminders to the professionals regarding the correct practices resulting from the radiation protection regulations applicable to gamma radiography.

At the same time, ASN organised technical meetings with the stakeholders to define standard scenarios for loss of source control, define technical recovery solutions and best practices in the event of an incident. The conclusions of this working group should be published in early 2015.

With regard to the monitoring of cyclotrons, ASN noted an incident in 2014 concerning pressure control faults in shielded enclosures.

In 2014, ASN completed deployment of the system for remote-declaration of construction site schedules for industrial radiography contractors.

Finally, despite the improvement in the administrative situation of the veterinary structures, certain best practices observed in the field and the strong commitment by the profession to harmonise practices nationally, ASN remains vigilant with regard to the activities performed on large animals and outside specialised veterinary facilities. In this field, areas for improvement have been identified with regard to operational dosimetry monitoring of workers, internal radiation protection checks, radiological zoning and radiation protection of outside persons participating in radiological diagnostics.

11 TRANSPORT OF RADIOACTIVE SUBSTANCES

About 980,000 packages of radioactive substances are carried in 770,000 shipments annually in France, representing a very small percentage of the hazardous goods traffic. 88% of the packages transported are intended for the health, non-nuclear industry or research sectors. The medical sector alone accounts for 31% of the packages transported and the nuclear industry 12% (for example, 389 annual shipments of new fuel, 220 of spent fuel, about 50 for MOX fuels and about 100 for plutonium oxide powder).

The content of the packages varies widely: their radioactivity level varies from a few thousand becquerels for low-activity pharmaceutical packages, to trillions of becquerels for spent fuel. Their weight also varies from a few kilogrammes to about a hundred tonnes. Road transport accounts for about 90% of radioactive substances shipments, rail 3% and sea 4%.

Air transport is widely used for small and urgent packages over long distances, for example, low activity radiopharmaceutical products. All of these shipments can be international. The main participants in transport arrangements are the consignor and the carrier. The consignor is responsible for package safety. ASN ensures correct application of the regulations concerning the safe transport of radioactive and fissile substances for civil uses. This safety must not be confused with security, or physical protection, which is the prevention of theft or misappropriation of nuclear materials (usable for making weapons), for which ASN is not responsible. The major risks in the transport of radioactive substances are the risks of irradiation, contamination, criticality, but also toxicity or corrosion. To prevent them, the radioactive substances in the packages must be protected from fire, mechanical impact, water ingress into the packaging (leading to a criticality risk), chemical reaction between package components, etc. Safety is thus based above all on the robustness of the package, which is the subject of rigorous regulatory requirements. Given the international nature of these shipments, the regulations are drawn up on the basis of recommendations issued under the aegis of the International Atomic Energy Agency (IAEA). Although all packages must comply with strict rules, only 3% require ASN approval.

SIGNIFICANT EVENTS

In 2014, ASN urged the carriers of radiopharmaceutical products to make efforts to optimise radiation protection. A study requested from IRSN by ASN in 2013 showed that exposure of the drivers working for radiopharmaceutical package carriers over the past five years was higher than the average of workers exposed in France, with significant variations from one company to another.

Dangerous goods transport operations can take place on private roads within BNIs. These operations are subject to the provisions of the order of 7th February 2012. In 2014, several BNIs thus sent ASN revisions of their baseline safety requirements to take account of on-site transports. ASN analysed the on-site transport procedures for the site of La Hague and requested modification of the on-site transport packages for hulls and end-pieces resulting from the cutting up of spent fuel and of waste containers.

In 2014, in response to frequently asked questions, ASN drew up an information sheet on the transport of radioactive substances, intended for the general public and available on *www.asn.fr*.

In 2014, ASN issued 41 approval certificates. Most of these certificates concern prolongations or extensions of certificates already granted and two certificates concerned new package models. Eighteen of these certificates concern the transport of new or spent nuclear fuels.

In 2014, ASN carried out 113 inspections in radioactive substance transport (all sectors considered).

Half of these inspections concern shipments and carriers. They reveal incomplete familiarity with the regulations, especially in the medical sector. ASN pays particular attention to surveillance of the contractors, who are frequently called on.

In early 2014, ASN more specifically carried out two inspections on the drop tests for the new TN G3 spent fuel shipment packaging, which by 2020 should be replacing the TN 12/2 and TN 13/2 – for which ASN decided not to renew the approval. ASN also inspected the manufacture of new package models for the transport of vitrified waste and spent fuels from research or power reactors respectively. For these latter, the inspection was carried out jointly with the Swiss safety regulator.

In 2014, ASN carried out several inspections on transport package maintenance, in particular for the transport of MOX fuel and radioactive liquid effluents.

In 2014, ASN continued inspections on packages that do not require approval. These inspections show that the ASN recommendations expressed in its guide concerning these packages are beginning to be taken into account. There are still inadequacies, in particular as regards the demonstration of package compliance with the regulations.

ASN also carried out three inspections in 2014 in the railway sector, more specifically in collaboration with the French rail safety institution (Établissement français de sécurité ferroviaire). The follow-up letters to these inspections are available on *www.asn.fr*.

In 2014, 63 events rated level 0, and 3 events rated level 1 on the INES scale were notified to ASN. More than half of the events are notified by the industrial stakeholders in the nuclear cycle (EDF and Areva in particular). Nearly one quarter of the events concern radioactive pharmaceutical products. The conventional industry and research sectors notify very few transport events, probably owing to the lack of notification by the professionals in the small-scale nuclear sector.

In 2014, ASN took part in two emergency exercises involving a shipment of radioactive substances, one concerning a shipment of depleted uranium, the other – jointly with Belgium – a shipment of uranium hexafluoride.

In 2014, ASN submitted a guide to the drafting of emergency plans for public consultation. The guide was published in December 2014.

OUTLOOK

The actions undertaken in 2014 will be pursued in 2015 and particular attention will be given to compliance with the regulatory requirements of the order of 7th February 2012 concerning on-site transports, packages not requiring ASN approval, the manufacture and maintenance of packagings and analysis of the lessons learned from the Fukushima Daiichi accident with regard to transport.

12 EDF NUCLEAR POWER PLANTS (NPPs)

The 58 electricity generating reactors operated by EDF are at the heart of the nuclear industry in France. ASN imposes stringent safety requirements on these facilities, the regulation and monitoring of which mobilises nearly 200 of its staff and as many IRSN experts on a daily basis.

ASN has developed an integrated approach to regulation, covering not only the design of new facilities, their construction, modification and the integration of operating experience feedback, but also social, organisational and human factors, radiation protection, environmental protection, worker safety and the application of social laws.

SIGNIFICANT EVENTS

Continued operation of the nuclear power plants

In accordance with the Environment Code, EDF must carry out a periodic safety review of its reactors every ten years. This review consists, on the one hand, of a detailed check on designs and equipment and, on the other, of a reassessment of the safety of the reactors by comparison with the most recent facilities and international best practices. On this occasion, EDF corrects the deviations detected and identifies the modifications it intends to make to reinforce reactor safety. On a case by case basis, ASN then decides on the continued operation of each reactor, if necessary issuing additional prescriptions designed to strengthen safety.

In late 2014, all of the 1300 MWe reactors had undergone their second ten-yearly outage inspections. ASN has not identified any element that would compromise EDF's ability to manage the safety of these reactors until the next periodic safety review.

In February 2015, ASN ruled on the orientations of the periodic safety review associated with the second ten-early outages of the 1450 MWe reactors. On this occasion, it recalled that the safety objectives to be considered for the review of these reactors must be defined with reference to those set for the fourth ten-yearly outage inspections of the 900 MWe reactors.

Experience feedback from the Fukushima Daiichi accident

Following the accident at Fukushima Daiichi, ASN considered that stress tests needed to be carried out on French civil nuclear facilities in order to take account of the experience feedback from the accident. Further to these stress tests, ASN issued a range of resolutions in 2012, requiring EDF to take additional steps to reinforce the robustness of the NPPs to extreme situations, more specifically:

- a "hardened safety core" able to perform vital safety functions in the event of hazards or unforeseen circumstances exceeding those adopted for the general design of the facility;
- deployment of the "Nuclear Rapid Intervention Force" (FARN) proposed by EDF, a national emergency system involving specialised crews and equipment, capable of intervening on an affected site within less than 24 hours;
- reinforced measures to reduce the risk of uncovering of the spent fuel in the reactor fuel storage pits.

After analysis by IRSN and the Advisory Committee of Experts for Reactors (GPR) of the EDF proposal for the "hardened safety core" and having collated the comments from the public, ASN issued further resolutions on 21st January 2014 clarifying the components of this "hardened safety core" and the requirements applicable to their design and implementation.

Regulation of construction of the EPR in Flamanville

The Creation Authorisation Decree for the Flamanville 3 EPR was signed in April 2007 and construction work began in September 2007. The next regulatory step is ASN authorisation for reactor commissioning, for which EDF intends to submit its application in the spring of 2015. With this in mind and as of 2007, ASN initiated the review of certain topics requiring detailed examination and a check on the detailed design of the most important systems.

At the same time, ASN oversees the construction of the reactor through inspections and the examination of documents. Twenty-one inspections concerned the organisation of the project, the equipment assembly activities and the initial start-up tests. ASN also checked the manufacture of the nuclear pressure equipment intended for the main primary and secondary systems. Finally, the ASN labour inspectors carried out inspections on construction site safety and the fight against illegal labour.

Replacement of reactor 3 steam generators in the Le Blayais NPP

After examining the design and the manufacture of the new steam generators intended for reactor 3 at the Le Blayais NPP, ASN found that not all the required safety justifications had been provided. On 24th November 2014, ASN therefore asked Areva and EDF to provide additional safety justifications prior to installation and start-up of the new steam generators.

ASN ASSESSMENTS

Nuclear power plants

ASN considers that 2014 was relatively satisfactory in terms of nuclear safety and radiation protection in the NPPs, marked by improved management of reactor outages.

Management of operations is on the whole satisfactory. However, several activities were the origin of significant events in 2014. Their underlying causes lay in insufficient preparation, inadequate management of tag-outs or erroneous application or interpretation of operating documents. ASN considers that the operating documentation drafting process needs to be improved, with closer involvement of the end-users.

Although some improvements are visible with respect to 2013, efforts must be continued with regard to planning, preparation, periodic testing and interpretation of the results obtained. Although the shortcomings in the reference documentation partly explain the deviations observed in 2014, the skills of the players concerned are not always able to prevent their effects, despite the improvements made by EDF to the personnel training programmes and the implementation of a tutoring system for young recruits. EDF must continue to strengthen the jobs and skills management system.

The emergency management inspections carried out in 2014 confirmed that the sites had correctly assimilated the new PUI. However, these inspections did show that the management of emergency situations could be improved, more specifically with regard to the management of the mobile equipment used in an emergency situation and the corrective measures identified during the emergency exercises. The emergency response organisation was revised, notably with the integration of the FARN.

In terms of the organisation and internal training of the players involved in the processing of deviations, considerable progress was made by the NPPs in 2014, even if problems still exist with the implementation of and compliance with the baseline requirements issued by the EDF head office departments. The sites must continue their efforts, in particular with regard to the identification and traceability of the deviations detected. EDF has made undertakings, by means of a more detailed and more reactive review of deviations, to reinforce the assessment of their safety implications, in order to better identify and then prioritise the additional measures to be taken.

EDF has implemented a specific multi-year action plan designed to reinforce the management of activities scheduled and carried out during maintenance outages of nuclear power generating reactors. This action plan has in fact enabled the licensee to carry out more serene management of the preparation and performance phases. However, EDF's efforts must be continued over the long-term, more particularly with respect to work organisation, the preparation of certain activities, schedule compliance and coordination of the worksites.

In 2014, the condition of the first barrier and its management were on the whole stable but certain points could nonetheless be improved. 2014 was marked by the significant increase in the control rod cluster drop times for reactor 2 at the Nogent NPP, linked to the deformation of the fuel assemblies, entailing shutdown of the reactor before the end of its normal operating cycle, as well as the separation of a control rod in reactor 3 at the Tricastin NPP, which was not detected for more than one complete reactor operating cycle. ASN considers that particular attention must be paid to these points.

EDF's management of the second containment barrier is moving towards a satisfactory situation with the preventive strategy deployed in the programmes for replacement of the steam generators and the operations to keep their secondary parts clean.

By comparison with 2013, the number of events concerning the third barrier fell, in particular on the sites with an officer in charge of the "containment" function. Nonetheless, improvements are still expected with regard to the condition of the containment and the third barrier, more specifically concerning management of containment breaches in connection with the performance of work. The tests on the 900 MWe reactor containments performed in 2014 brought to light no particular problems liable to compromise their operation for a further ten years. On the other hand, ASN remains vigilant with respect to the double-wall containments of the 1300 and 1450 MWe reactors, which are not lined with a complete metal liner. It issued a ruling on this subject in June 2014 on the advice of the GPR and will be attentive to compliance with the undertakings that EDF made on this occasion.

The skills and qualifications management in place at the plants is on the whole satisfactory and the management processes well documented and coherent. Training programmes are, generally, implemented satisfactorily and the establishment of "academies" for the different professional disciplines is highlighted as a strong point for the training of newcomers to the sites.

Inadequacies at certain plants were however still observed by ASN during inspections, concerning forecast management of jobs and skills, even if considerable investments are being made by EDF for hiring and training, in order to anticipate the renewal of skills following the retirement of current staff. At some plants, the workforce in certain disciplines is insufficient and may lead to overwork, which is prejudicial to safety, and to problems in ensuring that young recruits are accompanied by more experienced tutors.

Given the scale of retirements expected in the coming years and the considerable work to be performed by EDF, ASN considers that EDF's recruitment and training efforts need to be continued.

In the NPPs, ASN plays a labour inspection role. Improvements were observed with respect to daily and weekly rest periods, to the consideration of certain risks, such as those linked to welding fumes. EDF also announced the broadening of the duties of the "zone managers" to all conventional worker safety aspects, which is a positive move.

Progress is still expected in the field of managing multi-contractor activity and the use of subcontractors. ASN also asked EDF to improve the distribution of operating experience feedback and good practices between the sites.

Generally speaking, ASN considers that the radiation protection organisation defined and implemented is on the whole satisfactory. The collective dose in 2014 fell by comparison with 2013. This drop is partly because of progress in implementing the Alara principle and improved management of the duration of reactor maintenance outages. Management of industrial radiography work is improving, even if there are still weaknesses in the preparation of these operations.

The organisation in terms of management of nuisances and the impact of NPPs on the environment is considered to be satisfactory at most plants, in particular through the implementation of structures that guarantee application of the regulatory requirements. However, contractor monitoring was felt to be insufficient and the plants do not all integrate operating experience feedback to the same extent. Improvements are also expected regarding the conformity of the facilities, the implementation of the maintenance programmes and waste management on the sites.

The ASN assessment of each NPP is detailed in chapter 8 of the report. Some plants stand out in this general assessment:
- with regard to nuclear safety: Saint-Laurent-des-Eaux;
- in the field of radiation protection: Chinon, Civaux, Golfech, Saint-Alban/Saint-Maurice, Saint- Laurent-des-Eaux;
- in the environmental field: Bugey, Dampierre-en-Burly, Saint- Laurent-des-Eaux.

Other NPPs are on the contrary under-performing with respect to at least one topic:
- with regard to nuclear safety: Bugey, Chinon;
- in the field of radiation protection: Bugey, Cattenom;
- in the environmental field: Belleville-sur-Loire, Cattenom, Chinon, Cruas Meysse.

Nuclear pressure equipment manufacturers

The order of 12th December 2005 concerning nuclear pressure equipment introduced a significant tightening up of the justification and monitoring of the design and manufacture of this equipment. It requires that the equipment manufacturers provide more justifications and demonstrations than before, in order to give stronger guarantees concerning the quality of this equipment.

The justifications and demonstrations provided by the manufacturers for new nuclear pressure equipment conformity assessments are still regularly unsatisfactory. ASN thus asked the manufacturers to modify their practices in order to bring them into line with the regulatory requirements.

OUTLOOK

In early 2015, ASN will rule on the generic aspects of the continued operation of 1300 MWe reactors beyond thirty years. It will then monitor the third ten-yearly outage inspection of Paluel NPP reactor 2. This third ten-yearly outage inspection will be the first carried out on a 1300 MWe reactor. Finally, ASN should be issuing its guidelines for the fourth periodic safety review of the 900 MWe reactors by the end of 2015.

Monitoring the implementation of the material and organisational measures prescribed following the Fukushima Daiichi accident will remain a priority for ASN. It will in particular examine the modifications made for the installation of additional generating sets and new emergency response centres. It will check EDF's ability to activate mobile response resources on the Gravelines site, the only French plant comprising six reactors.

In 2015, the Flamanville 3 EPR commissioning authorisation application will also be examined. The construction checks and EPR start-up tests will continue at a sustained rate.

13 NUCLEAR FUEL CYCLE INSTALLATIONS

The fuel cycle comprises the fabrication of the fuel and its subsequent reprocessing after it has been used, in order to extract the elements that are reusable in the nuclear reactors.

The main plants in the cycle – Comurhex, Areva NC Pierrelatte, Eurodif, Georges Besse II, FBFC, Melox, Areva NC La Hague – are part of the Areva group. These plants include facilities which have BNI status.

SIGNIFICANT EVENTS

The Comurhex II uranium conversion project is experiencing delays. These delays led Areva NC to ask ASN to allow continued operation of the former ICPE plants beyond July 2015. ASN is satisfied with Areva's replacement of the existing conversion units by a more modern and safer plant. It does however consider that continued operation would only be conceivable provided that the level of safety in the facilities is improved and that their shutdown date is compatible with the urban development programme around BNI 105. Based on the lessons learned from the Fukushima Daiichi accident, strengthening the safety of these facilities is also necessary. ASN will adopt a position in the first half of 2015.

With regard to the uranium enrichment activities, more specifically the Eurodif plant which has now been shut down, Areva carried on with rinsing of the circuits using chlorine trifluoride (ClF_3), as part of the Prisme project. The licensee will submit a Final Shutdown and Decommissioning (MAD-DEM) application for the installation before 31st March 2015, so that this new phase can begin at the end of the rinsing operations. In parallel with the Eurodif shutdown, the Georges Besse II plant, comprising two enrichment units, is gradually being brought on line. In a resolution dated 7th October 2014, ASN thus authorised start-up of the reception, sampling and packaging unit called REC II. ASN considered that the level of safety of the Georges Besse II plant was satisfactory in 2014.

With regard to the fuel fabrication activities on the FBFC site in Romans-sur-Isère, ASN asked the licensee to implement an ambitious plan of action to improve the safety of the facility and compensate for the observed lack of rigour in operations and safety management. ASN thus placed the licensee under heightened surveillance. FBFC met the first deadlines of the action plan transmitted. The results of the in-depth inspection conducted in November 2014 and concerning operational rigorousness is on the whole positive with regard to the steps taken by the licensee. However, the reorganisation and the actions examined by ASN were relatively recent. ASN will thus check that this positive trend is maintained in the long term.

With regard to the back-end of the cycle, the most significant point is the 9th December 2014 resolution concerning legacy waste recovery and packaging (RCD) on the La Hague site. Indeed, the recovery of this waste is monitored particularly closely by ASN, mainly because of the significant safety and radiation protection implications associated with it. This resolution therefore aims more specifically to regulate the progress and performance of this programme according to the safety implications of the operations. ASN will be particularly attentive to compliance with the deadlines concerning the RCD programme.

ASSESSMENT AND OUTLOOK

Cross-disciplinary aspects

ASN will be initiating a new process for examining safety and radiation protection management in the Areva group on the basis of the answers to the first examination phase which ended in 2011. It will notify Areva of its requirements, with a view to an examination in 2018.

ASN will be particularly attentive to the implementation of the internal authorisation systems approved in 2014 for the Tricastin and Melox sites, in addition to that already in place at La Hague.

ASN will continue to monitor the additional safety measures requested following the stress tests.

Fuel cycle consistency

In 2015, ASN will continue to monitor the "Cycle impact" file and its annual updates. ASN will in particular focus on monitoring the level of occupancy of the spent fuel underwater storage facilities (Areva and EDF). ASN in particular considers that saturation of the storage facilities for radioactive substances and wastes must be anticipated, in particular the spent fuel storage pools (pools at La Hague and fuel building pools of EDF reactors). ASN also wants Areva and EDF rapidly to define a management strategy going beyond 2030.

Tricastin site

ASN will continue to monitor the reorganisation of the Tricastin platform to ensure that these major organisational changes have no impact on the safety of the various BNIs on the site.

ASN will be vigilant in ensuring that the decommissioning authorisation application file for the Eurodif plant, to be submitted before the end of March 2015, gives a detailed description and justification of the operations necessary for the decommissioning and post-operational clean-out of the facility.

Romans-sur-Isère site

Areva NP still needs to carry out major conformity work on several buildings.

Given the malfunctions observed in recent years, ASN will pursue its heightened surveillance of the facility in 2015 in order to ensure that this licensee's nuclear safety performance is improved. It will be attentive to compliance with the deadlines for performance of the work defined in the facility's safety improvement plan and the revision of its safety baseline requirements. It will also be attentive to ensuring the implementation of the improvements planned as part of the stress tests.

La Hague site

For the La Hague plants, ASN considers that efforts must be continued for the recovery and packaging of legacy waste on the site in order to meet the prescribed deadlines. As part of the periodic safety reviews of the facilities, the adoption of an approach to identify elements important for safety and protection (EIP) at the operational level and improvements to the general operating rules for these plants will continue in 2015. The conclusions of the periodic safety review for the UP3-A plant will be the subject of an ASN resolution and a report to the Minister responsible for nuclear safety.

With regard to future changes to the processes in the La Hague facility, ASN attaches particular importance to replacement of the R7 evaporator and to the TCP project. The first will improve the availability of the facility's evaporator capacity, while the second will make it possible to process several particular fuel assemblies and thus postpone saturation of the storage ponds. Analysis of the event observed on the evaporators in the R2 unit should also be a priority for the licensee.

ASN will also be vigilant in ensuring that all the fuels received by the Areva NC plant are intended for processing in accordance with the plant's authorisation decrees.

14 NUCLEAR RESEARCH AND MISCELLANEOUS INDUSTRIAL FACILITIES

Nuclear research and miscellaneous industrial facilities, not directly linked to the nuclear power industry, are operated by the Alternative Energies and Atomic Energy Commission (CEA), for the civil part, and by a few other research organisations or industrial firms for commercial activities such as the production of radiopharmaceuticals, industrial ionisation or maintenance. The variety of activities covered and their past history explain the wide diversity of facilities concerned.

SIGNIFICANT EVENTS

Generic subjects on which ASN focused in 2014 were:

- the continued integration of experience feedback from the Fukushima Daiichi accident;
- the progress of CEA's major commitments;
- periodic safety reviews of CEA installations.

During the course of 2014, ASN called the CEA to hearings concerning:

- the progress of its strategic plan, in particular in terms of the creation, commissioning, final shutdown and decommissioning of its facilities;
- the Jules Horowitz reactor (JHR) and Astrid reactor projects;
- the tritium contamination incident in the buildings of the 2M Process company in Saint-Maur-des-Fossés.

In its opinion of 25th July 2014, ASN recalled that it was not in favour of continued operation of the Osiris facility beyond 2015 owing to the current level of safety of this reactor. This position already appeared in its 2008 resolution, which duly noted CEA's undertaking to cease activities at Osiris by the end of 2015. Reactor shutdown at the end of 2015 has since been confirmed by the Government and CEA transmitted the updated facility decommissioning plan in late 2014. CEA must also transmit a decommissioning authorisation application file in 2016.

For facilities other than those operated by CEA, ASN is concerned by the situation of the radiopharmaceuticals production facility operated by CIS bio international on the Saclay site.

ASN considers that CIS bio international is still demonstrating considerable difficulty in managing large-scale operations and that safety performance must make significant progress.

Further to the previous periodic safety review, ASN in 2013 prescribed measures that included reinforcing fire risk management, in particular through the installation of automatic fire extinguishing systems in various parts of the facility containing radioactive materials. The licensee's tardiness in initiating the work and complying with these prescriptions led ASN to issue several violation reports and serve formal notice on the licensee on several occasions, followed by procedures to ensure the deposit of funds corresponding to the cost of the work. CIS bio international is challenging these decisions and has appealed. ASN considers that CIS bio international must take all necessary steps to perform this conformity work concerning the fire risk within the prescribed time.

ASN also considers that the licensee must in particular improve the performance of many actions defined in the BNI's periodic safety review, in order to meet the deadlines to which it is committed in order to improve the plant's level of safety. A large amount of work to improve safety, which has been in progress for several years, is still not completed.

In 2015, ASN will therefore maintain heightened surveillance and monitoring of the facility.

ASSESSMENT AND OUTLOOK

A wide variety of research and other facilities are monitored by ASN. ASN will continue to oversee the safety and radiation protection of these installations as a whole and compare practices per type of installation in order to choose the best ones and thus encourage operating experience feedback. ASN will also continue its work to develop a proportionate approach when considering the issues involved in the facilities.

With regard to the stress tests, ASN will ensure compliance with the deadlines prescribed in its resolutions of 26th June 2012 and 8th January 2015. ASN will issue a position statement in 2015 for the final facilities of batch 2 without a hardened safety core and will examine the stress test reports for the batch 3 facilities received in 2014.

Concerning CEA

ASN considers that the "major commitments" approach, implemented by CEA since 2006, is on the whole satisfactory and should be continued and enhanced, more specifically by the adoption of new "major commitments" by CEA.

Generally speaking, ASN will remain vigilant to ensuring compliance with the commitments made by CEA, both for its facilities in service and those being decommissioned. Similarly, ASN will remain vigilant to ensuring that CEA performs exhaustive periodic safety reviews of its facilities so that ASN can conduct its examination in satisfactory conditions and so that the safety of the facilities benefits from the necessary improvements.

ASN will be particularly attentive to compliance with the deadlines for transmission of the decommissioning authorisation application files for CEA's old facilities which have been or will shortly be shut down. The drafting of all these decommissioning files and then performance of these decommissioning operations represents a major challenge for CEA, for which it must make preparations as early as possible. Finally, ASN will monitor CEA's preparations for final shutdown of the Osiris reactor at the end of 2015.

In 2015, ASN intends to:
- continue with surveillance of the operations on the RJH construction site and prepare for examination of the future commissioning authorisation application;
- rule on restart of the Cabri reactor;
- begin examination of the significant modification authorisation application for Masurca;
- complete examination of the periodic safety review files for the LECI, Poséidon, LEFCA facilities and issue a position statement on their possible continued operation;
- continue to examine the periodic safety review files for the LECA and Masurca facilities;
- prepare to examine the options file for the Astrid facility, after issuing its conclusions in 2014 on the main safety orientations of the project.

Concerning the other licensees

ASN intends to continue to pay particularly close attention to ongoing projects, that is ITER and the Ganil extension.

ASN will complete its examination of the periodic safety review files for the Ganil, BCOT and Somanu facilities and will decide on the conditions for their possible continued operation. ASN will continue to examine the periodic safety review files for Ionisos and will initiate that of the MIR inter-regional fuel warehouses.

Finally, in 2015, ASN will maintain its close surveillance of the radio-pharmaceuticals production plant operated by CIS bio international, with regard to the following points:
- increased operational rigour and safety culture;
- performance of the work prescribed for continued operation of the plant following its last periodic safety review;
- compliance with the undertakings made by the licensee in respect of the periodic safety review and not as yet honoured.

15 SAFE DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS

The term decommissioning covers all the activities performed after shutdown of a nuclear facility, in order to attain a predetermined final condition in which all the dangerous and radioactive substances have been removed. In 2014, about thirty nuclear facilities of all types were shut down or undergoing decommissioning in France.

POLICY AND REGULATIONS

In 2014, AIEA recognised two possible strategies for decommissioning nuclear facilities following their final shutdown: immediate dismantling and deferred dismantling. French policy and the regulations applicable to BNIs aim to ensure that the licensee adopts a strategy of immediate dismantling: decommissioning is initiated as soon as the facility is shut down, without a waiting period, although the decommissioning operations can take a long time. ASN supports the inclusion of this principle in the legislation and it has been incorporated by the Government into the green growth energy transition bill. This bill also renovates the decommissioning procedure by making a clearer distinction between final shutdown of the facility and its decommissioning.

In 2014, ASN drew up draft guidelines for remediation of soils and structures in nuclear facilities. They will be consulted by the stakeholders, for publication in 2015.

FACILITIES

The final shutdown and decommissioning authorisation decree for the Ulysse reactor operated by CEA in Saclay was published on 18th August 2014 and makes provision for a five-year decommissioning period.

To examine the decommissioning authorisation application for the Phenix reactor, the Advisory Committee of Experts for Laboratories and Plants met on 12th November 2014 and considered the plant's decommissioning procedures to be acceptable, in particular the sodium processing option. ASN will issue a position statement in 2015. The ASN resolution of 8th January 2015 also sets additional prescriptions specifying the requirements applicable to the "hardened safety core" of the Phenix reactor and the management of emergency situations.

In a resolution of 9th January 2015, the old Siloé research reactor, mainly used for technological irradiation of structural materials and nuclear fuels, was delicensed.

ASN returned its conclusions on the stress tests submitted by EDF in order to take account of the lessons learned from the Fukushima Daiichi accident for the BNIs being decommissioned (Chinon A1, A2 and A3, Saint-Laurent-des-Eaux A1 and A2, Bugey 1, Chooz A, Superphénix, Brennilis) and the Fuel Evacuation Facility (Apec) in Creys-Malville. The ASN Commission also called EDF to a hearing on its decommissioning strategy for the old gas-cooled reactors (UNGG) with a view to issuing a position statement in 2015. ASN will also issue a position statement on the decommissioning authorisation application for the Irradiated Material Facility (Ami) in Chinon.

The legacy waste recovery and packaging project (RCD) currently under way in the HAO silo and the organised disposal of hulls (SOC) represent the first hold point in decommissioning of the spent fuel reprocessing plant operated by Areva NC at La Hague. ASN authorised Areva NC to build the recovery and packaging unit in a resolution dated 10th June 2014. ASN issued a resolution on 2nd December 2014 stipulating its requirements concerning the content of the complete decommissioning application files for the old plants at La Hague, to be submitted by Areva NC in 2015, and set additional prescriptions concerning the safety of the decommissioning operations.

2015 will be marked by a large number of decommissioning authorisation application files for major facilities, such as Eurodif, the old plants at La Hague, the CEA centre at Fontenay-aux-Roses and so on. This illustrates the growth in the decommissioning work being done on old nuclear facilities.

16 RADIOACTIVE WASTE AND CONTAMINATED SITES AND SOILS

The management of radioactive waste is governed by the 28th June 2006 Programme act on the sustainable management of radioactive materials and waste, today codified in the Environment Code. This act sets a clear framework for management of all radioactive waste, in particular by requiring the adoption of a National Plan for Radioactive Materials and Waste Management (PNGMDR) revised every three years.

The purpose of the PNGMDR is to inventory the existing radioactive materials and waste management methods, to identify the foreseeable needs in terms of storage or disposal facilities and to clarify the necessary capacity for these facilities and the storage durations. Concerning radioactive waste for which there is as yet no final management solution, the PNGMDR defines the objectives.

SIGNIFICANT EVENTS, ASSESSMENTS AND OUTLOOK

Generally speaking, ASN considers that the French radioactive waste management system, built around a specific legislative and regulatory framework, a National Plan for Radioactive Materials and Waste Management (PNGMDR) and an agency for management of radioactive waste independent of the waste producers, is capable of regulating and implementing a structured and coherent national waste management policy. ASN considers that there must eventually be safe management for all waste, more specifically by means of a disposal solution. The updating of the PNGMDR, which should take place by the end of 2015, will be an opportunity to review progress and set new short and medium term objectives.

With regard to the regulations concerning the management of radioactive waste

ASN will contribute to the transposition of Council directive 2011/70/Euratom of 19th July 2011 establishing a community framework for the responsible and safe management of spent fuel and radioactive waste. This transposition will in particular allow the definition of a procedure carried out by the administrative authority to requalify materials as radioactive waste, with reinforced administrative and penal sanctions in this field.

In 2015, ASN will finalise the resolutions concerning the study of waste management, the inventory of waste produced in the BNIs and the packaging of radioactive waste. It will draw up draft resolutions concerning radioactive waste disposal facilities and radioactive waste storage facilities as well as a draft guideline on the application of the resolution concerning waste studies.

ASN will also be vigilant in ensuring that the work to transpose directive 2013/59/Euratom of 5th December 2013, setting basic radiation protection standards, does not compromise the French policy in which there are no clearance levels for waste from BNIs, while reinforcing the monitoring of TENORM waste.

Concerning licensee waste management strategies

ASN periodically assesses the strategies put into place by the licensees to ensure that each type of waste has an appropriate solution and that the range of solutions implemented form a coherent whole. ASN in particular remains attentive to ensuring that the licensees have the necessary treatment or storage capacity for managing their radioactive waste and anticipate sufficiently far in advance the construction of new facilities or renovation work on older facilities. In 2015, ASN will continue to closely monitor the legacy waste or spent fuel recovery and packaging operations, focusing on those with the most significant safety implications, for example in the Areva facility at La Hague.

In this respect, ASN will in 2015 be assessing EDF's waste management strategy and in 2016 will be receiving that of Areva.

Concerning reversible deep geological disposal (Cigéo project)

The year was marked by the conclusions of and the follow-up to the public debate held in 2013.

With regard to the Cigéo project for disposal of high and intermediate level, long-lived waste, ASN notes that a key step in the development of the project was reached in 2014, when Andra launched the preliminary design phase and published the conclusions of the public debate held on this project. Following the public debate, Andra decided to continue its studies so that in late 2017 it could submit a creation authorisation application for a deep geological radioactive waste disposal facility. Andra is also proposing new procedures for the development of its project.

Prior to routine operation of its facility, Andra is aiming for a phase which it refers to as the “pilot industrial phase”. ASN had underlined the importance of a gradual “ramp-up” phase for the installation before routine operation. It also specified that Andra should conduct in-situ tests on a representative scale. ASN thus considers that, in principle, this “pilot industrial phase” is able to meet these requirements. However, Andra shall be required to clarify the objectives.

The reversibility of deep geological disposal is a requirement contained in the Environment Code. It should be specified in a future act. In 2015, Andra will be submitting a file to ASN presenting the main technical options to ensure the recoverability of the emplaced waste packages.

ASN considers that the notion of reversibility must not only guarantee recoverability, in other words the possibility of recovering the waste packages already emplaced for a given period of time, but also that the facility is adaptable, so that during the construction and the operation of the disposal facility, it is possible to modify the previously adopted provisions. So that these safety issues are incorporated as of the design studies, ASN considers that it is essential for the technical requirements linked to reversibility to be defined prior to submission of the creation authorisation application for such a disposal facility, in compliance with the 2006 act.

2015 will be marked by the submission of several major files by Andra: a safety options file, a recoverability technical options file, a preliminary version of the waste acceptance specifications and a project development plan. This file will be the first overall safety file for the facility since 2009.

Finally, in 2015, ASN will publish its initial policy on the reversibility of a deep geological disposal facility, more specifically with regard to the need to take account of the possibility of adapting the disposal facility to a potential change in the inventory of waste emplaced.

Concerning the management of the former uranium mining sites and polluted sites and soils

With regard to the former uranium mining sites, ASN will in 2015 attempt to address the concerns of the Regional Directorate of the Environment, Planning and Housing (DREAL) regarding the Areva Mines action plan for the management of mining waste rock. It will focus more specifically on the management of potentially sensitive situations, in particular with regard to the radon risk. It will aim to ensure that the measures are taken in complete transparency and with the involvement of local stakeholders and it will continue its work on the management of former mining sites, in collaboration with the Ministry for the Environment.

ASN will also continue its involvement in international work on these topics, in particular within IAEA, ENSREG, WENRA, as well as bilaterally with its counterparts.

IRRS MISSION: ASN PEER-REVIEWED

From 17th to 28th November 2014, ASN hosted an IRRS (Integrated Regulatory Review Service) peer review mission organised under IAEA supervision and concerning all activities regulated and monitored by ASN. The mission was chaired by Mark Satorius, Chief Operations Officer of the US Nuclear Regulatory Commission and by Ann McGarry, Director of the Office of Radiological Protection at the Irish Environmental Protection Agency. It examined the strengths and weaknesses of the French nuclear safety and radiation protection oversight system by comparison with IAEA standards.

In 2006, ASN hosted the first IRRS (Integrated Regulatory Review Service) mission concerning all the activities of a safety regulator, with a follow-up mission in 2009. This practice is now incorporated into the European nuclear safety directive, which requires a peer review mission every ten years. The aim is to assess the national regulatory infrastructures against the IAEA safety standards and to provide a framework for discussion between safety regulators concerning nuclear safety and radiation protection technical and policy questions.

ASN, together with IRSN and the relevant departments of the Ministry for Ecology, Sustainable Development and Energy, had been preparing for this mission for a year.

During the course of the mission, twenty-nine experts from the nuclear safety and radiation protection regulators of Australia, Belgium, Canada, Cuba, Czech Republic, Finland, Germany, Hungary, India, Ireland, Japan, Morocco, Norway, Pakistan, South Korea, Spain, Switzerland, United Kingdom, United States and IAEA, met teams from ASN and from the other Government departments concerned. Mr Satorius and Mrs McGarry also had a meeting with Mr Le Déaut, Chairman of the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST).

The conclusions of the mission were presented to ASN on 28th November 2014 and were the subject of a press release from IAEA. This extremely detailed mission confirmed the robustness and rigorousness of the regulation and monitoring carried out in France by ASN.

The positive points or best practices underlined included the operation of ASN as an independent regulatory body, the effective regulatory structure benefiting from the support of IRSN and the Advisory Committees of Experts, the strong commitment in France to safety and the robust and effective organisational structure, giving great importance to the impartiality of the commissioners, advisory committees and the personnel as a whole, the extensive involvement of the stakeholders in the regulatory process and the transparency of the decision-making process, wide-ranging communication and, finally, the coordination between the oversight organisations involved in emergency planning and the effective interaction with the licensees in this field.

Attention was however drawn to several points:
- the need to assess the exhaustiveness of the regulatory framework for monitoring exposure in the medical field and the coordination between the organisations involved;
- the reinforcement of the system used by ASN to assess and modify its regulatory framework;
- in ASN's integrated management system, the need to specify all the processes ASN needs in order to perform its role.

The conclusions of the mission also show that new means must be examined in order to guarantee that ASN has the human and financial resources it needs for effective oversight of nuclear safety and radiation protection in the future.

The IAEA final report was transmitted to France in the first quarter of 2015 and posted on the ASN website.

ASN considers that the IRRS missions make a significant contribution to the international safety and radiation protection system. ASN is thus closely involved in hosting missions in France and in participating in missions in other countries. Commissioner Philippe Jamet and the ASN Director-general, Jean-Christophe Niel, have thus led IRRS missions in Finland and Switzerland respectively.

GREEN GROWTH ENERGY TRANSITION BILL

In 2014, the Government presented a green growth energy transition bill, part VI of which is entitled "Reinforcing nuclear safety and information of the citizens". The bill was adopted at its first reading by the National Assembly on 14th October 2014 and it should be finally adopted at the beginning of 2015.

This text requires that the share of nuclear energy in the national production of electricity be reduced but it will nonetheless remain considerable: 50% in 2025. The French nuclear fleet will continue to be one of the world's largest and its safety will have to be reinforced, with reference to the requirements applicable to the new reactors and by learning the lessons from the Fukushima Daiichi accident.

Without in any way pre-judging the final vote on the bill, ASN is pleased to see that this bill introduces a number of advances in the field of nuclear safety and radiation protection oversight and that it reinforces information of the citizens on these subjects.

It in particular notes the following positive points.

ENHANCED TRANSPARENCY AND INFORMATION OF THE CITIZENS

Each year, the local information committees (CLI) will be holding at least one meeting open to the public and the CLIs of BNIs situated in *départements* on the borders will include representatives of the foreign States concerned. Moreover, the CLIs may ask to visit the facility, in order to understand its normal operation and any significant events rated on the INES scale which may have occurred in it.

Without having to ask for it, those living in the vicinity of a BNI will, at the expense of the licensee, receive regular information about safety measures and the steps to be taken in the event of an accident. These population information operations will be regularly presented to the CLI.

Given the stakes associated with the continued operation of the nuclear reactors beyond forty years, the measures proposed by the licensee during the reactor periodic safety reviews performed after thirty-five years of operation, will be the subject of a public inquiry.

Finally, the public's right to information about radiological risks will be extended to all the risks and drawbacks of the nuclear facilities.

EVOLUTION OF THE BNI AUTHORISATION SYSTEM

Depending on the stakes involved and their scale, BNI modifications shall be the subject of:
- either a modification of the creation (or decommissioning) authorisation decree, after a public inquiry;
- or an ASN authorisation, which may involve participation by the public;
- or notification of ASN by the licensee.

This graduated system will thus allow processing appropriate to the risks and drawbacks of the facility and its modifications.

EVOLUTION OF THE BNI SHUTDOWN AND DECOMMISSIONING SYSTEM

The bill gives priority to BNI decommissioning as soon as possible after shutdown and incorporates the principle of immediate dismantling into the Environment Code. It renovates the decommissioning procedure, by making a clearer distinction than previously between the following:
- final shutdown of the facility, which is the responsibility of the licensee and must be notified to ASN;
- decommissioning of the facility, the procedures of which must be approved by the State on the basis of a file proposed by the licensee.

Final shutdown of a facility may also be declared automatically if it has not been in operation for several years.

REINFORCEMENT OF THE ASN MEANS OF INSPECTION AND POWERS OF SANCTION

The bill also provides for authorisations to legislate by means of ordinance in order to reinforce ASN's means of oversight and powers of sanction.

ASN should in particular be able:
- to impose measures to ensure the security of radioactive sources against malicious acts and verify correct application of these measures;
- to impose administrative fines and daily administrative penalties, impound items, take samples or require the deposit of funds, as well as conduct negotiated transactions. These actions will be taken by a sanctions committee, created within ASN, in order to maintain the principle of separation between the investigative and sentencing functions;
- to extend the inspections carried out by its inspectors to activities important for safety performed outside BNIs by the licensee, its suppliers, contractors, or subcontractors;
- in the BNIs, to check certain regulations linked to industrial risks (chemical risks, non-radioactive waste, explosive atmosphere) and have third party assessments carried out at the expense of the party concerned;
- to ensure that research is tailored to the needs of nuclear safety and radiation protection.

CLARIFICATION OF THE ORGANISATION OF THE OVERSIGHT OF NUCLEAR SAFETY AND RADIATION PROTECTION

ASN is in charge of the regulation and oversight of nuclear safety and radiation protection.

The bill incorporates into the Environment Code the existence and the duties of the French Institute for Radiation Protection and Nuclear Safety (IRSN). It recalls that ASN benefits from the technical support of IRSN and that these assessment activities are supported by research.

It also clarifies the relations between ASN and IRSN, indicating that ASN "guides IRSN's strategic decisions concerning this technical support" and that the ASN Chairman is an automatic and fully-fledged member of the Board of the institute.

The bill also mentions the principle of the publication of IRSN opinions.

REINFORCED MONITORING OF FORMER NUCLEAR SITES

The bill requires that the person acquiring land on which a BNI was operated, then decommissioned and delicensed, shall receive information about the past activities carried out on the site.

Sites polluted by radioactive substances and which present environmental risks could be subject to active institutional controls designed to protect the population.

CONCLUSION

While the examination of the green growth energy transition bill continues in Parliament, ASN considers that the provisions of the current draft lead to an improvement in the oversight of nuclear safety and radiation protection, so that it is more effective and more closely tailored to the stakes involved. It also notes with satisfaction that transparency and public information have been reinforced. ASN will be consulted by the Government about the regulatory texts implementing the future act.

GREEN GROWTH ENERGY TRANSITION BILL

In the related chapters, these boxes present the changes brought about by the act in the fields concerned.

01
NUCLEAR ACTIVITIES: IONISING RADIATION AND HEALTH AND ENVIRONMENTAL RISKS


asn

Ionising radiation may be of natural origin or caused by human activities, referred to as nuclear activities.

The exposure of the population to naturally occurring ionising radiation is the result of the presence of radionuclides of terrestrial origin in the environment, radon emanations from the ground and exposure to cosmic radiation.

Nuclear activities are defined by the Public Health Code as *"activities entailing a risk of human exposure to ionising radiation, emanating either from an artificial source, whether a substance or a device, or from a natural source when natural radioelements are or have been processed owing to their fissile or fertile radioactive properties..."* These nuclear activities include those carried out in Basic Nuclear Installations (BNI) and during the transport of radioactive substances, as well as in the medical, veterinary, industrial and research fields.

The various principles with which the nuclear activities must comply, particularly those of nuclear safety and radiation protection, are set out in chapter 3.

In addition to the effects of ionising radiation, BNIs are similar to all industrial installations in that they are the source of nonradiological risks and detrimental effects such as the discharge of chemical substances into the environment, or noise. The provisions relative to environmental protection are described in chapter 3.

1. STATE OF KNOWLEDGE OF THE HAZARDS AND RISKS ASSOCIATED WITH IONISING RADIATION

Ionising radiation is defined as being capable of producing ions – directly or indirectly – when it passes through matter. It includes X-rays, alpha, beta and gamma rays, and neutron radiation, all of which have different energies and penetration powers.

1.1 Biological and health effects

Whether it consists of charged particles, for example an electron (beta radiation) or a helium nucleus (alpha radiation), or of electromagnetic radiation photons (X rays or gamma rays), ionising radiation interacts with the atoms and molecules making up the cells of living matter and alters them chemically. Of the resulting damage, the most significant concerns the DNA of the cells and this damage is not fundamentally different from that caused by certain toxic chemical substances, whether exogenous or endogenous (resulting from cellular metabolism).

When not repaired by the cells themselves, this damage can lead to cell death and the appearance of health effects once tissues are no longer able to carry out their functions.

These effects, called "deterministic effects", have been known for a long time, as the first effects were observed with the discovery of X rays by W. Roentgen (1895). They depend on the type of tissue exposed and are certain to appear as soon as the quantity of radiation absorbed exceeds a certain dose level. These effects include, for example, erythema, radiodermatitis, radionecrosis and cataract formation. The higher the radiation dose received by the tissue, the more serious the effects.

Cells can also repair the damage thus caused, although imperfectly or incorrectly. Of the damage that persists, that to DNA is of a particular type, because residual genetic anomalies can be transmitted by successive cellular divisions to new cells. A genetic mutation is still far removed from transformation into a cancerous cell, but the damage due to ionising radiation may be a first step towards cancerisation.

The suspicion of a causal link between exposure to ionising radiation and the appearance of a cancer dates back to the early 20th century (observation of skin cancer in a case of radiodermatitis).

Since then, several types of cancers have been observed in occupational situations, including certain types of leukaemia, broncho-pulmonary cancers (owing to radon inhalation) and bone sarcomas. Outside the professional area, the monitoring for more than 60 years of a cohort of about 85,000 people irradiated at Hiroshima and Nagasaki has enabled the regular assessement of the morbidity[1] and mortality due to cancer following exposure to ionising radiation, and the description of the dose-effects relationships – which often form the basis of current regulations. Other epidemiological work, for example, has revealed a statistically significant rise in cancers (secondary effects) among patients treated using radiotherapy and attributable to ionising radiation. We can also mention the Chernobyl accident which, as a result of the radioactive iodines released, caused in the areas near the accident an excess in the incidence of thyroid cancers in people irradiated during childhood.

The radiation-induced carcinogenic effects appear for different levels of exposure and are not linked to the exceeding of thresholds. They are revealed by an increase in the probability of cancer in a population of a given age and sex. These are called probabilistic, stochastic or random effects.

The internationally established health objectives related to radiation protection aim to prevent the appearance of deterministic effects and reduce the probabilities of cancers arising from exposure to ionising radiation, which are also known as radiation-induced (or radio-induced) cancers; the results of the studies as a whole seem to indicate that radio-induced cancers represent the predominant health risk associated with exposure to ionising radiation.

1.2 Evaluation of risks linked to ionising radiation

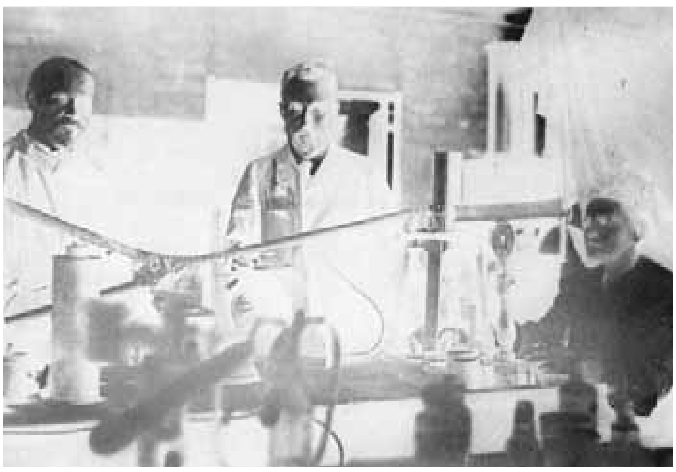
The monitoring of cancers in France is based on 14 general registers in metropolitan France (covering 18 *départements* and the greater Lille urban area) and 3 registers in the overseas French *départements*. In addition to this, there are 12 specialised registers: 9 *département* registers covering 16 continental *départements*, 2 national cancer registers for children under 15 years of age concerning malignant haemopathy and solid tumours, and 1 multicentric mesothelioma register for France as a whole.

The aim of the register for a given area is to highlight spatial differences in incidence and to reveal trends in terms of increased or reduced incidence over time in the different cancer locations, or to identify clusters of cases.

This method of monitoring aims to be descriptive but is unable to highlight any causal effect between an exposure to ionising radiation and cancers, given that other environmental factors may also be suspected. Furthermore, it should be noted that the *département* registers do not necessarily cover the areas close to the nuclear installations.

Epidemiological investigation supplements monitoring. The purpose of epidemiological surveys is to highlight an association between a risk factor and the occurrence of a disease, between a possible cause and an effect, or at least to enable such a causal relation to be postulated with a very high degree of probability. The difficulty in conducting these surveys or in reaching a convincing conclusion when the illness is slow to appear or when the expected number of cases is low, which is the case with low exposure levels of a few tens of millisieverts (mSv) for example, must nevertheless be borne in mind. Cohorts such as that of Hiroshima and Nagasaki have clearly shown an excess of cancers, with the average exposure being about 200 mSv; studies on nuclear industry workers published in recent years suggest risks of cancer at lower doses. Updated results should be published by the International Agency for Research on Cancer (IARC) in early 2015.

Low-dose risks are assessed for risk-management purposes by extrapolating the risks observed at higher doses. This calculation gives an estimate of the risks entailed by exposure to low doses of ionising radiation. For these estimates, the prudent hypothesis of a linear no-threshold relationship between exposure and the number of deaths from cancer (see diagram 1) has been adopted internationally. This hypothesis implies that there is no dose threshold below which one can assert that there is no effect. The legitimacy of these estimates and of this hypothesis nevertheless remains scientifically controversial, as very large scale studies would be necessary to further support the hypothesis.



Pierre and Marie Curie in their laboratory, circa 1900.

1. Number of persons suffering from a given disease for a given time - usually one year - in a population.

UNDERSTAND

UNSCEAR

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was set up in 1955 during the 10th session of the General Assembly of the United Nations. It comprises representatives from 21 countries and reports to the General Assembly of the United Nations. It is a scientific organisation created to conduct global and regional studies and evaluations of exposure to radiation and its effects on the health of the exposed groups. The committee also studies the progress made in understanding the biological mechanisms whereby radiation influences health or the environment.

Recent publications:

- Biological mechanisms of radiation actions at low doses (2012).
- Sources, effects and risks of ionising radiation:
  - Vol. I - Annex A - Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and tsunami (2013).
  - Vol. II - Annex B - Effects of radiation exposure of children (2013).
- Ability to attribute risks and effects to exposure to radiation (2012).

On the basis of the scientific syntheses of UNSCEAR (see box opposite), the International Commission on Radiological Protection – ICRP (see publication ICRP 103, chapter 3, point 1.1.1) has published risk coefficients for death from cancer due to ionising radiation, showing a 4.1% excess risk per sievert (Sv) for workers and 5.5% per sievert for the general public.

The evaluation of the risk of lung cancer caused by radon (radon is a naturally occurring radioactive gas which emits alpha particles; it is a decay product of uranium and of thorium and is classified by the IARC as a definite human carcinogen) is based on a large number of epidemiological studies performed directly in the home, in France and internationally. These studies have revealed a linear relationship, even at low exposure levels (200 becquerels per cubic metre (Bq/m^3)) over a period of 20 to 30 years. The World Health Organisation (WHO) has synthesised the studies and recommends maximum annual exposure levels of between 100 and 300 Bq/m^3 for the general public. The ICRP (publication 115) compared the risks of lung cancer observed through studies on uranium miners with those observed on the general population and concluded that there was a very good correlation between the risks observed in these two conditions of exposure to radon. The ICRP recommendations confirm those issued by the WHO which considers that, after tobacco, radon constitutes the highest risk factor in lung cancer.

DIAGRAM 1: Linear "dose-effect" relationship (no-threshold)

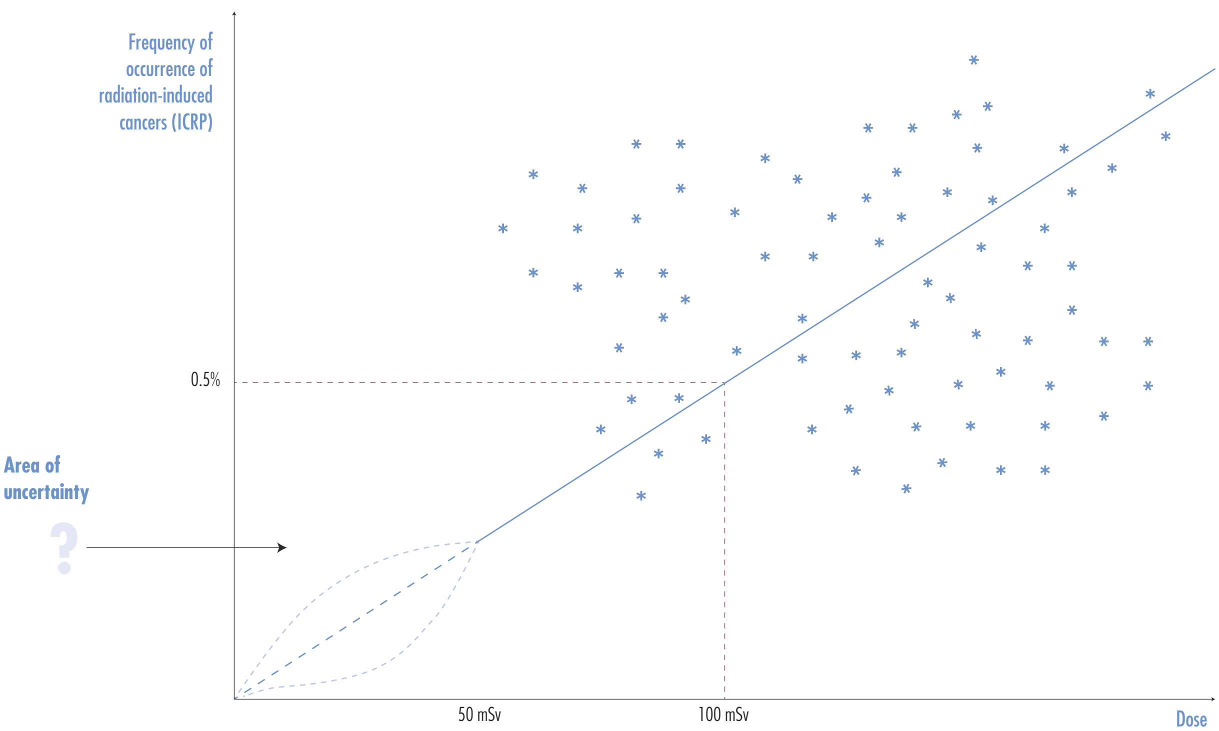


Illustration based on UNSCEAR – ICRP data

In metropolitan France, about 19 million people spread over some 9,400 municipalities are potentially exposed to radon. According to InVS (French Health Monitoring Institute) figures from 2007, between 1,200 and 2,900 deaths from lung cancer can be attributed each year to radon exposure in the home, that is to say between 5 and 12% of deaths due to cancer. A national action plan for managing radon-related risks has been implemented since 2004 on the initiative of ASN and is updated periodically (see point 3.2.2).

1.3 Scientific uncertainties and vigilance

The action taken in the fields of nuclear safety and radiation protection in order to prevent accidents and limit detrimental effects has led to a reduction in risks but not to zero risk, whether in terms of the doses received by workers or those associated with discharges and releases from BNIs. However, many uncertainties persist and require that ASN remain attentive to the results of the scientific work in progress, for example in radiobiology and radiopathology, with possible consequences for radiation protection, particularly with regard to management of risks at low doses.

One can for instance mention several areas of uncertainty concerning radiosensitivity, certain radiopathologies at high doses, the effects of low doses, the radiological signature of cancers and certain non-cancerous pathologies.

1.3.1 Radiosensitivity

The effects of ionising radiation on personal health vary from one individual to the next. Since it was stated for the first time by Bergonié and Tribondeau in 1906, it is for example known that the same dose does not have the same effect when received by a growing child and when received by an adult.

Individual hypersensitivity to high doses of ionising radiation has been extensively documented by radiotherapists and radiobiologists. This is the case with genetic anomalies in DNA repair and cell signalling, which means that certain patients may display extreme hypersensitivity that can lead to “radiological burns”.

At low doses, there is both cell radiosensitivity and individual radiosensitivity, which could concern about 5 to 10% of the population. Recent methods of immunofluorescence of molecular targets for signalling and repairing DNA damage help to document the effects of ionising radiation at low doses, reducing the detection thresholds by a factor of 100. The effects of a simple X-ray examination then become visible and measurable. The research carried out using these new investigative methods is producing results, although they still have to be confirmed before they can be considered conclusive.

This then raises delicate issues, some of which go beyond the strict context of radiation protection:
- if individual radiation hypersensitivity tests become available, should screening prior to any radiotherapy or repeated computed tomography examinations be recommended?
- should hypersensitivity screening be carried out on all workers liable to be exposed to ionising radiation?
- should the general regulations, for example, provide for specific protection for those concerned by hypersensitivity to ionising radiation?

These questions have ethical implications owing to the potential use of the results of individual radiation sensitivity tests, for example to discriminate between potential employees.

Whatever the case, there should be no unnecessary exposure of individuals to ionising radiation, in other words without justification. Children should receive particularly close attention in the event of exposure to ionising radiation for medical purposes.

1.3.2 Effects of low doses

The Linear No-Threshold (LNT) relationship. This hypothesis of this relationship, adopted to model the effects of low doses on health (see point 1.2), albeit practical from the regulatory standpoint, and albeit conservative from the health standpoint, is not as scientifically well-grounded as might be hoped for: there are those who feel that the effects of low doses could be higher, while others believe that these doses could have no effect below a certain threshold, and some people even assert that low doses have a beneficial effect. Research into molecular and cellular biology is leading to progress, as are epidemiological surveys of large groups. But faced with the complexity of the DNA repair and mutation phenomena, and faced with the limitations of the methods used in epidemiology, uncertainties remain and the public authorities must exercise caution.

Dose, dose rate and chronic contamination. The epidemiological studies performed on individuals exposed to the Hiroshima and Nagasaki bombings have given a clearer picture of the effects of radiation on health, concerning exposure due to external irradiation (external exposure) received in a few fractions of a second at high dose and high dose rate. The studies carried out in the countries most affected by the Chernobyl accident (Belorussia, Ukraine and Russia) were also able to improve our understanding of the effects of radiation on health caused by exposure through internal contamination (internal exposure) more specifically through radioactive iodine. Studies on nuclear workers have given a clearer picture of the risk due to chronic exposure established over many years, whether as a result of external exposure or internal contamination.

Hereditary effect. The appearance of possible hereditary effects from ionising radiation in humans remains uncertain. Such effects have not been observed among the survivors of the Hiroshima and Nagasaki bombings. However, hereditary effects are well documented in experimental work on animals: mutations induced by ionising radiation in embryonic germ cells can be transmitted to descendants. The recessive mutation of a chromosome gene will remain invisible as long as the same gene carried by the other counterpart chromosome is not affected. Although it cannot be absolutely ruled out, the probability of this type of event nonetheless remains low.

TO BE NOTED

Individual radiosensitivity

A seminar entitled "Individual radiosensitivity: the future of an old notion" was organised by ASN on 16th December 2013. It attracted about 60 people including researchers, physicians concerned by the use of ionising radiation at low or high doses (radiologists, nuclear physicians, radiotherapists) and representatives from the institutions concerned as well as patient associations.

The aim was to review the variability of the individual response to ionising radiation, both at high doses, with the side effects and complications of radiotherapy and at low doses, with the potential risks primarily of cancer from exposure to ionising radiation for medical purposes.

Among the conclusions of this seminar, which are available on *www.asn.fr,* we can mention:
- the urgency to make available appropriate, robust and standardised tests of the early and latent complications of radiotherapy, to enable the practitioners involved to deliver target treatments by using "tailored" protocols;
- the duty to alert the health professionals, especially general practitioners, on the particular sensitivity and radiesthesia (genetic profiles having an increased risk of radio-induced cancer) of certain children with respect to ionising radiation;
- the need for jurists, institutional bodies, and ASN in particular, to remain attentive to advances in knowledge in order to anticipate the regulatory decisions that could or must be taken.

Environmental Protection. The purpose of radiation protection is to prevent or mitigate the direct or indirect harmful effects of ionising radiation on individuals, including in situations of environmental contamination. Over and beyond environmental protection aiming at the protection of humans and present or future generations, the protection of non-human species as such forms part of the environmental protection prescribed in the French constitutional Charter for the environment. This subject has been taken into consideration by the ICRP since 2007 (ICRP 103) and the practical means of dealing with the protection of nature in the specific interests of animal and plant species has been the subject of several publications since 2008 (ICRP 108, 114 and 124).

1.3.3 Radiological signature of cancers

It is currently impossible to distinguish a radiation-induced cancer from a cancer that is not radiation induced. The reason for this is that the molecular lesions caused by ionising radiation seem no different to those resulting from the normal cellular metabolism, with the involvement of free radicals - oxygenated in particular – in both cases. Furthermore, to date, neither anatomopathological examinations nor research for specific mutations have been able to distinguish a radiation-induced tumour from a sporadic tumour.

It is known that in the first stages of carcinogenesis a cell is created with a particular combination of DNA lesions that enables it to escape from the usual verification of cellular division, and that it takes about ten to one hundred DNA lesions (mutations, breaks, etc.) at critical points to pass through these stages. All the agents capable of damaging cellular DNA (tobacco, alcohol, various chemical substances, ionising radiation, high temperature, other environmental factors, notably nutritional and free radicals of normal cellular metabolism, etc.) contribute to cellular aging, and ultimately to carcinogenesis.

Consequently, in a multi-risk approach to carcinogenesis, can we still talk about radiation-induced cancers? Yes we can, given the large volumes of epidemiological data which indicate that the risk increases as the dose increases, but the approach is undoubtedly more complex, since in certain cases cancer results from an accumulation of lesions originating from different risk factors. However, the radiation-induced event can also in certain cases be the only event responsible (radiation-induced cancers in children).

Highlighting a radiation signature of cancers, that is to say the discovery of markers that could indicate whether a tumour has a radiation-induced component or not, would be of considerable benefit in the evaluation of the risks associated with exposure to ionising radiation.

The multi-risk nature of carcinogenesis pleads in favour of a precautionary approach with regard to all the risk factors, since each one of them can contribute to DNA impairment. This is particularly important in persons displaying individual hyper-radiosensitivity and for the most sensitive organs such as the breast and the bone marrow, and all the more so if the persons are young. Here, the principles of justification and optimisation are more than ever applicable (see chapter 2).

2. THE DIFFERENT SOURCES OF IONISING RADIATION

2.1 Natural radiation

In France, exposure to the different types of natural radioactivity (cosmic or terrestrial) represents on average about 65% of the total annual exposure.

2.1.1 Natural terrestrial radiation (excluding radon)

Natural radionuclides of terrestrial origin are present at various levels in all the compartments of our environment, including inside the human body. They lead to external exposure of the population owing to gamma radiation emissions produced by the uranium-238 and thorium-232 chains and by the potassium-40 present in the soil, but also to internal exposure by inhalation of particles in suspension and by ingestion of foodstuffs or drinking water.

The levels of natural radionuclides in the ground are extremely variable. The highest external exposure dose rates in the open air in France, depending on the region, range from a few nanosieverts per hour (nSv/h) to 100 nSv/h.

The dose rate values inside residential premises are generally higher owing to the contribution of construction materials (about 20% higher on average).

Based on assumptions covering the time individuals spend inside and outside residential premises (90% and 10% respectively), the average effective dose due to external exposure to gamma radiation of terrestrial origin in France is estimated at about 0.5 mSv per person per year.

The doses due to internal exposure of natural origin vary according to the quantities of radionuclides of the uranium and thorium families incorporated through the food chain, which depend on each individual's eating habits. According to UNSCEAR (2000), the average dose per individual is about 0.23 mSv per year. The average concentration of potassium-40 in the organism is about 55 Becquerels per kilogram, resulting in an average effective dose of about 0.18 mSv per year.

Waters intended for human consumption, in particular groundwater and mineral waters, become charged in natural radionuclides owing to the nature of the geological strata in which they spend time. The concentration of uranium and thorium daughters, and of potassium-40, varies according to the resource exploited, given the geological nature of the ground. For waters displaying high radioactivity, the annual effective dose resulting from daily consumption (2 litres/inhabitant/day) may reach several tens or hundreds of microsieverts (µSv).

2.1.2 Radon

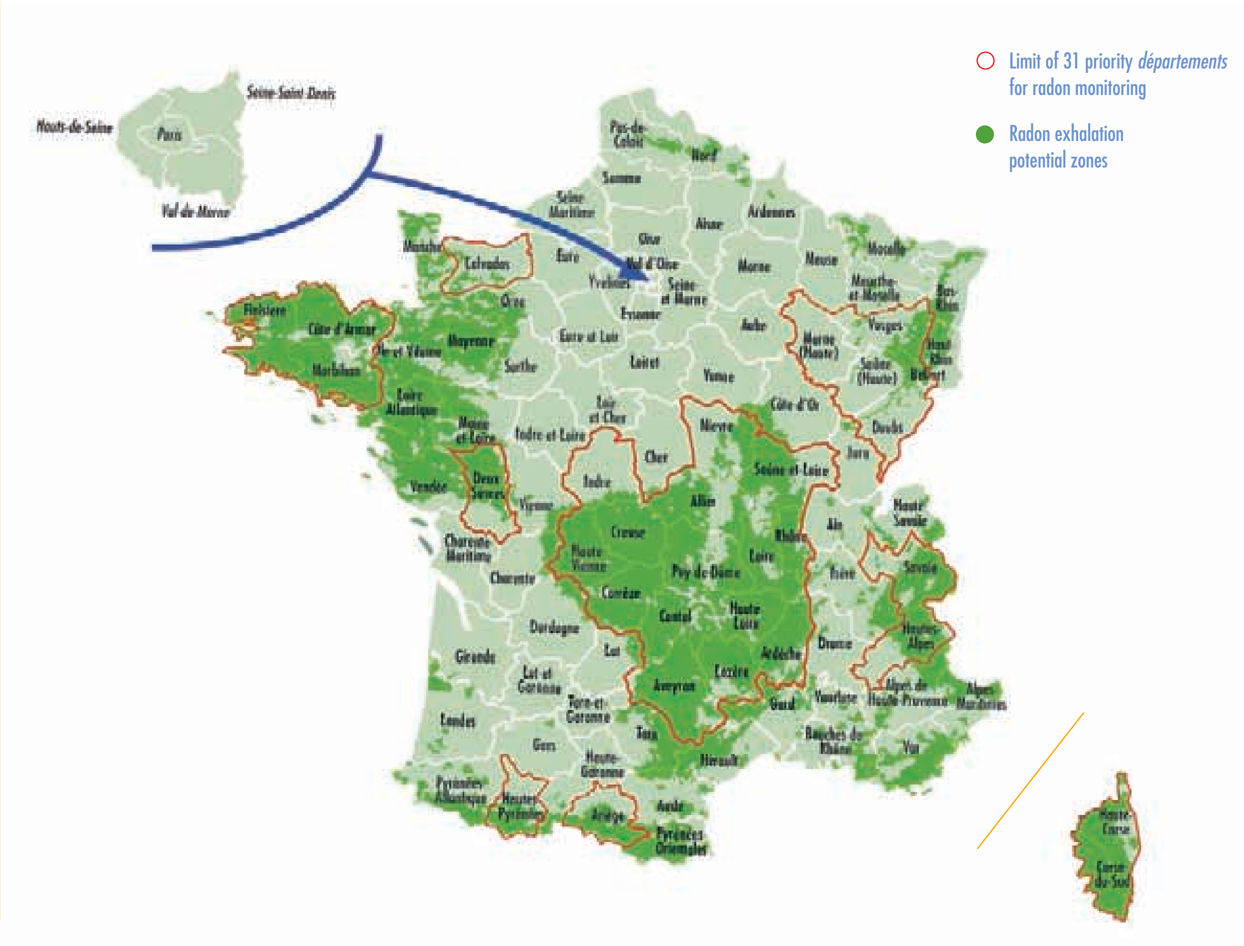
Some geological areas have a high radon exhalation potential due to the geological characteristics of the ground (granitic bedrock, for example). The concentration measured inside homes also depends on the tightness of the building (foundations) and the ventilation of the rooms.

So-called "domestic" exposure to radon (radon in dwellings) was estimated by IRSN (French Institute for Radiation Protection and Nuclear Safety) through measurement campaigns followed by statistical interpretations (see *www.irsn.fr*). The average radon activity value measured in France is 63 Bq/m^3, with about half the results being below 50 Bq/m^3, 9% above 200 Bq/m^3 and 2.3% above 400 Bq/m^3.

These measurements have allowed the French *départements* to be classified according to the radon exhalation potential of the ground (see map on next page).

In 2011, IRSN published a new map of France (see map on next page) considering the radon exhalation potential of the ground, based on data from the French Geological and Mining Research Office (BRGM).

MAP of radon exhalation potential (IRSN source)



2.1.3 Cosmic radiation

Cosmic radiation is of two types, with an ionic component and a neutronic component. At sea level, the dose rate resulting from the ionic component is estimated at 32 nSv per hour and that resulting from the neutronic component at 3.6 nSv per hour.

Considering the average time spent inside the home (which itself attenuates the ionic component of the cosmic radiation), the average individual effective dose in a locality at sea level in France is 0.27 mSv per year, whereas it could exceed 1.1 mSv per year in a mountain locality situated at an elevation of about 2,800 metres. The average annual effective dose per individual in France is 0.33 mSv. It is lower than the global average value of 0.38 mSv per year published by UNSCEAR.

Finally the exposure of aircrews to cosmic radiation, aggravated by prolonged periods at high altitude, also warrants dosimetric monitoring (see point 3.1.3).

2.2 Ionising radiation arising from human activities

The human activities involving a risk of exposure to ionising radiation, called nuclear activities, can be grouped into the following categories:
- operation of Basic Nuclear Installations;
- transport of radioactive substances;
- small-scale nuclear activities;
- disposal of radioactive waste;
- management of contaminated sites;
- activities enhancing natural ionising radiation.

2.2.1 Basic Nuclear Installations

Regulations classify nuclear facilities, called Basic Nuclear Installations (BNI), in various categories corresponding to more or less restrictive procedures, depending on the significance of the potential risks (see chapter 3, point 3).

The main BNI categories are:
- nuclear reactors;
- some particle accelerators;
- the plants that prepare, enrich or transform radioactive substances, particularly nuclear fuel production plants, irradiated fuel processing plants, and the facilities for processing and storing the radioactive waste produced by these plants;
- the installations intended for the processing, disposal, storage or use of radioactive substances, including waste, when the quantities involved exceed thresholds set by regulations.

The list of BNIs as at 31st December 2014 is given in appendix A.

Accident prevention and nuclear safety

The fundamental internationally adopted principle underpinning the specific organisational system and regulations applicable to nuclear safety is that of the responsibility of the licensee (see chapter 2). The public authorities ensure that this responsibility is fully assumed, in compliance with the regulatory requirements.

As regards the prevention of risks for workers, BNI licensees are required to implement all necessary means to protect workers against the hazards of ionising radiation, and more particularly to comply with the general rules applicable to all workers exposed to ionising radiation (work organisation, accident prevention, medical monitoring of workers, including those from outside contractors, etc.) (see chapter 3).

As regards protection of the population and the environment, the BNI licensee must also take all necessary steps to achieve and maintain an optimum level of protection. Discharges of liquid and gaseous effluents, whether radioactive or not, are in particular strictly limited (see chapter 4).

2.2.2 Transport of radioactive substances

When transporting radioactive substances, the main risks are those of internal or external exposure, criticality, as well as risks of a chemical nature. Safe transport of radioactive substances relies on an approach called defence in depth:
- the robustness of the packaging is the first line of defence. The packaging plays a vital role and must be able to withstand all foreseeable transport conditions;
- the reliability of the transport operations constitutes the second line of defence;
- finally, the third line of defence consists of the response resources implemented to deal with an incident or accident.

2.2.3 Small-scale nuclear activities

Ionising radiation, whether emitted by radionuclides or generated by electrical equipment, is used in many areas, including medicine (radiology, radiotherapy, nuclear medicine), human biology, research, industry, but also for veterinary and forensic applications as well as for the conservation of foodstuffs.

The employer is required to take all necessary measures to protect workers against the hazards of ionising radiation. The licensee of the facility must also implement the provisions of the Public Health Code for the management of the ionising radiation sources in its possession (radioactive sources in particular) and, where applicable, manage the waste produced and limit discharges of liquid and gaseous effluents. In the case of use for medical purposes, patient protection issues are also taken into account (see chapter 3).

2.2.4 Radioactive waste management

Like all industrial activities, nuclear activities can generate waste, some of which is radioactive. The three fundamental principles on which strict radioactive waste management is based are the responsibility of the waste producer, the traceability of the waste and public information.

The technical management provisions to be implemented must be tailored to the hazard presented by the radioactive waste. This hazard can be mainly assessed through two parameters: the activity level, which contributes to the toxicity of the waste, and the half-life, the time after which the activity level is halved.

Finally, management of radioactive waste must be determined prior to any creation of new activities or modification of existing activities in order to:
- ensure the availability of processing channels for the various categories of waste likely to be produced, from the front-end phase (production of waste and packaging) to the back-end phase (storage, transport and disposal).
- optimise the waste disposal routes.

2.2.5 Management of contaminated sites

Management of sites contaminated by residual radioactivity resulting either from a past nuclear activity or an activity which generated deposits of natural radionuclides warrants specific radiation protection actions, in particular if rehabilitation is envisaged.

In the light of the current or future uses of the site, decontamination targets must be set and disposal of the waste produced during clean-out of the premises and the contaminated soils must be controlled, from the site up to the storage or disposal location. The management of contaminated objects also follows these same principles.

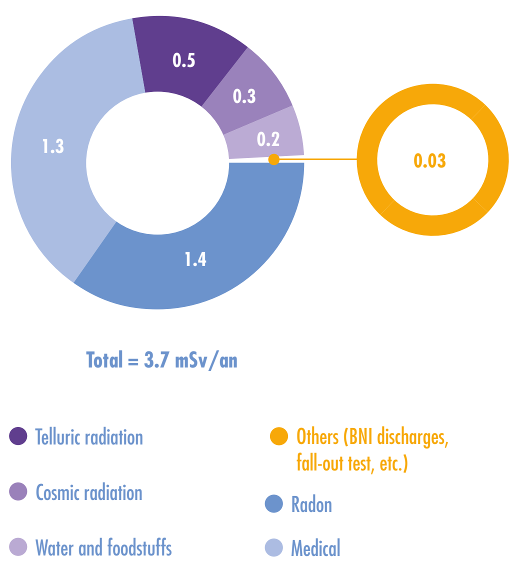
2.2.6 Industrial activities resulting in the enhancement of natural ionising radiation

Certain professional activities which at present are not covered by the definition of "nuclear activities" can thus significantly increase exposure to ionising radiation of the workers and, to a lesser extent, the populations living in the vicinity of the locations where these activities are carried out, in the event of discharge of effluents or disposal of low-level radioactive waste. This is in particular the case with activities using raw materials or industrial residues containing natural radionuclides which are not used for their fissile or fertile radioactive properties.

The natural families of uranium and thorium are the main radionuclides found. The industries concerned include the phosphate mining and phosphated fertiliser manufacturing industries, the dyes industries, in particular those using titanium oxide and those using rare earth ores such as monazite.

The radiation protection actions required in this field are based on precise identification of the activities, estimation of the impact of the exposure on the individuals concerned, taking corrective action to reduce this exposure if necessary, and monitoring.

DIAGRAM 2: The French population's exposure to ionising radiation (mSv/year)



Source: IRSN 2010.

3. MONITORING OF EXPOSURE TO IONISING RADIATION

Given the difficulty in attributing a cancer solely to the ionising radiation risk factor, "risk monitoring" is performed by measuring ambient radioactivity indicators (measurement of dose rates for example), internal contamination or, failing this, by measuring values (concentration of radionuclides in radioactive effluent discharges) which can then be used - by modelling and calculation - to estimate the doses received by the exposed populations.

The entire population of France is exposed to ionising radiation of natural or anthropogenic origin, but to different extents across the country. The average exposure of the French population is estimated at 3.7 mSv per person per year, but this exposure is subject to wide individual variability, in particular depending on the place of residence and the number of radiological examinations received (source: IRSN 2010); the average annual individual effective dose can thus vary by a factor of 2 to 5 depending on the *département*. Diagram 2 represents an estimate of the respective contributions of the various sources of French population exposure to ionising radiation.

These data are however still too imprecise to allow identification of the most exposed categories or groups of individuals for each exposure source category.

3.1 Doses received by workers

3.1.1 Exposure of nuclear workers

The system for monitoring the external exposure of persons liable to be exposed to ionising radiation, working in BNIs or in small-scale nuclear facilities, has been in place for several decades. This system is primarily based on the mandatory wearing of a passive dosimeter by workers liable to be exposed and it is used to check compliance with the regulation limits applicable to workers: these limits concern, on the one hand, the total exposure (since 2003, the annual limit, expressed in terms of effective dose, has been 20 mSv for 12 consecutive months), obtained

SOURCES AND ROUTES OF EXPOSURE to ionising radiation

External irradiation
Internal contamination by inhalation of radioactive substances
Cutaneous contamination

External irradiation
Internal contamination by ingestion of contaminated foodstuffs
Cutaneous contamination and involuntary ingestion

by adding the dose due to external exposure to that resulting from any internal contamination and, on the other, the external exposure of certain parts of the body, such as hands and the lens of the eye (see chapter 3).

The recorded data allow the identification of the cumulative exposure dose for a given period (month or quarter) for each worker in nuclear activities, including workers from outside companies; the data are collected in the ionising radiation exposure monitoring information system (SISERI) managed by IRSN and are published annually. The monitoring system does not include worker exposure to radon.

The results of dosimetric monitoring of worker external exposure in 2013 published by IRSN in July 2014 show on the whole that the prevention system introduced in facilities where sources of ionising radiation are used is effective, because for more than 96% of the population monitored, the annual dose remained lower than 1 mSv (effective annual dose limit for the public as a result of nuclear activities).

For each sector, tables 1 and 2 give the breakdown into the populations monitored, the collective dose and the number of times the annual limit of 20 mSv was exceeded. They clearly show a significant disparity in the breakdown of doses depending on the sector. For example, the medical and veterinary activities sector, which comprises a significant share of the population monitored (nearly two thirds of the total), in fact only accounts for about 35% of the collective

TABLE 1: Dosimetry of workers in the nuclear field (year 2013)

Source: IRSN.

	NUMBER OF PERSONS MONITORED	COLLECTIVE DOSE (man-Sv*)	DOSE > 20 mSv
Reactors and energy production (EDF)	24,121	7.21	0
Fuel cycle; decommissioning	8,910	2.37	0
Transport	854	0.11	0
Logistics and maintenance (contractors)	10,942	8.55	1
Others	20,065	8.37	0

TABLE 2: Dosimetry of workers in small-scale nuclear activities (year 2013)

Source: IRSN.

	NUMBER OF PERSONS MONITORED	COLLECTIVE DOSE (man-Sv*)	DOSE > 20 mSv
Medicine	130,366	12.32	4
Dental	47,784	1.9	1
Veterinary	19,814	0.53	0
Industry	33,555	16.58	2
Research	13,158	0.38	0
Miscellaneous	25,011	9.062	1

** Man-Sv (man-sievert): the SI unit for collective dose. For information, the collective dose is the sum of the individual doses received by a given group of persons.*

Radiation protection inspectors wearing their dosimeters (Guingamp hospital centre, 2012).

dose; however, out of a total of 9 cases where the annual limit of 20 mSv was exceeded, 5 were in the medical sector, including 1 of the 2 cases that exceeded 50 mSv.

The latest statistics show a slight but regular increase in the number of persons subject to dosimetric monitoring since 2005 (see diagram 3); the mark of 350,000 individuals was exceeded in both 2012 and 2013 (although 2013 shows no further growth), progress that is largely due to the increase in persons monitored in the medical and veterinary sectors. The collective dose, consisting of the sum of the individual doses, has been falling (by about 43%) since 1996 at a time when the populations monitored have grown by about 50%.

The number of monitored workers whose annual dose exceeded 20 mSv has also been falling significantly (see diagram 4).

With regard to extremity dosimetry (fingers and wrist), 25,790 workers were monitored in 2013 and the total dose was 125.35 man.Sv. Out of all the persons monitored, nobody exceeded the regulatory equivalent dose limit of 500 mSv.

TO BE NOTED

Results of dosimetry monitoring of worker external exposure to ionising radiation in 2013

(source: Occupational exposure to ionising radiation in France - 2013 results, IRSN, July 2014)

- Total population monitored: 352,082 workers.
- Monitored population for whom the dose remained below the detection threshold: 274,639 workers, or about 78%.
- Monitored population for whom the dose remained between the detection threshold and 1 mSv: 63,551 workers, or about 18%.
- Monitored population for whom the dose remained between 1 mSv and 20 mSv: 13,883 workers, or about 3.9%.
- Monitored population for whom the annual effective dose of 20 mSv was exceeded: 9 including 2 above 50 mSv.
- Collective dose (sum of individual doses): 68.47 man-Sv.
- Annual average individual dose in the population which recorded a dose higher than the detection threshold: 0.88 mSv.

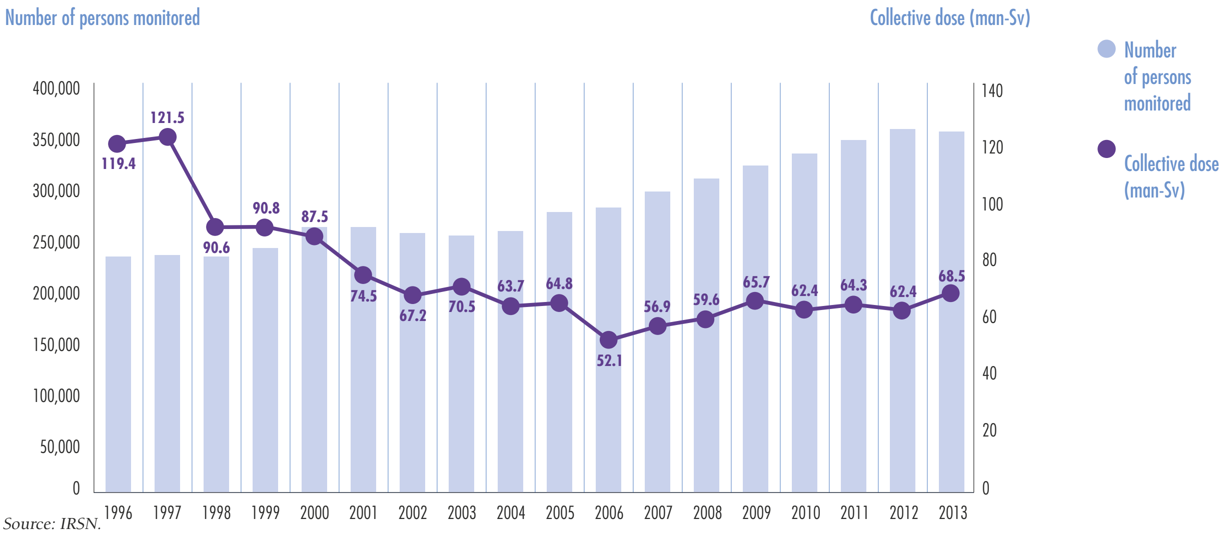
Results of internal exposure monitoring in 2013

- Number of routine examinations carried out: 354.878 (of which fewer than 1% were considered positive).
- Population for which dose estimation was made: 461 workers.
- Number of special monitoring examinations or verifications performed: 10,144 (of which 14% were above the detection threshold).
- Population having recorded a committed effective dose exceeding 1mSv: 18 workers.

Results of cosmic radiation exposure monitoring in 2013 (civil aviation)

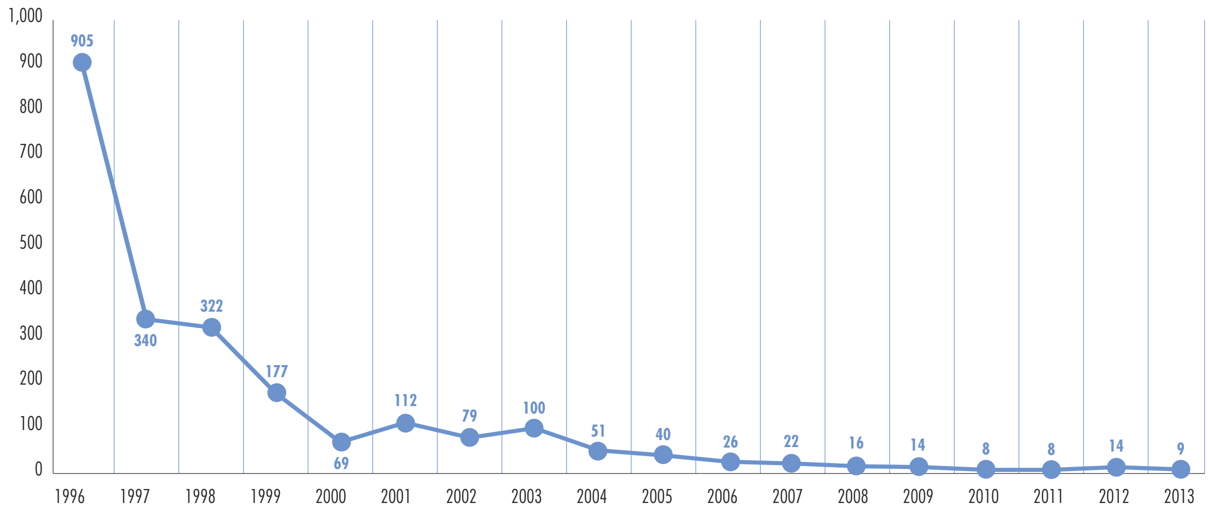
- Collective dose for 18,979 flight crew members: 36 man-Sv.
- Annual average individual dose: 1.9 mSv.

DIAGRAM 3: Monitored population and collective dose trends, from 1996 to 2013



Source: IRSN.

DIAGRAM 4: Evolution of number of workers monitored, with an annual effective dose in excess of 20 mSv from 1996 to 2013



Source: IRSN.

3.1.2 Worker exposure to TENORM

Occupational exposure to enhanced natural ionising radiation is the result either of the ingestion of dust containing large amounts of radionuclides (phosphates, metal ore), or of the inhalation of radon formed by uranium decay (poorly ventilated warehouses, thermal baths) or of external exposure due to process deposits (scale forming in piping for example).

The results of the studies carried out in France since 2005 and published by ASN in January 2010, as well as the studies received since then, show that 85% of the doses received by workers in the industries concerned remained below 1 mSv/year. The industrial sectors in which worker exposure is liable to exceed 1mSv/year are the following: titanium ore processing, heating systems and recycling of refractory ceramics, maintenance of parts comprising thorium alloys in the aeronautical sector, chemical processing of zircon ore, mechanical transformation and utilisation of zircon and processing of rare earths.

3.1.3 Flight crew exposure to cosmic radiation

Airline flight crews and certain frequent flyers are exposed to significant doses owing to the altitude and the intensity of cosmic radiation at high altitude. These doses can exceed 1 mSv/year.

The "SIEVERT" observation system set up by DGAC (General Directorate for Civil Aviation), IRSN, the Paris Observatory and the Paul-Émile Victor French Institute for Polar Research *(www.sievert-system.com)*, is used to estimate flight crew exposure to cosmic radiation on the flights they make during the course of the year.

The doses received by 18,979 flight crew members were recorded in SISERI in 2013. The individual doses are less than 1 mSv in 15.4% of cases and between 1 mSv and 5 mSv in 84.6% of cases.

3.2 Doses received by the population

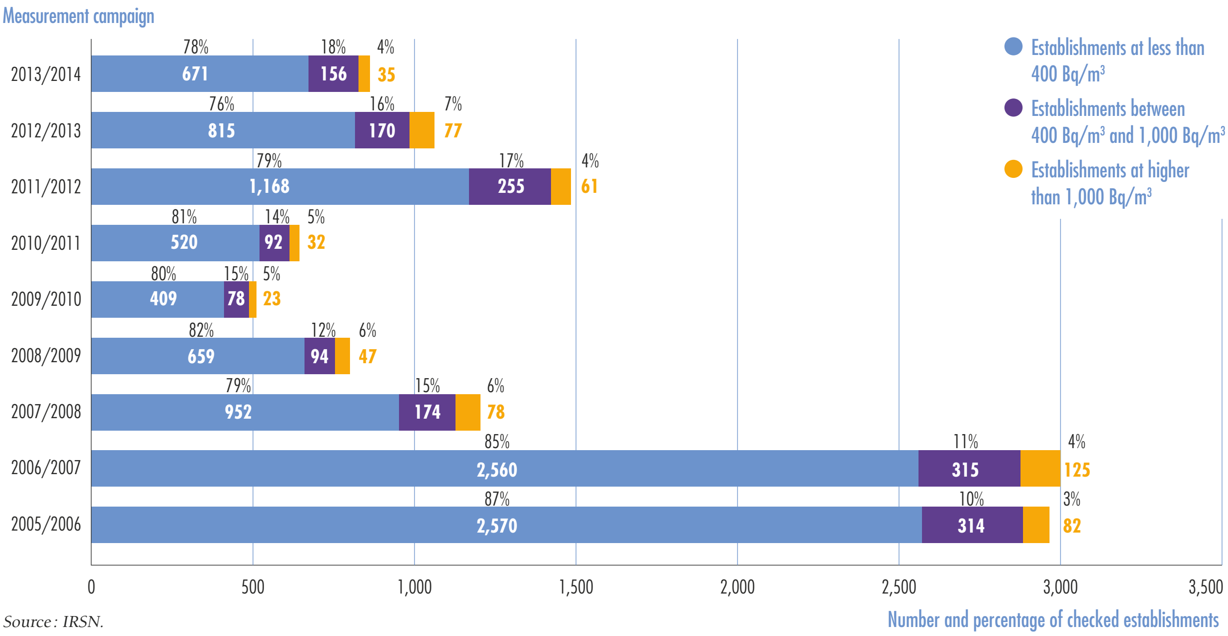
3.2.1 Doses received by the population as a result of nuclear activities

The automated monitoring networks managed nationwide by IRSN (Téléray, Hydrotéléray and Téléhydro networks) offer real-time monitoring of environmental radioactivity and can highlight any abnormal variation. In the case of an accident or incident leading to the release of radioactive materials, these measurement networks would play an essential role by providing data to back the decisions to be taken by the authorities and by notifying the population. In a normal situation, they contribute to the evaluation of the impact of BNIs (see chapter 4).

However, there is no overall monitoring system able to provide an exhaustive picture of the doses received by the population as a result of nuclear activities. Consequently, compliance with the population exposure limit (effective dose set at 1 mSv per year) cannot be controlled directly. However, for BNIs, there is detailed accounting of radioactive effluent discharges and radiological monitoring of the environment is implemented around the installations. On the basis of the data collected, the dosimetric impact of these discharges on the populations in the immediate vicinity of the installations is then calculated using models for simulating transfers to the environment. The dosimetric impacts vary, according to the type of installation and the lifestyles of the reference groups chosen, from a few microsieverts to several tens of microsieverts per year.

There are no known estimates for nuclear activities other than Basic Nuclear Installations, owing to the methodological difficulties involved in identifying the impact of the facilities and in particular the impact of discharges containing small quantities of artificial radionuclides resulting from the use of unsealed radioactive sources in research or biology laboratories, or in nuclear medicine units. To give an example, the impact of hospital discharges leads to doses of a few microsieverts per year for the most exposed persons, particularly for certain work stations

DIAGRAM 5: Results of radon measurement campaigns



Source: IRSN.

in sewage networks and wastewater treatment plants (IRSN studies 2005 and 2014).

Situations inherited from the past, such as atmospheric nuclear tests and the Chernobyl accident, can make a marginal contribution to population exposure. Thus the average individual effective dose currently being received in metropolitan France as a result of fall-out from the Chernobyl accident is estimated at between 0.010 mSv and 0.030 mSv/year (IRSN 2001). That due to the fall-out from atmospheric testing was estimated in 1980 at about 0.020 mSv. Given a decay factor of about 2 in 10 years, current doses are estimated at well below 0.010 mSv per year (IRSN, 2006). With regard to the fall-out in France from the Fukushima Daiichi accident (Japan), the results published for France by IRSN in 2011 show the presence of radioactive iodine at very low levels, resulting in very much lower doses for the populations than those estimated for the Chernobyl accident, and having negligible impact.

3.2.2 Exposure of the population to NORM

Exposure due to natural radioactivity in drinking water. The results of the Regional Health Agencies' monitoring of the radiological quality of the tap water distributed to consumers between 2008 and 2009 (DGS/ASN/IRSN report published in 2011) showed that 99.83% of the population receives tap water whose quality complies at all times with the total indicative dose of 0.1mSv/year set by the regulations. This overall assessment can also be applied to the radiological quality of packaged mineral waters and spring waters produced in France (DGS/ASN/IRSN report published in 2013).

Exposure due to radon. Since 1999, it is compulsory to take periodic radon measurements in places open to the public, especially in educational establishments and health and social institutions, due to the risk of lung cancer attributable to prolonged exposure to radon. Since August 2008, this compulsory monitoring has been extended to workplaces located in priority geographical areas.

Results of the measurement campaigns conducted since 2005 by organisations approved by ASN are presented in diagram 5. The percentages of the measurement results higher than the action levels (400 and 1,000 Bq/m^3) remain comparable from one year to the next. A new ten-yearly screening cycle was started in 2009.

The results of the inspections in places open to the public are not appropriate for precisely assessing the doses linked to exposure of the general public due to the fact that exposure in the home accounts for the largest part of the doses received during one's lifetime. It should be noted that the data for the average activity concentrations in the home date from the national radon exposure measurement campaign of 2000 (IPSN-DGSNR report).

Over and beyond the regulatory aspects (see chapter 3), the management of radon risks forms the subject of an interministerial action plan for the period 2011-2015, coordinated by ASN. In 2014, ASN organised a European seminar jointly with the NRPA in order to discuss the different risk management strategies implemented in the European states (see box on page 65).

TO BE NOTED

European seminar on the national action plans for management of the radon risk

ASN and the Norwegian Radiation Protection Authority (NRPA) jointly organised a European seminar dedicated to the national radon risk management strategies in European countries which ran from 30th September to 2nd October 2014. This seminar, which was attended by representatives from twenty European countries, was held in ASN's premises. The US, Canadian and Russian authorities were also represented at this event which was supported by the World Health Organisation (WHO), the International Atomic Energy Agency (IAEA), the Heads of the European Radiological protection Competent Authorities (HERCA) and the European Commission.

This initiative, which brought together the authorities in charge of radiation protection, health, labour and housing, is to be placed within the framework of work undertaken by the European Union member countries to transpose the new Council Directive 2013/59 Euratom setting the basic standards in radiation protection, as the countries have 4 years to prepare or update their strategy to reduce exposure associated with radon and the corresponding national action plan.

The final report of this seminar should be published in early 2015. Among the lessons that emerged is that for the strategies to be efficient, they must aim both at raising awareness and motivating the public and all the actors, at the national, regional and local levels, and at providing appropriate training for professionals in the health and building sectors. Regulations also have their place in these strategies, being, for example, a particularly relevant tool for new constructions and in existing buildings such as places open to the public, work places and individual dwelling houses in the rented housing sector.

TABLE 3: Average number of medical imaging procedures and average effective dose in France in 2007 and 2012

	AVERAGE NUMBER OF PROCEDURES		AVERAGE EFFECTIVE DOSE PER INHABITANT PER YEAR
	TOTAL	PER INHABITANT	
2007 • (63.7 million inhabitants)	74.6 million	1.2	1.3 mSv
2012 • (65.2 million inhabitants)	81.8 million	1.2 (1,247 procedures /1,000 inhab)	1.6 mSv

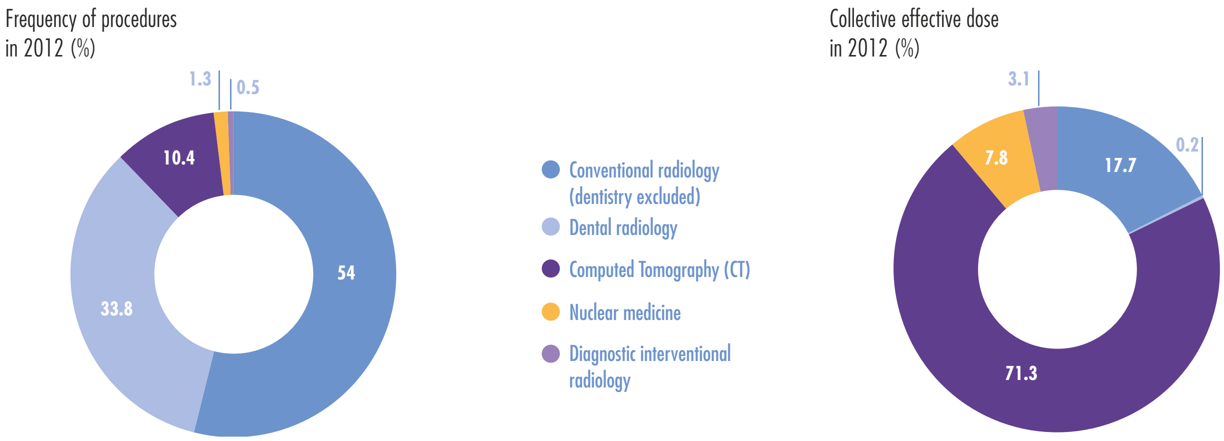
Source: IRSN.

TABLE 4: Total number of procedures and associated collective effective dose for each imaging method (rounded values) in France in 2012

IMAGING METHOD	PROCEDURES		COLLECTIVE EFFECTIVE DOSE	
	NUMBERS	%	mSv	%
Conventional radiology (dentistry excluded)	44,175,500	54.0	18,069,200	17.7
Dental radiology	27,616,000	33.8	165,700	0.2
Computed Tomography (CT)	8,484,000	10.4	72,838,900	71.3
Diagnostic interventional radiology	377,000	0.5	3,196,400	3.1
Nuclear medicine	1,103,000	1.3	7,928,300	7.8
TOTAL	**81,755,500**	**100.0**	**102,198,500**	**100.0**

Source: IRSN.

DIAGRAM 6: Distribution of the frequency of procedures and of the effective collective dose per type of diagnostic examination in France in 2012



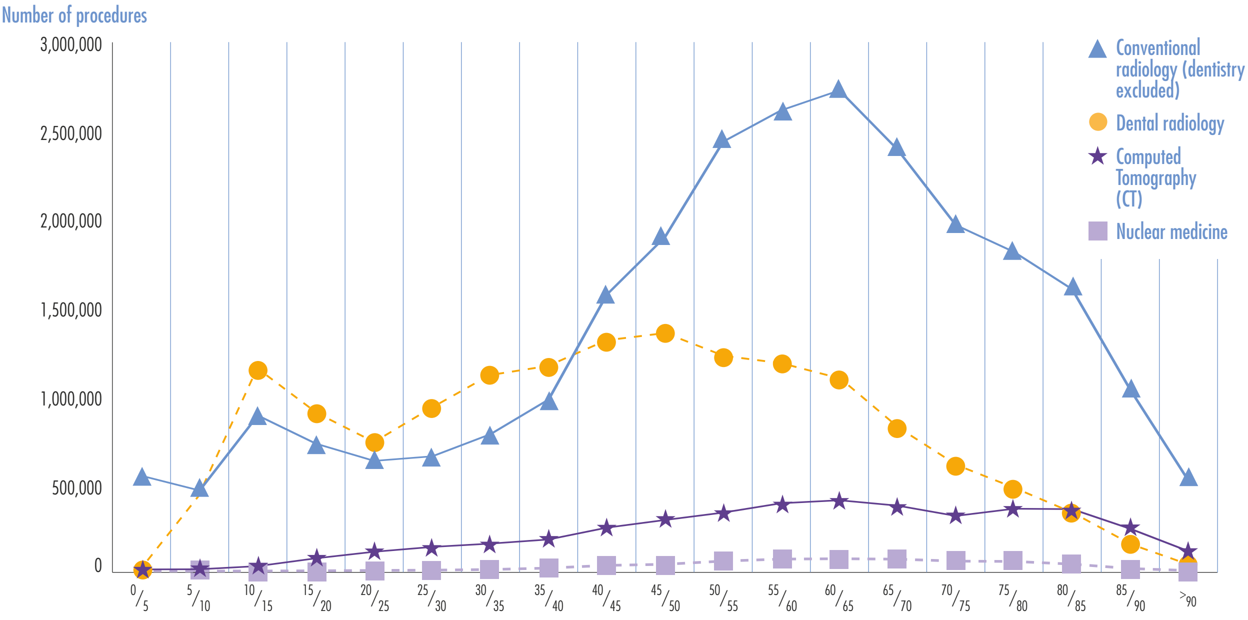
Source: IRSN.

3.3 Doses received by patients

In France, exposure for medical purposes represents the greatest part of the artificial exposures of the public to ionising radiation. It continues to increase due to the growing number of radiological examinations and better knowledge of diagnostic practices, to the orientation of therapeutic strategy, the monitoring of treatment effectiveness and to the treatment itself by interventional radiology.

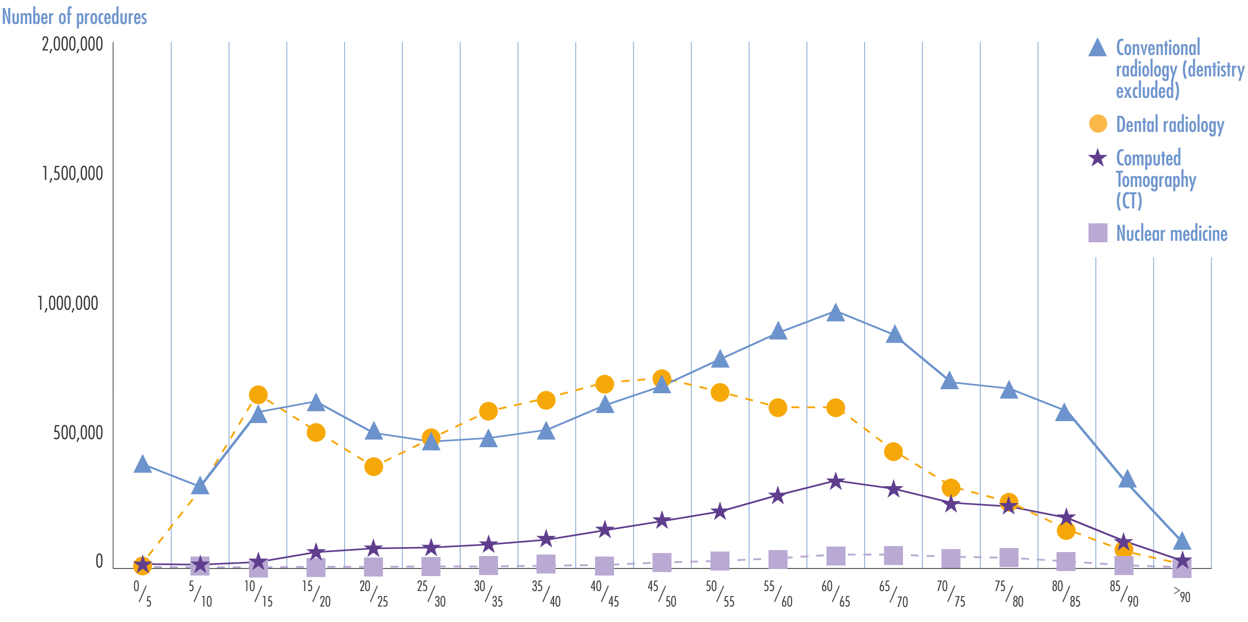
The average effective dose per inhabitant resulting from diagnostic radiological examinations has been evaluated at 1.6 mSv for the year 2012 (IRSN report 2014) for some 81.8 million diagnostic procedures performed (74.6 million in 2007), i.e. 1247 procedures for 1000 inhabitants per year. It is to be noted that the cumulative individual exposure for 2012 is very varied. Thus, although about one third of the French population underwent at least one procedure (excluding dental procedures), 85% of that population received doses of less than 1 mSv.

DIAGRAM 7: Breakdown of the number of diagnostic procedures carried out on women in France in 2012 according to age and imaging methods



Source: IRSN.

DIAGRAM 8: Breakdown of the number of diagnostic procedures carried out on men in France in 2012 according to age and imaging methods



Source: IRSN.

Thus the average effective individual dose increased by 23% between 2007 and 2012 (it was 1.3 mSv in 2007); it had already increased by 50% between 2002 and 2007 (IRSN/InVS report 2010).

Conventional radiology (54%), computed tomography (10.5%) and dental radiology (34%) account for the largest number of procedures. However, the contribution of computed tomography to the effective collective dose remains preponderant and more significant in 2012 (71%) than in 2007 (58%) whereas that of dental radiology is low (0.2%).

These developments can be explained chiefly by an increase in the number of computed tomography procedures (+12%) and having better knowledge of their utilisation and of the doses delivered to the patients.

TO BE NOTED

In December 2014, ASN presented a progress report to health professionals on the national action plan that it recommended as of 2011 to achieve real control over the doses delivered to patients during medical imaging examinations. This report will be published in early 2015.

In the general context of the growing increase in medical examinations using ionising radiation, particularly in computed tomography and interventional radiology, ASN had drawn up a specific action plan comprising 32 actions grouped around 6 themes (quality and safety of practices, including the management of quality and safety, human resources and training, facilities and their oversight, radiation safety oversight, relations with patients and knowledge of practices and exposures).

At the end of 2014, programme implementation had reached about 88% considering the actions completed (25%) and those in progress (63%). The results of the actions undertaken are still too distant to draw definitive conclusions, but the following trends can be underlined:
- progress in terms of quality and safety of practices (good practices baselines, teleradiology);
- encouraging initiatives in the training of professionals (patient radiation protection, utilisation of medical devices, justification of procedures);
- the persistence of the human resource shortages in medical imaging (medical physicists, X-ray generators operated by non-qualified personnel in operating theatres);
- results that are still limited with regard to equipment (MRI) and safety of facilities (evaluation of innovative technologies, etc.).

To give an example, thoracic and abdominal pelvic CT scans remain the most frequent (50% in 2012 vs 30% in 2007), more particularly in men after the age of 50 years (4.2% in 2012 vs 1.4% in 2007). Women underwent more conventional radiology procedures (mammograms and limb examinations) than men.

In adolescents, conventional radiology and dental procedures are more numerous (1020 and 1220 procedures respectively for 1000 individuals in 2012). Despite their frequency in this population, dental radiology procedures represent only 0.5% of the collective dose.

Nevertheless, the number of conventional radiology procedures and the frequency of computed tomography procedures remain much lower in France than in some other European countries. For example, exposure of the French population remains at a level far below that of Belgium, which has the most exposed population in Europe (2.7 mSv per year and per inhabitant in 2013). Beyond this, the average annual effective dose per person in the United States, which was estimated at 3 mSv in 2006, remains by far the highest.

It is noteworthy that in a sample of about 600,000 persons covered by health insurance, 44% underwent at least one diagnostic procedure in 2012. The analysis of the effective doses for these people shows that 70% of them received less than 1 mSv, 18% received between 1 and 10 mSv, 11% between 10 and 50 mSv and 1% more than 50 mSv.

Particular attention is required in order to control and reduce the doses linked to medical imaging, more specifically when alternative techniques can be used for a same given indication, because the multiplication of the most heavily irradiating examinations for the same person could lead to the effective dose value of several tens of millisieverts being reached; at this level of exposure, certain epidemiological surveys have revealed the occurrence of radio-induced cancers.

Based on a sample of 100,000 children (1% of the French population), IRSN (2013 report) estimated that in 2010, one out of three children was exposed to ionising radiation for diagnostic purposes. The mean and median values for the effective dose are estimated at 0.65 mSv and 0.025 mSv respectively for all the children exposed. They are 5.7 mSv and 1.7 mSv respectively for children who have undergone at least one computed tomography procedure (1% of the population monitored).

Controlling the doses delivered to patients remains a priority for ASN, which has undertaken - in collaboration with the stakeholders (institutional and professional) - a programme of actions in various areas (quality and safety of practices/quality assurance, human resources/training, safety of facilities, etc.).

3.4 Exposure of non-human species (animal and plant species)

The international radiation protection system was created to protect humans against the effects of ionising radiation. Environmental radioactivity is thus assessed with respect to its impact on human beings and, in the absence of any evidence to the contrary, it is today considered that the current standards also protect other species.

Protection of the environment from the radiological risk and more specifically the protection of non-human species, must however be guaranteed independently of the effects on humans. Pointing out that this objective is already incorporated in the national legislation, ASN will ensure that the impact of ionising radiation on non-human species be effectively included in the regulations and in the authorisations for nuclear activities as soon as evaluation methods are available.

ASN has referred this question to IRSN, and the Advisory Committee of experts for radiation protection for industrial applications and research into ionising radiation and the environment (GPRADE) is expected to give its opinion in early 2015.

4. OUTLOOK

As in the preceding years, the review of worker exposure in 2013 published by IRSN confirms the stabilisation of the number of monitored workers whose annual dose exceeded 20 mSv at less than 10 cases, and the stabilisation at a low level of the collective dose following the reduction that began in 1996.

ASN will remain particularly attentive to the recommendations on the individual monitoring of worker exposure to ionising radiation (white paper) expected in 2015 from a pluralistic working group placed under the aegis of the DGT (General Directorate for Labour).

The European seminar on national radon risk management plans organised in 2014 by ASN and the NRPA evidenced the weakness of the second national plan for 2011-2015 in terms of strategic management. The preparation and validation of the third national plan in 2015 should help remedy this weakness, which results for example in a lack of visibility over the new mapping of priority areas with high radon potential, made necessary after the recent work of IRSN, but which is also manifest in the information delivered to the public and elected officials and in radon screening strategies in existing dwellings.

Regarding the question of the regular increase in doses delivered to patients during medical imaging examinations since 2002, which was confirmed in 2014, ASN will continue to step up the actions it has undertaken since 2011 to maintain the mobilisation, at all levels, of the health authorities and health professionals. As with radon, setting up a strategic management system for this action plan, involving the assistance of the health authorities with the measures provided for in Cancer Plan 3, is a prerequisite for achieving real control over the doses delivered to patients during radiological examinations.

02

PRINCIPLES AND STAKEHOLDERS IN THE REGULATION OF NUCLEAR SAFETY AND RADIATION PROTECTION


IRE
GRESSER
A SÛRETÉ
NUCLÉAIRE
ET LA
ADIOPROTECTION

Nuclear safety is defined in the Environment Code as *"the set of technical provisions and organisational measures – related to the design, construction, operation, shutdown and decommissioning of Basic Nuclear Installations (BNIs), as well as the transport of radioactive substances – which are adopted with a view to preventing accidents or limiting their effects"*. Radiation protection is defined as *"protection against ionising radiation that is the set of rules, procedures and means of prevention and surveillance aimed at preventing or mitigating the direct or indirect harmful effects of ionising radiation on individuals, including in situations of environmental contamination"*.

Nuclear safety and radiation protection obey principles and approaches that have been put in place progressively and continually enhanced by a process of feedback. The basic guiding principles are advocated internationally by International Atomic Energy Agency (IAEA). In France, they are included in the Constitution or enacted in law, as well as now figuring in European directives.

The regulation of civilian nuclear safety and radiation protection in France is the task of ASN, an independent administrative authority, working with Parliament and other State players, within the Government and the Prefectures, and relying on technical expertise provided, notably, by the French Institute for Radiation Protection and Nuclear Safety (IRSN).

1. THE PRINCIPLES OF NUCLEAR SAFETY AND RADIATION PROTECTION

1.1 Fundamental principles

Nuclear activities must be carried out in compliance with the principles that underlie the legislative texts.

This primarily concerns:
- at the national level, the principles enshrined in the Environment Charter, annexed to the Constitution, and in the various codes (Environment Code and Public Health Code);
- at the European level, rules defined by directives establishing a community framework for the safety of nuclear facilities and for the responsible and safe management of spent fuel and radioactive waste;
- at an international level, ten fundamental safety principles defined by IAEA (see box below and chapter 7, point 2.2) implemented by the Convention on Nuclear Safety (see chapter 7 point 4.1), which established the international framework for the oversight of nuclear safety and radiation protection.

These various measures of differing origins extensively overlap. They can be grouped into the eight main principles presented below.

1.1.1 Principle of licensee responsibility

This principle, defined in Article 9 of the Convention on Nuclear Safety, is the first of IAEA's fundamental safety principles. It stipulates that responsibility for the safety of nuclear activities entailing risks lies with those who undertake or perform them.

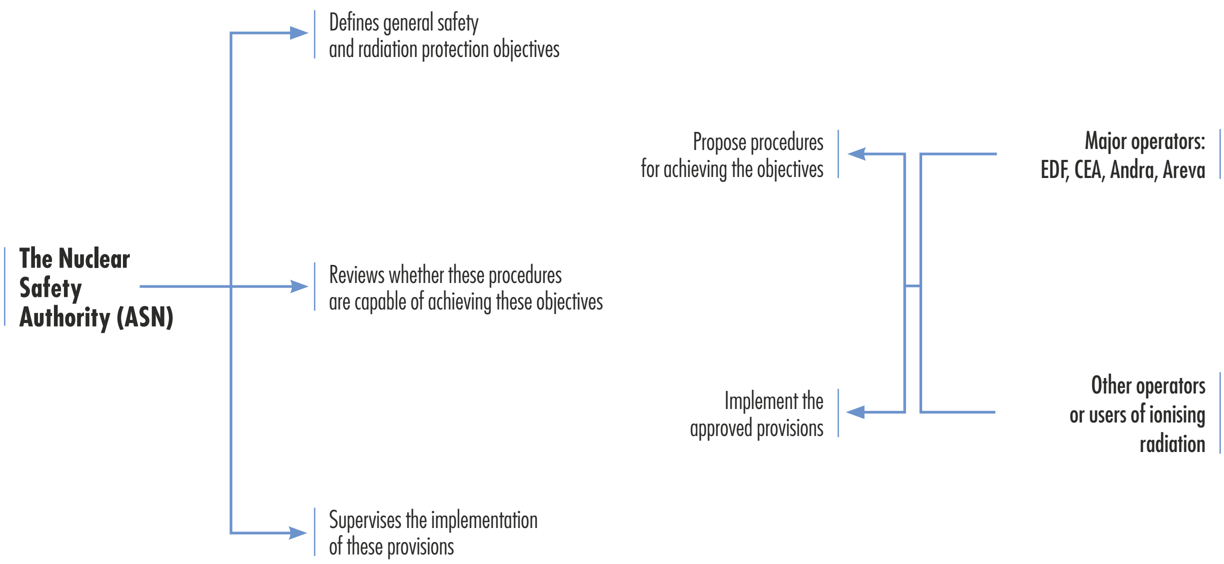
It applies directly to all nuclear activities.

1.1.2 "Polluter-pays" principle

The "polluter-pays" principle, spelling out the operator's responsibility, ensures that the costs of measures to prevent or reduce pollution are borne by those responsible for environmental damage. This principle is defined in Article 4 of the Environment Charter in these terms: *"An individual must contribute to reparation of the environmental damage he or she has caused"*.

This principle entails the taxation of Basic Nuclear Installations (BNI) ("BNI" tax and contribution to IRSN), the taxation of radioactive waste producers (additional waste taxes), of disposal facilities (additional "disposal" tax) and of Installations Classified on Environmental Protection grounds (ICPE) (fraction of the General Tax on Polluting Activities - TGAP). These taxes are presented in greater detail in part 3.

RESPONSIBILITY of licensees and responsibility of ASN



1.1.3 Precautionary principle

The precautionary principle, defined in Article 5 of the Environment Charter, states that: *"the absence of certainty, in the light of current scientific and technical knowledge, must not delay the adoption of effective and proportionate measures to prevent a risk of serious and irreversible damage to the environment"*.

Application of this principle results, for example, in the adoption of a linear, no-threshold dose-effect relationship where the biological effects of exposure to low doses of ionising radiation are concerned. This point is clarified in chapter 1 of this report.

1.1.4 Public participation principle

This principle allows public participation in the taking of decisions by public authorities. In line with the Aarhus Convention, it is defined in Article 7 of the Environment Charter as follows: *"Within the conditions and limits defined by law, all individuals are entitled to access environmental information in the possession of the public authorities and to take part in the taking of public decisions affecting the environment"*.

In the nuclear field, this principle entails the organisation of national public debates, which are mandatory prior to the construction of a nuclear power plant for example, as well as public enquiries, especially when examining the creation or decommissioning of nuclear facilities, as well as consultations and public access to information, which are mandatory for all matters liable to lead to a significant increase in water intake or discharges in the environment of a nuclear facility.

Chapter 6 of this report presents the way in which the right to information is applied to all ASN's areas of activity.

1.1.5 The principle of justi cation

The principle of justification, given expression in Article L. 1333-1 of the Public Health Code, states that: *"A nuclear activity or an intervention can only be undertaken or carried out if its health, social, economic or scientific benefits so justify, given the risks inherent in the human exposure to ionising radiation that it is likely to entail"*.

Depending on the type of activity, justification decisions are taken at various levels of authority: they are the responsibility of Parliament for questions of general interest, of the Government for the creation or decommissioning of a BNI, and of ASN where transport operations or sources of radiation are concerned.

Assessment of the expected benefit of a nuclear activity and the corresponding health drawbacks may lead to prohibition of an activity for which the benefit would not seem to outweigh the health risk. For existing activities, justification may be reassessed if the state of know-how and technology so warrants.

1.1.6 The principle of optimisation

The principle of optimisation, defined in Article L. 1333-1 of the Public Health Code, states that: *"Human exposure to ionising radiation as a result of a nuclear activity or medical procedure must be kept as low as reasonably achievable, given current technology, economic and social factors and, where applicable, the intended medical purpose."*

This principle, referred to as the ALARA (as low as reasonably achievable) principle, leads for example to reducing the quantities of radionuclides present in the radioactive effluents from nuclear installations allowed in the discharge licenses, to requiring surveillance of exposure in the working environment in order to reduce it to the strict minimum and to ensuring that medical exposure as a result of diagnostic procedures remains close to the pre-determined reference levels.

1.1.7 The principle of limitation

The principle of limitation, expressed in Article L. 1333-1 of the Public Health Code, states that: *"Exposure of an individual to ionising radiation as a result of a nuclear activity may not increase the sum of the doses received beyond the limits set by regulations, except when the individual is exposed for medical or biomedical research purposes"*.

The exposure of the general public or of workers as a result of nuclear activities is subject to strict limits. These limits include significant safety margins to prevent deterministic effects from appearing, as well as aiming at reducing to the lowest level possible the appearance of probabilistic effects in the long term.

Exceeding these limits leads to an abnormal situation and one which may give rise to administrative or legal sanction.

In the case of medical exposure of patients, no strict dose limit is set, provided that this voluntary exposure is justified by the expected health benefits to the person exposed.

1.1.8 The principle of prevention

To anticipate any environmental damage, the principle of prevention, defined in Article 3 of the Environment Charter, stipulates the implementation of rules and measures which must take account of *"the best available technology at an economically acceptable cost"*.

In the nuclear field, this principle underlies the concept of defence in depth, presented below.

1.2 Some aspects of the safety approach

The safety principles and approaches presented below were gradually implemented and incorporate experience feedback from accidents. Absolute safety can never be guaranteed and despite all the precautions taken in the design, construction and operation of nuclear facilities, an accident can never be completely ruled out. The willingness to move forward and to create a continuous improvement approach is thus essential if the risks are to be reduced.

UNDERSTAND

The fundamental safety principles

IAEA establishes the following 10 principles in its publication "SF-1":

1. The prime responsibility for safety must rest with the person or organisation responsible for facilities and activities that give rise to radiation risks;
2. An effective legal and governmental framework for safety, including an independent regulatory body, must be established and sustained;
3. Effective leadership and management for safety must be established and sustained in organisations concerned with, and facilities and activities that give rise to, radiation risks;
4. Facilities and activities that give rise to radiation risks must yield an overall benefit;
5. Protection must be optimised to provide the highest level of safety that can reasonably be achieved;
6. Measures for controlling radiation risks must ensure that no individual bears an unacceptable risk of harm;
7. People and the environment, both present and future, must be protected against radiation risks;
8. All practical efforts must be made to prevent and mitigate nuclear or radiation accidents;
9. Arrangements must be made for emergency preparedness and response for nuclear or radiation incidents;
10. Protective actions to reduce existing or unregulated radiation risks must be justified and optimised.

1.2.1 Safety management

Safety management means fostering a safety culture within risk management organisations.

Safety culture is defined by the International Nuclear Safety Advisory Group (INSAG), an international nuclear safety consultative group reporting to the General Director of IAEA, as: *"that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance"*.

Safety culture therefore determines the ways in which an organisation and individuals perform their duties and accept responsibility, with safety in mind. It is one of the key fundamentals in maintaining and improving safety. It commits organisations and individuals to paying particular and appropriate attention to safety. At the individual level it is given expression by a rigorous and cautious approach and a questioning attitude making it possible to both obey rules and take initiative. In operational terms, the concept underpins decisions and actions relating to activities.

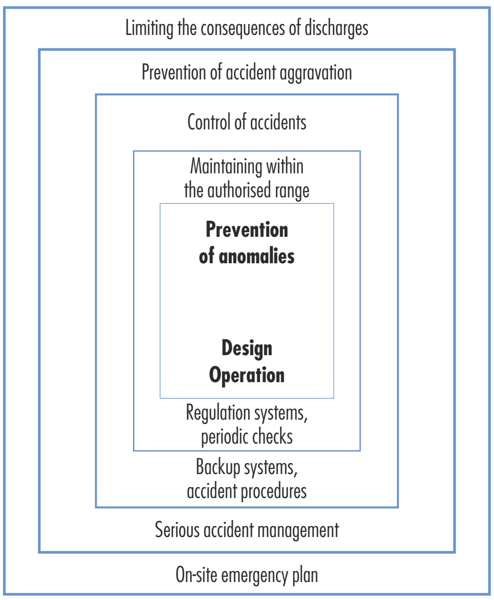
1.2.2 The "Defence in Depth" concept

The main means of preventing accidents or limiting their potential consequences is "defence in depth". This consists in implementing material or organisational provisions (sometimes called lines of defence) structured in consecutive and independent layers, and which are capable of preventing the development of an accident. If one level of protection fails, the next level takes over.

An important element for the independence of the levels of defence is the use of different technologies ("diversified" systems).

The design of nuclear installations is based on a defence in depth approach. Five levels of protection are defined for nuclear reactors:

THE 5 LEVELS of "Defence in Depth"



Level 1: Prevention of abnormal operation and system failures

This is a question firstly of designing and building the facility in a robust and conservative manner, integrating safety margins and planning for resistance with respect to its own failures or to hazards. It implies conducting the most exhaustive study possible of normal operating conditions to determine the severest stresses to which the systems will be subjected. It is then possible to produce an initial design basis for the facility, incorporating safety margins. The facility must then be maintained in a state at least equivalent to that planned for in its design through appropriate maintenance. The facility must be operated in an informed and careful manner.

Level 2: Keeping the installation within authorised limits

Regulation and governing systems must be designed, installed and operated such that the installation is kept within an operating range that is far below the safety limits. For example, if the temperature in a system increases, a cooling system starts up before the temperature reaches the authorised limit. Monitoring of the condition and correct operation of systems forms part of this level of defence.

Level 3: Control of accidents without core meltdown

The aim here is to postulate that certain accidents, chosen for their "envelope" characteristics (the most penalising in a given family) can happen, and to design and size backup systems to withstand those conditions.

Such accidents are generally studied with pessimistic hypotheses, that is to say the various parameters governing this accident are assumed to be the least favourable possible. The single-failure criterion is also applied, in other words, in the accident situation, we also postulate the failure of any given component. As a result of this, the systems coming into play in the event of an accident (safeguard systems ensuring emergency shutdown, injection of cooling water into the reactor, etc.) comprise at least two redundant and independent channels.

Level 4: Control of accidents with core meltdown

These accidents have been considered since the Three Mile Island accident (1979) and are now taken into account in the design of new reactors such as the EPR. The aim is to preclude such accidents or to design systems that can withstand them.

Level 5: Mitigation of the radiological consequences of significant releases

This requires implementation of the measures provided for in the emergency plans, including measures to protect the general public: shelter, taking of stable iodine tablets to saturate the thyroid and avoid fixation of released radioactive iodine, evacuation, restrictions on consumption of water and of agricultural products, etc.

1.2.3 Interposing of barriers

To limit the risk of releases, several superposed barriers are placed between the radioactive materials and the environment. Barriers must be designed to have a high degree of reliability and must be monitored to detect any weaknesses or failures. There are three such barriers for pressurised water reactors: the fuel cladding, the boundary of the reactor primary system, and the containment (see chapter 12).

1.2.4 Deterministic and probabilistic approaches

Postulating the occurrence of certain accidents and verifying that, thanks to the planned functioning of the equipment, the consequences of these accidents will remain limited, is known as a deterministic approach. This approach is simple to apply in principle and allows an installation to be designed (and its systems to be sized) with good safety margins, by using so-called "envelope" cases. It does not, however, lead to a realistic view of the most probable scenarios and does not rank risks satisfactorily, since it focuses attention on accidents studied with very pessimistic assumptions.

The deterministic approach therefore needs to be supplemented by an approach that takes better account of possible accident scenarios in terms of their probability, that is to say the probabilistic approach used in the "Probabilistic Safety Assessments" (PSA).

Thus for nuclear power plants, the level 1 Probabilistic Safety Assessments (PSA) consist in establishing event trees, for each initiating event leading to the activation of a safeguard system (level 3 of defence in depth), defined by the failures (or the success) of the actions planned for in the reactor management procedures and the failures (or correct operation) of the reactor equipment. The probability of each sequence is then calculated based on statistics on the reliability of systems and on the rate of success of actions (including data on "human reliability"). Similar sequences of events that correspond to the same initiating event are grouped into families, making it possible to determine the contribution of each family to the probability of reactor core meltdown.

Although the PSAs are limited by the uncertainties concerning the reliability data and the approximations in the modelling of the facility, they consider a broader set of accidents than the deterministic assessments and enable the design resulting from the deterministic approach to be verified and supplemented if necessary. They are therefore to be used as a complement to deterministic studies and not as a substitute for them.

The deterministic studies and probabilistic assessments constitute an essential element in the demonstration of nuclear safety that addresses equipment internal faults, internal and external hazards, and plausible combinations of these events.

To be more precise, the internal faults correspond to malfunctions, failures or damage to facility equipment, including as a result of inappropriate human action. The hazards correspond to events originating inside or outside the facility and which can call into question the safety of the facility.

Internal faults include for example:
- loss of the electrical power supplies or the cooling systems;
- ejection of a rod cluster control assembly;
- rupture of a pipe in the primary or secondary system of a nuclear reactor;
- reactor emergency shutdown failure during an incidental transient.

With regard to internal hazards, the following in particular must be considered:
- flying projectiles, notably those resulting from the failure of rotating equipment;
- pressure equipment failures;
- collisions and falling loads;
- explosions;
- fires;
- hazardous substance emissions;
- floods originating within the perimeter of the facility;
- electromagnetic interference;
- malicious acts.

Finally, external hazards more specifically comprise:
- the risks induced by industrial activities and communication routes, including explosions, hazardous substance emissions and airplane crashes;
- earthquakes;
- lightning and electromagnetic interference;
- extreme meteorological or climatic conditions;
- fires;
- floods originating outside the perimeter of the facility;
- malicious acts.

1.2.5 Operating experience feedback

Experience feedback contributes to defence in depth. It consists in implementing a reliable system for detecting any anomalies which can occur, such as equipment failures or procedural errors. This system should allow early detection of any abnormal operation and the relevant conclusions to be drawn (especially in terms of organisation) so as to prevent these anomalies from happening again. Operating experience feedback encompasses events, incidents and accidents occurring both in France and abroad, whenever relevant to enhancing nuclear safety or radiation protection.

1.2.6 Social, organisational and human factors

The importance of SOHF for nuclear safety, radiation protection and environmental protection

The contribution of humans and organisations to safety, radiation protection and environmental protection is decisive in the design, commissioning, operation and decommissioning of facilities, as well as in the transport of radioactive substances. Similarly, the way in which people and organisations manage deviations from the regulations, from the baseline requirements and from the state of the art, plus the corresponding lessons learned, is also decisive. Therefore, all those involved, regardless of their position in the hierarchy and their functions, make a contribution to safety, radiation protection and environmental protection, owing to their ability to adapt, detect and correct errors, rectify degraded situations and counter certain difficulties involved in the application of procedures.

ASN defines Social, Organisational and Human Factors (SOHF) as being all the aspects of working situations and of the organisation which have an influence on the work done by the operators. The elements considered concern the individual (training received, fatigue or stress, etc.) and the organisation within which he or she works (functional and hierarchical links, joint contractor work, etc.), the technical arrangements and, more broadly, the working environment with which the individual interacts. The working environment for instance concerns the heat, sound or light environment of the workstation, as well as the accessibility of the premises.

The variability in worker characteristics (vigilance varies with the time of day, the level of expertise varies according to the seniority in the position) and in the situations encountered (unexpected failure, social tension) explains that workers constantly need to adapt how they work so as to optimise effectiveness and efficiency. This performance must be achieved at an acceptable cost to the persons concerned (in terms of fatigue or stress) and they must also benefit from it (the feeling of a job well done, recognition by both peers and the hierarchy, development of new skills). Thus, an operating situation or a task achieved at very high cost to the operators is a potential source of risks: a small variation in the working context, human environment or working organisation can prevent the persons concerned from performing their tasks as expected.

The integration of SOHF into the work done

ASN considers that SOHF must be taken into account in a manner commensurate with the safety implications of the facilities and the radiation protection of workers during:

- the design of a new facility, equipment, software, transport package, or the modification of an existing one. ASN in particular wants to see design focusing on the human operator, through an iterative process comprising an analysis phase, a design phase and an evaluation phase. Therefore, the ASN resolution of 13th February 2014 concerning physical modifications to BNIs requires that *"the design of the physical modification envisaged shall, when it is applied and put into operation, take account of the interactions between the modified or newly installed equipment on the one hand and the users and their needs on the other"*.
- operations or activities performed by the workers during the commissioning, operation and decommissioning of nuclear facilities, as well as during the transportation of radioactive substances.

ASN also considers that the licensees must analyse the root causes (often organisational) of the significant events and identify, implement and assess the effectiveness of the corresponding corrective measures, on a long-term basis.

ASN's SOHF requirements

The Order of 7th February 2012 setting the general rules for BNIs, requires that the licensee define and implement an Integrated Management System (IMS) designed to ensure that the safety, radiation protection and environmental protection requirements are systematically taken into account in all decisions concerning the facility. The IMS specifies the steps taken with regard to organisation and resources of all types, in particular those adopted to manage the important activities. ASN thus asks the licensee to set up an IMS able to maintain and continuously improve safety, notably through the development of a safety culture.

2. THE STAKEHOLDERS

The organisation of the regulation of nuclear safety in France complies with the CNS, Article 7 of which requires that *"Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations"* and Article 8 of which requires that each Party *"shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7 and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities"*. These provisions were confirmed by the European directive of 25th June 2009 concerning nuclear safety, the provisions of which were themselves reinforced by the amending directive of 8th July 2014.

In France, the regulation of nuclear safety and radiation protection is primarily the responsibility of three parties: Parliament, the Government and ASN.

2.1 Parliament

Parliament's principal role in the field of nuclear safety and radiation protection is to make laws. Two major acts were therefore passed in 2006: the TSN Act of 13th June 2006, on transparency and security in the nuclear field; and the Programme Act of 28th June 2006, on the sustainable management of radioactive materials and waste.

In 2015, Parliament will be examining the green growth energy transition bill, an entire section of which is devoted to nuclear matters (Title VI entitled "Reinforcing nuclear safety and information of the citizens"). The Government submitted this draft text to the National Assembly on 30th July 2014 and resorted to an "accelerated procedure" examination of it.

Like the other independent administrative authorities and in application of the provisions of the Environment Code, ASN makes regular reports on its activity to Parliament, notably to the OPECST (Parliamentary Office for the Evaluation of Scientific and Technological Choices) and to the parliamentary commissions concerned.

The role of the OPECST is to inform Parliament of the consequences of the scientific or technological choices so that it can take informed decisions; to this end, the OPECST gathers information, implements study programmes and conducts evaluations. ASN regularly reports on its activities to the OPECST, particularly by submitting the annual Report on the State of Nuclear Safety and Radiation Protection in France to it each year.

ASN also reports on its activities to the Parliamentary Commission of the National Assembly and the Senate, notably on the occasion of hearings held by the commissions responsible for the environment or economic affairs.

The exchanges between ASN and elected officials are presented in more detail in chapter 6.

2.2 The Government

The Government exercises regulatory powers. It is therefore in charge of laying down the general regulations concerning nuclear safety and radiation protection. The Environment Code also tasks it with taking major decisions concerning BNIs, for which it relies on proposals or opinions from ASN. The Government can also call on consultative bodies such as the High Committee for Transparency and Information on Nuclear Safety (HCTISN).

The Government is responsible for civil protection in the event of an emergency.

2.2.1 Ministers responsible for nuclear safety and radiation protection

On the advice of and, as applicable, further to proposals from ASN, the Minister responsible for Nuclear Safety defines the general regulations applicable to BNIs and those concerning the construction and use of pressure equipment specifically designed for these installations (ESPN).

Also on the advice of and, as applicable, further to proposals from ASN, this same Minister takes major individual decisions concerning:
- the design, construction, operation, final shutdown and decommissioning of BNIs;
- the final shutdown, maintenance and surveillance of radioactive waste disposal facilities.

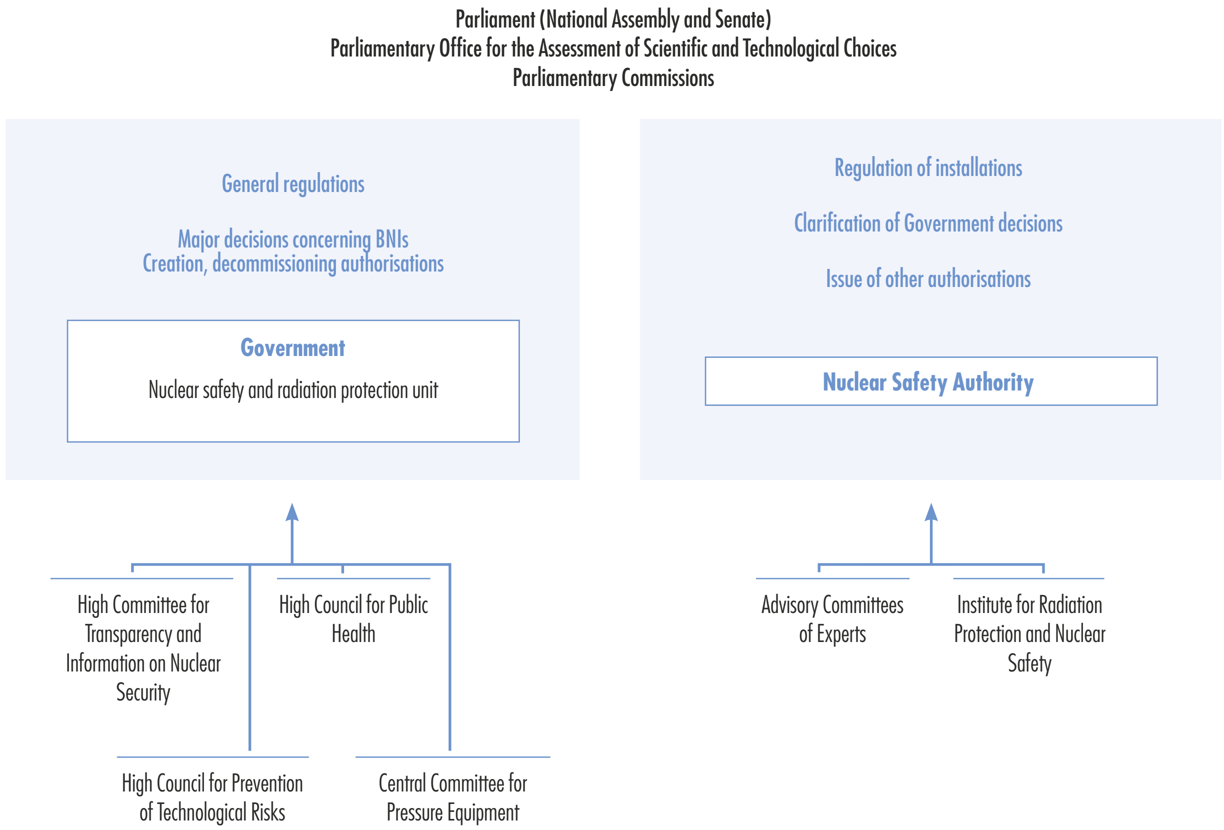
If an installation presents serious risks, the above-mentioned Minister(s) can suspend the operation of an installation on the advice of ASN.

Furthermore, the Minister(s) responsible for radiation protection also define(s) – on the basis of ASN proposals if necessary – the general regulations applicable to radiation protection.

The regulation of worker radiation protection is the responsibility of the Minister for Labour.

The Ministers responsible for nuclear safety and for radiation protection approve the ASN internal regulations by means of an interministerial order. Each of them also approves ASN technical statutory

REGULATION OF NUCLEAR SAFETY and radiation protection in France



resolutions and certain individual resolutions (setting BNI discharge limits, delicensing a BNI, etc.) affecting their own particular field.

The Nuclear Safety and Radiation Protection Mission

The Nuclear Safety and Radiation Protection Mission (MSNR), within the General Directorate for Risk Prevention at the Ministry of Ecology, Sustainable Development and Energy, is tasked - in collaboration with ASN - with proposing Government policy on nuclear safety and radiation protection, except for defence-related activities and installations and the radiation protection of workers against ionising radiations.

Defence and Security High Official

The purpose of nuclear security, in the strictest sense of the term (IAEA definition, less wide-ranging than that of Article L 591-1 of the Environment Code) is to protect and monitor nuclear materials, their facilities and their transportation. It aims to ensure protection of the populations and environment against the consequences of malicious acts, in accordance with the provisions of the Defence Code.

This responsibility lies with the Minister for Ecology, Sustainable Development and Energy, with the support of the Defence and Security High Official (HFDS) and more specifically the nuclear security department (DSN). The HFDS thus acts as the nuclear security authority, by drafting regulations, issuing authorisations and conducting inspections in this field, with the support of IRSN.

Although the two regulatory systems and approaches are clearly different, the two fields, owing to the specificity of the nuclear field, are closely linked. ASN and the HFDS are therefore regularly in contact with each other.

2.2.2 The Prefects

The Prefects are the Government's local representatives. They are the guarantors of public order and play a particularly important role in the event of an emergency, in that they are responsible for measures to protect the general public.

The Prefect intervenes during the various procedures presented in chapter 3. He in particular issues his opinion on authorisation applications and, at the request of ASN, calls on the Departmental Council for the Environment and Health and Technological Risks, to obtain its opinion on water intake, effluent discharges and other detrimental effects of BNIs.

2.3 ASN

The TSN Act created an independent administrative Nuclear Safety Authority (ASN) to monitor and regulate nuclear safety and radiation protection. ASN's remit comprises regulation, authorisation and monitoring as well as providing support to the public authorities for management of emergencies and contributing to informing the general public.

ASN is made up of a commission and of various departments. From a technical point of view, ASN relies on the expertise with which it is provided, notably by IRSN and by Advisory Committees of Experts (GPEs).

2.3.1 Role and duties

Regulation

ASN is consulted on draft decrees and ministerial orders of a regulatory nature and dealing with nuclear safety.

It can issue statutory resolutions of a technical nature to complete the implementing procedures for decrees and orders adopted in the nuclear safety or radiation protection field, except for those relating to occupational medicine. These resolutions are subject to approval by the Ministers responsible for nuclear safety and for radiation protection.

Approval orders and approved resolutions are published in the Official Journal.

Authorisation

ASN reviews BNI authorisation or decommissioning applications, issues opinions and makes proposals to the Government concerning the decrees to be issued in these fields. It defines the requirements applicable to these installations with regard to the prevention of risks, pollution and detrimental effects. It authorises commissioning of these installations and pronounces delicensing following completion of decommissioning.

Some of these ASN resolutions require approval by the Ministers responsible for nuclear safety.

ASN also issues the licenses provided for in the Public Health Code concerning small-scale nuclear activities and issues authorisations or approvals for radioactive substances transport operations.

ASN's resolutions and opinions are published in its Official Bulletin on its website (*www.asn.fr*).

Chapter 3 of this report describes ASN's roles in the fields of regulation and authorisation.

Control

ASN checks compliance with the general rules and specific prescriptions concerning nuclear safety and radiation protection applicable to BNIs, the design, manufacturing and use of pressure equipment designed specifically for these installations, the transport of radioactive substances and the activities mentioned in Article L. 1333-1 of the Public Health Code and the persons mentioned in Article L. 1333-10 of the same code.

ASN organises a permanent radiation protection watch throughout the national territory.

From among its own staff, it appoints nuclear safety inspectors, radiation protection inspectors and officers in charge of verifying compliance with pressure equipment requirements. It issues the required approvals to the organisations participating in the verifications and nuclear safety or radiation protection monitoring.

Some of the provisions of Title VI entitled "Reinforcing nuclear safety and information of the citizens" of the green growth energy transition bill aim to reinforce ASN's oversight resources and powers of sanction and broaden its areas of competence.

ASN's powers of oversight and sanction could be reinforced in order to improve the effectiveness of its oversight of nuclear safety and radiation protection. These policing powers will be extended to activities important for safety conducted outside the perimeter of the BNIs by the licensee, its suppliers, contractors or subcontractors, in the same conditions as within the facilities themselves.

A sanctions commission is to be set up within ASN to implement these new prerogatives in order to comply with the principle of separation between the investigation, charging and sentencing functions instituted in French law and in international conventions on the right to a fair trial.

Chapter 4 of this report describes ASN actions in this field.

Radiological emergencies

ASN takes part in managing radiological emergency situations. It provides technical assistance to the competent authorities for the drafting of emergency response plans, taking account of the risks resulting from nuclear activities.

When such an emergency situation occurs, ASN verifies the steps taken by the licensee to make the facility safe. It assists the Government with all matters within its field of competence and submits its recommendations on the medical or health measures or civil protection steps to be taken. It informs the general public of the situation, of any releases into the environment and their consequences. It acts as the competent authority within the framework of international conventions, by notifying international organisations and foreign countries of the accident.

Chapter 5 of this report describes ASN actions in this field.

In the event of an incident or accident concerning a nuclear activity and pursuant to Decree 2007-1572 of 6th November 2007 concerning technical inquiries into accidents or incidents concerning a nuclear activity, ASN may carry out a technical inquiry.

Information

ASN participates in informing the public in its areas of competence. Chapter 6 of this report describes ASN actions in this field.

Research monitoring

The quality of ASN's resolutions and decisions relies primarily on robust technical expertise which, in turn, requires the best and most up-to-date knowledge. In this respect, the green growth energy transition bill makes provision for ASN overseeing the adaptation of public research to the needs of nuclear safety and radiation protection.

Consequently, ASN is already concerned about the availability of the knowledge required to underpin the expertise it may need to call upon in the medium and long term. ASN is also attentive to the quality of research initiatives, with the prospect of them being integrated into the licensees' safety demonstrations.

In 2010, ASN set up a Scientific Committee to examine its proposed orientations concerning the research work to be conducted or taken further in the fields of nuclear safety and radiation protection. In a resolution dated 8th July 2014, the ASN Commission renewed for a further four years the mandates of the eight members of the Committee, appointed for their expertise in the field of research. Under the presidency of Ashok Thadani, former director of research at the USA's Nuclear Regulatory Commission (NRC), the Committee consists of Bernard Boullis, Marie-Pierre Comets, Jean-Claude Lehmann, Michel Schwarz, Patrick Smeesters, Michel Spiro and Victor Teschendorff. The Scientific Committee met twice in 2014.

On the basis of the work done by the Scientific Committee, ASN issued a first opinion in April 2012 underlining the importance it attaches to research, and identifying the initial research topics to be further investigated in the fields of nuclear safety and radiation protection.

A second opinion was issued in early 2015 on the research topics to be taken further in the following fields:
- waste packaging;
- deep geological disposal;
- transport of radioactive materials;
- severe accidents.

The Fukushima nuclear accident also highlighted the need for more research in the field of nuclear safety.

SCIENTIFIC COMMITTEE

From left to right: Michel Schwarz, Patrick Smeesters, Ashok Thadani, Michel Spiro, Bernard Boullis, Marie-Pierre Comets, Jean-Claude Lehmann and Victor Teschendorff.

GREEN GROWTH ENERGY TRANSITION BILL

Some provisions of Title VI "Reinforcing nuclear safety and information of the citizens" of this bill stipulate a reinforcement of the powers and competencies of ASN. These provisions in particular state that:

- Within BNIs, ASN shall have certain competencies concerning non-radioactive waste, products and equipment entailing risks (for example equipment for explosive atmosphere), or chemical products;
- to back-up its resolutions, ASN may resort to third party assessments, inspections and studies at the expense of the party being assessed or inspected, in a manner comparable to that used for ICPEs;
- ASN can ensure that public research is tailored to the needs of nuclear safety and radiation protection.

A call for projects in the field of nuclear safety was therefore issued by the French National Research Agency (ANR) under the Investing in the Future programme. In May 2013, the Government announced the winning candidates. ASN is a member of the steering committee for this call for projects.

2.3.2 Organisation

ASN Commission

The Commission comprises five Commissioners holding the post on a full-time basis. These are permanent appointments with a 6-year non-renewable mandate.

The Commission defines ASN strategy. More specifically, it is involved in developing overall policy, i.e. the doctrines and principles that underpin ASN's main missions of regulation, inspection, transparency, management of emergency situations and international relations. To this end, it develops a Multi-Year Strategic Plan (PSP).

Pursuant to the Environment Code, the Commission submits ASN's opinions to the Government and issues the main ASN resolutions. It decides on the public position to be adopted on the main issues within ASN's sphere of competence. The Commission adopts the ASN internal regulations which lay down its organisation and working rules, as well as its ethical guidelines. The Commission's resolutions and opinions are published in ASN's Official Bulletin.

In 2014, the ASN Commission met 71 times. It issued 27 opinions and 85 resolutions.

ASN central services

The ASN central services comprise an Executive Committee, an Office of Administration, a Management and Expertise Office and eight departments covering specific themes.

Under the authority of the ASN Director-General, the Executive Committee organises and manages the departments on a day to day basis. It ensures that the orientations determined by the Commission are followed and that ASN's actions are effective. It oversees and coordinates the various entities.

The role of the departments is the national management of the activities for which they are responsible. They take part in drafting the general regulations and coordinate the actions of the ASN divisions.

THE COMMISSION

From left to right: Jean-Jacques Dumont, Philippe Chaumet-Riffaud, Pierre-Franck Chevet, Margot Tirmarche and Philippe Jamet.

- The Nuclear Power Plant Department (DCN) is responsible for the regulation and monitoring of the safety of the NPPs in operation, as well as the safety of future power generating reactor projects. It contributes to development of regulation/monitoring strategies and ASN actions on subjects such as facility ageing, reactor service life, assessment of NPP safety performance, and harmonisation of nuclear safety in Europe.
The DCN comprises five branches: "Reassessment - Equipment - Hazard", "Operation", "Core - Studies", "Radiation Protection - Environment and Labour Inspections" and "Regulations and New Installations".

- The Nuclear Pressure Equipment Department (DEP) is responsible for monitoring the safety of pressure equipment installed in BNIs. It is primarily tasked with developing regulations on the design, manufacture and operation of nuclear pressure equipment and with monitoring application of these regulations by manufacturers and their sub-contractors, and by nuclear operators. The DEP also considers applications from approved organisations wishing to carry out regulatory inspections on nuclear pressure equipment.
The DEP comprises three Branches: "Manufacturing", "In-service Monitoring" and "Relations with Divisions-Operations", plus a "Design" unit.

- The Transport and Radiation Sources Department (DTS) is responsible for monitoring activities relating to sources of ionising radiation in the non-medical sectors and to transport of radioactive substances. It contributes to the development of technical regulations, to monitoring their application and to managing authorisation procedures (installations and equipment emitting ionising radiation in non-medical sectors, suppliers of medical and non-medical sources, accreditation of packaging and of relevant organisations). It is preparing to take charge of regulating radioactive source security.
The DTS comprises three Branches: "Transport Management", "Radiation Protection and Sources" and "Source Security".

- The Waste, Research Facilities and Fuel Cycle Department (DRC) is responsible for monitoring nuclear fuel cycle facilities, research facilities, nuclear installations being decommissioned, contaminated sites and radioactive waste management. It takes part in monitoring and inspecting the Bure underground research laboratory and the research facilities covered by international conventions, such as CERN or ITER.
The DRC comprises four Branches: "Cross-discipline topics and Research facilities", "Fuel cycle facilities", "Management of Radioactive Waste" and "Decommissioning and Clean-out".

- The Ionising Radiation and Health Department (DIS) is tasked with regulating medical applications of ionising radiation and - in collaboration with IRSN and the various health authorities - organising the scientific, health and medical watch with regard to the effects of ionising radiation on health. It contributes to the drafting of the regulations in the field of radiation protection, including with respect to natural ionising radiation, and the updating of health protection measures should a nuclear or radiological event take place.
The DIS comprises two Branches: "Exposure in the Medical Sector" and "Exposure of Workers and the Public".

- The Environment and Emergency Department (DEU) is responsible for monitoring environmental protection and management of emergency situations. It establishes policy on nationwide radiological monitoring and on the provision of information to the public and helps to ensure that discharges from BNIs are as low as reasonably achievable, in particular by establishing general regulations. The DEU also contributes to defining the organisational framework of public authorities and nuclear operators where management of emergency situations is concerned and establishes ASN regulatory policy.
The DEU comprises three Branches: "Safety and Emergency Preparedness", "Environment and Prevention of Nuisances" and "Development of Regulations".

- The International Relations Department (DRI) is in charge of ASN's bilateral and multilateral international relations. It develops exchanges with ASN's counterpart organisations in other countries, to gain greater understanding of their practices, to provide information about and explain the French approach and practices and to provide the countries concerned with useful information on the safety of French nuclear installations close to their borders.
The DRI coordinates ASN representation within international bodies such as the European Union, IAEA or the OECD's Nuclear Energy Agency (NEA).

THE EXECUTIVE COMMITTEE

From left to right: Ambroise Pascal, Jean-Luc Lachaume, Jean-Christophe Niel, Julien Collet and Alain Delmestre (missing: Henri Legrand).

THE DIRECTORS

From left to right: Remy Catteau, Anne-Cécile Rigail, Vivien Tran-Thien, Thomas Houdré, Luc Chanial, Bénédicte Genthon, Stéphane Pailler, Jean-Luc Godet and Alain Delmestre (missing: Fabien Schilz).

THE REGIONAL HEADS

From left to right: Pierre Boquel, Guillaume Bouyt, Pierre Siefridt, Sophie Letournel, Paul Bougon, Delphine Ruel, Alain Rivière, Laurent Deproit and François Godin (missing: Matthieu Mangion and Jean-Michel Férat).

- The Communication and Public Information Department (DCI) develops and implements ASN's policy on communication and information regarding nuclear safety and radiation protection. It coordinates communication and information actions targeting different audiences, with a focus on handling requests for documentation, making ASN's position known and explaining regulations.
  The DCI comprises two Branches: "Public Information" and "Publications and Multimedia".

- The Office of Administration (SG) helps to provide ASN with the adequate, appropriate and long-term resources necessary for it to function. It is responsible for managing human resources, including with regard to skills, and for developing social dialogue. It is also responsible for ASN real estate policy and its logistical and material resources. It is in charge of ASN budget policy and ensures optimised use of its financial resources. Finally, it provides legal expertise for ASN as a whole.
  The SG comprises four Branches: "Human Resources", "Budget-Finance", "Logistics - Real Estate" and "Legal Affairs".

- The Management and Expertise Office (MEA) provides ASN with IT resources and a high level of expertise. It ensures that ASN's actions are coherent, by means of a quality approach and by overseeing coordination of the workforce.
  The MEA comprises three Branches: "Information Technology and Telephony", "Expertise and Research" and "Coordination and Quality".

ASN regional divisions

The eleven ASN regional divisions carry out their activities under the authority of regional representatives. The director of the Regional Directorate for the Environment, Planning and Housing (DREAL) or of the Regional Directorate for the Environment and Energy (DRIEE) in which the division in question is located, takes on this responsibility as regional representative. He or she is placed at the disposal of ASN to fulfil this role which is not exercised under the authority of the Prefect. This person is delegated with power of signature by the Chairman for decisions at the local level.

The divisions carry out most of the direct inspections on the BNIs, on radioactive substance transport operations and on small-scale nuclear activities, and review most of the authorisation applications filed with ASN by the nuclear activity licensees within their regions. They are organised into two to four hubs, depending on the activities to be regulated in their territory.

In emergency situations, the divisions assist the Prefect, who is in charge of protecting the general public, and supervise the operations carried out to safeguard the facility on the site. To ensure preparedness for these situations, they take part in drawing up the emergency plans drafted by the Prefects and in periodic emergency exercises.

The divisions contribute to ASN's public information duty. They for example take part in the meetings of the Local Information Committees (CLIs) and maintain regular relations with the local media, elected officials, associations, licensees and local administrations.

ASN's divisions are presented in chapter 8 of this report.

2.3.3 Operation

Human ressources

As at 31st December 2014, the total ASN workforce stood at 474, divided between the central services (255 staff members), the regional divisions (213 staff members) and various international organisations (6 staff members).

This workforce can be further broken down as follows:
- 369 tenured or contract staff members;
- 105 staff members seconded from public bodies (Andra, Assistance publique - Hôpitaux de Paris, CEA, IRSN).

A balanced age pyramid and a policy of diversity in recruitment and experience, gives ASN the qualified and complementary human resources it needs to meet its responsibilities. In addition, the training, the method of integration of the new arrivals and the transmission of know-how help to obtain the required level of expertise.

To ensure that it always has staff with the required competence, ASN must be able to offer them - in relation to its needs - varied career paths, enhancing their existing experience in particular.

Skills management

Competence is one of the four key values of ASN. The tutor system, initial and continuing training, whether general, linked to nuclear techniques, the field of communication, or legal matters, as well as day-to-day practices, are essential aspects of the professionalism of ASN staff.

Management of the skills of ASN personnel is based primarily on a technical training programme tailored to each staff member, based on training requirements that include minimum experience conditions.

Pursuant to the provisions of Articles L. 592-22 and L. 592-23 of the Environment Code, which more specifically state that *"ASN shall appoint nuclear safety inspectors […] and radiation protection inspectors […] from among its staff"* and Decree 2007-831 of 11th May 2007 setting the procedures for appointing and qualifying nuclear safety inspectors, which states that the *"nuclear safety inspectors and the staff responsible for checking nuclear pressure equipment […] are chosen for their professional experience and their legal and technical knowledge"*, ASN set up an official process for accrediting certain of its staff members to perform its inspections and, as necessary, carry out judicial policing roles. For each of the inspectors it qualifies, the accreditation decision taken by ASN is based on the adequacy of the skills acquired, both within and outside ASN, with those specified in the professional baseline requirements.

Furthermore, and in order to recognise the expertise and experience of its inspectors, ASN has set up a process enabling it to select those of its inspectors to whom it can entrust inspections that are more complex or with more significant implications. The inspectors recognised in this way are known as "senior inspectors".

An accreditation committee was created in 1997 to give its opinion to the Director General concerning the qualification procedure prior to accreditation as inspector or senior inspector. In particular, the Committee reviews the applicable training curriculum and the qualification reference systems and conducts interviews with inspectors as part of a confirmation process. Chaired by Philippe Saint Raymond, the Accreditation Committee comprises senior ASN inspectors and persons qualified in inspection, human resources, appraisal and teaching in the field of nuclear safety and inspection of classified installations. Its competence was extended in 2009 to the radiation protection field.

The Accreditation Committee met once in 2014 and proposed the confirmation of three inspectors. As at 31st December 2014, 46 ASN nuclear safety and radiation protection inspectors were senior inspectors, or nearly 17% of the 273 ASN staff members holding at least one accreditation.

In 2014, nearly 2,665 days of training were provided to ASN staff through 191 sessions forming part of 125 different courses. The financial cost of the courses, provided by organisations other than ASN, amounted to €0.41 M.

Social dialogue

Maintaining and developing a high level of social dialogue is a key objective in ASN's human resources policy.

During the course of 2014, the ASN Social Dialogue Committee (SDC) met on four occasions. Numerous discussions were held with the personnel representatives: change in the pricing applied in the joint-companies canteen in Montrouge, staff travel conditions, follow-up to the move by the ASN head office departments and staff support arrangements, organisation of professional elections of 4th December 2014 and so on.

Complementing the action of the ASN SDC, the Joint Consultative Commission (CCP) - which has competence for contract staff - met twice. Together with the personnel representatives and with regard to ASN contract staff, it more specifically examined the application of the tenure process stipulated by the 12th March 2012 Act on access to tenured employment and improvement of the working conditions of contract staff in the civil service.


Meeting of the ASN Social Dialogue Committee on 15th December 2014.

TO BE NOTED

High level of participation in the professional elections held by ASN on 4th December

The professional elections were held on 4th December 2014 in the three public functions (State, regional and hospitals) to renew all the consultative bodies, thus marking the completion of the process to merge the electoral calendars specified in the 5th July 2010 Act on the renovation of social dialogue.

Following these elections, for which turn-out was high (85.3 % for the SDC vote and 83.8 % for the CCP vote), the UNSP-OF union, with four seats and the CFDT union, with two seats, will represent the personnel on the ASN SDC and CHSCT.

For the CCP, the two seats were awarded to the CFDT.

Finally, the ASN Health, Safety and Working Conditions Committee (CHSCT) met on three occasions in 2014. The number of subjects debated within this recent body, created in 2012, has gradually increased: radiation protection results, general health, safety and working conditions situation, management of individual protection equipment, controlled area entry conditions for ASN inspectors, methodology for drafting the ASN single document and security measures for ASN inspectors performing hydraulic tests.

Professional ethics

Three legislative texts set specific rules of professional ethics applicable to ASN:
- the Environment Code stipulates that as soon as the ASN Commission members are appointed, they shall draw up a declaration indicating the interests they hold or have held in the course of the previous five years in the areas falling under the competence of ASN. This declaration, which is filed at the ASN headquarters and is held at the disposal of the members of the Commission, is updated at the initiative of the Commissioner concerned as soon as any change occurs. No member of the Commission may, during their mandate, hold an interest that could affect their independence or impartiality (Article L. 592-6 of the Environment Code);
- the act of 29th December 2011 relative to the reinforcing of the safety of medicines and health products, known as the "Medicines Act", establishes a modernised framework for professional ethics and sanitary expertise with which the Authorities involved in the area of health and sanitary safety must comply. For ASN, these particular ethical rules apply to its activity relative to the safety of health products. The declarations of interests of the persons concerned within ASN, and the members of the ASN Commission in particular, are published on *www.asn.fr*.
- Act 2013-907 of 11th October 2013 concerning transparency in public life, requires that a declaration of the interests held as at the date of nomination and for the five years preceding this date be sent to the High Authority for Transparency in Public Life (HATVP), along with an exhaustive, accurate and true declaration of individual or common assets, more specifically by the members of independent administrative authorities. For ASN, the members concerned are the members of the Commission.

Chapter 3 of the ASN's Rules of Procedure sets out the rules applicable to all ASN employees, focusing in particular on:
- observance of professional secrecy and duty of discretion;
- abuse of authority and breaches of the duty of integrity;
- conflicts of interest;
- guarantees of independence with regard to persons or entities subject to ASN oversight.

Financial resources

ASN's financial resources are presented in part 3.

ASN management tools

The Multi-year Strategic Plan

The Multi-year Strategic Plan (PSP), prepared under the authority of the ASN Commission, outlines ASN's strategic orientations for a three year period. It is presented annually in an operational orientation document that sets the year's priorities for ASN, and which is in turn adapted by each entity into an annual action plan that is subject to periodic monitoring.

This three-level approach is an essential part of ASN's development, organisation and management. The PSP for the period 2013-2015, entitled "Taking up the challenges of nuclear safety and radiation protection: regulation, independence and transparency", comprises the following five strategic lines:
- Enhance the legitimacy of ASN's resolutions and position statements.
- Develop an efficient working environment and enhance skills.
- Develop our forward-looking actions.
- Make the European hub a driving force for nuclear safety and radiation protection around the world.
- Raise and fuel discussions and debates on the topic of nuclear safety and radiation protection.

The PSP for the period 2013-2015 is accessible on *www.asn.fr*.

The ASN internal management system

Within ASN, there are many forums for discussion, coordination and oversight.

These bodies, supplemented by the numerous cross-disciplinary structures, reinforce the safety culture of its staff through sharing of experience and the definition of coherent common positions.

Quality management system

To guarantee and improve the quality and effectiveness of its actions, ASN defines and implements a quality management system inspired by the ISO and IAEA international standards. This system is based on:
- an organisation manual containing organisation notes and procedures, defining the rules to be applied for each task;

TO BE NOTED

The French system for the oversight of nuclear safety and radiation protection was assessed by a team of twenty-nine international experts under the supervision of IAEA.

ASN welcomed an IAEA peer review mission from 17th to 28th November 2014. This Integrated Regulatory Review Service (IRRS) mission concerned all the activities regulated by ASN. It examined the strengths and weaknesses of the French nuclear safety and radiation protection oversight system against IAEA standards.

The mission was chaired by Mark Satorius, CEO of the American Nuclear Regulatory Commission and by Ann McGarry, Director of the Office of Radiological Protection at the Irish Environmental Protection Agency. It was carried out by a team of twenty-nine experts from the nuclear safety and radiation protection authorities of Australia, Belgium, Canada, Cuba, Czech Republic, Finland, Germany, Hungary, India, Ireland, Japan, Morocco, Norway, Pakistan, South Korea, Spain, Switzerland, United Kingdom, United States and IAEA.

The mission in particular met teams from the Government departments concerned. Mr Satorius and Mrs McGarry also had a meeting with Mr Le Déaut, a member of Parliament and Chairman of the OPECST.

ASN, together with IRSN and the relevant departments of the Ministry for Ecology, Sustainable Development and Energy, had been preparing for this mission for a year.

The conclusions of the mission were presented to ASN on 28th November 2014 and were the subject of a press release from IAEA, which more specifically stated that:

The best practices identified by the IRRS team include:
- the involvement of the stakeholders in the regulatory processes and in the transparency of the decisions taken, as well as wide-ranging communication to promote participation in the regulatory activities and decisions;
- the independence of the ASN commissioners and personnel in the performance of their regulatory duties;
- the coordination between the oversight organisations involved in emergency planning and the effective interaction with the licensees in this field.
- the mission identified a few points worthy of particular attention or improvement, in particular:
  - the regulatory framework for monitoring exposure in the medical field should be evaluated to ensure that there are no shortcomings and that the coordination between the organisations involved is appropriate;
  - the system used by ASN to assess and modify its regulatory framework should be reinforced;
  - all the processes ASN needs in order to perform its role should be specified in its integrated management system and implemented in full;
  - new means must be examined in order to guarantee that ASN has the human and financial resources it needs for effective oversight of nuclear safety and radiation protection in the future.

ASN considers that the IRRS missions make a significant contribution to the international safety and radiation protection system. ASN is thus closely involved in hosting missions in France and in participating in missions in other countries. Commissioner Philippe Jamet and the ASN Director General, Jean-Christophe Niel, have thus carried out IRRS missions in Finland and Switzerland respectively.

In 2006, ASN hosted the first IRRS (Integrated Regulatory Review Service) mission concerning all the activities of a safety regulator, with a follow-up mission in 2009.

This audit is the result of the European nuclear safety directive which requires a peer review mission every ten years.

The reports for the 2006, 2009 and 2014 IRRS missions are available for consultation on *www.asn.fr*.

- internal and external audits to check rigorous application of the system's requirements;
- listening to the stakeholders;
- performance indicators for monitoring the effectiveness of action taken;
- a periodic review of the system, to foster continuous improvement.

Internal communication

In the same way as human resources management, ASN's internal communication aims to foster the sharing of information and experience between teams and activities, by reinforcing the internal culture and reasserting the specific nature of ASN's remit, rallying the staff around the strategic orientations defined for their missions, and developing strong group dynamics.

In 2014, ASN used a variety of media to highlight the expertise and achievements of its staff: in addition to the internal communication media (intranet and the in-house "web TV", an activity report, *Transparence* magazine - see chapter 6), ASN invited its staff to now well-established events; the traditional New Year's wishes evening, during which the ASN Chairman and Director General present future prospects to the staff; the presentation to the staff of the annual report on the state of nuclear safety and radiation protection in France, before the presentations to Parliament and the press which take place each year. ASN has also initiated a cycle of two-monthly internal conferences on topics linked to its activities. For the fourth year in a row, ASN also took part in the Odyssea race against breast cancer organised in Paris and the regions. It has been a partner of the association since 2012.

Lastly, the sharing of information on the work of ASN's regional divisions continues to be encouraged: the regional information notices are published on Oasis, the ASN intranet. The daily press review, that all ASN staff members receive by e-mail, ensures that they are kept abreast of any articles commenting on ASN actions.

2.4 The consultative and discussion bodies

2.4.1 High Committee for Transparency and Information on Nuclear Security

The TSN Act created a High Committee for Transparency and Information on Nuclear Security (HCTISN), an information, discussion and debating body dealing with the risks inherent in nuclear activities and the impact of these activities on human health, the environment and nuclear safety.

The High Committee can issue an opinion on any question in these fields, as well as on controls and the relevant information. It can also deal with any issue concerning the accessibility of nuclear safety information and propose any measures such as to guarantee or improve nuclear transparency. It can be called on by the Government, Parliament, the local information committees or the licensees of nuclear facilities, with regard to all questions relating to information about nuclear safety and its regulation and monitoring.

The HCTISN's activities in 2014 are described in chapter 6.

2.4.2 The High Council for Public Health

The High Council for Public Health (HCSP), created by Act 2004-806 of 9th August 2004 concerning public health policy, is a scientific and technical consultative body reporting to the Minister responsible for Health.

The HCSP contributes to defining the multi-year public health objectives, reviews the attainment of national public health objectives and contributes to their annual monitoring. Together with the health agencies, it provides the public authorities with the expertise necessary for managing health risks and for defining and evaluating prevention and health safety policies and strategies. It also anticipates future developments and provides advice on public health issues.

2.4.3 The High Council for Prevention of Technological Risks

Consultation about technological risks takes place before the High Council for Prevention of Technological Risks (CSPRT), created by Order 2010-418 of 27th April 2010. Alongside representatives of the State, the Council comprises licensees, qualified personalities and representatives of environmental associations. The CSPRT, which takes over from the high council for classified facilities, will see the scope of its remit extended to pipelines transporting gas, hydrocarbons and chemicals, as well as covering BNIs.

The Government is required to submit ministerial orders concerning BNIs to the CSPRT for its opinion. ASN may also submit resolutions relating to BNIs to it.

2.4.4 The Central Committee for Pressure Equipment

The Central Committee for Pressure Equipment (CCAP), created by Article 26 of Decree 99-1046 of 13th December 1999 concerning Pressure

Equipment (PE), is a consultative organisation reporting to the Minister responsible for the Environment.

It comprises members of the various administrations concerned, persons chosen for their particular competence and representatives of the pressure equipment manufacturers and users and of the technical and professional organisations concerned.

The Government and ASN are required to submit all questions concerning the legislative and regulatory aspects of nuclear pressure equipment (Ministerial Orders and individual decisions concerning BNIs alike) to the CCAP. Accident reports concerning pressure equipment are also communicated to it.

2.4.5 Local Information Committees for the Basic Nuclear Installations

The Local Information Committees (CLI) for BNIs are tasked with a general duty of monitoring, information and consultation on the subject of nuclear safety, radiation protection and the impact of nuclear activities on humans and the environment, with respect to the site or sites which concern them. They may request expert assessments or have measurements taken on the installation's discharges into the environment.

The CLIs, whose creation is incumbent upon the President of the General Council, comprise various categories of members: representatives of General Councils, of the municipal councils or representative bodies of the groups of communities and the Regional Councils concerned, members of Parliament elected in the *département*, representatives of environmental protection associations, economic interests and representative employee and medical profession union organisations, and qualified personalities.

The status of the CLIs was defined by the TSN Act and by Decree 2008-251 of 12th March 2008.

The activity of the CLIs is described in chapter 6.

2.5 Technical support organisations

ASN benefits from the expertise of technical support organisations to prepare its resolutions. The French Institute for Radiation Protection and Nuclear Safety (IRSN, *www.irsn.fr*) is the main such organisation. ASN has been making efforts to diversify its experts for several years.

2.5.1 IRSN

IRSN was created by Act 2001-398 of 9th May 2001 and by Decree 2002-254 of 22nd February 2002 as part of the national reorganisation of nuclear safety and radiation protection regulation, in order to bring together public expertise and research resources in these fields. IRSN reports to the Ministers for the environment, health, research, industry and defence.

Articles L.592-41 to L.592-43 of the Environment Code specify that IRSN is a State public industrial and commercial institution which carries out expert appraisal and research missions in the field of nuclear safety – excluding any responsibility as nuclear licensee. IRSN contributes to information of the public and publishes the opinions requested by a public authority or ASN, in consultation with them. It organises the publicity of scientific data resulting from the research programmes run at its initiative, with the exception of those relating to defence matters.

For the performance of its missions, ASN receives technical support from IRSN, consisting of expert appraisals supported by research activities. The ASN Chairman is now a member of the IRSN Board.

IRSN conducts and implements research programmes in order to build its public expertise capacity on the very latest national and international scientific knowledge in the fields of nuclear and radiological risks. It is tasked with providing technical support for the public authorities with competence for safety, radiation protection and security, in both the civilian and defence sectors.

IRSN also has certain public service responsibilities, in particular monitoring of the environment and of populations exposed to ionising radiation.

IRSN manages national databases (national nuclear material accounting, national inventory of radioactive sources, file for monitoring worker exposure to ionising radiation, etc.), and contributes to information of the public concerning the risks linked to ionising radiation.

IRSN workforce

As at 31st December 2014, IRSN's overall workforce stood at 1,700 employees, of which 400 are devoted to ASN technical support.

IRSN budget

The IRSN budget is presented in point 3.

A five-year agreement defines the principles and procedures for the technical support provided to ASN by the Institute. This agreement is clarified on a yearly basis by a protocol identifying the actions to be performed by IRSN to support ASN.

GREEN GROWTH ENERGY TRANSITION BILL

This bill clarifies the organisation of the system built around ASN and IRSN:

- it enshrines the existence and duties of IRSN within a new section 6 of the Environment Code entitled "The Institute for Radiation Protection and Nuclear Safety" in chapter II concerning "The Nuclear Safety Authority (ASN)" of Title IX of Book V of the Environment Code;
- it recalls that ASN benefits from IRSN technical support, indicating that this support comprises expert appraisal activities "supported by research";
- it clarifies the relations between ASN and IRSN, indicating that ASN "guides IRSN's strategic decisions concerning this technical support" and that the ASN Chairman is an ex-officio and fully-fledged member of the Board of the institute.
- it also mentions the principle of the publication of IRSN opinions.

2.5.2 Advisory Committees of Experts

To prepare its resolutions, ASN relies on the opinions and recommendations of seven Advisory Committees of Experts (GPE), with competence for waste, nuclear pressure equipment, reactors, transport and laboratories and factories, medical radiation protection, radiation protection in non-medical sectors and the environment, respectively.

ASN consults the GPEs in preparing its main resolutions and decisions. In particular, they review the preliminary, provisional and final safety analysis reports for each BNI. They can also be consulted about changes in regulations or doctrine.

For each of the subjects covered, the GPEs examine the reports produced by IRSN, by a special working group or by one of the ASN departments. They issue an opinion backed up by recommendations.

The GPEs comprise experts nominated for their individual competence. They come from various backgrounds; universities, associations, appraisal and research organisations. They can also be licensees of nuclear facilities or come from other sectors (industrial, medical, etc.). Participation by foreign experts can help diversify the approach to problems and provide the benefit of experience acquired internationally.

Following the Médiator case, ASN felt that the time was right to review the organisation of the traditional GPEs, in order to rule out any suspicion surrounding the independence of their opinions.

The first discussions on the reorganisation took place in September 2012. They continued in 2013 and led to a new GPE organisation, giving a broader role to civil society and preserving the technical quality of the GPE opinions, while guaranteeing their independence from the licensees. The renewal process, which began in late 2013, led to new GPE composition decisions in May 2014.

The desire to prevent any conflict of interest also led to Advisory Committee members being required to submit a declaration of interest and to the reinforcement of the internal operating rules of the Advisory Committees to ensure that experts with a direct interest in the subject being addressed do not take part in establishing the position of the Advisory Committee.

Since 2009, as part of its commitment to transparency in nuclear safety and radiation protection, ASN has published the GPE letters of referral, the opinions of the GPEs and ASN's position statements based on these opinions. IRSN for its part publishes the syntheses of the technical investigation reports it presents to the GPEs.

In 2014, the ASN budget allocated to the GPEs was around €0.125 M.

Advisory Committee for Waste (GPD)

The Advisory Committee for Waste (GPD) is chaired by Pierre Bérest and comprises 36 experts appointed for their competence in the nuclear, geological and mining fields.

In 2014, it held three plenary meetings, one information meeting and one two-day bipartite meeting with German experts in Cadarache, during which ITER, Tore Supra and certain CEA waste storage facilities were visited.

Advisory Committee for Nuclear Pressure Equipment (GPESPN)

Since 2009, the GPESPN has replaced the Standing Nuclear Section (SPN) of the CCAP. The GPESPN is chaired by Philippe Merle and comprises 28 experts appointed for their competence in the field of pressure equipment.

In 2014, it held one plenary meeting and one internal meeting.

Advisory Committee for Radiation Protection in Medical and Forensic Applications of Ionising Radiation (GPMED)

Chaired by Bernard Aubert, the GPMED comprises 30 experts appointed for their competence in the field of radiation protection of health professionals, the general public and patients and for medical and forensic applications of ionising radiation.

It held two meetings in 2014.

Advisory Committee for Radiation Protection for Industrial and Research Applications of Ionising Radiation and in the Environment (GPRADE)

Chaired by Jean-Paul Samain, the GPRADE comprises 27 experts appointed for their competence in the fields of radiation protection of workers (other than health professionals) and the public, for industrial and research applications using ionising radiation and for exposure to ionising radiation of natural origin, and protection of the environment.

It held two meetings in 2014.

Advisory Committee for Nuclear Reactors (GPR)

The Advisory Committee for Nuclear Reactors is chaired by Philippe Saint Raymond and comprises 34 experts appointed for their competence in the field of nuclear reactors.

In 2014, it held six plenary meetings, including two which lasted two days, and one internal meeting.

Advisory Committee for Transport (GPT)

Chaired by Jacques Aguilar, the GPT comprises 27 experts appointed for their competence in the area of transport.

In 2014, it held one joint plenary meeting with the GPU and one internal meeting.

Advisory Committee for Laboratories and Plants (GPU)

The Advisory Committee for Laboratories and Plants is chaired by Jérôme Joly and comprises 32 experts appointed for their competence in the field of laboratories and factories in which radioactive substances are used.

In 2014, it held six plenary meetings, three of which were held jointly with another Advisory Committee, and visited one facility.

2.5.3 The ASN's other technical support organisations

To diversify its expertise and to benefit from other specific skills, ASN also has its own budget, amounting to €0.539 million in 2014.

In 2013, it also set up a framework agreement with expert appraisal organisations to ensure more dynamic use of a diversified panel of expertise.

In 2014, ASN continued or initiated collaboration with:
- the Scientific and Technical Centre for Building (CSTB): questions relating to population exposure to radon in the home (multi-year action 2012-2014);
- the French Nuclear Protection Evaluation Centre (CEPN): assistance with radon-related work;
- the Néodyme company: technical audit, detailed analysis and owner's assistance mission for management of the project to create an electronic database of BNI atmospheric and liquid discharge;
- the APSYS company: expert risk assessment by the French foundry industries technical centre (CTIF) concerning the risk of explosion and the steps to be taken to mitigate this risk with respect to the

GPR meeting on 18th September 2014.

restart of the Centraco fusion furnace following the industrial accident of 12th September 2011;
- the CNAM-ErgoManagement company: detailed examination of the steps taken by EDF to manage subcontracted engineering and design activities.

2.6 The pluralistic working groups

ASN has set up several pluralistic working groups; they enable the stakeholders to take part in the development of doctrines, the definition of action plans or the monitoring of their implementation.

UNDERSTAND

ASN creates a Steering Committee for Social, Organisational and Human Factors (COFSOH)

Social, organisational and human factors received particular attention during the stress tests further to the Fukushima accident. On completion of the various investigations, ASN indicated in January 2012 that it had identified three priorities in this area:
- the renewal of the licensees' workforce and skills;
- the organisation of the use of subcontracting;
- research on these topics, for which programmes must be set up, at national or European levels.

Further to the stress tests, ASN has set up a pluralistic working group on these subjects, called the COFSOH (Steering Committee for Social, Organisational and Human Factors). In addition to ASN members, this committee includes representatives of institutions and environmental protection associations, personalities chosen for their scientific, technical, economic, social, or information and communication expertise, persons in charge of nuclear activities, representatives of nuclear industry professional federations and representative employees' unions.

Six plenary meetings of this committee have been held since 2012, during which the following topics were discussed: the conditions for the performance of subcontracting and the relationship between the ordering customer and the subcontractors, the connection between "managed security" and "regulated security", skills management in a context of workforce renewal and the use of pertinent OHF indicators for safety assessment.

Since the beginning of 2013 and in parallel with the plenary meetings, the work of the COFSOH has been continuing through three working groups. The twenty-eight meetings held to date have addressed the following subjects:
- subcontracting in normal operating situations: work organisation and conditions;
- management of emergency situations;
- the legal questions raised in connection with the subjects addressed in the other two working groups.

2.6.1 The Working Group for the National Plan for Management of Radioactive Materials and Waste

Article L.542-1-2 of the Environment Code requires the production of the French National Plan for the Management of Radioactive Materials and Waste (PNGMDR), which is revised every three years and serves to "review the existing management procedures for radioactive materials and waste, to identify the foreseeable needs for storage and disposal facilities, specify the necessary capacity of these facilities and the storage durations and, for radioactive waste for which there is as yet no final management solution, to determine the objectives to be met".

The Working Group (WG) tasked with producing the PNGMDR comprises environmental protection associations, representatives of elected officials and regulatory authorities, alongside the radioactive waste producers and managers. It is co-chaired by the DGEC (General Directorate for Energy and the Climate) of the Ministry for Ecology, Sustainable Development and Energy and by ASN.

The work of the PNGMDR WG is presented in greater detail in chapter 16.

2.6.2 The Steering Committee for Managing the Nuclear Post-Accident Phase (CODIRPA)

Pursuant to the interministerial directive of 7th April 2005, ASN, in association with the Ministerial departments concerned, is responsible for defining, preparing and implementing the steps necessary for managing a post-accident situation.

In order to develop a doctrine and after testing post-accident management during national and international exercises, ASN brought all the players concerned together within the CODIRPA (Steering Committee responsible for Post-Accident Management). This committee, headed by ASN, has representatives from the ministerial departments concerned, the health agencies, associations, the CLI, and IRSN.

The work of the CODIRPA is presented in greater detail in chapter 5.

2.6.3 The Steering Committee for Social, Organisational and Human Factors (COFSOH)

ASN considers that there is a need to move forward with regard to the reflections and work being done on the contribution of people and organisations to the safety of nuclear facilities and in 2012 it therefore decided to set up the Steering Committee for Social, Organisational and Human Factors (see box).

2.6.4 The other pluralistic groups

In 2014, the National Committee responsible for monitoring the national radon risks management plan, chaired by ASN, carried out a midway interim evaluation of the 2011-2015 action plan (see chapter 1).

2.7 Other stakeholders

As part of its mission to protect the general public from the health risks of ionising radiation, ASN cooperates closely with other competent institutional stakeholders addressing health issues.

2.7.1 The National Agency for the Safety of Medication and Health Products

The National Agency for the Safety of Medication and Health Products (ANSM) was created on 1st May 2012. The ANSM, a public institution reporting to the Ministry of Health, has taken up the duties of the AFSSAPS alongside other new responsibilities. Its key role is to offer patients equitable access to innovation and to guarantee the safety of health products throughout their life cycle, from initial testing through to monitoring after receiving marketing authorisation.

TABLE 1: Advisory Committee meetings and visits in 2014

GPE	MAIN TOPIC	DATE
GPU / GPT	Periodic safety review for the UP3-A plant in BNI 116 – La Hague (Areva NC): on-site transport operations	14 January
GPR	Examination of level 1 probabilistic safety assessments for the Flamanville EPR reactor	30 January
GPR	Operating experience feedback from EDF NPP and foreign reactors over the period 2009-2011	13 February et 6 March
GPU	Conformity of plant UP3-A in BNI 116 – La Hague (Areva NC) with its baseline safety requirements, management of ageing of this facility and safety of maintenance operations	26 March
GPR	Examination of 4th generation nuclear systems	10 April
GPR	Nuclear power reactors – baseline requirements concerning primary loss of coolant accident	17 April
GPR	Safety classification of the Flamanville EPR reactor	29 April
GPMED	Review of envisaged changes for training in the radiation protection of patients and information about the transposition of directive 2013/59/Euratom	17 June
GPU	Periodic safety review of the waste treatment station in BNI 37 (Cadarache)	25 June
GPD	Cigéo – Information meeting about the radioactive waste disposal project	30 June
GPD	Cigéo – Examination of radioactive waste disposal project closure structures	1 July
GPRADE	Protection of non-human species: presentation by IRSN of the state of the art and methods for assessing the radiological risk to ecosystems. Information concerning the transposition of directive 2013/59/Euratom concerning the European Union's new basic radiation protection standards	3 July
GPR	Inaugural meeting further to renewal of the composition of the GPR	18 September
GPD	Meeting between the GPD and its German counterpart ESK in Cadarache	22, 23 and 24 September
GPRADE	Recommendations for consideration of the protection of non-human species: operating experience feedback and IRSN recommendation	26 September
GPT/GPESPN	Inaugural meetings further to renewal of the composition of the GPT and GPESPN	10 October
GPESPN	Postponement of the repairs to vessel bottom head penetration N°4 of reactor 1 in the Gravelines NPP	10 October
GPR	EDF nuclear power reactors – Summary of generic studies conducted as part of the periodic safety reviews of the 1300 MWe reactors during their third ten-yearly outage inspections (VD3 1300)	15 et 16 October
GPU	Visit to the Phenix NPP (BNI 71)	20 October
GPU/GPD	Creation authorisation application for the Diadem BNI	29 October
GPU	Final shutdown, decommissioning and periodic safety review of the Phenix NPP (BNI 71)	12 November
GPMED	Presentation by IRSN of the report on the medical exposure of the French population to ionising radiation. Progress of ASN action plan on medical imaging and recommendations concerning the conditions for implementation of the "new techniques and practices" in radiotherapy	9 December
GPD/GPU	Cigéo – Review of "management of preliminary operational risks and phase sequencing of Cigéo project"	10 December

The Agency and its activities are presented on its website: *www.ansm.sante.fr.* The ASN-ANSM convention was renewed on 2nd September 2013.

2.7.2 French National Authority for Health

The French National Authority for Health (HAS), a body created by the French Government in 2004, is tasked primarily with maintaining an equitable health system and with improving patient care.

The Authority and its activities are presented on its website *www.has-sante.fr.* An ASN-HAS convention was signed on 4th December 2008.

2.7.3 French National Cancer Institute

Created in 2004, the French National Cancer Institute (INCa) is primarily responsible for coordinating activities in the fight against cancer.

The Institute and its activities are presented on its website: *www.e-cancer.fr* An ASN-INCa convention was signed on 17th February 2014.

2.7.4 The French Health Monitoring Institute (InVS)

The French Health Monitoring Institute (InVS), a public body created in 1998, is tasked primarily with watching over all areas of public health and raising the alert where necessary.

The Institute and its activities are presented on its website: *www.invs.sante.fr.* An ASN-InVS convention was renewed on 24th January 2014.

3. FINANCING THE REGULATION OF NUCLEAR SAFETY AND RADIATION PROTECTION

Since 2000, all the personnel and operating resources involved in the performance of the responsibilities entrusted to ASN have been covered by the State's general budget.

In 2014, the ASN budget amounted to €79.95 million in payment credits. It comprised €40.68 million in ASN payroll credits and €39.27 million in operating credits for the ASN central services and its eleven regional divisions.

The total IRSN budget for 2014 amounted for its part to €212 million, of which €84 million were devoted to the provision of technical support for ASN. IRSN credits for ASN technical support are covered in part (€45 million) by a subsidy from the State's general budget allocated to IRSN and included in action 11 "Research in the field of risks" of programme 190 "Research in the fields of energy and sustainable development and spatial planning", of the interministerial "Research and higher education" mission. The rest (€39 million) is covered by a contribution from the nuclear licensees. This contribution was put into place by the budget amendment act of 29th December 2010. Each year, ASN is consulted by the Government concerning the corresponding part of the State subsidy to IRSN and the amount of the annual contribution due from the BNI licensees.

In total, the State's 2014 budget for transparency and the regulation of nuclear safety and radiation protection in France, amounted to €174.7 million: €79.95 million for the ASN budget, €84 million for IRSN technical support to ASN, €10.6 million for other IRSN missions and €0.15 million for the working of the HCTISN (French High Committee for Transparency and Information on Nuclear Security).

As shown in the following table, these credits are split between five budget programmes (181, 217, 333, 218 and 190), to which must be added the annual contribution on behalf of IRSN.

To put this into perspective, the amount of the BNI tax, paid to the general State budget, amounted in 2014 to €576.7 M.

This complex funding structure is detrimental to the overall clarity of the cost of regulation. It moreover leads to difficulties in terms of budgetary preparation, arbitration and implementation.

TABLE 2: Budget structure of the credits allocated to transparency and the regulation of nuclear safety and radiation protection in France (January 2015)

				BUDGET RESOURCES				REVENUE
				INITIAL BUDGET ACT 2014		INITIAL BUDGET ACT 2015		
MISSION	PROGRAMME	ACTIONS	NATURE	AE (M€)	CP (M€)	AE (M€)	CP (M€)	BNI TAX 2014 (M€)
Ministerial mission **Ecology, sustainable development and spatial planning**	**Programme 181:** Risk Prevention	**Action 9:** Regulation of nuclear safety and radiation protection	Staff costs (including seconded employees)	40.68	40.68	40.85	40.85	
			Operating and intervention spending	13.48	18.50	13.32	18.34	
			TOTAL	**54.16**	**59.18**	**54.17**	**59.19**	
		Action 1: Prevention of technological risks and pollution	Operation of the HCTISN (High Committee for Transparency and Information on Nuclear Security)	0.15	0.15	0.15	0.15	
	Programme 217: Management and coordination of policies for ecology, energy and sustainable development and the sea	-	Operation of ASN's 11 regional divisions	13.35 (1)	13.35 (1)	13.35 (1)	13.35 (1)	
Ministerial mission **Oversight of government actions**	**Programme 333:** Resources shared by decentralised administrations	-		1.15	1.15	1.15	1.15	576.66
Interministerial mission **Management of public finances and human resources**	**Programme 218:** Implementation and oversight of economic and financial policy	-	Operation of the ASN central services (2)	6.27	6.27	6.27	6.27	
			SUB-TOTAL	75.08	80.10	75.09	80.11	
Interministerial mission **Research and higher education**	**Programme 190:** Research in the fields of energy and sustainable development and spatial planning	**Sub-action 11-2 (area 3):** French Institute for Radiation Protection and Nuclear Safety (IRSN)	IRSN technical support activities for ASN (3)	45.15	45.15	43.00	43.00	
		Sub-action 11-2 (area 3): French Institute for Radiation Protection and Nuclear Safety (IRSN)		141.25	141.25	135.41	135.41	
Annual contribution to IRSN instituted by Article 96 of budget amendment Act 2010-1658 of 29th December 2010				39.80 (4)	39.80 (4)	41.95 (5)	41.95 (5)	
			SUB-TOTAL	226.20	226.20	220.36	220.36	576.66
			TOTAL	**301.28**	**306.30**	**295.45**	**300.47**	**576.66**

(1) Source: Budget Bills for 2013 and 2014 (annual performance project 2014 of programme 181).
(2) Source: 2006 Budget Bill (after deduction of transfer made under 2008 Budget Bill).
(3) Source: Budget Bills for 2014 and 2015 (annual performance project 2014 of programme 190).
(4) Out of a total contribution income of €53 million in 2014.
(5) Out of a total expected contribution income estimated at €59.90 million in 2014.

UNDERSTAND

BNI tax, additional waste taxes, additional disposal tax, special Andra contribution and contribution to IRSN

Pursuant to the Environment Code, the ASN Chairman is responsible for assessing and ordering payment of the BNI tax, introduced under Article 43 of the 2000 Budget Act (Act 99-1172 of 30th December 1999). The revenue generated by this tax, the amount of which is set yearly by Parliament, came to €576.7 million in 2014. The proceeds go to the central state budget.

In addition, the "Waste" Act creates three further taxes levied on nuclear reactors and spent nuclear fuel reprocessing plants, known as the "research", "support" and "technological dissemination" taxes. They are allocated to the financing of economic growth and of Andra's research into underground disposal and storage. The revenue from these new taxes amounted to €175.05 million in 2014.

Article 2 of Act 2009-1673 of 30th December 2009 also created an additional tax on ultimate disposal facilities. This tax is paid to the local communities and inter-communities public cooperation establishments around the disposal facility. The revenue from this tax amounted to €3.3 million in 2014.

In addition and for the first time in 2014, ASN was tasked with assessing and ordering payment of the special contribution on behalf of Andra created by Article 58 of the 2013 budget amendment Act 2013-1279 of 29th December 2013, which will be payable up until the date of the deep geological disposal facility's creation authorisation. In the same way as the additional taxes, this contribution is due by BNI licensees, as of the creation of their facility and up until the delicensing decision. The revenue from this contribution represents €112.64 million in 2014.

Finally, Article 96 of Act 2010-1658 of 29th December 2010 creates an annual contribution on behalf of IRSN to be paid by BNI licensees. This contribution is in particular designed to finance the review of the safety cases submitted by the BNI licensees. The revenue from this contribution amounted to €53.05 million in 2014.

TABLE 3: Breakdown of licensee contributions

LICENSEE	AMOUNT FOR 2014 (MILLIONS OF EUROS)			
	BNI TAX	ADDITIONAL WASTE AND DISPOSAL TAXES	SPECIAL ANDRA CONTRIBUTION	CONTRIBUTION ON BEHALF OF IRSN
EDF	543.63	135.48	88.20	43.35
Areva	14.54	8.70	5.52	3.93
CEA	6.23	28.50	18.92	4.99
Andra	5.41	3.30	-	0.20
Others	6.89	2.37	-	0.58
TOTAL	**576.70**	**178.35**	**112.64**	**53.05**

4. OUTLOOK

France is committed to an ambitious energy transition policy. In this context, the share of nuclear energy in the production of electricity will be reduced but will remain significant: 50% in 2025.

The French nuclear NPP fleet will continue to be one of the largest in the world. Safety will continue to be enhanced, with reference to the requirements applicable to the new reactors and by learning the lessons from the Fukushima Daiichi accident.

The regulatory and monitoring system today faces unprecedented safety challenges: the necessary reinforcement of safety following the Fukushima accident, the ageing of the NPPs and the review of the application for extension of their operation beyond the fourth periodic safety review, commissioning of the EPR reactor on the Flamanville site, development of the Cigéo project, the growing issue of decommissioning, the first periodic safety reviews for more than fifty facilities operated by CEA and Areva, in particular the La Hague plant and management of the doses of ionising radiation delivered to patients.

In this context, ASN considered that the human and financial resources of ASN and IRSN needed to be significantly increased. In its preparations for the budget bill for the years 2015 to 2017, it therefore requested an additional 190 employees by the end of 2017 (125 employees for ASN, 65 for IRSN) and a budget increase of €36 million (€21 million for ASN, €15 million for IRSN).

ASN duly noted the budgetary compromises made, granting it an additional 30 staff members for the period 2015-2017, in annual increments of 10 staff members, while maintaining its operating credits. Although ASN appreciates the efforts made by the Government in an extremely difficult budget context, it nonetheless considers that its additional staff and credit requirements still need to be met, as do those of IRSN.

ASN is concerned by the inadequacy of these budgetary measures and recalls its request for a reform of the financing devoted to the regulation and monitoring of nuclear safety and radiation protection, expert assessment and information about civilian nuclear safety and radiation protection, based partly on the State budget and partly on an annual contribution from the nuclear licensees, set by Parliament.

The green growth energy transition bill also offers an opportunity to take a significant step forward in the field of regulation with:
- increased powers of inspection and sanction;
- while, at the same time, developing transparency and public information and participation.

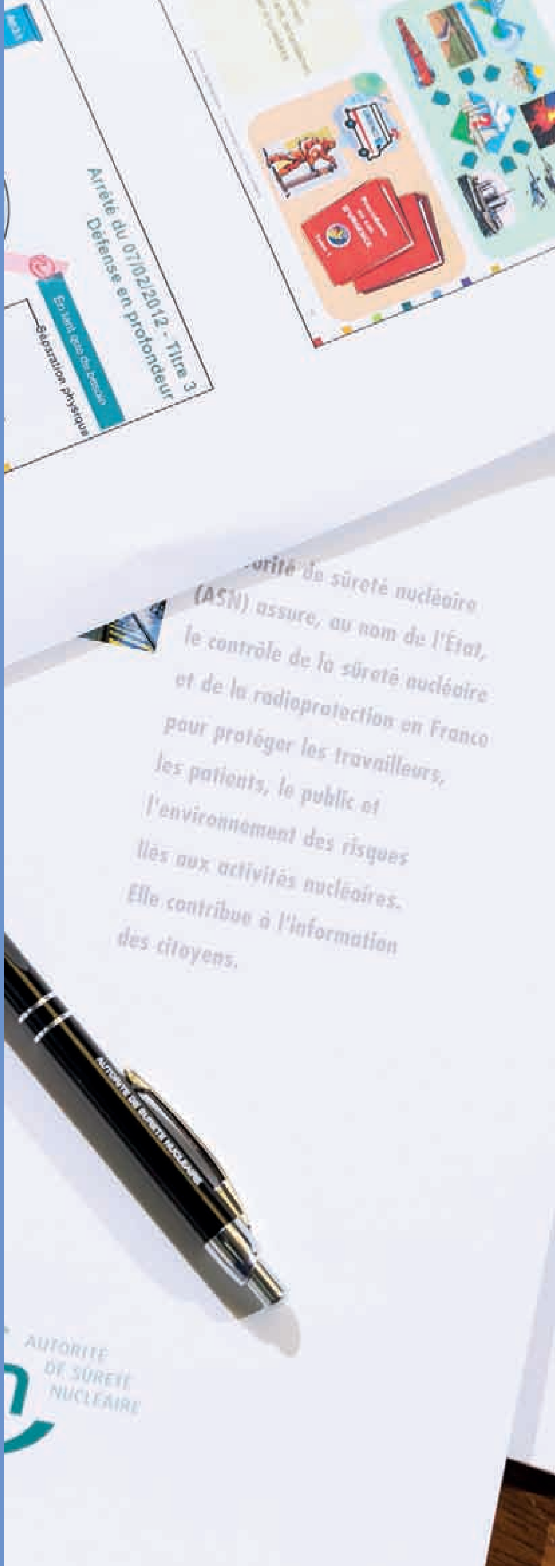
In the coming years, ASN will maintain strong ties - while retaining its full independence - with the other stakeholders involved in the oversight and information duties, in the field of nuclear safety and radiation protection. ASN will in particular promote the involvement of the stakeholders in pluralistic working groups, in particular the COFSOH.

When preparing its resolutions, ASN relies on the opinions and recommendations of seven Advisory Committees (GPE). ASN aims to continue to reinforce the guarantees of independence of the expertise on which it relies, and transparency in the process of drafting its resolutions and decisions.

Moreover, following the IRRS mission in November 2014, ASN will initiate the implementation of an action plan designed to address the recommendations made.

03

REGULATIONS



Nuclear activities are highly diverse, covering any activity relating to the preparation or utilisation of radioactive substances or ionising radiation. Nuclear activities are covered by a legal framework that aims to guarantee, depending on the nature of the activity and the associated risks, that it will not be likely to be detrimental to safety, public health or the protection of nature and the environment.

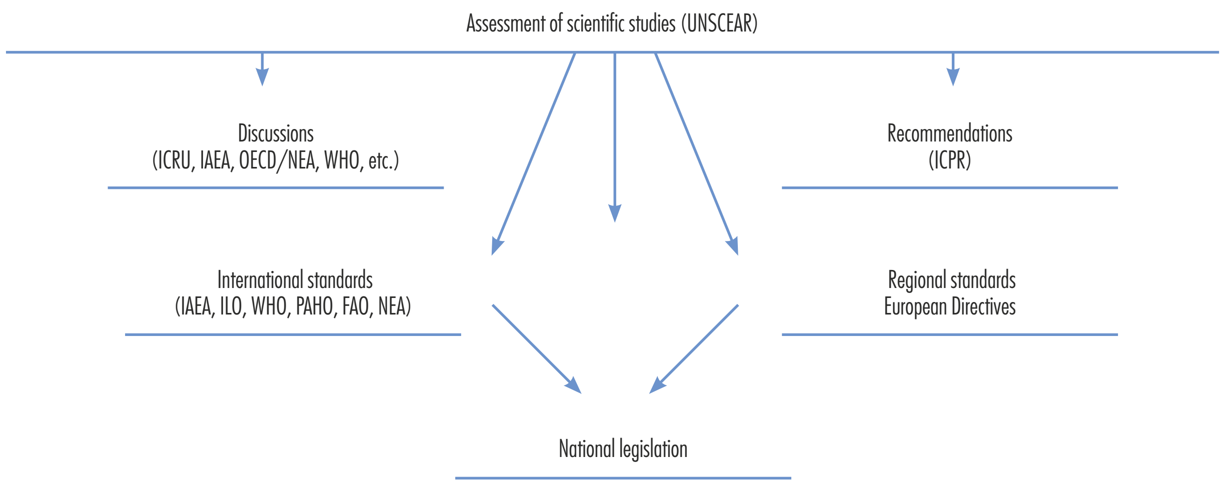
This legal framework is tailored to the type of nuclear activity. Consequently, medical or industrial activities that involve ionising radiation or radioactive sources are regulated by the French Public Health Code (CSP). Beyond a given threshold of radioactive substances contained or used in an installation, that installation falls within the system of Basic Nuclear Installations (BNI).

The 13th June 2006 Act concerning transparency and security in the nuclear field, called the "TSN Act" (now codified in books I and V of the Environment Code by Ordinance 2012-6 of 5th January 2012), extensively overhauled the BNI legal system. It has in particular given this system an "integrated" nature, that is to say that it seeks to prevent the hazards and detrimental effects of any type that the BNIs could create: accidents – whether nuclear or not, pollution - whether radioactive or not, waste - whether radioactive or not, noise, etc.

1. THE GENERAL LEGAL FRAMEWORK APPLICABLE TO NUCLEAR ACTIVITIES

Nuclear activities are defined in Article L. 1333-1 of the CSP (Public Health Code). They are subject to various specific requirements aiming at protecting individuals and the environment and applying either to all these activities, or only to certain categories. This set of regulations is described in this chapter.

DIAGRAM 1: Drafting of radiation protection doctrine and basic standards



1.1 The regulatory basis of nuclear activities

1.1.1 International radiation protection baseline requirements

The specific legal requirements for radiation protection are based on various standards and recommendations issued internationally by various organisations. The following in particular can be mentioned:

- the International Commission on Radiation Protection (ICRP), a non-governmental organisation comprising international experts in various disciplines, which publishes recommendations concerning the protection of workers, the general public and patients against ionising radiation, based on an analysis of the available scientific and technical knowledge. The latest ICRP recommendations were published in 2007 in ICRP publication 103;
- International Atomic Energy Agency (IAEA) which regularly publishes and revises standards in the fields of nuclear safety and radiation protection. The basic requirements concerning protection against ionising radiation and the safety of radiation sources (Basic Safety Standard No.115), based on the recommendations of ICRP 60, were published in 1996. A new standard on fundamental safety principles was published by IAEA at the end of 2006 and, to take account of the new recommendations in ICRP 103, the basic safety standards (BSS) were updated and published in July 2014 (Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards – Series No. GSR Part 3);
- the International Standards Organisation (ISO) which publishes international technical standards which are a key part of the radiation protection system: they provide a bridge between principles, concepts and units, and the body of regulatory texts for which they guarantee harmonised application.

At the European level, the Euratom Treaty, in particular its Articles 30 to 33, defines the procedures for drafting EU provisions concerning protection against radiation and specifies the powers and obligations of the European Commission with respect to their enforcement. The corresponding Euratom directives are binding on the various countries, such as Directive 96/29/Euratom of 13th May 1996 laying down Basic Safety Standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation; Directive 97/43/Euratom of 30th June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure; and directive 2003/122/Euratom of 22nd December 2003 on the control of high-level sealed radioactive sources and orphan sources.

Work was started in 2008 to update the Euratom directives, leading to the adoption on 5th December 2013 of the new Euratom Directive setting radiation protection basic standards, Council Directive 2013/59/Euratom of 5th December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom, published in the Official Journal of the European Union (OJEU) on 17th January 2014.

TO BE NOTED

The new Directive 2013/59/Euratom of 5th December 2013 groups together five previous Directives:

- Directive 89/618/Euratom of 27th November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency;
- Directive 90/641/Euratom of 4th December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas;
- Directive 96/29/Euratom of 13th May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation;
- Directive 97/43/Euratom of 30th June 1997 on health protection of individuals against the dangers of ionising radiation in relation to medical exposure, repealing Directive 84/466/Euratom;
- and Directive 2003/122/Euratom of 22nd December 2003 on the control of high-activity sealed radioactive sources and orphan sources.

It also takes account of the latest recommendations from the International Commission on Radiological Protection (ICRP 103) and the basic standards published by IAEA.

The member States have a period of four years in which to transpose this Directive (the transposition deadline is set for 6th February 2018).

In November 2013, with the approval of the Government, ASN set up a transposition committee for this new Directive for which it now handles coordination and technical secretariat duties. The committee decided that its first working priority would be the legislative changes to be made, in particular to the Public Health Code.

Over and above these legislative subjects, ASN takes part in all the regulatory work initiated in 2014 to update the Public Health Code, the Labour Code and the Environment Code.

DIAGRAM 2: Various levels of regulation in the field of small-scale nuclear activities in France

ICRP, IAEA, HERCA	Orientation, Recommendations	Not legally binding
European Commission	Directives	Legally binding
Parliament	Acts	
Government	Decrees and Orders	
ASN/ Government approval	Technical Statutory Resolutions	
ASN	Individual Decisions (Technical requirements)	
ASN	ASN guides/BSR*	Not legally binding

** Basic Safety Rules.*

1.1.2 The codes and the main acts applicable to the regulation of nuclear activities in France

The legal framework applicable to nuclear activities in France has been extensively revised in recent years. The legislative package is now relatively thorough and the publication of the implementing texts is well advanced, even if not yet totally completed.

The Public Health Code

Chapter III ("ionising radiation") of title III of book III of the first part of the Public Health Code defines all "nuclear activities", that is to say all activities involving a risk of human exposure to ionising radiation, emanating either from an artificial source, whether a substance or a device, or from a natural source when the natural radionuclides are or have been treated owing to their fissile or fertile radioactive properties. It also includes "interventions" aimed at preventing or mitigating a radiological risk following an accident, due to environmental contamination.

Article L.1333-1 of the Public Health Code defines the general principles of radiation protection (justification, optimisation and limitation), established internationally (ICRP) and incorporated into the IAEA requirements, into Directive 96/29/Euratom and Directive 2013/59/Euratom. These principles, described in chapter 2, constitute guidelines for the regulatory actions for which ASN is responsible.

The Public Health Code also institutes the radiation protection inspectorate, in charge of verifying compliance with its radiation protection requirements. This inspectorate, set up and coordinated by ASN, is presented in chapter 4. The Code also defines a system of administrative and criminal sanctions, described in the same chapter.

The legislative part of the Public Health Code must be updated for the transposition of the new Euratom Directive. In 2014, together with the Ministries for Health, Ecology and Labour, ASN prepared measures which should be introduced in an order included in the Health Bill (currently being examined by Parliament).

Environment Code

The Environment Code defines various notions. According to Article L.591-1 of the Environment Code, nuclear security is a concept comprising *"nuclear safety, radiation protection, the prevention and fight against malicious acts, and also civil protection actions in the event of an accident"*. In some texts, however, the expression "nuclear security" remains limited to the prevention and fight against malicious acts.

Nuclear safety is *"the set of technical provisions and organisational measures - related to the design, construction, operation, shut-down and decommissioning of Basic Nuclear Installations (BNIs), as well as the transport of radioactive substances - which are adopted with a view to preventing accidents or limiting their effects[1] "*.

1. Nuclear safety, within the meaning of Article L. 591.1 of the Environment Code, is thus a more limited concept than that of the objectives of the BNI legal system as described in point 3 of this chapter.

Radiation protection is defined as *"the set of rules, procedures and prevention and surveillance means aimed at preventing or mitigating the direct or indirect harmful effects of ionising radiation on individuals, including in situations of environmental contamination"*.

Nuclear transparency is defined as *"the set of provisions adopted to ensure the public's right to reliable and accessible information on nuclear security as defined in Article L.591-1"*.

Article L. 591-2 of the Environment Code, stipulates the State's role in nuclear security: it *"defines the nuclear security regulations and implements the checks necessary for their application"*. In accordance with Article L. 125-13 of the Environment Code, *"the State ensures that the public is informed of risks linked to nuclear activities defined in the first paragraph of Article L. 1333-1 of the Public Health Code and of their impact on individual health and safety as well as on the environment"*. The general principles applicable to nuclear activities are mentioned in turn in Articles L. 591-3 and L. 591-4 of the Environment Code. These principles are presented in point 1.1 of chapter 2.

Chapter II of title IX of book V of the Environment Code creates ASN, defines its general duties and attributions, and specifies its composition and operation. Its missions are presented in points 2.3.1 and 2.3.2 of chapter 2.

Chapter V of title II of book I of the Environment Code addresses information of the public about nuclear security. This subject is developed in greater detail in chapter 6.

Other codes or acts containing requirements specific to nuclear activities

The Labour Code defines specific requirements for the protection of workers, whether or not salaried, exposed to ionising radiation. They are presented in point 1.2.1 of this chapter.

Programme Act No 2006-739 of 28th June 2006 on the sustainable management of radioactive materials and waste, called the "Waste Act", now extensively codified in Chapter II of title IV of Book V of the Environment Code, sets the legal requirements for the management of radioactive materials and waste. It also obliges the BNI licensees to make provision for the cost of managing their waste and spent fuel, and for decommissioning their facilities. Chapter 16 describes the main contributions of this act in detail.

Finally, the Defence Code contains various measures concerning protection against malicious acts in the nuclear field, or the regulation of defence-related nuclear activities and installations. They are presented in point 5.3 of this chapter.

The other regulations concerning nuclear activities

Some nuclear activities are subject to a variety of rules with the same goal of protecting individuals and the environment as the above-mentioned regulations, but with a scope that is not limited to the nuclear field alone. This for example includes international conventions (e.g. Aarhus convention), European or Environment Code provisions concerning impact assessments, public information and consultation, and the regulations governing hazardous materials transport or pressure equipment. The applicability of some of these rules to nuclear activities is mentioned in the applicable chapters of this report.

Signed on 25th June 1998 in Aarhus (Denmark), the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention), was ratified by France on 8th July 2002 and entered into force in France on 6th October 2002. With the aim of helping to protect the right to live in a clean environment that guarantees health and wellbeing, the signatory States guarantee the right of access to information about the environment, public participation in the decision-making process and access to justice in environmental matters.

Fitting in the Aarhus Convention, Article 7 of the Environment Chart states that *"everyone has the right, within the conditions and limits defined by the law […] to take part in the drafting of public decisions with an impact on the environment"*. Most of the resolutions issued by ASN, whether statutory or individual, fall within this category.

Following a number of decisions by the Constitutional Council, issued on priority questions of constitutionality, a number of procedures for the adoption of public decisions in the environmental field and, by extension, in the nuclear field, were declared anti-constitutional in that they failed to meet the obligations of Article 7 of the Environment Charter, which carries constitutional weight.

Act 2012-1460 of 27th December 2012 concerning implementation of the principle of public participation as defined in Article 7 of the Environment Charter and then order 2013-714 of 5th August 2013 concerning implementation of the principle of public participation as defined in Article 7 of the Environment Charter, set the conditions and limits for implementation of the principle of public participation in statutory resolutions and individual resolutions with an environmental impact respectively. In both cases, these are "subsidiary" public participation procedures, in other words, procedures which apply if specific texts do not stipulate a particular procedure.

For statutory resolutions with an impact on the environment, Article L. 120-1 of the Environment

GREEN GROWTH ENERGY TRANSITION BILL

In 2014, Parliament presented a green growth energy transition bill (PLTECV), comprising a title devoted to nuclear matters (Title VI "Reinforcing nuclear safety and information of citizens"). The bill was adopted at its first reading by the National Assembly on 14th October 2014 and it should be finally adopted in 2015.

This bill comprises the following main points:
- enhanced transparency and information of citizens;
- creation of a system of institutional controls for management of land, constructions or structures liable to cause human exposure to the dangerous effects of ionising radiation and justifying radiation protection monitoring;
- management of resorting to subcontracting;
- evolution in the BNI authorisation system;
- renovation of the periodic safety review for nuclear power reactors on the occasion of their fourth ten-yearly outage;
- evolution in the BNI final shutdown and decommissioning system;
- reinforcement of ASN's means of inspection and powers of sanction;
- reinforcement of ASN's powers and competencies;
- transposition of the European Directives;
- clarification of the organisation built around ASN and IRSN;
- "early" entry into force in French law of the protocols signed on 12th February 2004, reinforcing the Paris Convention of 29th July 1960 and the Brussels Convention of 31st January 1963 concerning civil liability in the field of nuclear energy.

The provisions regarding the extension of the obligations of information by BNI licensees, the sanctions that ASN can impose, the extension of its areas of competence, the possibility of implementing institutional controls on sites polluted by radioactive substances and the transposition of European Directives, could be adopted through orders for which the bill includes the necessary authorisations. These orders should be adopted within a period of 6 to 10 months from the enactment of the bill.

Code, in force since 1st January 2013, requires that the draft resolution be made available to the public in electronic format for a time which may not be less than 21 days, except in the event of an emergency relating to protection of the environment, public health or public order.

For individual decisions with a direct or significant impact on the environment, Article L. 120-1-1 of the Environment Code, in force since 1st September 2013, requires that the draft decision or, when the decision is issued on request, the application file, be made available to the public in electronic format for a time that may not be less than 15 days except in the case of urgency relating to protection of the environment, public health, or public order.

ASN has adopted a relatively ambitious approach towards implementing this procedure for public participation in the drafting of its resolutions (see Chapter 6).

1.2 The regulations applicable to the various categories of individuals and the various situations involving exposure to ionising radiation

The various exposure levels and limits set by the regulations are presented in the appendix to this chapter.

1.2.1 General protection of workers

The Labour Code contains a number of requirements specific to the protection of workers, whether or not salaried, exposed to ionising radiation. It transposes into French law two Euratom Directives, namely 90/641/Euratom of 4th December 1990 on the operational protection of outside workers exposed to the risk of ionising radiation during their activities in controlled areas, and the above-mentioned Directive 96/29/Euratom.

The Labour Code establishes a link with the three radiation protection principles contained in the Public Health Code.

A General Directorate for Labour/ASN joint Circular No. 4 of 21st April 2010 indicates the conditions of application of the provisions of the Labour Code concerning the radiation protection of workers.

Articles R. 4451-1 to R. 4451-144 of the Labour Code create a single radiation protection system for all workers (whether or not salaried) liable to be exposed to ionising radiation during the course of their professional activities.

Of these requirements, the following should be mentioned:
- application of the optimisation principle to the equipment, processes and work organisation (Articles R. 4451-7 to R. 4451-11), which leads to clarification of where responsibilities lie and how information

is circulated between the head of the facility, the employer, in particular when he or she is not the head of the facility, and the person competent in radiation protection;

- the annual dose limit (Articles R. 4451-12 to 4451-15) set at 20 mSv for 12 consecutive months, barring waivers resulting from exceptional exposure levels justified in advance, or emergency occupational exposure levels;
- the dose limits for pregnant women (Article D. 4152-5) or more accurately for the unborn child (1 mSv for the period from the declaration of pregnancy up until birth).

TO BE NOTED

Council Directive 2013/59/Euratom of 5th December 2013

Laying down basic standards for protection against the dangers arising from exposure to ionising radiation and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom and the Labour Code.

For workers liable to be exposed, the Directive introduces an annual effective dose limit of 20 millisieverts (mSv), to replace the value of 100 mSv over five consecutive years. As early as 2003, this limit had been incorporated into the Labour Code (20 mSv over 12 consecutive months). However, the equivalent dose limit of 150 mSv over 12 consecutive months for the lens of the eye will have to be modified and reduced to 20 mSv per year.

The new Euratom Directive will lead to modification of the existing PCR system, differentiating between consultancy and more operational duties. The RPE (Radiation Protection Expert) is responsible for giving the head of the company or the employer an opinion on questions concerning worker and public exposure, while the RPO (Radiation Protection Officer) is responsible for operational application of radiation protection. As of 2013, ASN and the General Directorate for Labour (DGT) began to examine this subject.

The new Euratom Directive does not modify the general rules for the demarcation of monitored and controlled areas. However, on the basis of the opinions issued by the Advisory Committee of Experts for Radiation Protection for Industrial Applications and Research into Ionising Radiation and the Environment (GPRADE), and the Advisory Committee of Experts for Radiation Protection for the Medical and Forensic Applications of Ionising Radiation (GPMED), the DGT and ASN have already announced their intention during the course of the transposition work to update and simplify the existing system on the basis of a risk graded approach.

The same applies to the radiological monitoring of workers for which an assessment of the existing regulatory system was initiated in late 2013 in collaboration with the DGT and the Institute for Radiation Protection and Nuclear Safety (IRSN). The publication of a "white paper" on this latter point is expected during the first half of 2015.

Zoning

Provisions concerning the demarcation of monitored areas, controlled areas and specially regulated areas (subject to special checks) were issued, regardless of the activity sector, by the Order of 15th May 2006 (published in the Official Journal of 15th June 2006). This order also defines the health, safety and maintenance rules to be observed in these zones.

When defining the regulated zones, different levels of protection are taken into account: the effective dose for external exposure and, as applicable, internal exposure of the whole body; the equivalent doses for external exposure of the extremities and, as applicable, the dose rates for the whole body. A General Directorate for Labour/ASN joint circular of 18th January 2008 specifies the implementation procedures.

The person with competence in radiation protection (PCR)

The PCR is placed under the responsibility of the employer and tasked with numerous radiation protection duties, including optimisation, implementation of radiological monitoring, information about risks, but also demarcation of regulated areas and job analyses.

Without waiting for the updating of the provisions of the Labour Code with regard to the PCR, in order to take account of the provisions of the new Euratom Directive concerning the RPE/RPO system (see box opposite), the order of 26th October 2005 concerning PCR training procedures and trainer certification was repealed by the order of 24th December 2013, on the basis of the recommendations issued by the Advisory Committee of Experts for Radiation Protection for the Medical and Forensic Applications of Ionising Radiation (GPMED) and the Advisory Committee of Experts for Radiation Protection for Industrial Applications and Research into Ionising Radiation and the Environment (GPRADE). The number of days of training was modified according to the potential risks, with an increase in the number of days for the most complex installations or those with the highest risk.

Dosimetry

The procedures for approval of the organisations responsible for worker dosimetry are defined by the Order of 6th December 2003 as amended; the procedures for medical monitoring of workers and the transmission of individual dosimetry data are specified in the Order of 30th December 2004. In order to take account of operating experience feedback and changing technologies, these two orders were replaced respectively by the Order of 21st June 2013 concerning the conditions for the accreditation of organisations responsible for individual monitoring of worker exposure to ionising radiation and the Order of 17th July 2013 concerning the medical monitoring card and dose monitoring of workers exposed to radiation. This latter order entered into force on 1st July 2014, on which date the Order of 30th December 2004 was repealed. ASN delivers the required approvals to the dosimetry organisations and laboratories (see chapter 1).

Radiation protection checks

Technical control of sources and devices emitting ionising radiation, protection and alarm devices and measuring instruments, as well as ambient environment checks, can be entrusted to the French Institute for Radiation Protection and Nuclear Safety (IRSN), to the department with competence for radiation protection or to organisations approved under application of Article R. 1333-97 of the Public Health Code. The nature and frequency of the radiation protection technical checks are defined by ASN resolution 2010-DC-0175 of 4th February 2010.

These technical checks concern sources and devices emitting ionising radiation, the ambient environment, measuring instruments and protection and alarm devices, management of sources and of any waste and effluents produced. Some of these controls are carried out as part of the licensee's in-house inspection processes and some by outside organisations (the outside checks must be performed by IRSN or an organisation approved under Article R. 1333-97 of the Public Health Code – see point 2.1.4).

Radon in the workplace

(See point 2.3.1).

1.2.2 General protection of the general public

Apart from the special radiation protection measures included in individual nuclear activity licenses for the benefit of the general public and the workers, a number of general measures included in the Public Health Code help to protect the public against the dangers of ionising radiation.

Public dose limits

The annual effective dose limit (Article R. 1333-8 of the Public Health Code) received by a member of the public as a result of nuclear activities, is set at 1 mSv/year; the equivalent dose limits for the lens of the eye and the skin are set at 15 mSv/year and 50 mSv/year respectively. The calculation method for the effective and equivalent dose rates and the methods used to estimate the dosimetric impact on a population are defined by Ministerial Order of 1st September 2003.

Radioactivity in consumer goods and construction materials

The intentional addition of natural or artificial radionuclides in all consumer goods and construction materials is prohibited (Article R. 1333-2 of the Public Health Code). Waivers may however be granted by the Minister of Health after receiving the opinion of the French High Council for Public Health (HCSP) and ASN, except with respect to foodstuffs and materials placed in contact with them, cosmetic products, toys and personal ornaments. The Government order of 5th May 2009 specifies the content of the waiver application file and the consumer information procedures stipulated in Article R. 1333-5 of the Public Health Code. This waiver arrangement was used in 2011 to cover the gradual phase-out of ionisation smoke detectors (see chapter 10) used in fire protection. This prohibition principle does not concern the radionuclides naturally present in the initial components or in the additives used to prepare foodstuffs (for example potassium-40 in milk) or for the manufacture of constituent materials of consumer goods or construction products (for example: uranium and its daughter products in granite).

Furthermore, the use of materials or waste from a nuclear activity is also prohibited, when they are contaminated or likely to have been contaminated by radionuclides as a result of this activity.

The Public Health Code comprises regulatory provisions (Article R. 1333-14) to limit the natural radioactivity in construction materials, if necessary, when this radioactivity is naturally present in the constituents used in their manufacture. This provision has never been applied yet. The transposition of the new Euratom Directive should further tighten up this restriction through an obligation to measure the radiation emitted.

Further to a proposal from ASN, the French High Committee for Transparency and Information on Nuclear Security (HCTISN) set up a working group for the information and consultation procedures in the event of a request for waivers concerning the ban on the intentional addition of radionuclides in consumer goods or construction products. This group is chaired by an ASN Commissioner, Philippe Jamet, and suspended its work in 2014 pending the renewal of the HCTISN (see chapter 6).

Radioactivity and the environment

A national network for the measurement of environmental radioactivity was set up in 2009 (Article R. 1333-11 of the Public Health Code) and the data collected will help estimate the doses received by the population. The network's orientations are defined by ASN and it is managed by IRSN (ASN resolution 2008-DC-0099 of 29th April 2008 on the organisation of a national network for the measurement of environmental radioactivity and setting the conditions for laboratory approval). To guarantee the quality of the measurements, the laboratories in this network must meet approval criteria, which in particular include intercomparison benchmarking tests.

A detailed presentation of the national measurement network is given in chapter 4.

The radiological quality of water intended for human consumption

Pursuant to Article R. 1321-3 of the Public Health Code, water intended for human consumption is subject to radiological quality inspection. The monitoring procedures are specified in the Order of 12th May 2004. They form part of the sanitary monitoring carried out by the Regional Health Agencies (ARS). The Order of 11th January 2007 concerning water quality limits and benchmarks introduces four radiological quality indicators for water intended for human consumption. These indicators and the corresponding limits are the total alpha activity (0.1 Bq/L), the total residual beta activity (1 Bq/L), the tritium activity (100 Bq/L) and the Total Indicative Dose - TID (0.1 mSv/year). The circular from the General Directorate for Health (DGS) dated 13th June 2007, accompanied by recommendations from ASN, specifies the policy underpinning this regulation.

Radiological quality of foodstuffs

Restrictions on the consumption or sale of foodstuffs may be necessary in the event of an accident or of any other radiological emergency situation.

In Europe, these restrictions are determined by Council Regulation 3954/87/Euratom of 22nd December 1987, modified by Council Regulation 2219/89/EEC of 18th July 1989, laying down maximum permitted levels of radioactive contamination of foodstuffs and livestock feedstuffs. The maximum permitted levels were defined to *"safeguard the health of the population while maintaining the unified nature of the market"*.

In the event of a confirmed nuclear accident, "automatic" application of this regulation cannot exceed a period of three months, after which it will be superseded by specific measures (see the regulation specific to the Chernobyl accident, the values of which are given in the appendix). Following the accident which struck Fukushima Daiichi on 11th March 2011, this system was activated by the European Commission on numerous occasions between 2011 and 2013, to take account of the changing radiological situation in the regions concerned[2]. For example, in the EU's first post-Fukushima regulation (297/2011 of 25th March 2011), the maximum permitted levels for 134/137Cs in milk were 1000 Bq/L as stipulated in Euratom regulation 3954/87. They were lowered a first time in April 2011 to 200 Bq/L and then a second time in April 2012 to 50 Bq/L, in line with the lowering of the maximum permitted levels in Japan.

Radioactive waste and effluents

Management of waste and effluents from BNIs and Installations Classified on Environmental Protection grounds (ICPEs) is subject to the provisions of the special regulations concerning these installations (for BNIs, see point 3.4.3). For the management of waste and effluents from other establishments, including hospitals (Article R. 1333-12 of the Public Health Code), general rules are established in ASN resolution 2008-DC-0095 of 29th January 2008. These effluents and waste must be disposed of in duly authorised facilities, unless there are special provisions for on-site organisation and monitoring of their radioactive decay (this concerns radionuclides with a radioactive half-life of less than 100 days).

French policy for the management of very low level waste in BNIs and facilities subject to the Public Health Code is clear and protective: it makes no provision for a "clearance level" for this waste (in other words a generic radioactivity level below which effluents and waste produced by a nuclear activity can be disposed of without control), but on the contrary ensures that they are managed in a special stream to ensure traceability. ASN considers that the use of clearance levels would have three major drawbacks:
- the difficulty in defining universal levels;
- the difficulty in controlling the clearance of this waste;
- and the incentive to dilute this waste in the environment.

With regard to the possibilities for reuse of the waste, ASN is not in favour of the reuse in consumer goods or construction products of waste that is or is likely to be contaminated. Waste from areas in which the production of nuclear waste is a possibility may only be reused within the nuclear sector.

1.2.3 Protection of persons in a radiological emergency situation

The general public is protected against the hazards of ionising radiation in the event of an accident or of radiological emergency situations through the implementation of specific actions (or countermeasures) appropriate to the nature and scale of the exposure. In the particular case of nuclear accidents, these actions were defined in the government circular of 10th March 2000 which amended the off-site emergency plans (PPI)

2. *European regulation (UE) 297/2011, then modified by regulations 351/2011, 506/2011, 657/2011, 961/2011, 1371/2011, 284/2012, 561/2012, 996/2012 and 495/2013*

applicable to BNIs, by expressing intervention levels in terms of doses. These levels constitute reference points for the public authorities (Prefects) who have to decide locally, on a case-by case basis, what action is to be taken.

Reference and intervention levels

The intervention levels were updated in 2009 by ASN statutory resolution 2009-DC-0153 of 18th August 2009, with a reduction of the level concerning exposure of the thyroid. Henceforth, the protection measures to be taken in an emergency situation, and the corresponding intervention levels, are:
- sheltering, if the predicted effective dose from the releases exceeds 10mSv;
- evacuation, if the predicted effective dose from the releases exceeds 50mSv;
- distribution of thyroid blocking stable iodine (ITB) when the predicted equivalent dose to the thyroid from the releases is liable to exceed 50 mSv.

The regulatory exposure limits set by the Labour Code do not apply to emergency workers. On the basis of the optimisation principle, "reference levels", comparable to guideline values to be considered for the performance of any intervention in circumstances such as these, are defined by the regulations (Article R. 1333-84 and R. 1333-86 of the Public Health Code). Two groups of emergency workers are thus defined:
- the first group comprises the personnel making up the special technical or medical response teams set up to deal with a radiological emergency. These personnel benefit from radiological surveillance, a medical aptitude check-up, special training and equipment appropriate to the nature of the radiological risk;
- the second group comprises personnel who are not members of the special response teams but who are called in on the basis of their expertise. They are given appropriate information.

The reference individual exposure levels for the participants, expressed in terms of effective dose, should be set as follows:
- the effective dose which may be received by personnel in group 1 is 100 mSv. It is set at 300 mSv when the intervention measure is aimed at protecting other people;
- the effective dose which may be received by personnel in group 2 is 10 mSv. In exceptional circumstances, volunteers informed of the risks involved in their acts may exceed the reference levels, in order to save human life.

Public information in a radiological emergency

The ways in which the general public is informed in a radiological emergency situation are covered by a specific EU Directive (Directive 89/618/Euratom of 27th November 1989 on informing the general public about health protection measures to be applied and steps to be taken in the event of a radiological emergency). This Directive was transposed into French law by Decree 2005-1158 of 13th September 2005 concerning the off-site emergency plans for certain fixed structures or installations, implementing Article 15 of Act 2004-811 of 13th August 2004 on the modernisation of civil protection.

Two implementing orders were published:
- the Order of 4th November 2005 concerning public information in the event of a radiological emergency situation;
- the Order of 8th December 2005 concerning the medical aptitude check-up, radiological surveillance and training or information of the personnel involved in managing a radiological emergency situation.

1.2.4 Protection of the general public in a long-term exposure situation

The contamination of sites by radioactive substances is the result of a nuclear activity in the remote or more recent past (use of unsealed sources, radium industry, etc.) or an industrial activity utilising raw materials containing non-negligible quantities of natural radionuclides of the uranium or thorium family (activity generating exposure to "enhanced" natural radiation, see point 2.3.2). Most of these sites are listed in the inventory sent out and updated periodically by the French National Agency for Radioactive Waste Management (Andra).

The contamination of the sites can also be the result of accidental releases of radioactive substances into the environment (see chapter 5).

These different exposure situations are qualified as "lasting exposure" in the Public Health Code (since 2007, ICRP publication 103 uses the expression "existing exposure situation"). For these situations, in accordance with the international texts, no exposure limit for the general public has been set at the regulatory level, as the management of these sites is chiefly based on a case-by-case application of the optimisation principle.

A guide on the management of sites potentially polluted by radioactive substances (published in December 2011), drafted under the coordination of ASN and the Ministry of the Environment, assisted by IRSN, describes how to deal with the various situations that could be encountered in the framework of the remediation of sites (potentially) contaminated by radioactive substances.

2. REGULATORY REQUIREMENTS APPLICABLE TO SMALL-SCALE NUCLEAR ACTIVITIES

The expression "small-scale nuclear" refers to medical, industrial and research applications of ionising radiation when not covered by the BNI or ICPE systems. This more specifically concerns the manufacture, possession, distribution – including import and export – and use of radionuclides or products and devices containing them.

2.1 Procedures and rules applicable to small-scale nuclear activities

The procedures and rules applicable to small-scale nuclear activities, if not the beneficiaries of an exemption, are described in section 3 of chapter III of title III of book III of the first part of the Public Health Code. Licenses and approvals are issued by ASN and notifications are filed with the ASN regional divisions.

2.1.1 The licensing system

The licensing system applies indiscriminately to companies or facilities which have radionuclides on-site, and to those which trade in them or use them without directly possessing them.

The renewable ASN license is delivered for a period that cannot exceed 10 years. The license application or notification is made with a form that can be downloaded from the *www.asn.fr* website or obtained from the ASN regional divisions. The conditions for filing license applications, established by Articles R. 1333-23 and following of the Public Health Code, are set out by ASN resolution 2010-DC-192 of 22nd July 2010, which establishes the content of the dossiers enclosed with the license application. The requirements applicable to the medical and non-medical fields are harmonised.

The new forms setting out the resolutions have been progressively put on line since 2011.

It should be noted that the licenses issued under the authorisation systems for BNI, ICPE and Mining Code industries (for ICPE and Mining Code industries, the license is issued by the Prefect) are due to the need of an authorisation for manufacturing or owning ionising radiation sources (see Chapter 10), but do not constitute exemption from compliance with the provisions of the Public Health Code.

Licensing of medical applications and biomedical research

ASN issues licenses for the use of radionuclides, or products and devices containing them, used in nuclear medicine and brachytherapy, for the use of particle accelerators in external radiotherapy, tomography appliances and blood product irradiators. For medical applications and biomedical research, owing to specific patient radiation protection issues, the decision was taken not to use the clearance levels given in the Public Health Code; the licensing system thus comprises no exemptions.

It should be noted that the irradiation of blood products using X-ray generators should in 2015 be subject to the notification system. Irradiators using radioactive sources will remain subject to the licensing system.

Licensing of non-medical activities

ASN is responsible for issuing licenses for industrial and non-medical research applications. This concerns:
- the import, export and distribution of radionuclides and products or devices containing them;
- the manufacture, possession and use of radionuclides, products or devices containing them, devices emitting ionising radiation, the use of accelerators other than electron microscopes and the irradiation of products of any nature, including foodstuffs, with the exception of activities which are licensed under the terms of the Mining Code, the BNI legal system or that applicable to ICPEs.

The license exemption criteria adopted by Directive 96/29/Euratom (Annex 1, table A) are appended to the Public Health Code (table A, annex 13-8).

Exemption will be possible if one of the following conditions is met:
- the total quantity of radionuclides possessed is less than the exemption values in Bq;
- the radionuclide concentrations are less than the exemption values in Bq/kg.

2.1.2 The noti cation system

The list of activities requiring notification pursuant to Article R.1333-19-1 of the Public Health Code was updated in 2009 by ASN resolution 2009-DC-0146 of 16th July 2009, supplemented by ASN resolution 2009-DC-0162 of 20th October 2009. As in low-intensity medical radiology, radiology in veterinary practices is now included in the activities requiring notification. It is added to the list of non-medical activities requiring notification, pursuant to Article R.1333-19-3 of the Public Health Code.

ASN acknowledges receipt of the notification filed by the natural or artificial person responsible for the nuclear activity. As the maximum validity period for a notification has been abolished, a new notification for regularly notified activities only becomes necessary if significant changes have been made to the installation (replacement or addition of an appliance, transfer or substantial modification of the premises or change in the license holder).

Finally, the X-ray facilities used for forensic procedures (for example, radiological examination to determine the age of an individual, use of X-rays to detect objects hidden within the human body, etc.), are regulated by the licensing or notification system applicable to facilities designed for medical uses, depending on the type of equipment used (see point 2.2 2).

2.1.3 Licensing the suppliers of ionising radiation sources

ASN resolution 2008-DC-0109 of 19th August 2008 concerns the licensing system for the distribution, import and/or export of radionuclides and products or devices containing them. This resolution covers products intended for industrial and research purposes, but also health products: drugs containing radionuclides (radiopharmaceutical drugs, precursors and generators), medical devices (gamma-ray teletherapy devices, brachytherapy sources and associated applicators, blood product irradiators, etc.) and in vitro diagnosis medical devices (for radioimmunology assay).

ASN resolution 2008-DC-0108 of 19th August 2008 concerns the license to possess and use a particle accelerator (cyclotron) and the manufacture of radiopharmaceuticals containing a positron emitter.

2.1.4 Approval of radiation protection technical supervision organisations

Technical supervision of the radiation protection organisation, including supervision of the management of radioactive sources and any associated waste, is entrusted to approved organisations (Article R. 1333-97 of the Public Health Code). The conditions and procedures for approval of these organisations are set by ASN resolution 2010-DC-0191 of 22nd July 2010. ASN is responsible for issuing these approvals. The list of approved organisations is available on the ASN website *(www.asn.fr)*. The nature and frequency of the radiation protection technical checks are defined in ASN resolution 2010-DC-0175 mentioned in point 1.2.1.

2.1.5 Radioactive source management rules

The general radioactive source management rules are contained in section 4 of chapter III of title III of book III of the first part of the Public Health Code. These rules are as follows:
- no person may transfer or acquire radioactive sources without a license;
- prior registration with IRSN is compulsory for the purchase, distribution, import and export of radionuclides as sealed or unsealed sources, or of products or devices containing them; this prior registration makes it possible to track the sources from their entry onto the market until the end of their life;
- each establishment is required to ensure the traceability of radionuclides in the form of sealed or unsealed sources and of products or devices that contain them;
- ASN must be notified in the event of loss or theft of radioactive sources;
- users of sealed sources are obliged to have the expired, damaged or end-of-life sources taken back by the supplier, who is obliged to recover them.

The conditions of implementation and payment of the financial guarantees incumbent on the source suppliers must be defined by an order from the Ministers responsible for health and finance (Articles R. 1333-53 and R. 1333-54-2 of the Public Health Code). In the absence of such an order, the particular licensing conditions established by the CIREA (Interministerial Commission on Artificial Radioelements) in 1990 are taken up as requirements in the licenses and are consequently applicable to the licensees.

2.1.6 The rules for the design of facilities

ASN technical resolutions, subject to approval by the Ministers responsible for radiation protection, may be adopted to determine the design and operating rules for facilities in which sources of ionising radiation are used.

With regard to the design of the facilities, the Union technique de l'électricité (UTE) conducted a revision of standard NF-C 15-160 and the associated specific standards (installation standards). On the basis of this work, ASN has initiated an update of the design and layout rules for facilities inside which X-rays are produced and used. After several presentations of the guidelines and prescriptions to the GPRADE and GPMED, ASN adopted resolution 2013-DC-0349 of 4th June 2013 laying down minimum technical rules for the design of facilities in which X-rays are present. This resolution has entered into force, subject to certain provisions, for all facilities commissioned or for which the calculation parameters are modified on 1st January 2014. This resolution concerns industrial and scientific (research) facilities such as industrial radiography using X-rays in a bunker, veterinary radiology and medical facilities such as conventional radiology, dental radiology and scanners (see chapters 9 and 10).

This resolution also replaces the Order of 30th August 1991 determining the installation conditions to be met by X-ray generators.

On 23rd October 2014, ASN adopted resolution 2014-DC-0463 concerning minimum technical rules for the design, operation and maintenance of in vivo nuclear medicine facilities. The new rules set out in the above-mentioned resolution of 23rd October 2014 replace rules existing since 1981; they mainly concern the rules for the ventilation of laboratories handling radiopharmaceuticals and hospital rooms reserved for patients who have received therapeutic treatment (in particular iodine 131).

2.2 Protection of persons exposed for medical and medico-legal purposes

Radiation protection for individuals exposed for medical purposes is now based on two regulatory principles mentioned in paragraphs 1 and 2 of Article L. 1333-1 of the Public Health Code: justification of the procedures and optimisation of exposure, which are under the responsibility of both the practitioners prescribing medical imaging examinations entailing exposure to ionising radiation and the practitioners carrying out these procedures. These principles cover all the diagnostic and therapeutic applications of ionising radiation, including radiological examinations requested for screening, occupational health, sports medicine and forensic purposes.

In medical imaging (see Chapter 9), the final responsibility for exposure lies with the practitioners performing the exams. The rules applicable for the radiation protection of patients set out in the Public Health Code are different from those established for the protection of professionals, set out in the Labour Code, even if the competence of the physicians and professionals involved in delivering the dose must cover both domains.

2.2.1 Justi cation of practices

A written exchange of information between the prescribing practitioner and the practitioner carrying out the procedure exposing the patient should provide justification of the benefit of the exposure for each procedure. This "individual" justification is required for each procedure. Articles R. 1333-70 and R. 1333-71 of the Public Health Code respectively require the publication of "prescription of routine procedures and examinations" guides (also called "indication guides") and "performance of procedures" guides (called "procedure guides").

2.2.2 Optimisation of exposure

Optimisation in medical imaging (radiology and nuclear medicine) consists in delivering the lowest possible dose compatible with obtaining a quality image that provides the diagnostic information being sought. Optimisation in therapy (external radiotherapy, brachytherapy and nuclear medicine) consists in delivering the prescribed dose to the tumour to destroy cancerous cells while limiting the dose to healthy tissues to the strict minimum.

Standardised guides for conducting procedures using ionising radiation have been prepared and are regularly updated by health professionals, or are currently being prepared, to facilitate practical application of the optimisation principle (table 1).

Diagnostic reference levels

The Diagnostic Reference Levels (DRL) are one of the tools used for dose optimisation. As required in Article R. 1333-68 of the Public Health Code, the DRL are defined in the Order of 24th October 2011 concerning diagnostic reference levels in radiology and nuclear medicine. For radiology, this consists of dose values, while for nuclear medicine it consists of activity levels administered in the course of the most common or most heavily irradiating examinations.

TABLE 1: List of Referral Criteria for Imaging and Procedure Guides for the performance of medical procedures entailing exposure to ionising radiation

	SPECIALTIES				
	MEDICAL RADIOLOGY		MEDICAL RADIOLOGY	RADIOTHERAPY	DENTAL RADIOLOGY
DOCUMENTS	Procedure guide	Referral criteria for imaging guide	Referral criteria for imaging and procedure guide	External radiotherapy procedure guide	Referral criteria for imaging and procedure guide
AVAILABLE ON	www.sfrnet.org www.irsn.org	www.sfrnet.org www.irsn.org	www.sfmn.org	www.sfro.org	www.adf.asso.fr www.has-sante.fr

Depending on the type of examination, periodic measurements or readings shall be taken in each radiology and nuclear medicine unit.

Dose constraints

In the field of biomedical research, where exposure to ionising radiation is of no direct benefit to the persons exposed, dose constraints designed to optimise the doses delivered must be established by the medical doctors.

Medical radiation physics

The safety of radiotherapy and optimisation of the doses delivered to the patients in medical imaging require particular expertise in the field of medical physics. The employment of a Specialised Medical Radiation Physicist (PSRPM), formerly called a "radiophysicist", has been extended to radiology, having already been compulsory in radiotherapy and nuclear medicine.

The duties of the PSRPM were clarified and broadened by the Order of 19th November 2004. Thus medical radiation physicist must ensure the appropriateness of the equipment, data and computing processes for determining and delivering the doses and activity levels administered to the patient in any procedure involving ionising radiation. In the field of radiotherapy, they guarantee that the radiation dose received by the tissues due to be irradiated matches that prescribed by the prescribing physician.

Furthermore, they estimate the dose received by the patient during diagnostic procedures and play a part in quality assurance including inspecting the quality of the medical devices.

Temporary criteria determining the conditions for the presence of radiation physicists in radiotherapy centres have been defined by decree (Decree 2009-959 of 29th July 2009). Since the end of the transient period (May 2012), the criteria defined by the National Cancer Institute (INCa) are now applicable pursuant to Decree 2007-388 of 21st March 2007, and in particular the criterion concerning the obligatory presence of a radiation physicist during the treatment sessions.

Since 2005, heads of facilities have had to draw up plans for medical radiation physics, defining the resources allocated, primarily in terms of staffing, in the light of the medical procedures carried out in the establishment, the actual or probable patient numbers, existing dosimetry skills and resources allocated to quality assurance and control.

The conditions of training of the PSRPMs were updated by the Orders of 28th February and 6th December 2011.

In the same way as the medical doctor or the radiation technologist, the PSRPM can be designated as the PCR by the employer in accordance with the Labour Code, although the PCR's tasks are different. It should be noted that in operating theatres using X-ray generators, optimisation of the doses delivered to the patients, which is the competence of the PSRPM, contributes to optimisation of the doses delivered to the professionals performing the procedure.

UNDERSTAND

The new Euratom Directive and the Public Health Code (radiation protection of patients)

The new Euratom Directive introduces the obligation to define a "system for recognition of experts in medical physics". This requirement should lead to a forthcoming publication laying down a status for medical physicists and dosimetrists (currently under preparation under the responsibility of the General Directorate for the provision of health care - DGOS). For radiotherapy, the Directive makes risk assessment, recording and analysis of undesirable events mandatory, along with their notification to the authorities, a system which is already in force in France.

For medico-legal applications of ionising radiation, the new Euratom Directive introduces a new terminology ("deliverable exposure of individuals for non-medical imaging purposes") and should lead to a review of the existing arrangements, with more operational application of the justification principles.

Radiotherapy quality assurance

The quality assurance obligations of radiotherapy centres, provided for in Article R.1333-59 of the Public Health Code, were specified by ASN resolution 2008-DC-0103 dated 1st July 2008, which mainly concerns the Quality Management System (QMS), the management's commitments as stipulated in the QMS, the documentary system, staff responsibility, the analysis of the risks incurred by the patients during the radiotherapy process, and the identification and handling of undesirable situations or malfunctions, whether organisational, human or equipment-related.

These obligations entered into force in September 2011.

Medical imaging quality assurance obligations also appear in the Public Health Code but have not yet been clarified by an ASN resolution. Faced with the regular increase in the doses delivered to patients over the past decade, ASN intends to publish this resolution in 2015. This action is part of the Cancer Plan 3 adopted by the Minister responsible for Health in January 2014.

Maintenance and quality control of medical devices

Maintenance and quality control, both internal and external, of medical devices using ionising radiation (Articles R. 5211-5 to R. 5211-35 of the Public Health Code) have been mandatory since publication of the order of 3rd March 2003. External quality control is entrusted to organisations approved by the Director General of the ANSM (French National Agency for the Safety of Medication and Health Products) who is responsible for issuing a decision defining the acceptability criteria, the monitoring parameters and the frequency of the inspections on the medical devices concerned. The published decisions are posted on the ANSM website.

Training and information

Additional major factors in the optimisation approach are the training of health professionals and the information of patients.

Thus the objectives and content of training programmes for personnel conducting procedures using ionising radiation, or who take part in these procedures, were defined in the Order of 18th May 2004. To ensure the traceability of the data on application of the justification and optimisation principles, the report on the procedure, written by the medical practitioner carrying out the examination, must provide information justifying the procedures and the operations carried out as well as the data used to estimate the dose received by the patient (Order of 22nd September 2006). These training courses were evaluated by ASN in 2012, and work is in progress to improve this training system, with updating of the order planned for late 2015.

Finally, before carrying out a diagnostic or therapeutic procedure using radionuclides (nuclear medicine), the physician must give the patient oral and written guidelines on radiation protection that are of use to him/herself, his/her relations, the public and the environment. In the event of a nuclear medicine procedure for therapeutic purposes, this information, issued in a written document, provides lifestyle hints to enable potential contamination to be minimised and states, for example, for how many days contacts with the spouse and children should be reduced. Recommendations (French High Public Health Council, learned societies) were distributed by ASN (January 2007) to enable the content of the information already sent out to be harmonised.

ASN in-depth inspection of La Pitié-Salpêtrière hospital, October 2014.

2.2.3 Medico-legal applications of ionising radiation

In the medico-legal field, ionising radiation is used in a wide variety of sectors such as occupational medicine, sports medicine or for investigative procedures required by the courts or insurance companies. The principles of justification and optimisation apply to both the person requesting the examinations and the person performing them.

In occupational medicine, ionising radiation is used for medical monitoring of workers (whether or not professionally exposed to ionising radiation, for example workers exposed to asbestos).

2.3 Protection of persons exposed to "enhanced" natural radiation

2.3.1 Protection of persons exposed to radon

The regulatory framework applicable to management of the radon-related risk in premises open to the public (Article R. 1333-15 and following of the Public Health Code) introduce the following clarifications:
- the radon monitoring obligation applies in geographical areas in which radon of natural origin is likely to be measured in high concentrations and in premises in which the public is likely to stay for extended periods;
- the measurements are made by organisations approved by ASN, these measurements being repeated every 10 years and whenever work is carried out to modify the ventilation or the radon tightness of the building.

In addition to introducing action trigger levels of 400 and 1,000 Bq/m^3, the implementing Order of 22nd July 2004 concerning management of the radon risk in premises open to the public defined geographical zones and premises open to the public for which radon measurements are now mandatory:
- the geographical areas are the 31 *départements* classified as having priority for radon measurement (see chapter 1);
- the categories of premises open to the public cover teaching institutions, health and social institutions, spas and prisons.

The obligations of the owner of the facility are also specified when the action levels are found to have been exceeded. The Order of 22nd July 2004 was accompanied by the publication in the Official Journal of a notice defining the action and work to be carried out if the action trigger levels of 400 and 1,000 Bq/m^3 were to be exceeded (published in the Official Journal of 22nd February 2005). The conditions for approval of organisations qualified to measure an activity concentration, and the measurement conditions, were updated by three ASN resolutions:
- ASN resolution 2009-DC-0134 of 7th April 2009, amended by resolution 2010-DC-0181 of 15th April 2010, sets the approval criteria, provides the detailed list of information to be enclosed with the approval application, and specifies the conditions of issue, verification and withdrawal of approval;
- ASN resolution 2009-DC-0135 of 7th April 2009 specifies the conditions in which the radon activity concentration is measured;
- ASN resolution 2009-DC-0136 of 7th April 2009 concerns the objectives, duration and content of the training programmes for the individuals carrying out radon activity concentration measurements.

The list of approved organisations is published in the ASN Official Bulletin on *www.asn.fr.*

Act 2009-879 of 21st July 2009 reforming the hospital system and concerning patients, health and the regions, introduced new requirements concerning radon into the Public Health Code (Article L.1333-10). Thus, measurement of radon in residential buildings is required every ten years. This legislative provision is still awaiting clarification by an implementing decree. Finally, in the workplace, Article R. 4451-136 of the Labour Code requires the employer to carry out radon activity measurements and take the necessary steps to reduce exposure when the results of the measurements reveal an average radon concentration higher than the levels set in an ASN decision. The Order of 7th August 2008 defined the workplaces in which these measurements are required and ASN resolution 2008-DC-0110 of 26th September 2008 specifies the reference levels above which the radon concentration must be reduced.

The legislative framework should be reviewed on the occasion of the transposition of the new Euratom Directive to introduce a reference to the national action plan and to reinforce public information in those geographical areas where radon measurement in buildings is mandatory. The updating of the regulatory map by ministerial order, based on the work done by IRSN (see Chapter 1), is expected in 2015.

2.3.2 Other sources of exposure to "enhanced" natural radiation

Professional activities which use materials which naturally contain radionuclides not used for their intrinsic radioactive properties but which are likely to create exposure likely to harm the health of workers and the public ("enhanced" natural exposure) are subject to the provisions of the Labour Code (Articles R. 4451-131 to 135) and the Public Health Code (Article R. 1333-13).

UNDERSTAND

The new Euratom Directive and the Public Health Code (protection of the population)

The Euratom Directive does not modify the limits of public exposure to ionising radiation (1 mSv/year). It does however introduce:
- a new regulatory framework for regulating natural radioactivity in construction materials: new regulations will need to be prepared in France;
- the obligation of establishing a national radon action plan (already in place in France, see Chapter 1) but also of reducing the reference level from 400 Bq/m^3 to 300 Bq/m^3.
- in the nuclear activities system, the need to include professional activities which use materials containing naturally-occurring radionuclides not used for their radioactive properties.

The Order of 25th May 2005 defines the list of professional activities using raw materials naturally containing radionuclides, the handling of which can lead to significant exposure of the general public or of workers[3].

For these activities, the Public Health Code requires an estimation of the doses to which the general public is exposed on account of the installation or the production of consumer goods or construction materials (see Chapter 1). In addition, and if protection of the public so warrants, it will also be possible to set radioactivity limits for the construction materials and consumer goods produced by some of these industries (Article R. 1333-14 of the Public Health Code). This latter measure complements the ban on the intentional addition of radioactive materials to consumer goods.

For the occupational exposure resulting from these activities, the Labour Code requires a dose assessment to be carried out under the responsibility of the employer. Should the dose limit of 1 mSv/year be exceeded, steps to reduce exposure should be taken. The above-mentioned Order of 25th May 2005 specifies the technical procedures for evaluating the doses received by the workers.

3. This concerns: the combustion of coal in coal-fired power stations; the treatment of tin, aluminium, copper, titanium, niobium, bismuth and thorium ores; the production of refractory ceramics and the glasswork, foundry, iron and steel and metallurgy activities that use them; the production or use of compounds containing thorium; the production of zircon and baddaleyite, and the foundry and metallurgy activities that use them; the production of phosphated fertilisers and phosphoric acid; the treatment of titanium dioxide; the treatment of rare earths and the production of pigments containing them; the treatment of underground water by filtration for the production of water for human consumption and mineral waters and spas.

Finally, the Labour Code (Article R. 4451-140) stipulates that for aircrews likely to be exposed to more than 1 mSv/year, the employer must evaluate the exposure, take steps to reduce it (particularly in the event of a declared pregnancy) and inform the personnel of the health risks. The order of 7th February 2004 defines the procedures for implementing these measures. The transposition of the new Euratom Directive should lead to these activities being subject to the legal system for nuclear activities as defined in Article L. 1333-4 of the Public Health Code.

3. THE LEGAL SYSTEM APPLICABLE TO BASIC NUCLEAR INSTALLATIONS

Basic Nuclear Installations (BNIs) are installations which, due to their nature or to the quantity or activity of the radioactive substances they contain, are subject to particular provisions in order to protect the general public and the environment.

3.1 The legal bases

3.1.1 International conventions and standards

IAEA develops, on proposals from member States, reference texts called “Safety Standards” describing safety principles and practices. They concern installation safety and radiation protection, the safety of waste management and the safety of radioactive substances transportation. Although these documents are not binding, they do nonetheless constitute references which are widely drawn on in the drafting of national regulations.

Several legislative and regulatory provisions relative to BNIs are derived from or take up international conventions and standards, and notably those of IAEA.

Two conventions deal with safety (Convention on Nuclear Safety and Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management), while two others deal with the operational management of the consequences of any accidents (Convention on early notification of a nuclear accident and Convention on assistance in the case of a nuclear accident or radiological emergency). France is a contracting party to these four international conventions. These conventions are presented in detail in Chapter 7.

The other conventions linked to nuclear safety and radiation protection

Other international conventions, the scope of which does not fall within the remit of ASN, may be linked to nuclear safety. Of particular relevance is the Convention on the Physical Protection of Nuclear Material, the purpose of which is to reinforce protection against malicious acts and against misappropriation of nuclear materials. This convention entered into force in February 1987 and as at 31st December 2013, it comprised 145 contracting parties.

For France, these conventions are a tool to be used to reinforce nuclear safety, periodically presenting the international community with the status of the facilities concerned and the steps taken to ensure their safety.

3.1.2 European texts

Several European community texts apply to BNIs. The more important ones are described below.

The Euratom Treaty

The Euratom Treaty, which was signed in 1957 and came into force in 1958, aimed to develop nuclear power while protecting the general public and workers from the harmful effects of ionising radiation.

Chapter III of title II of the Euratom Treaty deals with health protection as linked to ionising radiation.

Articles 35 (implementation of means for checking compliance with standards), 36 (information to the Commission on environmental radioactivity levels) and 37 (information to the Commission on planned effluent discharges) deal with the issues of discharges and environmental protection.

The provisions regarding information of the Commission were integrated into decree 2007-1557 of 2nd November 2007, amended, relative to Basic Nuclear Installations and to the regulation of the nuclear safety of the transport of radioactive substances, known as the "BNI Procedures Decree". In particular, the decrees for BNI creation authorisation or final shutdown, as well as for significant modifications to the facilities leading to an increase in discharge limit values, are only issued once the opinion of the Commission has been obtained.

Directive of 25th June 2009 establishing a community framework for the nuclear safety of nuclear facilities

Council Directive 2009/71/Euratom of 25th June 2009 creates an EU framework for nuclear safety and paves the way for the creation of a common legal framework for nuclear safety among all member States.

This directive defines basic obligations and general principles in this field. It strengthens the role of the national regulatory organisations, contributes to harmonising the safety requirements between the member States in order to develop a high level of safety in the installations and encourages a high level of transparency on these issues.

It comprises stipulations regarding cooperation between nuclear regulators, in particular the creation of a peer review mechanism, staff training, regulation and inspection of nuclear installations and public transparency. In this respect, it reinforces cooperation between the member States.

Finally, it creates a framework for the harmonisation work being carried out by the Western European Nuclear Regulators Association (WENRA), (see Chapter 7, point 2.8).

On 8th July 2014, the European Council of Ministers adopted Directive 2014/87/Euratom which modifies Directive 2009/71/Euratom of 25th June 2009. This Directive comprises the following substantial improvements:
- concepts converging with those of IAEA (incident, accident, etc.);
- underlying of the principles of "defence in depth" and "safety culture";
- clarification of responsibilities in the oversight of the safety of nuclear installations;
- the safety objectives for nuclear installations which stem directly from the safety requirements used by the WENRA association;
- a safety reassessment of each nuclear facility at least once every ten years;
- every 6 years, the organisation of peer reviews by the European counterparts on specific safety topics, conducted in the spirit of the stress tests;
- the obligation for nuclear facility licensees and the nuclear safety authorities to inform local populations and the stakeholders.

During the negotiations concerning Directive 2014/87/Euratom of 8th July 2014, ASN supported France's position in favour of these measures which significantly reinforce the European community framework for oversight of the safety of nuclear facilities (see Chapter 7, point 2.8).

This directive must be transposed into French law no later than 15th August 2017. ASN has already set up a working group jointly with the Ministry responsible for the Environment, with a view to drawing up the provisions transposing this directive.

Directive of 19th July 2011 establishing a European community framework for the responsible and safe management of spent fuel and radioactive waste

Council Directive 2011/70/Euratom of 19th July 2011 establishes a European community framework for the responsible and safe management of spent fuel and radioactive waste. It applies to the management of spent fuel and the management of radioactive waste, from production to disposal, when this waste is the result of civil activities. Like the Euratom Directive of 25th June 2009, it calls for each member State to set up a coherent and appropriate national framework and sets various requirements for the States, the safety regulators and the licensees. By the 23rd August 2013 deadline set by this directive for its transposition into the laws of the member States, most of this directive had been transposed into French law.

For the drafting of these two directives, the institutions of the European Union benefit from the work done by the WENRA association (see Chapter 7, point 2.8).

3.1.3 National texts

The legal system applicable to the BNIs was revised in depth by Act 2006-686 of 13th June 2006 on transparency and security in the nuclear field, called the "TSN Act", and its application decrees, and in particular Decree 2007-1557 of 2nd November 2007 as amended, concerning BNIs and the regulation of nuclear safety in the transport of radioactive substances, called the "BNI Procedures Decree".

Since 6th January 2012, the provisions of the three main acts that specifically concern BNIs, namely the TSN Act, Programme Act 2006-739 of 28th June 2006 relative to the sustainable management of radioactive materials and waste (called the "Waste Act"), and Act 68-943 of 30th October 1968 relative to civil liability in the field of nuclear energy (called the "RCN Act") - have been codified in the Environment Code.

ASN will again assist the Ministry responsible for the Environment with codifying in the Environment Code the regulatory provisions in effect (particularly those of the BNI Procedures Decree of 2nd November 2007).

The BNI legal system should be modified by the PLTECV, which comprises a title devoted to nuclear matters (title VI "Reinforcing nuclear safety and information of the citizens") which should be finally adopted in early 2015.

GREEN GROWTH ENERGY TRANSITION BILL

The PLTECV, which comprises a title devoted to nuclear matters (title VI "Reinforcing nuclear safety and information of the citizens") empowers the Government to issue ordinances containing measures transposing several of the European Directives in force into French law; that is:
- Directive 2010/75/EU of 24th November 2010 (known as the "IED Directive") concerning industrial emissions;
- Directive 2012/18/EU of 4th July 2012 (known as the "Seveso III" Directive) on the control of major accident hazards involving dangerous substances.

The IED and Seveso III Directives are the two European environmental protection instruments applying to industrial installations. The purpose of the first is to reduce pollutant emissions during normal operation, while the second is designed to mitigate the consequences of a major accident on human health and the environment.

The IED Directive, which was to be transposed into French law no later than 7th January 2013, was only partially transposed by ordinance 2012-7 of 5th January 2012 transposing Chapter II of Directive 2010/75/EU of the European Parliament and of the Council of 24th November 2010 concerning industrial emissions (integrated pollution prevention and mitigation).

As for the Seveso III Directive, it is to be transposed into French law no later than 1st June 2015 (on which date it will "replace" the Seveso II Directive). Its transposition will imply an in-depth revision of the list of ICPEs.

- Council Directive 2011/70/Euratom of 19th July 2011 establishing a European community framework for the responsible and safe management of spent fuel and radioactive waste. By the 23rd August 2013 deadline set by this Directive for its transposition into the laws of the member States, most of this directive had been transposed into French law.

In addition, on 8th July 2014, the European Commission adopted Directive 2014/87/Euratom which modifies Directive 2009/71/Euratom of 25th June 2009 establishing a Community framework for the nuclear safety of nuclear installations. This directive is to be transposed into French law no later than 15th August 2017. ASN has already set up a working group jointly with the Ministry responsible for the Environment, with a view to drawing up the provisions transposing this directive.

Environment Code

The provisions of chapters III, V and VI of title IX of book V of the Environment Code underpin the BNI licensing and regulation system.

The legal system applicable to BNIs is said to be "integrated" because it aims to cover the prevention or control of all the risks and detrimental effects, whether or not radioactive, that a BNI could create for man and the environment.

About fifteen decrees implement the legislative provisions of book V of the Environment Code, in particular Decree 2007- 830 of 11th May 2007 concerning the list of BNIs and Decree 2007-1557 of 2nd November 2007 as amended, concerning BNIs and the regulation of the nuclear safety of the transport of radioactive substances, known as the "BNI Procedures Decree" (see below).

The provisions of chapter II of title IV of book V of the Environment Code (drawn in particular from the codification of the "Waste Act") introduce a coherent and exhaustive legislative framework for the management of all radioactive waste.

"BNI Procedures Decree" of 2nd November 2007

Decree 2007-1557 of 2nd November 2007 as amended concerning BNIs and regulation of the nuclear safety of the transport of radioactive substances, implements Article L. 593-38 of the Environment Code.

It defines the framework in which the BNI procedures are carried out and covers the entire lifecycle of a BNI, from its authorisation decree to commissioning, to final shutdown and decommissioning. Finally, it explains the relations between the Minister responsible for Nuclear Safety and ASN in the field of BNI safety.

The decree clarifies the applicable procedures for adoption of the general regulations and for taking individual decisions concerning BNIs. It defines how the act is implemented with regard to inspections and administrative or criminal sanctions. Finally, it defines the particular conditions for application of certain regimes within the perimeter of the BNIs.

This will need to be modified after the green growth energy transition bill is passed and the relevant ordinances are published. It will also be codified in the Environment Code.

3.2 General technical regulations

The general technical regulations provided for by Article L. 593-4 of the Environment Code, comprise all the general texts laying down the technical rules concerning nuclear safety, whether binding (ministerial orders and ASN statutory resolutions) or non-binding (circulars, basic safety rules, ASN guides).

Following the publication of the TSN Act on 13th June 2006, ASN began working to overhaul the general technical regulations applicable to BNIs, with the order of 7th February 2012, called the "BNI Order", setting general rules for Basic Nuclear Installations, and about twenty ASN statutory resolutions, which have not all been adopted yet.

3.2.1 Ministerial Orders

The entry into force, on 1st July 2013 of most of the provisions of the order of 7th February 2012 setting out the general rules for Basic Nuclear Installations, known as the "BNI Order", is a key milestone in the overhaul of the general technical regulations applicable to BNIs.

"BNI Order" of 7th February 2012

Issued pursuant to Article L. 593-4 of the Environment Code, the "BNI Order" defines the essential requirements applicable to the BNIs to protect the interests listed in the act: public safety, health and sanitary conditions; protection of nature and the environment.

It significantly reinforces the regulatory framework applicable to BNIs, as it:
- incorporates into French regulations the "reference levels" defined by WENRA, which worked for several years on defining a common baseline of requirements. The work done by WENRA was built around the IAEA safety standards and the regulations or best practices employed in the member states of the association. This work led to the definition of a range of requirements designed to harmonise the safety of the reactors in operation in Europe;
- incorporates and clarifies numerous requirements resulting from previous orders, in the light of experience feedback, adapting them to the new legislative framework;
- offers a unique legal foundation for several ASN requirements, for example formulated further to analysis of the stress tests and imposed on the licensees following the Fukushima Daiichi accident.

The BNI Order of 7th February 2012, modified by the order of 26th June 2013, applies throughout the existence of the facility, from design through to delicensing. It recalls the principle of "integrated safety", that is the protection of all the interests mentioned in Article L. 593-1 of the Environment Code (safety, public health and protection of nature and the environment), in addition to simply preventing accidents) and of the "graded approach" (in other words the gradual nature of the requirements and oversight, which must be commensurate with the potential consequences of the issues being dealt with).

The BNI Order of 7th February 2012 addresses the following subjects:
- organisation and responsibility;
- the demonstration of nuclear safety;
- control of detrimental effects and the impact on health and the environment;
- pressure equipment designed specifically for BNIs;
- waste management;
- preparation and management of emergency situations.

In addition, the BNI Order of 7th February 2012 defines some particular provisions applicable to certain categories of installations or to certain activities within a BNI: nuclear power reactors, on-site transport of hazardous goods, decommissioning, storage of radioactive substances and radioactive waste disposal facilities.

The main provisions of the BNI Order entered into force on 1st July 2013. However, particular deadlines were set for the implementation of the requirements liable to entail adaptations or significant preparatory work, owing to the scale or the scope of these requirements. In this respect, one could mention the case of:
- monitoring of outside contractors by the licensee: these provisions came into effect on 1st January 2014;
- the integration of certain technical expertise which was hitherto outsourced and the drafting of the notice describing it, as well as consideration of a combination of certain trigger events in the safety demonstration: these provisions came into force on 1st July 2014;
- the performance of probabilistic assessments, the practical exclusion of certain events, the approach for the qualification of elements important for protection (EIP) or the application of certain new rules taken from the regulations applicable to ICPEs (except for large cooling towers - TAR). These provisions may require the revision of certain points in the safety demonstration, entailing detailed analysis, which could also lead to the revision of certain construction or operating provisions. They will enter into force at the next periodic safety review or the next significant modification of the BNI, or on the occasion of final shutdown and decommissioning of the facility taking place as of 1st July 2015.

The provisions concerning the notification requirements, aiming to comply with the European requirements, have for their part been applicable since July 2012.

The deferred entry into force of some of the provisions of the BNI Order of 7th February 2012 should thus enable the licensees to make optimum preparation for their implementation.

3.2.2 ASN statutory resolutions

Pursuant to Article L. 592-19 of the Environment Code, ASN may issue statutory resolutions to clarify decrees and orders in the field of nuclear safety or radiation protection, which have to be approved by the Minister in charge of nuclear safety.

TO BE NOTED

General technical regulations applicable to BNIs

The entry into force of the BNI Order of 7th February 2012 constituted a profound evolution in the regulatory framework applicable to BNIs. In addition to setting up a monitoring and feedback system of the implementation, ASN organised a seminar on 21st March 2014 to present and discuss the main progress achieved in the overhaul of the general technical regulations applicable to BNIs, intended for all the nuclear stakeholders and bringing together,nearly three hundred professionals (licensees, contractors, local information committees (CLI), administrations, etc.).

Given the success of this operation, ASN intends to continue this support for all the nuclear stakeholders for the duration of the process to overhaul the general technical regulations applicable to BNIs, which should continue until 2016 (by which date all statutory resolutions and guidelines should be published).

This approach reflects ASN's desire to promote one of its missions: regulation as a foundation of nuclear safety. ASN considers that its regulatory mission is not only to draw up or contribute to drafting regulations, but also to explain them and discuss them with all the stakeholders (in particular those being regulated) in order to clear up any ambiguity concerning the understanding and interpretation of the texts and ensure that they are implemented on-time and in the best possible conditions, with the common goal of guaranteeing a high level of nuclear safety.

To do this, ASN has set up an internal strategy committee to raise stakeholder awareness of the general technical regulations applicable to BNIs and intends to organise regular information briefings about future statutory resolutions and guidelines which will supplement and clarify the BNI Order of 7th February 2012.

A special section was created on *www.asn.fr* in which ASN makes a certain number of documents available, in particular presentation media for the seminar of 21st March 2014, number 197 of *Contrôle* magazine which looks back at the various steps in the process to overhaul the general technical regulations applicable to BNIs, and provides a forum for the various stakeholders concerned by its implementation.

ASN has defined a programme for drafting these statutory resolutions aimed at clarifying the BNI Procedures Decree of 2nd November 2007 or the BNI Order of 7th February 2012. Even before being required by law, ASN has from the outset submitted its draft statutory resolutions to public consultation on *www.asn.fr* (see Chapter 6, point 2.2).

It should be pointed out that ASN proposed that some of its statutory resolutions also be presented to the Higher Council for the Prevention of Technological Risks (CSPRT) (more specifically with regard to resolutions covering topics that the CSPRT examines within the context of the ICPE system) in order to ensure greater consistency between the requirements applicable to ICPEs and BNIs (see Chapter 2, point 2.4.3).

Diagram 3 shows the degree of progress of the project to overhaul the general technical regulations applicable to BNIs.

In 2014, four resolutions were adopted to supplement the implementation procedures of the BNI Order of 7th February 2012.

The resolution of 28th January 2014 concerning the rules applicable to Basic Nuclear Installations (BNI) with regard to the management of fire risks

ASN resolution 2014-DC-0417 of 28th January 2014 concerning the rules applicable to Basic Nuclear Installations (BNI) with regard to the management of fire risks sets the technical rules applicable within BNIs in order to meet the fire risk control objectives. In accordance with the defence in depth approach, the resolution defines requirements concerning measures to prevent the outbreak of fire, detection and fire-fighting measures and measures to prevent the propagation of a fire and mitigate its consequences.

The resolution of 13th February 2014 relative to physical modifications of Basic Nuclear Installations

Resolution 2014-DC-0420 of 13th February 2014 concerning physical modifications to Basic Nuclear Installations (BNI) supplements the provisions of Chapter VII of title III of the BNI Procedures Decree of 2nd November 2007. It clarifies the provisions that the licensee of a BNI implements, on the one hand to assess and minimise the possible consequences for the protected interests of a physical modification to the facility and justify the acceptability of the remaining consequences and, on the other, to prepare for and then carry out this modification.

The resolution of 15th July 2014 concerning shutdowns and restarts of PWR nuclear power reactors

Resolution 2014-DC-0444 of 15th July 2014 concerning PWR shutdowns and restarts requires ASN approval for restart of a reactor after a refuelling outage. It mainly defines the information to be sent to ASN by the licensee before, during and after the reactor outage, so that ASN can reach a decision on its restart and then remain informed of the overall results of the outage. All the provisions of this resolution simply restate [in the form of a regulatory text] most of the existing practices for information and oversight during reactor outages. The resolution stipulates that the licensee may be exempted from ASN approval to restart, provided that there is an internal authorisation system conforming to the provisions of resolution 2008-DC-0106 of 11th July 2008 concerning the use of internal authorisation systems in BNIs.

The resolution of 7th October 2014 concerning the control of the criticality risk in Basic Nuclear Installations (BNI)

Resolution 2014-DC-0462 of 7th October 2014 concerning the control of the criticality risk in Basic Nuclear Installations (BNI) aims to set technical rules applicable within BNIs in order to meet the goal of controlling the criticality risk. This resolution applies to all BNIs containing fissile material, except for those in which criticality is impossible owing to the physical-chemical characteristics of this material. In accordance with the defence in depth approach, the main provisions of this resolution concern:
- the objectives and general principles of criticality risk control (prevention of the criticality risk and mitigation of the consequences of a criticality accident);
- the principles of the design, operation and decommissioning of BNIs with regard to prevention of the criticality risk;
- the rules applicable to a safety-criticality demonstration;
- the organisation of the licensees in order to control the criticality risk.

ASN is working on drafting guidelines for application of this resolution, with a view to publication in 2016.

These four resolutions supplement the statutory resolutions already in force and mentioned below:
- resolution of 16th July 2013 relative to control of detrimental effects and the impact of Basic Nuclear Installations on health and the environment: resolution 2013-DC-0360 of 16th July 2013 supplements the implementation procedures of title IV of the BNI Order of 7th February 2012. Its main provisions concern methods for sampling water and liquid or gaseous chemical or radioactive discharges, the monitoring of water intake and discharges,

environmental monitoring, the prevention of detrimental effects and information of the regulatory authority and the public;
- resolution of 18th June 2013 concerning public access to modification project files specified in Article L. 593-15 of the Environment Code: resolution 2013-DC-0352 of 18th June 2013 specifies the implementation procedures for Article L. 593-15 of the Environment Code (and Article 26 of the BNI Procedures Decree of 2nd November 2007) which sets out the procedure for public access in the drafting of resolutions modifying the facility or its operating conditions which, without being significant, are nonetheless liable to cause a significant rise in water intake or environmental discharges. This public access procedure is run by the licensee (see Chapter 6, point 2.2);
- resolution of 3rd May 2012 supplementing certain conditions for application of the ministerial decision of 31st January 2006 relative to the conditions of use of spare parts in the main primary system and the main secondary systems of pressurised water nuclear reactors: ministerial decision JV/VF DEP-SD5-0048-2006 of 31st January 2006 defines the conditions for the use of these spares and specifies the associated documentation (in particular the references of the files stipulated by the manufacturing regulations) for each spare (the spares are either actual pressure equipment (for example: a valve, check valve, or steam generator) or components of the "main areas under pressure" of pressure equipment items (for example: a pipe section)). Even if the files stipulated by the manufacturing regulations are clearly identified for pressure equipment, no regulatory requirement is however defined for the components. Through its resolution 2012-DC-0236 of 3rd May 2012, ASN has defined the technical and manufacturing surveillance documentation required for these components in order to establish some consistency between these provisions and those applicable to the manufacture of pressure equipment;
- resolution of 11th July 2008 concerning the use of internal authorisation systems in BNIs: the purpose of a system of internal authorisations is to reinforce the licensee's responsibility for nuclear safety and radiation protection. The regulations thus enable the licensee to carry out minor operations provided that it implements a system of reinforced and systematic internal controls, offering sufficient guarantees of quality, independence and transparency. Within this context, it is exempted from the notification procedure specified in Article 26 of the BNI Procedures Decree of 2nd November 2007. ASN authorises the use of such systems and monitors them.

3.2.3 Basic safety rules and ASN guides

ASN has drafted basic safety rules (BSR) on a variety of technical subjects concerning BNIs. These are recommendations which specify safety objectives and describe practices ASN considers satisfactory. As part of the ongoing reorganisation of the general technical regulations applicable to BNIs, the BSR are gradually being replaced by ASN guides.

The ASN guides collection was created as an educational tool for professionals. In 2014, it comprised seventeen non-binding guides designed to affirm ASN doctrine, detail the recommendations, propose methods for achieving the objectives set in the texts and present methods and best practices stemming from experience feedback from significant events.

The ASN guides collection is presented in the appendix to this chapter.

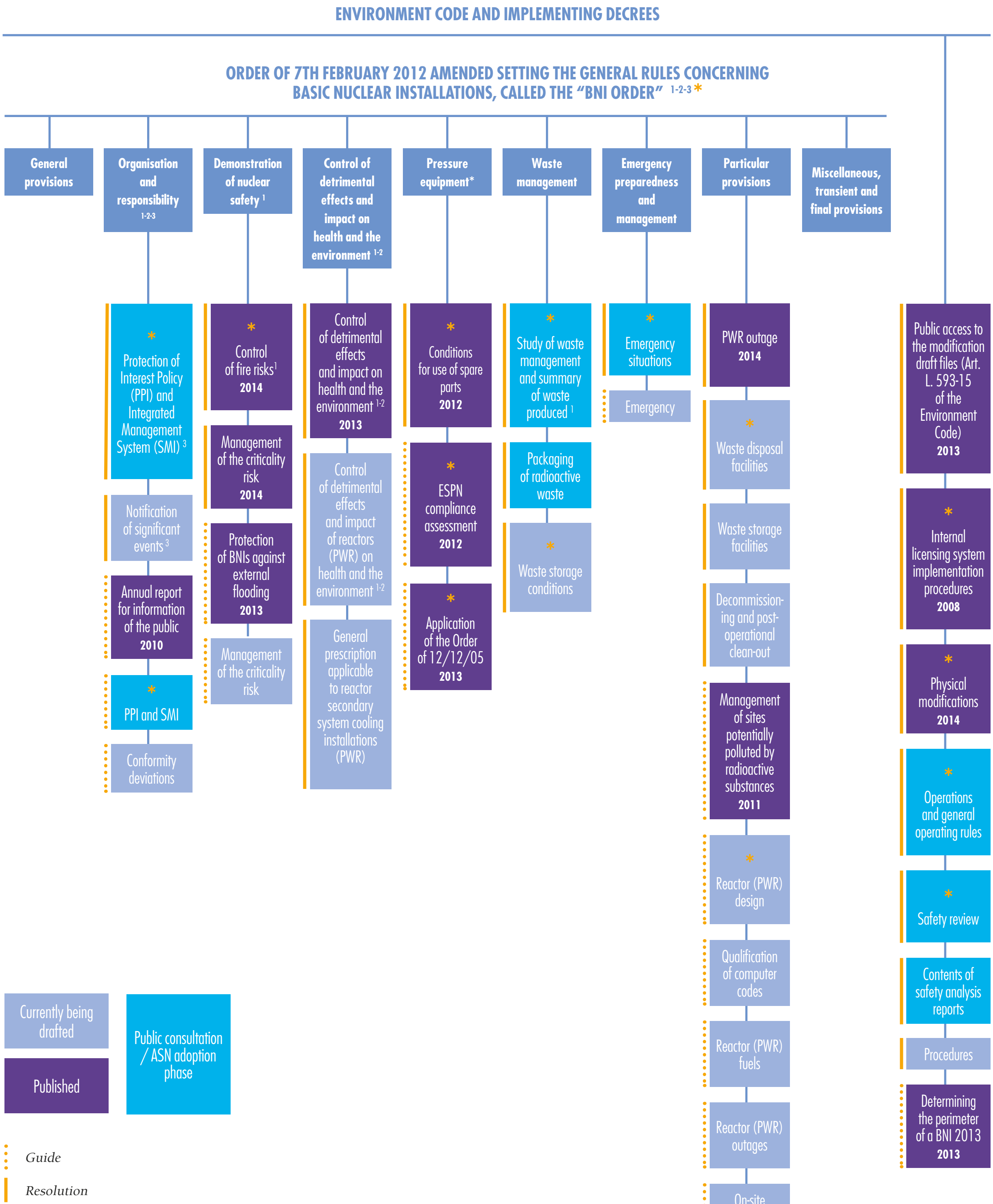
3.2.4 French nuclear industry professional codes and standards

The nuclear industry produces detailed rules dealing with the state of the art and industrial practices. It groups these rules in "Industrial Codes". These rules allow concrete transposition of the requirements of the general technical regulations, while reflecting good industrial practice. They thus facilitate contractual relations between customers and suppliers.

In the particular field of nuclear safety, the Industrial Codes are drafted by the French association for NSSS equipment construction rules (AFCEN), of which EDF and Areva are members. The RCC Codes of design and construction rules have been drafted for the Design, Manufacture and Commissioning of Electrical Equipment (RCC-E), Civil Engineering (RCC-G) and Mechanical Equipment (RCC-M). A collection of in-service monitoring rules for mechanical equipment (RSE-M) has also been drafted.

Production of these documents is the responsibility of the manufacturers, not ASN. ASN may however in certain cases recognise that they constitute a collection of best practices enabling certain ASN requirements to be met, by issuing a resolution or publishing a guide.

DIAGRAM 3: Status of progress of the overhaul of the general technical regulations applicable to BNIs, as at 22nd December 2014



1. Covering the scope of the Order of 31/12/1999
2. Covering the scope of the Order of 26/11/1999
3. Covering the scope of the Order of 10/08/1984
* Text concerned by the WENRA reference levels

* *Title V entitled "Pressure equipment specially designed for Basic Nuclear Installations" of the BNI Order refers to the Order of 10th November 1999 concerning the monitoring of main primary system and main secondary system operations in pressurised water nuclear reactors and the Order of 12th December 2005 concerning nuclear pressure equipment.*

Drafts for modification of these orders are currently being prepared.

3.3 Plant authorisation decrees and commissioning licenses

Chapter III of title IX of book V of the Environment Code contains a creation authorisation procedure, which may be followed by a number of licensing operations throughout the life of a BNI, from its commissioning up to final shutdown and decommissioning, including any modifications made to the facility.

3.3.1 Siting

Well before applying for a BNI authorisation decree, the licensee informs the administration of the site(s) on which it plans to build this installation. ASN checks the assessment of the safety characteristics of the site carried out by the licensee: seismicity, hydrogeology, industrial environment, cold water heat sink sources, etc.

Construction of a BNI requires the issue of a building permit by the Prefect, according to procedures specified in Articles R. 421-1 and following and Article R. 422-2 of the Town Planning Code.

3.3.2 Safety options

Any industrial concern intending to operate a BNI may, even before starting the creation authorisation application procedure, ask ASN for an opinion on all or part of the safety options it has adopted for its installation. The applicant is notified of the ASN opinion and will produce any additional studies and justifications as necessary for a possible creation authorisation application. ASN generally asks a competent Advisory Committee of Experts to review the project.

The safety options will then be presented in the creation authorisation application file, in the form of a preliminary safety analysis report (PSAR).

This preparatory procedure in no way exempts the applicant from the subsequent regulatory examinations but simply facilitates them.

3.3.3 Public debate

Pursuant to Articles L. 121-1 and following of the Environment Code, the creation of a BNI is subject to a public debate procedure when dealing with a new nuclear power generation site or a new site (other than for nuclear power generation) costing more than €300 M and, in certain cases, a new nuclear power generation site, or a new site (other than for nuclear power generation) costing between €150 M and €300 M (Article R. 121-1 of this same code).

The public debate looks at the suitability, objectives and characteristics of the project.

3.3.4 Plant authorisation decrees

The creation authorisation application for a BNI is filed with the Minister responsible for Nuclear Safety by the industrial concern which intends to operate the facility, which thus acquires the status of licensee. The application is accompanied by a file comprising several items, including the detailed drawing of the installation, the impact assessment, the preliminary safety analysis report, the risk management study and the decommissioning plan.

ASN is responsible for reviewing the file, jointly with the Minister responsible for Nuclear Safety. This is followed by a period of parallel consultation of the public and technical experts.

The impact assessment is submitted for its opinion to the environmental authority created within the Departmental Council for the Environment and Sustainable Development (CGEDD).

The public inquiry

Article L.593-8 of the Environment Code stipulates that the authorisation can only be granted after holding a public inquiry. Publication of Decree 2011-2018 of 29th December 2011 reforming the public inquiry process for operations liable to affect the environment, led to harmonisation of the public inquiry system, which meant that the procedure applicable to BNIs was no longer an exception but was incorporated into the general system. The purpose of the inquiry is to inform the public and collect their opinions, suggestions and counterproposals, in such a way as to provide the competent authority with all the elements necessary for it then to make an informed decision.

The inquiry is carried out in accordance with the provisions of Articles L. 123-1 to L. 123-19 and R. 123-1 to R. 123-27 of the Environment Code. The Prefect opens the public inquiry at least in each of the communities of which any part is situated less than five kilometres from the perimeter of the installation. This inquiry lasts from a minimum of one month to a maximum of two months. The dossier submitted by the licensee in support of its authorisation application is made available in the public inquiry dossier. However, the safety analysis report (document containing the inventory of installation risks, an analysis of the steps taken to prevent these risks and a description of the steps designed to minimise the probability and effects of accidents) is a large document that is difficult for non-specialists to understand. It is therefore supplemented by a risk control assessment.

Furthermore, the procedures concerning BNIs subject to a public inquiry are concerned by Decree 2011-2021 of 29th December, determining the list of projects, plans and programmes to be communicated electronically to the general public under the experiment specified in II of Article L. 123-10 of the Environment Code. This states that the Authority responsible for opening and holding the public inquiry shall communicate the main documents in the inquiry dossier to the general public in electronic format. This approach aims to make it easier for the public to become informed about the projects, in particular those who do not live in the places where the inquiry is being held. Using this means of providing access to information and the possibility of submitting observations in electronic format, as stipulated in Article R. 123-9 of the Environment Code since the publication of the above-mentioned Decree of 29th December 2011, aims to facilitate and improve the way in which the public can express their opinions. These recommendations came into force on 1st June 2012.

The creation of a local information committee (CLI)

The TSN Act of 13th June 2006, now codified in books I and V of the Environment Code, formally defined the status of the BNI Local Information Committees (CLI). The CLIs are presented in chapter 6.

The corresponding provisions can be found in sub-section 3 of section 2 of chapter V of title II of book 1 of the Environment Code. The CLI can be created as soon as the BNI creation authorisation application is made. Whatever the case, it must be constituted once the authorisation decree has been issued.

The modifications made by the PLTECV, which includes a title devoted to nuclear matters (title VI "Reinforcing nuclear safety and information of the citizens") are detailed in Chapter 6, point 2.3.1. In this respect, the bill stipulates that the specific nature of the CLIs of BNIs close to a border must be taken into account, by enabling foreign nationals from the countries concerned (more specifically Germany, Belgium, Luxembourg and Switzerland) to sit on the committees.

Consultation of other European Union countries

Pursuant to Article 37 of the Treaty instituting the European Atomic Energy Community and to the BNI Procedures Decree of 2nd November 2007, the creation of a facility liable to discharge radioactive effluents into the environment can only be authorised after consulting the European Commission.

Consultation of technical organisations

The preliminary safety analysis report appended to the creation authorisation application is transmitted to ASN, which may submit it for examination to one of the Advisory Committees reporting to it, following a report from IRSN.

Further to its investigation and the results of the consultations, ASN sends the Minister responsible for Nuclear Safety a draft decree proposal authorising or rejecting creation of the installation.

Authorisation decree

The Minister responsible for Nuclear Safety sends the licensee a preliminary draft decree granting or refusing Creation Authorisation (DAC, see diagram 5). The licensee has a period of two months in which to present its observations. The Minister then obtains the opinion of ASN. ASN resolution DC-0179 of 13th April 2010 gives licensees and the CLIs the possibility of being heard by the ASN Commission before it gives its opinion.

The creation authorisation for a BNI is delivered by a decree from the Prime Minister and countersigned by the Minister responsible for Nuclear Safety.

The Creation Authorisation Decree (DAC) establishes the perimeter and characteristics of the facility. It also specifies the duration of the authorisation, if applicable, and the installation commissioning deadline. It also specifies the essential elements required to protect public health and safety, or to protect nature and the environment.

The requirements defined by ASN for application of the authorisation decree

For application of the DAC, ASN defines the requirements regarding the design, construction and operation of the BNI that it considers to be necessary for nuclear safety.

ASN defines the requirements regarding the BNI water intakes and effluent discharges. The specific requirements setting limits on the discharges from the BNI into the environment are subject to approval by the Minister responsible for Nuclear Safety.

Modification of a BNI

The BNI system currently makes provision for two cases when dealing with modifications to the facility or its operating conditions:
- "significant" modifications to the facility, as specified in Article L. 593-14 of the Environment Code: these modifications are subject to a procedure similar to that of a creation authorisation application in accordance with the procedure specified in Articles L. 593-7 to L. 593-12 of this same code.

A modification is considered to be "significant" in the cases mentioned in Article 31 of the BNI Procedures Decree of 2nd November 2007:
- a change in the nature of the installation or an increase in its maximum capacity;
- a modification of the key elements protecting the interests mentioned in the first paragraph of Article L. 593-1 of the Environment Code, which appear in the authorisation decree;
- the addition, within the perimeter of the facility, of a new BNI, the operation of which is linked to that of the facility in question.

- the other modifications only require notification of ASN under the terms of Article 26 of the BNI Procedures Decree of 2nd November 2007. Thus, when a licensee envisages modifications to its facility or its operating conditions that are not considered to be significant, in accordance with the above-mentioned criteria, it shall first of all notify ASN of them. It cannot make the modifications until a renewable period of at least six months has expired, unless ASN gives its express agreement. If it so considers necessary, ASN may stipulate requirements so that the envisaged modifications are reviewed or accompanied by additional measures to guarantee the protection of the interests mentioned in the first paragraph of Article L. 593-1 of the Environment Code.

Pursuant to Article L. 593-15 of the Environment Code, BNI modification projects that could cause a significant increase in its water intake or effluent discharges to the environment have been made available to the public since 1st June 2012. This practice had previously been recommended to the licensees by ASN since 2008 and had been implemented on several occasions. ASN resolution 2013-DC-0352 of 18th June 2013 concerning public access to modification draft files specified in Article L. 593-15 of the Environment Code specifies the conditions for implementation of this procedure (see Chapter 6, point 2.2).

The other installations located within a BNI perimeter

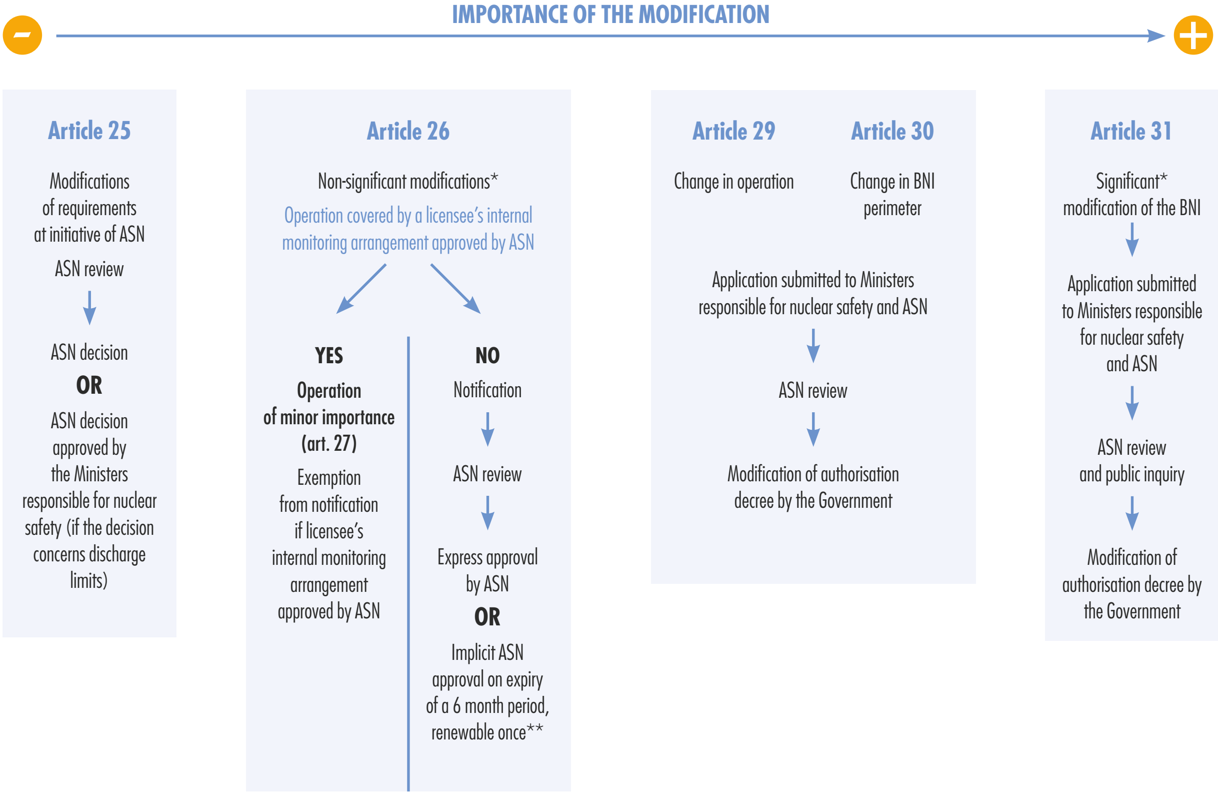
The following co-exist within the perimeter of a BNI:
- the equipment and installations which are part of the BNI: they constitute an element of this facility necessary for its operation. Technically, depending on its type, this equipment may be comparable to classified installations but, as a part of the BNI, it is subject to the BNI regulations;
- equipment and installations which are not necessarily linked to the BNI. The equipment necessary for BNI operation is fully covered by the BNI system specified in the BNI Procedures Decree. The other equipment subject to another system (water or ICPE) but located within the perimeter of the BNI remains subject to this system, but with a change in competent party, as individual measures are no longer taken by the Prefect, but by ASN.

GREEN GROWTH ENERGY TRANSITION BILL

Certain BNI modifications, which do not warrant a new complete authorisation procedure, are sufficiently large-scale to merit more than simple notification to ASN. This is why the PLTECV, which comprises a title devoted to nuclear matters (title VI "Reinforcing nuclear safety and information of the citizens") introduces a two-tier system in place of the notification system of Article 26 of the BNI Procedures Decree of 2nd November 2007: ASN authorisation for modifications that are significant and ASN notification for the others. The consequence of the creation of this system will be to give ASN new and appropriate powers.

Provisions will therefore be made for three situations:
- "substantial" modifications to the facility, its authorised operating conditions or elements which led to its authorisation (which correspond to the existing "significant" facility modifications) will continue to be covered by a procedure similar to that of a creation authorisation application (authorisation issued by decree) carried out in accordance with the procedure specified in Articles L. 593-7 to L. 593-12 of this same code;
- "significant" modifications to the facility, its authorised operating conditions, elements which led to its authorisation or its commissioning authorisation (corresponding to the existing modifications requiring notification under the terms of Article 26 of the BNI Procedures Decree of 2nd November 2007), shall, depending on their scale, be subject to:
  - either an ASN authorisation decision, concerning the more important modifications;
  - or notification to ASN, concerning the modifications of more limited impact.

DIAGRAM 4: Types of BNI modification provided for by the "BNI Procedures Decree" of 2nd November 2007



** Definition of significant modification of a BNI: a change in its nature or rise in its capacity, a change in the key aspects regarding the protection of public health and safety, nature and the environment, the addition of a new BNI within the perimeter of the initial BNI.*
*** This time allows ASN to proceed with a new review or issue additional requirements.*

3.3.5 Commissioning licenses

Commissioning corresponds to the first utilisation of radioactive materials in the installation or the first operation of a particle beam.

Prior to commissioning, the licensee sends ASN a dossier comprising the updated safety analysis report of the "as-built" installation, the general operating rules, a waste management study, the on-site emergency plan and the decommissioning plan.

After checking that the installation complies with the objectives and rules specified in chapter III of title IX of book V of the Environment Code and its implementing texts, ASN authorises commissioning of the installation and communicates this decision to the Minister responsible for Nuclear Safety and to the Prefect.

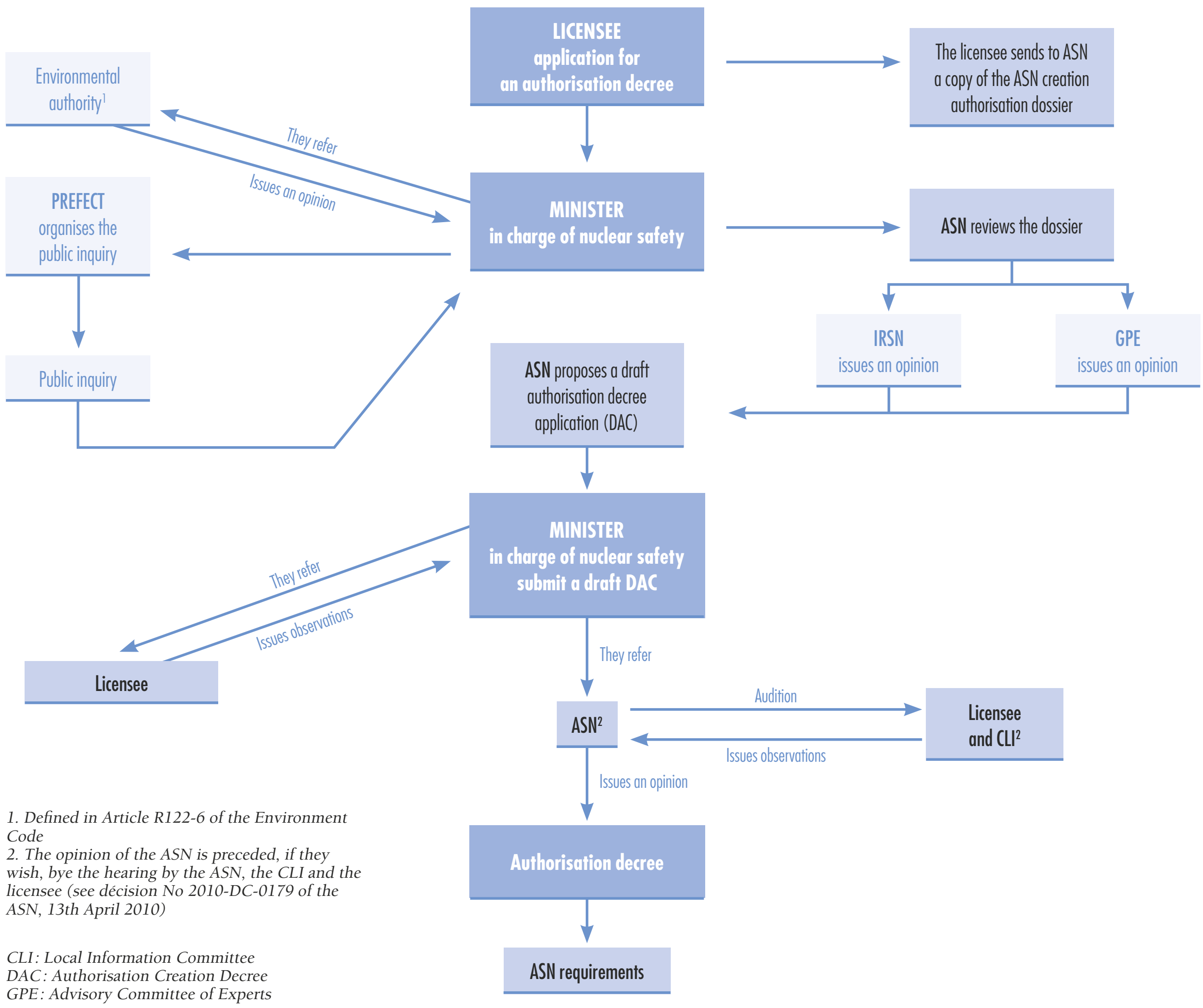
It also communicates it to the CLI.

3.4 Particular requirements for the prevention of pollution and detrimental effects

3.4.1 The OSPAR convention

The international OSPAR Convention (resulting from the merging of the Oslo and Paris conventions) is the mechanism whereby the European Commission and fifteen member States, including France, cooperate to protect the marine environment of the North-East Atlantic. The strategic orientations for radioactive substances consist in "preventing pollution of the maritime zone by ionising radiation by progressively and substantially reducing discharges, emissions and losses of radioactive substances. The ultimate aim is to achieve environmental concentrations that are close to the ambient values in the case of naturally occurring radioactive substances, and close to zero in the case of man-made radioactive substances".

DIAGRAM 5: Creation authorisation procedure for a Basic Nuclear Installation defined in chapter III or title IX of book V of the Environment Code



1. Defined in Article R122-6 of the Environment Code
2. The opinion of the ASN is preceded, if they wish, bye the hearing by the ASN, the CLI and the licensee (see décision No 2010-DC-0179 of the ASN, 13th April 2010)

CLI: Local Information Committee
DAC: Authorisation Creation Decree
GPE: Advisory Committee of Experts

To achieve these objectives, the following are taken into account:
- the radiological impacts on humans and biota;
- the legitimate uses of the sea;
- technical feasibility.

Within the French delegation, ASN takes part in the work of the committee tasked with assessing application of this strategy.

3.4.2 The ESPOO convention

The convention on the assessment of environmental impacts in a transboundary context, more commonly called the "ESPOO convention", requires that the contracting parties conduct an environmental assessment of the impacts of activities liable to have a transboundary environmental impact before licensing this activity and that they notify the neighbouring country concerned of this assessment. Certain nuclear facilities – such as NPPs, nuclear fuel production or enrichment facilities, radioactive waste disposal or reprocessing facilities – are directly concerned by this convention.

The ESPOO convention was adopted in 1991 and entered into force in September 1997.

3.4.3 ASN resolution 3.4.3-DC-0360 of 16th July 2013 concerning the control of detrimental effects and the health and environmental impact of BNIs

Resolution 2013-DC-0360 of 16th July 2013 concerning the control of detrimental effects and the health and environmental impact of BNIs supplements the implementation procedures of title IV of the BNI Order of 7th February 2012. Its main provisions concern methods for water intake and

liquid or gaseous, chemical or radioactive discharges, the monitoring of water intake and discharges, environmental monitoring, prevention of detrimental effects and information to the regulatory authority and the public. With regard to environmental protection, the BNI Order of 7th February 2012 and the resolution of 16th July 2013 more specifically aim to address the following main objectives or issues:
- implement the integrated approach specified by law, whereby the BNI system governs all the risks, pollution and detrimental effects created by these installations;
- include the regulations applicable to Basic Nuclear Installations prior to 1st July 2013;
- incorporate into the regulations the requirements applicable to the BNI licensees by certain individual ASN decisions concerning water intake and effluent discharge, in order to create a more general and uniform framework;
- set binding unified principles and rules applicable to the BNIs;
- for BNIs, adopt requirements at least equivalent to those applicable to ICPEs and installations, structures, works and activities (IOTA) concerned by the list specified in Article L. 214-2 of the Environment Code, more specifically those of the Order of 2nd February 1998 concerning water intake and consumption and emissions of all types from installations classified on environmental protection grounds subject to authorisation, in accordance with the provisions of the BNI Order of 7th February 2012;
- adopt provisions, the implementation of which is such as to guarantee the quality of the steps taken by the BNI licensees for monitoring of their facilities (monitoring of effluents and of the environment);
- improve public information practices, making the corresponding steps taken by the licensees more legible.

3.4.4 BNI discharges

BNI discharges management policy

Like all industries, nuclear activities (nuclear industry, nuclear medicine, research installations, etc.) create by-products, which may or may not be radioactive. Steps are being taken to minimise their quantity through reduction at source.

The radioactivity discharged in effluents represents a marginal fraction of that which is confined in the waste.

The choice of the means of discharge (liquid or gaseous) is part of a more general approach aimed at mitigating the overall impact of the installation.

ASN makes sure that the BNI creation authorisation application explains the licensee's choices, in particular the reduction at source measures, the decisions taken between confinement, treatment or dispersal of substances, based on safety and radiation protection considerations.

The optimisation efforts encouraged by the authorities and made by the licensees have - for "equivalent operation" - resulted in these emissions being constantly reduced. ASN hopes that setting discharge limit values will encourage the licensees to maintain their discharge optimisation and management efforts. It ensures that discharges are kept to the minimum possible by using the best techniques available, and has undertaken a revision of the discharge limits in recent years.

The impact of BNI chemical discharges

The substances discharged can have an impact on the environment and the population owing to their chemical characteristics.

ASN considers that BNI discharges should be regulated in the same way as those of other industrial facilities. The TSN Act of 13th June 2006, codified in books I and V of the Environment Code, and more broadly the general technical regulations concerning discharges and the environment, take this question into account. This integrated approach is little used abroad, where chemical discharges are often regulated by an Authority different from that in charge of radiological issues.

ASN wants the impact of chemical discharges on the populations and the environment to be as low as possible, in the same way as for radioactive substances.

The impact of BNI thermal discharges

Some BNIs, especially nuclear power plants, discharge cooling water into watercourses or the sea, either directly or after cooling in cooling towers. Thermal releases lead to a temperature rise in the receiving environment of up to several degrees.

The regulatory limits aim to prevent a modification of the receiving environment, in particular fish life, and to ensure acceptable health conditions if water is taken for human consumption downstream. These limits can thus differ according to the environment and the technical characteristics of each installation.

3.4.5 Prevention of accidental pollution

The BNI Order of 7th February 2012 and ASN resolution 2013-D-0360 of 16th July 2013 concerning the control of detrimental effects and the health and environmental impact of BNIs, impose obligations designed to prevent, or in the event of an accident, to minimise direct or indirect discharges of toxic, radioactive, flammable, corrosive or explosive liquids into the sewer systems or the environment.

3.5 Requirements concerning radioactive waste and decommissioning

3.5.1 Management of BNI radioactive waste

The management of waste, whether or not radioactive, in the BNIs is regulated by ASN, notably to prevent and minimise – in particular at the source – the production and harmfulness of the waste, more specifically by means of requirements concerning the design, classification, treatment and packaging.

In order to perform this regulation, ASN more specifically relies on a number of documents produced by the BNI licensees:
- the impact assessment, which is part of the creation authorisation application as described in Article 8 of the BNI Procedures Decree of 2nd November 2007;
- the waste management study, which is part of the commissioning authorisation application as described in Article 20 of the BNI Procedures Decree of 2nd November 2007, the contents of which are specified in Article 6.4 of the BNI Order of 7th February 2012. This study in particular includes an analysis of the waste produced or to be produced in the facility and the steps taken by the licensee to manage it, as well as the waste zoning plan;
- the waste summary specified in Article 6.6 of the BNI Order of 7th February 2012. This summary aims to verify that waste management complies with the provisions of the waste management study and to identify areas for improvement.

In order to clarify its requirements concerning these documents and the actual waste management operations, ASN is currently finalising a draft resolution. This was submitted to the public for consultation, from 18th August to 26th September 2014.

3.5.2 Decommissioning

The legal framework for BNI decommissioning and the modifications made by the PLTECV are described in detail in Chapter 15.

Once the licensee has decided to cease operations in its installation in order to proceed with final shutdown and decommissioning, it is no longer covered by the framework set by the licensing decree nor the baseline safety requirements system associated with the operating phase. Safety issues can be significant during active clean-out or dismantling operations and must never be neglected, including during passive surveillance phases.

In accordance with the provisions of chapter III of title IX of book V of the Environment Code, final shutdown and then decommissioning of a nuclear facility are authorised by a further decree, issued after consultation of ASN. The final shutdown and decommissioning (MAD-DEM) authorisation application is subject to the same consultations and inquiries as apply to BNI creation authorisation applications. This application shall be submitted at least one year before the date scheduled for final shutdown.

The MAD-DEM decree in particular determines the characteristics of decommissioning, its completion deadline and, as necessary, the operations under the responsibility of the licensee after decommissioning.

In order to avoid excessive fragmentation of the decommissioning projects and improve their overall consistency, the file presented to support the MAD-DEM authorisation application shall explicitly describe all the work envisaged, from final shutdown to conclusion of the target final state. The nature and scale of the risks presented by the facility as well as the means deployed to control them must be explained for each step.

ASN has detailed the regulatory framework for BNI decommissioning operations in guide No.6, which results from extensive work to clarify and simplify the administrative procedures while at the same time improving the integration of nuclear safety and radiation protection.

Installation delicensing

Following decommissioning, a nuclear installation can be delicensed. It is then removed from the BNI list and is no longer subject to the BNI system. To support its delicensing application, the licensee must provide a dossier demonstrating that the envisaged final state has indeed been reached and describing the state of the site after decommissioning (analysis of the state of the soil and remaining buildings or equipment, etc.). Depending on the final state reached, institutional controls may be implemented, according to the intended subsequent use of the site and buildings. These may contain a certain number of restrictions on use (only to be used for industrial applications for example) or precautionary measures (radiological measurements to be taken in the event of excavation, etc.). ASN can make the application of such institutional controls a prerequisite for delicensing.

3.5.3 The nancing of decommissioning and radioactive waste management

Sections 1 and 2 of chapter IV of title IX of book V of the Environment Code (previously Article 20 of the "Waste Act") create an arrangement for ring-fencing funds to meet the costs of decommissioning nuclear facilities and managing radioactive waste (see chapter 15, point 1.4). These arrangements are clarified by Decree 2007-243 of 23rd February 2007 concerning the secure financing of nuclear costs, modified by Decree 2013-678 of 24th July 2012 and the Order of 21st March 2007 concerning the secure financing of nuclear costs. The legal system created by these texts aims to secure the financing of nuclear costs, through implementation of the "polluter-pays" principle. It is therefore up to the nuclear licensees to ensure this financing, by setting up a portfolio of assets dedicated to the expected costs. This is done under the direct control of the State, which analyses the situation of the licensees and can prescribe measures should it be seen to be insufficient or inadequate. In any case, the nuclear licensees remain responsible for the satisfactory financing of their long-term costs.

It stipulates that the licensees must make a prudent assessment of the cost of decommissioning their installations or, for radioactive waste disposal installations, their final shutdown, maintenance and monitoring costs. They also evaluate the cost of managing their spent fuel and radioactive waste, according to Article L. 594-1 of the Environment Code. Pursuant to the Decree of 23rd February 2007, ASN issues an opinion on the consistency of the decommissioning and spent fuel and radioactive waste management strategy presented by the licensee with regard to nuclear safety.

From among the assets liable to be accepted to cover the provisions for the costs mentioned in Article L. 594-1 of the Environment Code (decommissioning of facilities, final shutdown, maintenance and monitoring costs, spent fuel and radioactive waste management costs), the Decree of 24th July 2013 identifies those which are mentioned by the provisions of the Insurance Code and those which are specific to the licensees of nuclear facilities. It makes certain types of debts acceptable (notably certain medium-term negotiable bonds and securitisation mutual funds) and, in certain conditions, unquoted stock; as a result of this extension, it more specifically clarifies the exclusion criteria for unquoted intra-group stock. It sets the maximum value of the assets within a given category or from the same issuer and determines new ceilings for assets that have become acceptable.

3.6 Particular requirements for pressure equipment

Pressure equipment is subject to the provisions of Chapter VII of title V of book V of the Environment Code, resulting from Act 2013-619 of 16th July 2013 comprising various provisions to adapt European Union law in the field of sustainable development, repealing Act 571 of 28th October 1943 concerning steam pressure equipment utilised on land and gas pressure equipment utilised on land or on-board seagoing vessels.

Pending a definition by decree from the Council of State concerning the actual implementation of this Chapter, the regulatory provisions in force are those defined by Decree 99-1046 of 13th December 1999 concerning pressure equipment and by its implementing tests. The principles of these regulations are those of the new approach pursuant to the European Pressure Equipment Directive.

Pressure equipment specially designed for BNIs, known as "nuclear pressure equipment" (ESPN) is subject to both the BNI system and the pressure equipment system. For this equipment, specific orders stipulate the provisions defined by the above-mentioned decree of 13th December 1999.

Nuclear pressure equipment is designed and produced by the manufacturer under its own responsibility. The manufacturer is required to comply with the main security and radiation protection requirements contained in the regulations and to have the conformity of its nuclear pressure equipment assessed by an independent, competent third-party organisation approved by ASN. The equipment in operation must be monitored and maintained by the licensee under ASN control and must undergo periodic technical inspections by ASN-approved organisations. The list of approved organisations and the associated approval decisions are available on the website at *www.asn.fr.*

ASN is responsible for monitoring the organisations it approves.

Article L. 592-24 of the Environment Code extends the competence of ASN to the regulation of other pressure equipment (known as "conventional") which is present in a BNI.

Table 2 summarises the texts applicable to the pressure equipment present in BNIs.

TABLE 2: Regulations applicable to pressure equipment

	NUCLEAR PRESSURE EQUIPMENT		NON-NUCLEAR PRESSURE EQUIPMENT
	PWR REACTOR MAIN PRIMARY AND SECONDARY SYSTEMS	OTHER NUCLEAR PRESSURE EQUIPMENT	
GENERAL PROVISIONS	Chapter VII of title V of book V of the Environment Code Title I, IV and V of decree 99-1046 of 13th December 1999		
	Title I and IV of the order of 12th December 2005	Title I and IV of the order of 12th December 2005	
MANUFACTURING PROVISIONS	Title II of the order of 12th December 2005	Title II of the order of 12th December 2005	Title II of decree 99-1046 of 13th December 1999
OPERATING PROVISIONS	Title III of decree 99-1046 of 13th December 1999; Order of 10th November 1999	Title III of decree 99-1046 of 13th December 1999; Title III of the order of 12th December 2005	Title III of decree 99-1046 of 13th December 1999; Order of 15th March 2000 as amended[1]

1. The technical provisions of the decree of 2nd April 1926, amended, regulating steam systems other than those placed on-board ships and decree 63 of 18th January 1943, amended, regulating gas pressure systems, can be applied to repair and modification operations when this pressure equipment is manufactured in compliance with these regulations.

4. REGULATIONS GOVERNING THE TRANSPORT OF RADIOACTIVE SUBSTANCES

4.1 International regulations

For the safe transport of radioactive substances, International Atomic Energy Agency (IAEA) has issued Safety Requirements document TS-R-1 "Regulations for the Safe Transport of Radioactive Material". ASN takes part in the work being done within IAEA concerning the transport of radioactive substances.

This basis specific to radioactive substances is used in the drafting of the "modal" transport safety regulations in force for dangerous goods: the ADR agreement (European Agreement on the international transport of Dangerous goods by Road) for road transport, the regulations concerning International Rail transport of Dangerous goods (RID) for rail transport, the regulations for the transport of Dangerous goods on the Rhine (ADNR) for river transport, the International Maritime Dangerous Goods code (IMDG) for maritime transport and the technical instructions of the ICAO (International Civil Aviation Organisation) for air transport.

Directive 2008/68/EC of 24th September 2008 establishes a common framework for all aspects of dangerous goods inland transport by road, rail and inland waterways within the European Union.

The regulations derived from IAEA recommendations specify the package performance criteria. The safety functions to be assured are containment, radiation protection, prevention of thermal hazards and criticality.

The level of safety of the package is tailored to the potential danger of the transported content: a certain number of resistance tests representative of the risks entailed by the transport operation, including the risk connected with the content of the package, are associated with each type of package.

The regulations also define the scope of intervention of the public authorities and the associated safety requirements for each type of package (see chapter 11, point 2).

4.2 National regulations

The "modal" regulations are transposed in full into French law and are made applicable by interministerial orders based on the provisions of the Transport Code, especially its Articles L. 1252-1 and following. ASN is in contact with the Administrations responsible for the various modes of transport (General Directorate for Infrastructure, Transport and the Sea (DGITM), General Directorate for Risk Prevention (DGPR) and General Directorate for Civil Aviation (DGAC)) and attends the French Interministerial Commission for the Carriage of Dangerous Goods (CITMD).

Directive 2008/68/EC of 24th September 2008 is transposed into French law by a single order covering all land transport on the national territory. This is the Order of 29th May 2009 as amended concerning the transport of dangerous goods by land, known as the "TMD" Order. This text has replaced the former "ADR", "RID" and "ADNR" modal orders since 1st July 2009.

Spent nuclear fuel from the Netherlands arriving in the Valognes rail terminal.

Other orders specific to a mode of transport apply to the transport of radioactive substances:
- the Order of 12th May 1997 as amended, concerning the technical conditions for the operation of aircraft by a public air transport operator (OPS1);
- the Order of 23rd November 1987 as amended, division 411 of the Regulation concerning the Safety of Ships (RSN);
- the Order of 18th July 2000 as amended, regulating the transport and handling of dangerous goods in sea ports.

The regulations require approval of the package models for certain radioactive substance transport operations (see chapter 11). These approvals are issued by ASN.

Article R. 1333-44 of the Public Health Code also requires that companies transporting radioactive materials in France be subject to either notification or licensing by ASN.

Implementation of the regulations on the safe transport of radioactive substances is checked by nuclear safety inspectors duly appointed by ASN.

5. PROVISIONS APPLICABLE TO CERTAIN RISKS OR CERTAIN PARTICULAR ACTIVITIES

5.1 Polluted sites and soils

The tools and the approach to be followed for management of polluted sites and soils are described in detail in Chapter 16. On 4th October 2012 ASN published a doctrine on the management of sites polluted by radioactive substances based on several principles. These principles are applicable to all sites polluted by radioactive substances. ASN's prime objective is to achieve the most thorough cleanout possible, aiming for complete removal of the radioactive pollution to allow unrestricted use of the cleaned out premises and land. Nevertheless, when this objective cannot be technically achieved, justification must be given and appropriate measures implemented to guarantee the compatibility of the site's condition with its actual or planned use.

The modifications made by the PLTECV are described in detail in Chapter 16.

5.2 ICPEs utilising radioactive substances

The ICPE system comprises objectives that are similar to those for BNIs, but it is not specialised and applies to a large number of installations involving risks or detrimental effects of all types.

Licensing by the Prefect, registration or simple notificaction is required for ICPEs according to the scale of the hazards they represent.

For installations requiring licensing, this license is issued by order of the Prefect following a public inquiry. The license comprises requirements which may be subsequently modified by a further order.

The list of ICPEs is given in column A of the appendix to Article R. 511-9 of the Environment Code. It defines the types of installations subject to the system and the applicable thresholds.

The ICPE list was modified following the publication of decree 2014-996 of 2nd September 2014 with regard to the 1700 sections linked to the use of radioactive substances (it deletes section 1715 and creates sections 1716 for radioactive substances in unsealed form, 2797 for radioactive waste and 2798 for temporary management of waste resulting from a nuclear or radiological accident). At the end of 2014, four sections of the ICPE list concerned radioactive materials:
- section 1716 for radioactive substances in unsealed form;
- section 2797 for radioactive waste;
- section 2798 for the temporary management of waste resulting from a nuclear or radiological accident;
- section 1735 which requires licensing of repositories, storage or disposal facilities for solid residues of uranium, thorium or radium ore, as well as their processing by-products not containing uranium enriched with isotope 235 and for which the total quantity exceeds one ton.

The following three points of the decree of 2nd September 2014 should be noted in particular:
- the activities and installations for the management of radioactive waste [pursuant to Council Directive 2011/70/Euratom of 19th July 2011 establishing a European community framework for the responsible and safe management of spent fuel and radioactive waste] are subject to licensing;
- only radioactive substances in unsealed form with potential environmental implications are subject to the ICPE system; all sealed sources are subject to the Public Health Code;
- the license or notification issued in accordance with section 1715 continues to carry the same value as a license or notification under the Public Health Code, until a new license is obtained under the Public Health Code or, failing which, for a maximum period of five years, in other words no later than 4th September 2019.

Pursuant to Article L. 593-3 of the Environment Code, an installation covered by the list of ICPEs which is also covered by the BNI legal system would in fact only be subject to the latter system.

Similarly, by virtue of Article L. 1333-4 of the Public Health Code, the licenses issued to ICPEs under the Environment Code for the possession or utilisation of radioactive sources take the place of the license required under the Public Health Code. However, except for the provisions concerning procedures, the legislative and regulatory provisions of the Public Health Code apply to them.

5.3 The regulatory framework for protection against malicious acts in nuclear activities

Malicious acts are among the BNI external hazards that must be considered in the procedures subject to the Environment Code and regulated and monitored by ASN. In this respect, in its safety analysis report, the licensee must present an assessment of the accidents liable to occur in the facility, regardless of the cause of the accident, including if it results from a malicious act. This assessment, which mentions the effects of accidents and the steps taken to prevent them or mitigate their effects, is taken into account when determining whether or not the creation authorisation can be granted. The most important risk prevention or mitigation measures can be the subject of ASN requirements.

However, ASN is not responsible for either determining the malicious threats to be considered, nor for regulating and monitoring the physical protection of nuclear facilities against malicious acts. The threats to be considered when examining malicious acts are defined by the Government (General Secretariat for Defence and National Security - SGDSN).

With regard to protection against malicious acts, two arrangements instituted by the Defence Code apply to certain nuclear activities:
- chapter III of title III of book III of the first part of the Defence Code defines the measures to protect and monitor nuclear materials. This concerns the following fusible, fissile or fertile materials: plutonium, uranium, thorium, deuterium, tritium, lithium-6, as well as chemical compounds comprising one of these elements, except ores. To prevent the dissemination of these nuclear materials, their

import, export, production, possession, transfer, use and transport are subject to licensing;
- chapter II of title III of book III of the first part of the Defence Code defines a system for protection of establishments which *"if unavailable, would risk significantly compromising the nation's combat or economic potential, its security or its capacity for survival"*. The TSN Act of 13th June 2006 supplemented Article L. 1332-2 of the Defence Code in order to enable the administrative authority to apply this system to facilities comprising a BNI *"when the destruction of or damage to (this BNI) could constitute a serious danger for the population"*. This protection system requires that the licensees take the protective measures stipulated in a particular protection plan prepared by them and approved by the administrative authority. These measures in particular include effective surveillance, alarm and material protection measures. If the plan is not approved and in the event of persistent disagreement, the decision is taken by the administrative authority.

With regard to nuclear activities outside the scope of national defence, these systems are monitored at the national level by the Defence and Security High Official (HFDS) at the Ministry responsible for energy.

Within the context of a joint working group, ASN and the HFDS regularly discuss accidents considered in the safety analysis reports, so that the regulation authorisation processes carried out pursuant to the Defence Code are consistent with those resulting from the Environment Code.

For radioactive sources which are not nuclear materials as specified above and which are not used in facilities subject to the protection obligations specified in the Defence Code, there are at present no arrangements for monitoring the steps taken by those in possession of these sources to prevent any malicious acts. Yet, such acts involving some of these sources could have serious consequences. This is why, in 2008, the Government adopted the principle of obligations to take preventive measures applicable to the holders, with implementation thereof being monitored by ASN. Legislative provisions have been drafted accordingly but not yet submitted to Parliament (see Chapter 10, point 3.6).

5.4 The particular system applicable to defence-related nuclear activities and installations

The provisions concerning defence-related nuclear facilities and activities were codified in the Defence Code (creation of a sub-section 2 entitled "Defence-related nuclear facilities and activities" in Chapter III of title II of book III of the first part of the legislative part) by ordinance 2014-792 of 10th July 2014 implementing Article 55 of Act 2013-1168 of 18th December 2013 concerning military planning for the years 2014 to 2019 and constituting various provisions concerning defence and national security.

Pursuant to Article L. 1333-15, defence-related nuclear facilities and activities are:
- Secret Basic Nuclear Installations (SBNI);
- military nuclear systems;
- defence-related nuclear experimentation sites and installations;
- the former nuclear experimentation sites in the Pacific;
- transport of fissile or radioactive materials involved in nuclear weapons and naval nuclear propulsion activities.

A large number of the provisions applicable to nuclear activities governed by ordinary law also apply to defence-related nuclear activities and installations; for example, they are subject to the same general principles as all nuclear activities and the requirements of the Public Health Code, including the system of licensing and notification of small-scale nuclear activities, and they concern defence-related nuclear activities and installations in the same conditions as the ordinary law activities, except for the fact that the licenses are granted by the Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (DSND), reporting to the Minister of Defence and the Minister of Industry. Oversight of these activities and installations is the responsibility of the personnel of the Defence Nuclear Safety Authority (ASND) headed by the DSND.

Other provisions are specific to defence-related nuclear activities and facilities. They are subject to particular information rules in order to comply with specific defence requirements. Similarly, the installations on the list of BNIs, but which are classified as SBNI by order of the Prime Minister, are not subject to the BNI system but to a special system defined by the Defence Code and implemented by the ASND (see section 2 of chapter III of book III of the first part of the Defence Code).

ASN and ASND maintain very close relations to ensure consistency between the systems for which they are responsible.

6. OUTLOOK

With regard to radiation protection, ASN plays an active role in preparing the transposition of the Euratom Directive on basic standards. Since November 2013 it has acted as secretary for the transposition committee. The Health Bill submitted by the Government in October 2014 makes provisions for the use of an ordinance for the legislative transposition measures. 2015 should in particular be devoted to drafting this ordinance and to continued work to update the regulatory parts of the Public Health Code and the Labour Code, which was started in 2014.

With regard to BNIs, ASN will in 2015 be continuing the considerable work to overhaul the general regulations applicable to BNIs, as part of a gradual but nonetheless significant process of evolution. The regulations will thus be updated and will incorporate the WENRA "reference levels" and the best practices already firmly established in common usage or in ASN's individual prescriptions, in order to provide a clear, comprehensive and uniform framework.

In the end, about twenty statutory resolutions and as many guides will supplement and clarify the BNI Order of 7th February 2012 in order to create a common regulatory foundation applicable to all BNIs, in line with the best European standards. There will thus be fewer individual resolutions (ASN authorisations and prescriptions) following their integration into the general regulations, and they will focus on the particular aspects specific to each BNI. As at 31st December 2014, eight statutory resolutions and six guides have already been published.

ASN will continue to support all the nuclear stakeholders, a process it initiated at the 21st March 2014 seminar presenting and discussing the main advances in the overhaul of the general technical regulations applicable to BNIs, throughout the process which should continue until 2016, so that it is implemented on-time and in the best conditions.

The PLTECV, which comprises a title devoted to nuclear matters (title VI "Reinforcing nuclear safety and information of the citizens") should be adopted in early 2015.

In 2015, ASN will assist in the drafting of the ordinances provided for by this act in the fields under its responsibility. The work concerning the implementing decrees will for its part be an opportunity to initiate the codification of the regulatory part of the BNI system.

APPENDIX

The collection of ASN guides

N°1	Final disposal of radioactive waste in deep geological formations (February 2008)
N°2	Transport of radioactive materials in airports (February 2006)
N°3	Recommendations for drafting annual information reports for the public concerning Basic Nuclear Installations (October 2010)
N°4	Auto-assessment of risk exposure of patients receiving external radiotherapy (January 2009)
N°5	Management of radiotherapy safety and quality of treatment (April 2009)
N°6	Final shutdown, decommissioning and delicensing of Basic Nuclear Installations in France (June 2010)
N°7	Civil transport of radioactive packages or substances on the public highway: • Volume 1: shipment certification and approval applications (February 2013). • Volume 2: Package models safety file, European "Package Design Safety Report" guide (September 2012).
N°8	Evaluation of nuclear pressure vessel conformity (September 2012)
N°9	Determining the perimeter of a BNI (October 2013)
N°10	Local involvement of CLIs in the 3rd ten-year outage of the 900 MWe reactors (June 2010)
N°11	Notification and codification of criteria relative to significant radiation protection events excluding BNIs and radioactive material transport operations (October 2009)
N°12	Notification and codification of criteria related to significant safety, radiation protection or environmental events applicable to BNIs and radioactive material transport operations (October 2005)
N°13	Protection of Basic Nuclear Installations against external flooding (January 2013)
N°14	Acceptable complete clean-out methodologies in BNIs in France (June 2010)
N°16	Significant radiation protection event affecting a radiotherapy patient: declaration and classification on the ASN-SFRO scale (October 2010)
N°17	Contents of radioactive substance transport incident and accident management plans (December 2014)
N°18	Disposal of effluents and waste contaminated by radionuclides, produced in facilities licensed under the Public Health Code (January 2012)
N°19	Application of the order of 12th December 2005 relating to nuclear pressure equipment (February 2013)
N°20	Drafting of the medical physics organisation plan (POPM) (April 2013).

APPENDIX

Regulation exposure limits and dose levels

ANNUAL EXPOSURE LIMITS contained in the Public Health Code and in the Labour Code

REFERENCES	DEFINITIONS	VALUES	OBSERVATIONS
ANNUAL LIMITS FOR THE GENERAL PUBLIC			
Article R.1333-8 of the Public Health Code	• Effective dose	1 mSv/an	• These limits comprise the sum of effective or equivalent doses received as a result of nuclear activities. These are limits that must not be exceeded.
	• Equivalent dose for the lens of the eye	15 mSv/an	
	• Equivalent dose for the skin (average dose over any area of 1 cm² of skin, regardless of the area exposed)	50 mSv/an	
WORKER LIMITS FOR 12 CONSECUTIVE MONTHS			
Article R. 4451-13 of the Labour Code	**Adults** • Effective dose • Equivalent dose for the hands, forearms, feet and ankles • Equivalent dose for the skin (average dose over any area of 1 cm² of skin, regardless of the area exposed) • Equivalent dose for the lens of the eye	20 mSv 500 mSv 500 mSv 150 mSv	• These limits comprise the sum of effective or equivalent doses received. These are limits that must not be exceeded. • Exceptional waivers are accepted: - when justified beforehand, they are scheduled in certain working areas and for a limited period, subject to special authorisation. These individual exposure levels are planned according to a ceiling limit which is no more than twice the annual exposure limit value; - emergency occupational exposure is possible in an emergency situation, in particular to save human life.
	Pregnant women • Exposure of the child to be born	1 mSv	
	Young people from 16 to 18 years old* : • Effective dose • Equivalent dose for the hands, forearms, feet and ankles • Equivalent dose for the skin • Equivalent dose for the lens of the eye	6 mSv 150 mSv 150 mSv 50 mSv	

** Only if covered by waivers, such as for apprentices.*

OPTIMISATION LEVELS for patient protection (Public Health Code)

REFERENCES	DEFINITIONS	VALUES	OBSERVATIONS
DIAGNOSTIC EXAMINATIONS			
Diagnostic reference level Article R.1333-68, Order of 16th February 2004	Dose levels for standard diagnostic examinations	E.g.: entrance dose of 0.3 mGy or dose area product (DAP) 25 cGy.cm² for an antero-posterior thorax radiograph	• The diagnostic reference levels, the dose constraints and the dose target levels are used by applying the principle of optimisation. They are simply guidelines. • The reference levels are created for standard patients by dose levels for typical radiology examinations and by the radioactivity levels of radiopharmaceutical products in diagnostic nuclear medicine.
Dose constraint Article R.1333-65, Order of 7th November 2007	Used when exposure offers no direct medical benefit to the person exposed		The dose constraint can be a fraction of a diagnostic reference level, in particular for exposure in the context of biomedical research or forensic procedures.
RADIOTHERAPY			
Target dose level Article R.1333-63	Dose necessary for the target organ or tissue (target organ or target-tissue) during radiotherapy (experimentation)		The target dose level (specialists talk of a target volume in radiotherapy) is used to adjust the equipment.

INTERVENTION TRIGGER LEVELS in cases of radiological emergencies (Public Health Code)

REFERENCES	DEFINITIONS	VALUES	OBSERVATIONS
PROTECTION OF THE GENERAL PUBLIC			
Intervention levels Art. R. 1333-80, Order of 14th October 2003, Circular of 10th March 2000	Expressed in effective dose (except for iodine), these levels are designed to assist with the relevant response decision to protect the general public: • sheltering • evacuation • administration of a stable iodine tablet (equivalent dose for the thyroid)	 10 mSv 50 mSv 50 mSv	The Prefect can make adjustments to take account of local factors.
PROTECTION OF PARTICIPANTS			
Reference levels Art. R.1333-86	These levels are expressed as effective dose: • for the special teams for technical or medical intervention • for the other participants	 100 mSv 10 mSv	This level is raised to 300 mSv when the intervention is designed to prevent or reduce exposure of a large number of people.

LIMIT VALUES for the consumption and sale of foodstuffs contaminated in the event of a nuclear accident

MAXIMUM PERMITTED LEVELS OF RADIOACTIVE CONTAMINATION FOR FOODSTUFFS (BQ/KG OR BQ/L)	BABY FOOD	DAIRY PRODUCTS	OTHER FOODSTUFFS EXCEPT THOSE OF LESSER IMPORTANCE	LIQUIDS INTENDED FOR CONSUMPTION
Strontium isotopes, particularly strontium-90	75	125	750	125
Iodine isotopes, particularly iodine-131	150	500	2,000	500
Plutonium isotopes and alpha-emitting transuranian elements, particularly plutonium-239 and americium-241	1	20	80	20
Any other radionuclide with a half-life of more than 10 days, in particular 134Cs and 137Cs	400	1,000	1,250	1,000

Source: regulation 2218/89/Euratom of 18th July 1989 amending Regulation 3954/87/Euratom of 22nd December 1987.

MAXIMUM PERMITTED LEVELS of radioactive contamination in livestock feedstuffs (caesium-134 and caesium-137)

ANIMAL CATEGORIES	BQ/KG
Pork	1,250
Poultry, lamb, veal	2,500
Others	5,000

Source: Regulation 770/90/Euratom of 29th March 1990.

GUIDELINE LEVELS en Bq/kg

RADIONUCLIDES	FOODSTUFFS INTENDED FOR GENERAL CONSUMPTION	BABY FOOD
Plutonium 238, plutonium 239, plutonium 240, americium 241	10	1
Strontium 90, ruthenium 106, iodine 129, iodine 131, uranium 235	100	100
Sulphur 35, cobalt 60, strontium 89, ruthenium 103, caesium 134, caesium 137, cerium 144, iridium 192	1,000	1,000
Tritium, carbon 14, technetium 99	10,000	1,000

Source: Codex alimentarius, July 2006.

04
REGULATION OF NUCLEAR ACTIVITIES AND EXPOSURE TO IONISING RADIATION

In France, nuclear activity licensees are responsible for the safety of their activity.

They cannot delegate this responsibility, and must ensure permanent surveillance of both this activity and the equipment used. Given the risks linked to ionising radiation for humans and the environment, the State regulates nuclear activities, a task it has entrusted to ASN.

Control and regulation of nuclear activities is a fundamental responsibility of ASN. The aim is to verify that all licensees fully assume their responsibility and comply with the requirements of the regulations relative to radiation protection and nuclear safety, in order to protect workers, patients, the public and the environment from risks associated with radioactivity.

Inspection is the key means of control available to ASN. Inspection involves an ASN inspector going to the site or department being inspected. The inspection is proportionate to the level of risk presented by the installation or the activity and the way in which the licensee assumes its responsibilities. It consists in performing spot checks on the conformity of a given situation with regulatory or technical baseline requirements. After the inspection, a follow-up letter is sent to the head of the inspected site and published on *www.asn.fr.* Any deviations found during the inspection can lead to administrative or penal sanctions.

ASN has a broad vision of control and regulation, encompassing material, organisational and human aspects. Its oversight actions take the tangible form of resolutions, requirements, inspection follow-up documents, sanctions where applicable and assessments of safety and radiation protection in each sector of activity.

1. VERIFYING THAT THE LICENSEE ASSUMES ITS RESPONSIBILITIES

1.1 The principles of ASN's oversight duties

ASN aims to ensure that the principle of licensee responsibility for nuclear safety and radiation protection is respected.

ASN applies the principle of proportionality when determining its actions, so that the scope, conditions and extent of its regulatory action is commensurate with the health and environmental safety implications involved.

Regulation is part of a multi-level approach and is carried out with the support of the Institute for Radiation Protection and Nuclear Safety (IRSN). It applies to all the phases in the performance of the activity, including the decommissioning phase for nuclear facilities:
- before the licensee exercises an activity subject to authorisation, by reviewing and analysing the files, documents and information provided by the licensee to justify its project with regard to safety and radiation protection. This verification aims to ensure that the information and demonstration supplied are both relevant and sufficient;
- during exercise of the activity, by visits, inspections, verification of licensee operations with significant potential consequences, review of operating reports and analysis of significant events. This verification comprises sampling and the analysis of justifications provided by the licensee with regard to the performance of its activities.

To consolidate the effectiveness and quality of its actions, ASN is adopting an approach involving continuous improvement of its regulatory practices. It uses the experience feedback from forty years of nuclear activity inspections and the exchange of best practices with its foreign counterparts.

ASN inspector in the control room of the Bugey NPP, November 2014.

1.2 The scope of regulation of nuclear activities

Article L. 592-21 of the Environment Code states that ASN must regulate compliance with the general rules and particular requirements of safety and radiation protection, applicable to:
• licensees of BNIs;
• those in charge of the construction and operation of Pressure Equipment (PE) used in BNIs;
• those in charge of radioactive substance transport;
• those in charge of activities entailing a risk of exposure of individuals and workers to ionising radiation;
• those in charge of implementing ionising radiation exposure monitoring measures.

In this chapter, these entities are called the "licensees". ASN also regulates the organisations and laboratories it approves in order to take part in the inspections and in guaranteeing safety and radiation protection, as well as carrying out labour inspection duties in the NPPs (see chapter 12).

Although historically based on verifying the technical conformity of facilities and activities with regulations or standards, regulation today also covers a broader field incorporating social, organisational and human factors (SOHF). It takes account of individual and collective behaviour and attitudes, management, organisation and procedures, relying on a variety of sources: significant events, inspections, relations with the stakeholders (personnel, licensees, contractors, trade unions, occupational physicians, inspection services, approved organisations, and so on).

2. ENSURING THAT REGULATION IS PROPORTIONATE TO THE IMPLICATIONS

ASN organises its regulatory work in a way that is proportionate to the implications of the activities. The licensee remains the key player in the regulation of its activities. The performance of certain inspections by organisations and laboratories offering the necessary guarantees as validated by ASN approval, contributes to this action.

2.1 Definition of the implications

In order first of all to take account of the health and environmental implications and the licensees' safety and radiation protection performance, and secondly the large number of activities it has to oversee, ASN periodically identifies and directly inspects the activities and topics with major potential consequences:
• some activities, namely those displaying the greatest risk in terms of safety and radiation protection, are carried over from one year to the next. To give an example, pressurised water reactors are inspected each year with regard to "human and organisational factors";
• others receive particular attention in a given year due to changes in the regulations or the findings of the previous year. Table 1 shows the major-implication activities and topics singled-out specifically for the year 2014.

In order to identify these activities and topics, ASN relies on current scientific and technical knowledge and uses the information collected by both itself and IRSN: results of inspections, frequency and nature of incidents, major modifications made to facilities, review of files, feedback of data concerning doses received by workers, information resulting from checks by approved organisations. It can revise its priorities further to significant events that have occurred in France or elsewhere in the world.

TABLE 1: Priority inspection topics for 2014*

FIELD	TOPICS OR ACTIVITIES WITH MAJOR IMPLICATIONS
Pressurised water reactors	• Human and organisational factors, skills, accreditations and training • Durability of equipment qualification • Conformity deviations management • Services • Emergency situations • Subcontracting and workstations presenting safety risks (labour inspectorate)
Fuel cycle facilities	• Safety and internal authorisations committee • Human and organisational factors
Small-scale nuclear activities in the industrial field	• Industrial radiography activities • Activities requiring high-level sealed sources • Equine veterinary activities • Source suppliers, manufacture of radioactive sources using a cyclotron
Small-scale nuclear activities in the medical field	• Computed Tomography • Teleradiology • Radiotherapy / brachytherapy • Nuclear medicine • Interventional radiology
Transport of radioactive substances	• On-site transport and application of the order of 7th February 2012 • Shipment • Training of the persons involved in transport • Integrating organisational and human factors necessary for compliance with safety requirements • Packaging maintenance • Preparing for emergency situations

** These activities and topics with major implications are in addition to the important topics always inspected each year by ASN.*

2.2 Checks performed by the licensees

The licensee is responsible for the safety and radiation protection of its activity. However, the operations that take place in the BNIs with the highest potential safety and radiation protection implications are subject to prior authorisation by ASN (see Chapter 3).

2.2.1 Operations subject to a licensee internal authorisation procedure

For operations presenting potential consequences in terms of safety and radiation protection that are significant but do not compromise the safety scenarios used in BNI operation or decommissioning, ASN allows the licensee to assume direct responsibility for the authorisations provided that it sets up a system of enhanced, systematic internal checks, offering sufficient guarantees of quality, independence and transparency. The decision on whether or not to carry out the operations must be the subject of a formal authorisation issued by the licensee's duly qualified staff. This organisation is called the "internal authorisations system". It is presented to the Local Information Committee (CLI) concerned.

This internal authorisations system is regulated by the Decree of 2nd November 2007 and by ASN resolution 2008-DC-106 of 11th July 2008, which specifies ASN's requirements.

ASN verifies correct application of the internal check arrangements by various means: inspections, review of the periodic reports communicated by the licensees, cross-checking of the dossiers, etc. It can at all times either terminate or temporarily suspend an "internal authorisations system" if it considers it to be unsatisfactorily implemented, in which case the corresponding operations must once again be referred to ASN for prior authorisation.

2.2.2 Internal monitoring of radiation protection by the users of ionising radiation sources

The aim of internal monitoring of radiation protection is to ensure regular assessment of the radiological safety of the activities using sources of ionising radiation. This monitoring is performed under the responsibility of the licensees. It may be carried out by the Person Competent in Radiation protection (PCR), appointed and mandated by the employer, or be entrusted to IRSN or to organisations approved by ASN. It does not replace either the periodic checks required by the regulations, or the inspections conducted by ASN. It for example concerns the performance of the protection systems, monitoring of the ambient atmosphere in regulated areas, or checks on medical appliances before they enter service or after modification.

2.2.3 Packages not requiring approval

The consignor is responsible for demonstrating that the package model used ensures compliance with the safety requirements set by the regulations, as well as being suitable for the contents to be transported. The following are subject to ASN approval: package models with the highest potential safety implications, in particular those intended for the transport of very high-level radioactive substances or those for which the content is liable to create a criticality risk (see Chapter 11). These packages, and those which are not subject to approval, are regularly inspected by ASN in order to verify the measures adopted by the consignors.

2.3 ASN approval of organisations and laboratories

Article L. 592-21 of the Environment Code states that ASN must issue the necessary approvals to the organisations taking part in the inspections and in ensuring nuclear safety and radiation protection watch. Depending on the health or safety implications of a nuclear activity or a facility category, ASN may rely on the results of checks carried out by independent organisations and laboratories it has approved and which it monitors via second level checks.

ASN thus approves organisations so that they can perform the technical inspections required by the regulations in the fields within its scope of competence:
- radiation protection checks;
- measurement of radon activity concentration in premises open to the public;
- assessment of nuclear pressure equipment conformity and inspection of equipment in service.

The checks carried out by these organisations contribute to ASN's overview of all nuclear activities.

In order to approve the applicant organisations, ASN ensures that they perform the inspections in accordance with their technical, organisational and ethical obligations and in compliance with the rules of professional good practice. Compliance with these provisions should enable the required level of quality to be obtained and maintained.

ASN ensures that benefit is gained from the approval, in particular through regular exchanges with the organisations it has approved and the mandatory submission of an annual report, in order to:
- turn operating experience feedback to good account;
- improve the approval process;
- improve the conditions of intervention by the organisations.

ASN also approves laboratories to conduct analyses requiring a high level of measurement quality if the results are to be usable. It thus approves laboratories:
- for monitoring environmental radioactivity (see point 4);
- for worker dosimetry (see chapter 1).

The list of approvals issued by ASN is kept up to date on *www.asn.fr* ("Bulletin officiel de l'ASN/agréments d'organismes" section).

As at 31st December 2014, the following are approved by ASN:
- 42 organisations tasked with radiation protection checks, of which 10 are approvals or approval renewals delivered during 2014;
- 49 organisations tasked with measuring radon activity concentration, of which 17 are approvals or approval renewals delivered during 2014;
- 22 organisations tasked with worker dosimetry (12 for the internal monitoring of workers, 8 for the external monitoring of workers and 2 for internal and external exposure of workers associated with natural radioactivity), of which 1 is a new approval and 1 a renewal delivered during 2014;
- 7 organisations tasked with nuclear pressure equipment inspections;
- 62 laboratories for environmental radioactivity measurements covering 826 approvals, of which 302 are approvals or approval renewals delivered during 2014.

ASN gives the General Directorate for Health (DGS) an opinion on the approval of the laboratories analysing radioactivity in water intended for human consumption.

It gives the Ministers responsible for nuclear safety and transport an opinion on the approval of the organisations responsible for:
- training the drivers of vehicles transporting radioactive substances (class 7 hazardous materials);
- organising safety adviser examinations for transport of dangerous goods by road, rail or navigable waterway;
- certifying the conformity of packaging designed to contain 0.1 kg or more of uranium hexafluoride (initial and periodic checks);
- issuing type approval for tank-containers and mobile tanker units intended for transport of class 7 dangerous goods by road;
- the initial and periodic checks of tankers for transport of class 7 hazardous materials by land.

3. REINFORCING THE EFFICIENCY OF ASN'S MEANS OF REGULATION

The licensee is required to provide ASN with the information it needs to meet its regulatory responsibilities. The volume and quality of this information should enable ASN to analyse the technical demonstrations presented by the licensee and target the inspections. It should also allow identification and monitoring of the milestones in the operation of a nuclear activity.

ASN's regulatory action takes the form of reviews of files, precommissioning visits, inspections, and consultation with professional organisations (trade unions, professional orders, learned societies, etc.).

3.1 Assessment of the files submitted by the licensee

The purpose of the documents supplied by the licensee is to demonstrate compliance with the objectives set by the general regulations, as well as those that it has set for itself. ASN is required to check the completeness of the data and the quality of the demonstration.

The review of these files may lead ASN to accept or to reject the licensee's proposals, to ask for additional information or studies or to ask for work to be done to bring the relevant items into conformity.

3.1.1 Analysing the information supplied by Basic Nuclear Installation (BNI) licensees

Reviewing the supporting documents produced by the licensees and the technical meetings organised with them are one of the forms of control carried out by ASN.

Whenever it deems necessary, ASN seeks the advice of technical support organisations, primarily IRSN. The safety review implies cooperation by numerous specialists, as well as efficient coordination, in order to identify the essential points relating to safety and radiation protection.

IRSN assessment relies on research and development programmes and studies focused on risk prevention and on improving our knowledge of accidents. It is also based on in-depth technical discussions with the licensee teams responsible for designing and operating the plants. For the more important issues, ASN requests the opinion of the competent Advisory Committee of Experts (GPE). For other matters, IRSN examines the safety analyses and gives its opinion directly to ASN. ASN procedures for requesting the opinion of a technical support organisation and, where required, of an Advisory Committee, are described in chapter 2.

At the design and construction stage, ASN - aided by its technical support organisation - examines the safety analysis reports describing and justifying basic design data, equipment design calculations, utilisation rules and test procedures, and quality organisation provisions made by the prime contractor and its suppliers. ASN also checks the construction and manufacture of structures and equipment, in particular PWR Main Primary Systems (MPS) and Main Secondary Systems (MSS). In accordance with the same principles, it checks the packages intended for the transport of radioactive substances.

Once the nuclear facility has been commissioned, following ASN authorisation, all changes to the facility or its operation made by the licensee that could affect security, public health and safety, or the protection of nature and the environment, are notified to ASN. Moreover, the licensee must perform periodic safety reviews to update the assessment of the facility, taking into account any changes in techniques and regulations, and experience feedback. The conclusions of these reviews are submitted to ASN, which can issue new provisions in order to tighten the safety requirements (see chapter 12 point 2.11.4).

Other data submitted by BNI licensees

The licensee submits routine activity reports and summary reports on water intake, liquid and gaseous discharges and the waste produced.

Similarly, there is a considerable volume of information on specific topics such as fire protection, PWR fuel management strategies, relations with contractors, and so on.

3.1.2 Review of the applications required by the Public Health Code

ASN is responsible for reviewing applications to possess and use ionising radiation sources in the medical and industrial sectors. ASN also deals with the specified procedures for the acquisition, distribution, import, export, transfer, recovery and disposal of radioactive sources. It in particular relies on the inspection reports from the approved organisations and the reports on the steps taken to remedy nonconformities detected during these inspections.

In addition to the internal inspections carried out under the responsibility of the establishments and the periodic checks required by the regulations, ASN carries out its own verifications. In this respect it directly carries out checks during the procedures for issue (pre-commissioning inspections) or renewal (periodic inspections) of the authorisations to possess and use radiation sources granted on the basis of Article R. 1333-23 of the Public Health Code. The authorisation notifications can only be issued if the requests submitted by ASN following the checks have been taken into account. These checks are in particular designed to compare the data contained in the files with the actual physical reality (sources inventory, check on the conditions of production, distribution and utilisation of the sources and the devices containing them). They also enable ASN to ask the establishments to improve their in-house provisions for source management and radiation protection.

3.2 Regulation of facilities and activities

ASN regulates nuclear activities and facilities in order to check that the licensees and those responsible for nuclear activities comply with the regulatory requirements and conditions specified in their authorisation license.

Regulation and monitoring of Basic Nuclear Installations

Safety covers the technical and organisational measures taken at all stages in the operation of nuclear facilities (design, creation, commissioning, operation, final shutdown, decommissioning) to prevent or mitigate the risks for safety, public health and the environment (see Chapter 3). This notion thus includes the measures taken to optimise waste and effluent management.

International Atomic Energy Agency (IAEA) defined the following principles in its safety fundamentals for nuclear facilities (safety collection No.110), taken up to a large extent by the European Directive on nuclear safety of 8th July 2014, modifying that of 2009:
- responsibility for nuclear safety lies primarily with the licensee;
- the organisation responsible for regulation and oversight is independent of the organisation responsible for promoting or using nuclear power. It must have responsibility for licensing, inspection and formal notice, and must have the authority, expertise and resources necessary for performance of the responsibilities entrusted to it. No other responsibility shall compromise or conflict with its responsibility for safety.

In France, pursuant to the Environment Code, ASN is the body that meets these criteria.

The green growth energy transition bill makes provision for expanding the scope of regulation and monitoring by ASN beyond the activities of the licensee, to enable the inspectors to carry out inspections at the suppliers and the contractors or subcontractors, including outside the BNIs.

In its regulatory duties, ASN is required to look at the equipment and hardware in the installations, the individuals in charge of operating it, the working methods and the organisation, from the start of the design process up to decommissioning. It reviews the steps taken concerning nuclear safety and the monitoring and limitation of the doses received by the individuals working in the facilities, and the waste management, effluents discharge monitoring and environmental protection procedures.

Regulation of pressure vessels

Numerous systems in nuclear facilities contain or carry pressurised fluids. They are therefore subject to pressure equipment regulations (see chapter 3, point 3.6).

Article L. 592-21 of the Environment Code requires that ASN ensure *"monitoring of compliance with the general rules and particular prescriptions with regard to nuclear safety and radiation protection applicable to […] the construction and utilisation of BNI pressure equipment"*. Furthermore, so that the BNI licensees only have to deal with a single point of contact, Article 50 of Act 2009-526 of 12th May 2009 on the simplification and clarification of the law and relaxation of procedures, entrusts ASN with the verification of application of the regulations for all pressure equipment in a facility comprising a BNI.

Pressure equipment operation is regulated. This regulation in particular applies to the in-service surveillance programmes, non-destructive testing, maintenance work, disposition of nonconformities affecting these systems and periodic post-maintenance testing of the systems.

ASN also assesses the regulatory conformity of the most important new nuclear pressure equipment items. It approves and monitors the organisations responsible for assessing the conformity of the other nuclear pressure equipment.

Regulation and monitoring of the transport of radioactive substances

Transport comprises all operations and conditions associated with movements of radioactive substances, such as packaging design, manufacture, maintenance and repair, as well as the preparation, shipment, loading, carriage, including storage in transit, unloading and reception at the final destination of the radioactive substance consignments and packages (see chapter 11).

The safety of transport of radioactive substances is ensured by three main factors:
- primarily, the robustness of package design and the quality of package construction;
- the reliability of transport and of certain special vehicle equipment;
- an efficient emergency response in the event of an accident.

ASN inspection in the Modane underground laboratory, September 2014.

Regulation and monitoring of activities comprising a risk of exposure to ionising radiation

In France, ASN fulfils this role by drafting and monitoring technical regulations concerning radiation protection (see chapter 3, point 1).

The scope of ASN's regulatory role in radiation protection covers all the activities that use ionising radiation. This duty is exercised, where applicable, jointly with other State services such as the labour inspectorate, the inspectorate for Installations Classified on Environmental Protection Grounds (ICPE), the departments of the Ministry of Health and the French National Agency for Medicines and Health Products Safety (ANSM). This action directly concerns either the users of ionising radiation sources, or organisations approved to carry out technical inspections on these users.

The methods of regulating the radiation protection players are presented in table 2.

TABLE 2: Methods of ASN regulation of the various radiation protection players

	REVIEW/ AUTHORISATION	INSPECTION	OPENNESS AND COOPERATION
Users of ionising radiation sources	• Review of the dossiers required by the Public Health Code (Articles R. 1333-1 to R. 1333-54). • Pre-commissioning inspection. • Registration of notification or delivery of the authorisation.	• Radiation protection inspection (Article L. 1333-17 of the Public Health Code).	• Jointly with the professional organisations, drafting of guides of good practices for users of ionising radiation.
Bodies approved for radiation protection inspections.	• Review of application files for approval to perform the inspections specified in Article R. 1333-95 of the Public Health Code and Articles R. 4451-29 to R. 4452-34 of the Labour Code. • Organisation audit. • Delivery of approval.	• Second level inspection: - in-depth inspections at head office and in the branches of the organisations, - unannounced field inspections.	• Jointly with the professional organisations, drafting of rules of good practices for performance of radiation protection inspections.

Regulating the application of labour law in the nuclear power plants

Labour inspection in the NPPs has been ensured from the outset by the administration tasked with technical oversight under the authority of the Minister responsible for Labour; the competence of ASN is now codified in Article r. 8111-11 of the Labour Code. The nineteen NPPs in operation, the nine reactors undergoing decommissioning and the EPR reactor under construction at Flamanville are the responsibility of the ASN labour inspectorate. The regulation of safety, radiation protection and labour inspection very often covers common topics, such as worksite organisation or the conditions of use of outside contractors (see Chapter 12).

The ASN labour inspectors have four essential duties:
1. checking application of all aspects of labour legislation (health, occupational safety and work conditions, occupational accident inquiries, quality of employment, collective labour relations);
2. advising and informing the employers, employees and personnel representatives about their rights, duties and labour legislation;
3. feeding back information to the administration on changes in the working environment and any shortcomings in the legislation;
4. facilitating conciliation between the parties.

The ASN labour inspectors also have powers of decision concerning authorisation applications (firing of personnel representatives, waivers to regulations in terms of work or rest times, health and safety).

The legitimacy of these duties is underpinned by international standards (International Labour Organisation (ILO) convention no. 81) and national regulations. These duties are carried out in liaison with the other Government departments concerned, mainly the departments of the Ministry responsible for Labour.

The six main issues related to conventional safety inspection duties in NPPs are:
1. exercise closer regulation of contractor working conditions and of EDF's surveillance of subcontracted activities;
2. deal with the growing problems of construction/ dismantling;
3. take full account of social organisational and human factors;
4. encourage EDF to include the goal of security in addition to safety and radiation protection;
5. ensure effective and consistent nationwide application of the Labour Code and collective agreements;
6. highlight ASN's extended labour inspection responsibility.

ASN has set up an organisation enabling it to deal with these issues. The action of the ASN labour inspectors (5.2 full-time equivalent - FTE) in the field has increased markedly since 2009, particularly during reactor outages, with inspection visits, advisory roles at the meetings of the committee for health, safety and working conditions (CHSCT) and the inter-company committee on safety and working conditions (CIESCT), as well as the regular discussions with the social partners.

The green growth energy transition bill aims to regulate the use of subcontracting. The bill intends to ban the licensees from delegating the supervision of outside contractors performing activities important for the interests protected by law.

3.2.1 Inspection objectives and principles

The inspection carried out by ASN is based on the following principles:
- the inspection aims to detect any deviations indicative of a possible deterioration in facility safety or the protection of individuals and any non-compliance with the legislative and regulatory requirements the licensee is bound to apply;
- the inspection is proportionate to the level of risk presented by the facility or activity;
- the inspection is neither systematic nor exhaustive, is based on sampling and focuses on subjects with the greatest potential consequences.

3.2.2 Inspection resources

To ensure greater efficiency, ASN's action is organised on the following basis:
- inspections, at a predetermined frequency, of the nuclear activities and topics of particular health and environmental significance;
- inspections on a representative sample of other nuclear activities;
- systematic technical inspections of all facilities by approved organisations.

Activities of more limited significance or with particularly high volume are inspected by the approved organisations, but can also be the subject of targeted inspections by ASN.

The inspections may be unannounced or notified to the licensee a few weeks before the visit. They take place mainly on the site or during the course of the relevant activities (work, transport operation). They may also concern the head office departments or design and engineering departments at the major licensees, the workshops or engineering offices of the subcontractors, the construction sites, plants or workshops manufacturing the various safety-related components.

ASN uses various types of inspections:
- standard inspections;
- in-depth inspections, which take place over several days and mobilise about ten or so inspectors. Their purpose is to carry out detailed examinations and they are overseen by senior inspectors;
- inspections with sampling and measurements. These are designed to check discharges by means of samples that are independent of those taken by the licensee;
- inspections carried out further to a particularly significant event;
- worksite inspections, ensuring a significant ASN presence on the sites on the occasion of reactor outages or particular work, especially in the decommissioning phase;
- inspection campaigns, grouping large numbers of inspections performed using an identical method and following a predetermined template.

The labour inspectors carry out various types of interventions[1], focusing in particular on:
- checking application of the Labour Code by EDF and outside contractors in the NPPs (verification operations that include inspections);
- participation in meetings of the CHSCT, CIESCT and inter-firm health, safety and working conditions Committee (CISSCT) (EPR construction site);
- performance of inquiries further to requests, complaints or information, after which they can issue resolutions.

These inspections give rise to records, made available to the licensee. They concern:
- anomalies or aspects warranting additional justifications;
- deviations between the situation observed during the inspection and the regulations or documents produced by the licensee pursuant to the regulations.

Some inspections are carried out with the support of an IRSN representative specialised in the facility visited or the topic of the inspection.

ASN inspectors

To meet its objectives, ASN has inspectors designated and accredited by the ASN chairman, in accordance with the conditions defined by Decree 2007-831 of 11th May 2007, subject to them having acquired the requisite legal and technical skills through professional experience, mentoring or training courses.

1. The intervention is the unit representative of the activity normally used by the labour inspectorate.

The inspectors take an oath and are bound to professional secrecy. They exercise their inspection activity under the authority of the ASN Director-General and benefit from regularly updated practical aids (inspection guides, decision aids) to assist them in their inspections.

As part of its continuous improvement policy, ASN encourages the exchange and integration of best practices used by other inspection organisations:
- by organising international exchanges of inspectors between safety authorities, either for the duration of one inspection or for longer periods that could extend to a secondment of up to three years. Thus, after having observed its advantages, ASN has adopted the concept of in-depth inspections described earlier. However, it did not opt for the system involving a resident inspector on a nuclear site, as ASN considers that its inspectors must work within a structure large enough to allow sharing of experience and that they must take part in checks on different licensees and facilities in order to acquire a broader view of this field of activity. This also avoids a confusion of responsibilities;
- by taking on inspectors trained in other inspection practices. ASN encourages the integration into its departments of inspectors from other regulatory authorities, such as DREAL, ANSM, regional health agencies (ARS), etc. It also proposes organising joint inspections with these authorities concerning the activities within its field of competence;
- by encouraging its staff to take part in inspections on subjects in different regions and domains, to ensure the uniformity of its practices, among other things.

Table 3 presents the headcount of inspectors as at 31st December 2014. Some inspectors operate in several inspection areas, and all the operational entity heads and their deputies fulfil both managerial and inspection functions.

Most of the inspections are carried out by inspectors assigned to the divisions; they represent 58% of the ASN inspectors. The 114 inspectors assigned to the departments take part in the ASN inspection effort within their field of competence; they represent 42% of the inspector headcount and performed 14% of the inspections in 2014.

Since 2009, ASN has carried out more than 2,000 inspections every year, including about 37% in BNIs and activities linked to pressure equipment, 58% in small-scale nuclear activities, approved organisations and laboratories and 5% for the transport of radioactive substances (see table 4).

In 2014, 2,170 inspections were carried out, including 686 in the BNIs, 87 in activities linked to pressure equipment, 113 in radioactive substances transport activities, 1,159 in activities employing ionising radiation and 125 in approved organisations and laboratories.

Graph 1 shows the trend in the number of inspections and inspectors between 2009 and 2014.

ASN inspections programme

To guarantee a distribution of the inspection resources, proportionate to the safety and radiation protection implications of the various facilities and activities, each year ASN drafts an forecast inspections schedule, taking into account the inspection implications (see point 2.1). This schedule is not known to the licensees or to those in charge of nuclear activities.

ASN ensures qualitative and quantitative monitoring of performance of the programme and the follow-up given to the inspections through periodic reviews. They enable the inspected activities to be assessed and contribute to the continuous improvement of the inspection process.

Information relative to the inspections

ASN informs the public of the follow-up to the inspections by posting the inspection follow-up letters on-line at *www.asn.fr.* This subject is developed in greater detail in chapter 6.

Moreover, for each in-depth inspection, ASN publishes an information notice on *www.asn.fr*.

3.2.3 Inspection of Basic Nuclear Installations (BNIs) and pressure equipment

In 2014, 773 inspections were carried out to check BNIs and pressure equipment, more than 28% of which were unannounced. These inspections can be broken down into 381 inspections in the NPPs, 305 in the other BNIs (fuel cycle facilities, research facilities, facilities undergoing decommissioning, etc.) and 87 for pressure equipment.

In the BNIs, two in-depth inspections were held in 2014, on the following sites:
- the Paluel NPP, on the topic “maintenance and management of ageing”;
- the Romans-sur-Isère site (FBFC plant) on the topic “safety management and operational rigour”.

The inspection breakdown by family of topics is shown in graph 2. The topics related to nuclear safety and social, organisational and human factors represent more than 50% of the BNI inspections. 12% of the inspections are devoted to environmental monitoring topics and to waste and effluents in the BNIs.

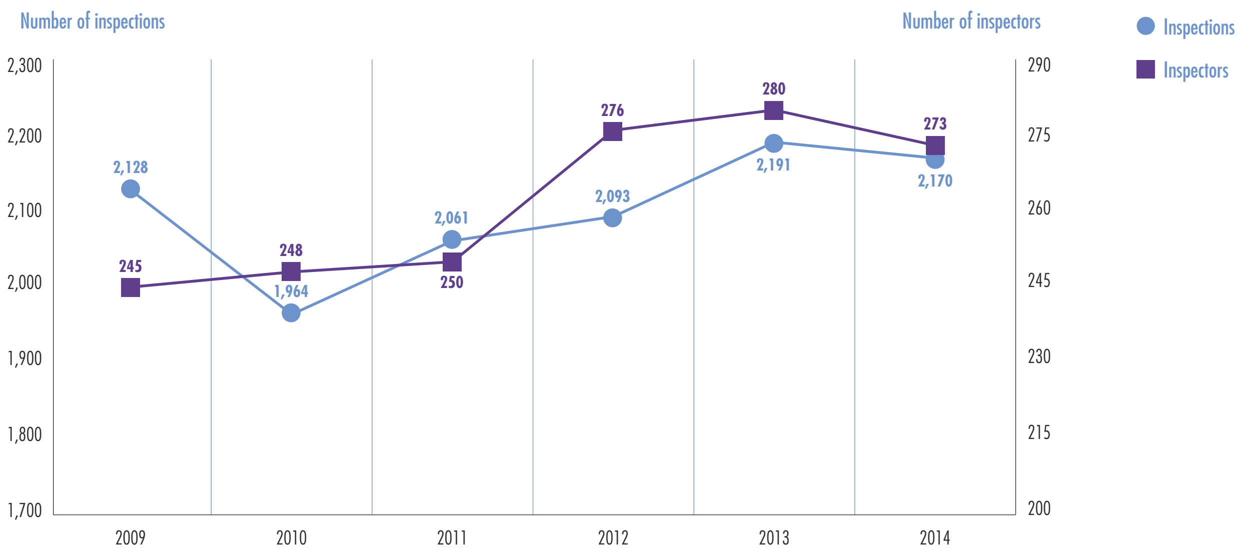
TABLE 3: Breakdown of inspectors per inspection domain (as at 31st December2014)

TYPE OF INSPECTOR	DEPARTMENTS	DIVISIONS	TOTAL
Nuclear safety inspector (BNI)	89	101	**190**
of which nuclear safety inspector (transport)	*7*	*36*	***43***
Staff responsible for oversight of pressure equipment	22	32	**54**
Radiation protection inspector	40	107	**147**
Labour inspector	0	12	**12**
Number of inspectors all domains	114	159	**273**

TABLE 4: Trend in number of inspections performed from 2009 to 2014

	NUMBER OF INSPECTIONS PERFORMED					
YEAR	BNI	PE	RMT	NPX	OA-LA	TOTAL
2014	686	87	113	1,159	125	**2,170**
2013	678	86	131	1,165	131	**2,191**
2012	726	76	112	1,050	129	**2,093**
2011	684	65	100	1,088	124	**2,061**
2010	665	72	92	1,002	133	**1,964**
2009	709	105	94	1,081	139	**2,128**

GRAPH 1: Trend in the number of ASN inspections and inspectors from 2009 to 2014



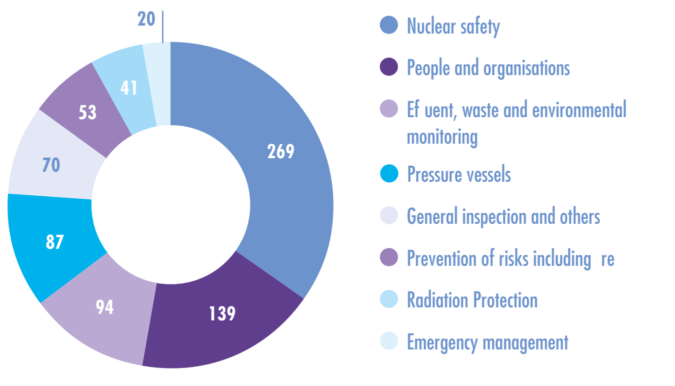
With regard to NPPs, ASN carried out 381 inspections in 2014, nearly one third of which concern topics relating to maintenance and operation. Social, organisational and human factors, the environment and the prevention and management of hazards are the other topics most widely inspected by ASN.

The ASN labour inspectorate also carried out 785 interventions during the 245 inspection days in the NPPs.

On the LUDD sites, ASN carried out 305 inspections in 2014, primarily on the "general inspection" and "status of systems, equipment and buildings (inspections, tests, ageing, works, etc.)" topics.

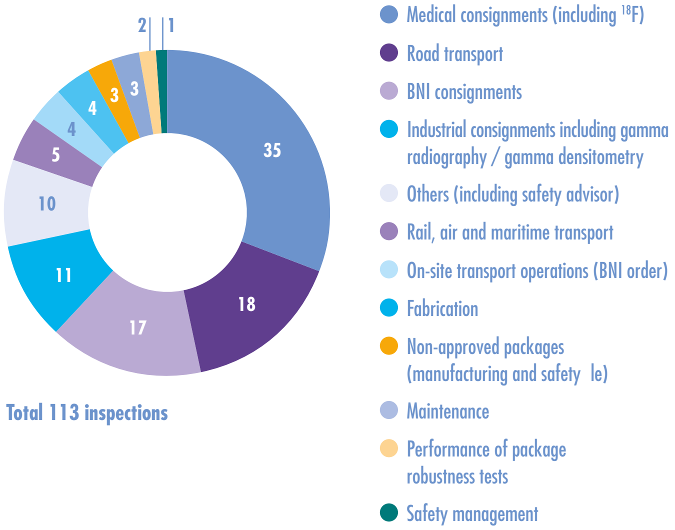
With regard to pressure equipment, ASN carried out 87 inspections in 2014 including 47 in the field of in-service monitoring of equipment, 14 in the field of inspecting the design and manufacture of nuclear pressure equipment and 19 on monitoring of recognised inspection services.

GRAPH 2: Breakdown of BNI inspections in 2014 by theme



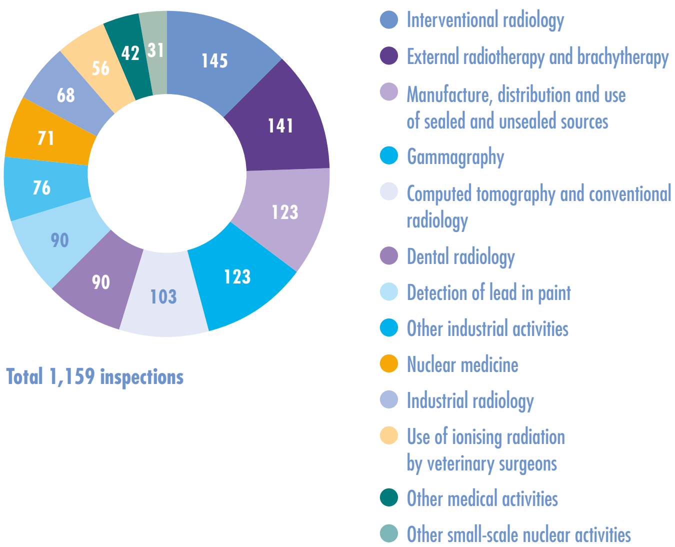
Total 773 inspections

GRAPH 3: Breakdown of radioactive material transport inspections in 2014



Total 113 inspections

GRAPH 4: Breakdown of small-scale nuclear activity inspections in 2014 according to nature of activity



Total 1,159 inspections

ISO 17020 accreditation for the ASN Nuclear Pressure Equipment Department, obtained for the first time in 2013, was renewed in 2014.

3.2.4 Inspection of radioactive material transport

ASN carried out 113 inspections on transport activities, 32% of which were unannounced; their breakdown into themes is illustrated in graph 3.

More than 55% of the inspections were carried out on the topic of “consignments” in industry, BNIs and the medical sector. Road carriage on the one hand and the other modes of transport on the other, account for 16% and 4% respectively of the inspections performed.

3.2.5 Inspection of small-scale nuclear activities

ASN organises its inspection activity so that it is proportionate to the radiological issues involved in the use of ionising radiation, and consistent with the actions of the other inspection services.

In 2014 ASN carried out 1,159 inspections - nearly one quarter of which were unannounced - in some of the 50,000 or so nuclear facilities and activities in the sector. These inspections were more specifically divided among the medical (52%), industrial or research (41%) and veterinary (5%) sectors.

In the small-scale nuclear activities sector, two in-depth inspections were held in 2014:
- at the French national institute for agricultural research (INRA) in Montpellier on the topic of radiation protection in industrial applications of ionising radiation;
- the first in-depth inspection in the medical field, at the Pitié-Salpêtrière Hospital (Paris) on the topic of radiation protection in medical applications of ionising radiation.

Medical or industrial activities entailing a high risk of human exposure are the most frequently inspected. Thus, 479 inspections were carried out in radiology and radiotherapy and 71 in nuclear medicine.

Moreover, from among the 480 inspections of industrial activities using ionising radiation, 123 concern gamma radiography and 123 the manufacture, distribution and utilisation of sealed and unsealed sources.

The breakdown of small-scale nuclear sector inspections according to the various activity categories is described in graph 4.

3.2.6 Inspection of ASN approved organisations and laboratories

ASN carries out a second level of inspection on approved organisations and laboratories. In addition to reviewing the application file and issuing the approval, this comprises surveillance such as the following:
- approval audits (initial or renewal audit);
- checks to ensure that the organisation and operation of the entity concerned comply with the applicable requirements;
- checks, which are usually unannounced, to ensure that the organisation's staff work in satisfactory conditions.

In 2014, ASN carried out 125 inspections on approved organisations and laboratories, 38% of which were unannounced, which can be broken down as follows:
- 68 inspections of organisations carrying out radiation protection technical checks;
- 40 inspections of organisations assessing nuclear pressure equipment conformity and carrying out in-service monitoring of operational equipment;
- 7 inspections of organisations measuring the activity concentration of radon;
- 10 inspections of laboratories approved for taking environmental radioactivity measurements.

3.2.7 Checks on exposure to radon and naturally occurring radioactive materials (norm)

ASN also monitors radiation protection in premises where exposure of individuals to natural ionising radiation can be enhanced owing to the underlying geological context (radon in premises open to the public) or the characteristics of the materials used in industrial processes (non-nuclear industries).

Monitoring exposure to radon

Article R. 1333-15 of the Public Health Code and Article R. 4451-136 of the Labour Code provide for the radon activity concentration to be measured either by IRSN or by ASN approved organisations.

These measurements are to be taken between 15th September of a given year and 30th April of the following year.

For the 2014-2015 measurement campaign, the number of approved organisations is indicated in table 5.

Monitoring exposure to natural ionising radiation in non-nuclear industries

The order of 25th May 2005 provides the list of professional activities (ore or rare earth processing industries, spas and facilities treating groundwater for human consumption) requiring monitoring of human exposure to natural ionising radiation, owing to the fact that the materials used contain natural radionuclides and are likely to generate doses that are significant from the radiation protection standpoint.

Monitoring natural radioactivity in water intended for human consumption

Since 1st January 2005 (order of 12th May 2004), monitoring of natural radioactivity in water intended for human consumption is an integral part of the health monitoring carried out by the ARS. The procedures for these checks take account of the recommendations issued by ASN and are taken up in the DGS circular of 13th June 2008. The results of the checks are jointly analysed and utilised by ASN and the services of the Ministry of Health.

3.3 Monitoring the environmental and health impact of nuclear activities

ASN considers that protection of the public and the environment is an essential part of its regulation of nuclear activities, whether carried out in a BNI or in the industrial and medical fields.

Regulation of the environmental and health impact of BNIs was put in place at the time the first installations were commissioned, and is the subject of particular provisions figuring in the order of 7th February 2012

TABLE 5: Number of organisations approved for measuring radon levels

	APPROVAL UNTIL 15 SEPTEMBER 2015	APPROVAL UNTIL 15 SEPTEMBER 2016	APPROVAL UNTIL 15 SEPTEMBER 2017	APPROVAL UNTIL 15 SEPTEMBER 2018	APPROVAL UNTIL 15 SEPTEMBER 2019
Level 1 option A*	15	17	10	1	5
Level 1 option B**	3	0	5	0	0
Level 2***	1	5	1	0	0

** Workplace and premises open to the public for all building types*
*** Workplace, cavities and underground structures (except buildings)*
**** Represents complementary investigations*

setting the general rules for BNIs and in ASN resolution 2013-DC-0360 of 16th July 2013 concerning the control of detrimental effects and the health and environmental impact of BNIs.

The impact is primarily assessed from the measurement or evaluation of discharges from the installations. The monitoring of discharges in this respect is particularly important, and is implemented as soon as a site is commissioned.

In the small-scale industrial nuclear sector, few plants discharge effluents apart from the cyclotrons (see chapter 10). The discharge permits stipulate requirements for the discharges and their monitoring, which are subject to particular scrutiny during inspections.

Lastly, with regard to activities in the medical sector, the impact was initially assessed on the basis of studies and estimates. More accurate monitoring based on discharge measurements is gradually being established under the impetus of ASN.

3.3.1 Monitoring of discharges

Monitoring discharges from BNIs

The monitoring of discharges from an installation is essentially the responsibility of the licensee. The provisions regulating discharges stipulate the minimum checks that the licensee is required to carry out. The monitoring focuses on the effluents (monitoring of the activity of discharges, characterisation of certain effluents prior to discharge, etc.) and environmental monitoring (checks during discharge, samples of air, milk, grass, etc.).

For the monitoring of radioactive discharges, the BNI licensees also regularly transmit a number of discharge samples to an independent laboratory for analysis. The results of these “cross-checks” are sent to ASN. This programme of cross-checks defined by ASN is a way of ensuring that the accuracy of the laboratory measurements is maintained over time.

Finally, through dedicated inspections, ASN ensures that the licensees comply with the regulatory provisions that apply to them. These generally unannounced inspections are run with the support of specialised, independent laboratories. Effluent and environmental samples are taken for radiological and chemical analyses. Since 2000, ASN has carried out ten to thirty inspections - with sampling- every year (21 in 2014).

Accounting of BNI discharges

The rules for accounting of discharges, both radioactive and chemical, are now set in the general regulations

ASN inspection on the topic of the environment at the Gravelines NPP, October 2014.

TO BE NOTED

ASN and the American nuclear safety regulator compare their environmental monitoring practices

A delegation of three ASN members went to the United States from 9th to 12th September 2014 to meet members of the US Nuclear Regulatory Commission (US NRC). Several meetings were held with the Office of Nuclear Reactor Regulation at the NRC headquarters in Washington, as well as the Region I office, one of the four regional divisions of the NRC, located in Pennsylvania, in order to discuss ASN and NRC environmental monitoring inspection practices.

The ASN delegation was also able to observe an “environment” inspection by the NRC agents on the site of the Peach Bottom NPP, one of the oldest NPPs in the United States, situated in Pennsylvania.

Following this mission, the two authorities will continue their exchanges, more specifically on the measurement of tritium in groundwater, the measurement of radioactivity around sites (availability of measurement results for different types of samples) and public information measures in the case of events affecting the facilities.

TO BE NOTED

Implementing remote-noti cation of BNI sampling and discharges

The results of the regulatory measurements are written up in registers which, in the case of BNIs, are forwarded on a monthly basis to ASN, which checks them. They in particular contain an accounting of the discharged substances or families of substances - radioactive or not - regulated in the resolutions issued by ASN in application of the abovementioned decree of 2nd November 2007.

As stipulated in Article 4.4.2 of the Order of 7th February 2012 setting the general rules for BNIs, these regulation registers are transmitted to ASN electronically. ASN wishes to change this transmission method, by creating a single remote-notification portal for the BNI licensees.

UNDERSTAND

With regard to the measurements

- The decision threshold (SD) is the value above which it is possible with a high degree of confidence that a radionuclide is present in the sample.
- The detection limit (LD) is the value as of which the measurement technique is able to quantify a radionuclide with a reasonable degree of uncertainty (the uncertainty is about 50% at the LD).

In general LD ≈ 2 x SD.

For the measurement results on chemical substances, the quantification limit (LQ) is equivalent to the LQ used to measure radioactivity.

Reference spectra used for NPPs

- Liquids: ^{3}H, ^{14}C, ^{131}I, other fission and activation products (^{54}Mn, ^{58}Co, ^{60}Co, ^{110m}Ag, ^{123m}Te, ^{124}Sb, ^{125}Sb, ^{134}Cs, ^{137}Cs);
- Gases: ^{3}H, ^{14}C, iodones (^{131}I, ^{133}I), other fission and activation products (^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs), rare gases: ventilations (permanent discharges: ^{133}Xe, ^{135}Xe), drainage of "RS" tanks (^{85}Kr, ^{131m}Xe, ^{133}Xe), decompression of reactor buildings (^{41}Ar, ^{133}Xe, ^{135}Xe).

by ASN resolution 2013-DC-0360 of 16th July 2013 relative to control of nuisance effects and the impact of Basic Nuclear Installations on health and the environment. Accounting is not based on overall measurements, but on an analysis per radionuclide, introducing the notion of "reference spectrum", more specifically listing the radionuclides most frequently encountered in the discharges.

The principles underlying the accounting rules are as follows:
- the radionuclides detected (activity higher than the decision thresholds) are all accounted;
- the radionuclides of the "reference spectrum" (see box) are accounted at the level of the decision threshold, if they are not detected (activity below the decision threshold).

Monitoring discharges in the medical sector

Pursuant to ASN resolution 2008-DC-0095 of 29th January 2008, radioactivity measurements are taken on the effluents coming from the places that produce them. In hospitals that have a nuclear medicine department, these measurements chiefly concern iodine-131 and technetium-99m. In view of the difficulties encountered in putting in place the permits to discharge radionuclides into the public sewage networks, as provided for by the Public Health Code, ASN has created a working group involving administrations, "producers" (nuclear physicians, researchers) and sanitation professionals. The report from this working group should review the current situation and propose recommendations for overcoming the difficulties.

3.3.2 Evaluating the radiological impact of the facilities

In application of the optimisation principle, the licensee must reduce the radiological impact of its facility to values that are as low as possible under economically acceptable conditions.

The licensee is required to assess the dosimetric impact of its activity. Depending on the case, this obligation arises from Article L. 1333-8 of the Public Health Code, or from the regulations concerning BNI discharges. The result must be compared with the annual dose limit for the public (1 mSv/year) defined in Article R.1333-8 of the Public Health Code. This regulation limit corresponds to the sum of the effective doses received by the public as a result of nuclear activities.

In practice, only traces of artificial radioactivity are detectable in the vicinity of the nuclear facilities; most measurements taken during routine surveillance are below the decision threshold or reflect the natural radioactivity. As these measurements cannot be used for dose estimations, models for the transfer of radioactivity to humans must be used, on the basis of measurements of discharges from the installation. These models are specific to each licensee.

Nonetheless, programmes to monitor the radioactivity present in the environment (water, air, earth, milk, grass, agricultural produce, etc.) are imposed on the licensees in order to check compliance with the scenarios postulated in the impact assessment. The laboratories carrying out these measurements must be approved by ASN (see point 4-3).

An estimation of the doses from BNIs is presented in table 6. For each site and per year, this table gives the effective doses received by the most exposed reference population groups.

The doses from BNIs for a given year are determined on the basis of the actual discharges from each installation for the year in question. This assessment takes account of the discharges through the identified outlets (stack, discharge pipe to river or seawater). It also includes diffuse emissions and sources of radiological exposure to the ionising radiation present in the facilities. These elements are the "source term".

The estimate is made in relation to one or more identified reference groups. These are uniform groups of people (adults, infants, children) receiving the highest average dose out of the entire population exposed to a given installation, following realistic scenarios (taking into account the distance from the site, meteorological data, etc.). All of these parameters, specific to each site, explain most of the differences observed between sites and from one year to another.

For each of the nuclear sites presented, the radiological impact remains far below 1% of the limit for the public (1 mSv per year). Therefore in France, the discharges produced by the nuclear industry have an extremely small radiological impact.

3.4 Lessons learned from significant events

3.4.1 Anomaly detection and analysis

History

The international conventions ratified by France (article 9v of the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management of 5th September 1997; Article 19vi of the Convention on Nuclear Safety of 20th September 1994) require that BNI licensees, on account of the defence in depth principle, implement a reliable system for early detection of any anomalies that may occur, such as equipment failures or errors in the application of operating rules.

Based on twenty years of experience, ASN felt that it would be useful to transpose this approach, which was initially limited to nuclear safety, to radiation protection and protection of the environment. ASN thus drafted two guides defining the principles and reiterating the obligations binding on the licensees with regard to notification of incidents and accidents:
- guide N° 12 of 21st October 2005 contains the requirements applicable to BNI licensees and to carriers. It concerns significant events affecting nuclear safety of BNIs and RMTs, radiation protection and protection of the environment;
- guide N° 11 of 15th June 2007 (modified on 7th October 2009) is intended for those in charge of nuclear activities as defined in Article L. 1333-1 of the Public Health Code and the heads of the facilities in which ionising radiation is used (medical, industrial and research activities using ionising radiation).

These guides can be consulted on the ASN website, *www.asn.fr*.

What is a significant event?

Detection of events (deviations, anomalies, incidents, etc.) by those in charge of the activities using ionising radiation, and implementation of corrective measures decided after analysis, play a fundamental role in accident prevention. The nuclear licensees detect and analyse about 100 to 300 anomalies each year for each EDF reactor and about fifty per year for any given research facility.

Prioritising the anomalies should enable the most important ones to be addressed first. ASN has defined a category of anomalies called "significant events". These are events that are sufficiently important in terms of safety or radiation protection to justify rapid notification of ASN, with a more complete analysis subsequently being sent to it. Significant events must be notified to it, as specified in the Order of 7th February 2012 (Art. 2.6.4), the Public Health Code (Articles L. 1333-3 and R. 1333-109 to R. 1333-111) and the Labour Code (Article R. 4451-99). The criteria for notifying the public authorities of events considered to be "significant" take account of the following:
- the actual or potential consequences for workers, the public, patients or the environment, of events that could occur and affect nuclear safety or radiation protection;
- the main technical, human or organisational causes that led to the occurrence of such an event.

This notification process is part of the continuous safety improvement approach. It requires the active participation of all licensees (users of ionising

TABLE 6: Radiological impact of BNIs since 2008 calculated by the licensees on the basis of the actual discharges from the installations and for the most exposed reference groups (data provided by the nuclear licensees). The values calculated by the licensee are rounded up to the next higher unit

LICENSEE/SITE	MOST EXPOSED REFERENCE GROUP / DISTANCE TO SITE IN km	Estimation of received doses, in mSv					
	[POPULATION] [a]	2008	2009	2010	2011	2012	2013
Andra / CSA	Pont du CD24 / 2,1 [Child] [Adult 2012] [Child 2013]	2.10^{-6}	5.10^{-6}	2.10^{-6}	3.10^{-6}	1.10^{-5}	1.10^{-6}
Andra / Manche	Hameau de La Fosse / 2,5 [Adult]	7.10^{-4}	6.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}	3.10^{-4}
	Fisherman Goury /8 [Adult]	5.10^{-8}	8.10^{-8}	8.10^{-8}	7.10^{-8}	2.10^{-8}	2.10^{-8}
Areva / FBFC	Ferme Riffard / 0,2 [Adult]	6.10^{-4}	8.10^{-4}	1.10^{-3}	6.10^{-4}	6.10^{-4}	5.10^{-4}
Areva / La Hague	Digulleville / 2,8 [Child, Adult (2012)]	8.10^{-3}	8.10^{-3}	$1. 10^{-2}$	9.10^{-3}	9.10^{-3}	2.10^{-2}
	Fisherman Goury / 6 [Adult, Child (2008, 2009, 2013)]	5.10^{-3}	4.10^{-3}	5.10^{-3}	5.10^{-3}	5.10^{-3}	6.10^{-3}
Areva / Tricastin (Areva NC, Comurhex, Eurodif, Socatri, SET)	Les Prés Guérinés / 1,5 [Adult, Child (2005)] Les Girardes / 1,2 Adult (2012, 2013)	5.10^{-4}	5.10^{-4}	*	*	3.10^{-4}	3.10^{-4}
	Clos de Bonnot / 0,1 [Adult (2012, 2013)]	7.10^{-4}	8.10^{-4}	7.10^{-4}	5.10^{-4}	2.10^{-4}	2.10^{-4}
CEA / Cadarache	Saint-Paul-Lez-Durance / 4,5 [Adult]	2.10^{-3}	2.10^{-3}	$2. 10^{-3}$	$3. 10^{-3}$	$2. 10^{-3}$	$2. 10^{-3}$
CEA / Fontenay-aux-Roses	Fontenay aux Roses / 1,5 [Child]	1.10^{-5}	5.10^{-6}	4.10^{-6}	1.10^{-5}	3.10^{-5}	3.10^{-5}
CEA / Grenoble [c]	Fontaine / 1 (gaseous discharges) et Saint-Egrève / 1,4 (liquid discharges) [Infant, Adult (2004, 2007, 2008, 2011, 2012, 2013)]	1.10^{-6}	5.10^{-7}	3.10^{-7}	2.10^{-9}	2.10^{-8}	5.10^{-9}
CEA / Marcoule (Atalante, Centraco, Phénix, Mélox, CIS bio)	Codolet [Adult / 2] [Child 2013]	4.10^{-4}	4.10^{-4}	3.10^{-4}	3.10^{-4}	2.10^{-4}	2.10^{-4}
CEA / Saclay	Christ de Saclay [Fisherman / 1]	7.10^{-4}	4.10^{-4}	7.10^{-4}	6.10^{-4}	1.10^{-3}	2.10^{-3}
EDF / Belleville-sur-Loire	Neuvy-sur-Loire / 1,3 [Adult] [Infant 2013]	6.10^{-4}	7.10^{-4}	6.10^{-4}	8.10^{-4}	8.10^{-4}	7.10^{-4}
EDF / Blayais	Le Bastion / 1,1 [Adult, Fisherman (2009, 2010, 2011, 2012, 2013)]	5.10^{-4}	5.10^{-4}	6.10^{-4}	6.10^{-4}	2.10^{-4}	2.10^{-3}
EDF / Bugey	St Etienne d'Hières sud / 0,6 [Adult (2011, 2012)] [Infant (2013)]	5.10^{-4}	5.10^{-4}	4.10^{-4}	5.10^{-4}	6.10^{-4}	4.10^{-4}
EDF / Cattenom	Garche Nord (2012), Warpich (2009, 2010, 2011, 2013) /1,5 [Adult, Infant (2009, 2010, 2011, 2013)]	3.10^{-3}	3.10^{-3}	3.10^{-3}	3.10^{-3}	3.10^{-3}	5.10^{-3}
EDF / Chinon	Le Neman / 1,25 [Adult] [Infant (2013)]	4.10^{-4}	4.10^{-4}	4.10^{-4}	5.10^{-4}	5.10^{-4}	3.10^{-4}
EDF / Chooz	Les Pirettes (gymnasium) / 0,8 [Adult , Infant (2009, 2013)]	2.10^{-3}	1.10^{-3}	1.10^{-3}	1.10^{-3}	9.10^{-4}	2.10^{-3}
EDF / Civaux	Ervaux Sud /0,7 [Adult] [Infant (2013)]	8.10^{-4}	7.10^{-4}	1.10^{-4}	7.10^{-4}	9.10^{-4}	2.10^{-3}
EDF / Creys-Malville	Ferme de Chancillon [Adult (2010, 2011, 2012) Infant (2013) / 0,85]	$2. 10^{-5}$	8.10^{-6}	$6. 10^{-5}$	$7. 10^{-4}$	7.10^{-4}	2.10^{-4}
EDF / Cruas-Meysse	Ferme de Grimaud, 1,25, Serres (2009,2010,2011,2012) / 1,5 [Adult (2008, 2011, 2012), Infant (2009, 2010, 2012, 2013)]	4.10^{-4}	5.10^{-4}	5.10^{-4}	5.10^{-4}	4.10^{-4}	4.10^{-4}
EDF / Dampierre-en-Burly	La Maison Neuve (2008), Les Serres (2009, 2010, 2011,2012, 2013) / 0,7 [Adult] [Infant 2013]	8.10^{-4}	1.10^{-3}	1.10^{-3}	2.10^{-3}	1.10^{-3}	9.10^{-4}
EDF / Fessenheim	Cité EDF(Koechlin) [Adult (2010, 2011, 2012)] [(Infant 2013)] / 1,2	8.10^{-5}	8.10^{-5}	1.10^{-4}	$8. 10^{-5}$	1.10^{-4}	1.10^{-4}
EDF / Flamanville	La Berquerie (2013) /0,8, Hameau es Louis (2009, 2010, 2011, 2012) / 0,8 [Adult, Fisherman (2009, 2010, 2011, 2012)] [Infant (2013)]	7.10^{-4}	9.10^{-4}	9.10^{-4}	2.10^{-3}	6.10^{-4}	7.10^{-4}
EDF / Golfech	Pascalet / 0,9, Labaquière (2009, 2010, 2011, 2012, 2013) /1 [Adult] [Infant (2013)]	8.10^{-4}	8.10^{-4}	9.10^{-4}	8.10^{-4}	7.10^{-4}	6.10^{-4}
EDF / Gravelines	Petit-Fort-Philippe /1,5, Espace Culturel Decaestecker (2009, 2010, 2011, 2012, 2013) /1,1 [Adult, Fisherman (2009, 2010, 2011, 2012, 2013)]	3.10^{-4}	1.10^{-3}	1.10^{-3}	2.10^{-3}	4.10^{-4}	6.10^{-4}

(continuation of table 6)

TABLE 6: Radiological impact of BNIs since 2008 calculated by the licensees on the basis of the actual discharges from the installations and for the most exposed reference groups (data provided by the nuclear licensees). The values calculated by the licensee are rounded up to the next higher unit

LICENSEE/SITE	MOST EXPOSED REFERENCE GROUP / DISTANCE TO SITE IN km	Estimation of received doses, in mSv					
	[POPULATION] [a]	2008	2009	2010	2011	2012	2013
EDF / Nogent-sur-Seine	Port Saint-Nicolas 2,25, Maison de l'Eclusier (2009, 2010, 2011, 2012, 2013) / 1 [Adult] [Infant (2013)]	7.10^{-4}	6.10^{-4}	9.10^{-4}	8.10^{-4}	6.10^{-4}	1.10^{-3}
EDF / Paluel	Le Tôt / 1,5 [Adult, Fisherman (2009, 2010, 2011, 2012)] Conteville / 1 [Adult, Fisherman]	2.10^{-3}	6.10^{-4}	7.10^{-4}	8.10^{-4}	5.10^{-4}	9.10^{-4}
EDF / Penly	Saint-Martin Plage / 1,1, Vassonville (2009, 2010, 2011, 2012) / 0,7 [Adult, Fisherman (2009, 2010, 2011, 2012)] Penly / 0,8 [Adult, Fisherman 2013]	3.10^{-3}	9.10^{-4}	1.10^{-3}	1.10^{-3}	6.10^{-4}	7.10^{-4}
EDF / St-Alban	Les Crès [Adult / 1,45] [Infant (2013)]	3.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}	4.10^{-4}
EDF / St-Laurent-des-Eaux	Port au Vin [Adult / 0,75] [Infant (2013)]	4.10^{-4}	3.10^{-4}	3.10^{-4}	3.10^{-4}	2.10^{-4}	2.10^{-4}
EDF / Tricastin	Clos du Bonneau / 1,25, Le Trop Long (2009, 2010, 2011, 2012, 2013) 1,35 [Adult, Infant (2009, 2010, 2011, 2012, 2013)]	4.10^{-4}	7.10^{-4}	9.10^{-4}	7.10^{-4}	7.10^{-4}	5.10^{-4}
Ganil / Caen	IUT / 0,6 [Adult]	$<9.10^{-3}$ **b**	3.10^{-3}	$<3.10^{-3}$	$<3.10^{-3}$	$<3.10^{-3}$	$<2.10^{-3}$
ILL / Grenoble	Fontaine / 1 (gaseous discharges) et Saint-Egrève (liquid discharges) / 1,4 [Infant]	*	1.10^{-4}	1.10^{-4}	5.10^{-5}	1.10^{-4}	2.10^{-4}

a: until 2008, for installations operated by EDF, only "adult" figures are calculated. From 2009 to 2012, the dose of the most exposed reference group of each site for the two age classes (adult or infant) is mentioned. As of 2013, the dose of the reference group is provided for three age classes (adult, child, infant) for all the BNIs.
b: value measured at site perimeter by means of passive dosimeters. Several dosimeters showed contamination readings, even when the facility was shut down. The value is thus highly over-estimated, according to the licensee.
c: because the outfall for the liquid discharges is geographically distant from the stack, two impact calculations are performed. One reflects the aggregate of maximum impact of gaseous discharges plus maximum impact of liquid discharges. The other corresponds to an actual reference group.
** Information not supplied by the licensee.*

radiation, carriers, etc.) in the detection and analysis of deviations. It enables the authorities:
- to ensure that the licensee has suitably analysed the event and taken appropriate measures to remedy the situation and prevent it happening again;
- to analyse the event in the light of the experience available to other parties in charge of similar activities.

The purpose of this system is not to identify or penalise any individual person or party. Moreover, the number and rating on the INES (International Nuclear and Radiological Event Scale) scale of the significant events which have occurred in a nuclear facility are not on their own indicators of the facility's level of safety. On the one hand, a given rating level is an over-simplification and is unable to reflect the complexity of an event and, on the other, the number of events listed depends on the level of notification. The trend in the number of events does not therefore reflect any real trend in the safety level of the facility concerned.

3.4.2 Implementation of the approach

Event notification

In the event of an incident or accident, whether or not nuclear, which has or risks having significant consequences for the safety of the facility or the transport operation, or risks harming people, property or the environment through significant exposure to ionising radiation, the licensee is obliged to notify ASN and the state representative in the *département* without delay.

According to the provisions of the Labour Code, employers are obliged to declare significant events affecting their workers. When the head of a facility carrying out a nuclear activity calls in an external contractor or non-salaried worker, the significant events affecting salaried or non-salaried workers are notified in accordance with the prevention plans and the agreements concluded pursuant to Article R. 4451-8 of the Labour Code.

The notifying party assesses the urgency of notification in the light of the confirmed or potential seriousness of the event and the speed of reaction necessary to avoid an aggravation of the situation or to mitigate the consequences of the event. The notification time of two working days, tolerated in the ASN notification guide, does not apply when the consequences of the event require intervention by the public authorities.

ASN analysis of the notification

ASN analyses the initial notification to check the implementation of immediate corrective measures, to decide whether to conduct an on-site inspection to analyse the event in depth, and to prepare for informing the public if necessary.

Within two months of the notification, it is followed by a report indicating the conclusions the licensee has drawn from analysis of the events and the steps it intends to take to improve safety or radiation protection and prevent the event from happening again. This information is taken into account by ASN and its technical support organisation, IRSN, in the preparation of the inspection programme and when performing the BNI periodic safety reviews.

ASN ensures that the licensee has analysed the event pertinently, has taken appropriate steps to remedy the situation and prevent it from recurring, and has circulated the operating experience feedback.

ASN's review focuses on compliance with the applicable rules for detecting and notifying significant events, the immediate technical, organisational or human measures taken by the licensee to maintain or bring the installation into a safe condition, and the pertinence of the submitted analysis.

ASN and IRSN subsequently examine the operating feedback from the events. The assessment by ASN, the significant event reports and the periodic reviews sent by the licensees constitute the basis of operating experience feedback. This experience feedback can lead to requests for improvement of the condition of the facilities and the organisation adopted by the licensee, as well as for changes to the regulations.

Operating experience feedback comprises the events which occur in France and abroad if it is pertinent to take them into account in order to reinforce safety or radiation protection.

3.4.3 Technical inquiries held in the event of an incident or accident concerning a nuclear activity

ASN has the authority to carry out an immediate technical inquiry in the event of an incident or accident in a nuclear activity. This inquiry consists in collecting and analysing all useful information, without prejudice to the judicial inquiry, in order to determine the circumstances and the identified or possible causes of the event, and draw up the appropriate recommendations if necessary. Articles L. 592-35 and following of the Environment Code give ASN powers to set up a commission of inquiry, determine its composition (ASN staff and people from outside ASN), define the subject and scope of the investigations and gain access to all necessary elements in the event of a judicial inquiry.

Decree 2007-1572 of 6th November 2007 on technical inquiries into accidents or incidents concerning a nuclear activity specifies the procedure to be followed. It is based on the practices established for the other investigation bureaus and takes account of the specific characteristics of ASN, particularly its independence, its ability to impose prescriptions or penalties if necessary and the concurrence of its investigative and other duties.

3.4.4 Public information

The public must be informed of those events whose importance so warrants (see chapter 6).

3.4.5 Statistical summary of events in 2014

In 2014, ASN was notified of:
- 1,114 significant events concerning nuclear safety, radiation protection and the environment in BNIs; 971 of these events were rated on the INES scale (872 events rated level 0 and 99 events rated level 1). Ten significant events were rated as "generic events" including 3 at level 1 on the INES scale;
- 63 significant events concerning the transport of radioactive substances, including 3 events rated level 1 on the INES scale;
- 650 significant events concerning radiation protection in small-scale nuclear activities, including 195 rated on the INES scale (of which 34 were level 1 events and 4 were level 2 events).

The general trend of rising numbers of significant events observed in recent years would seem to be slowing down. The trends must be differentiated according to the sector concerned. Between 2010 and 2014, despite fluctuations in certain years, the number of significant events notified in BNIs increased by about 8%. Over the same period, the number of significant events notified grew continuously in the small-scale nuclear activities sector, with an increase of more than 30%, but remained relatively stable in transports.

As indicated earlier, these data must nevertheless be used with caution: they do not in themselves constitute a safety indicator. ASN encourages the licensees to notify incidents, which contributes to transparency and the sharing of experience.

The distribution of significant events rated on the INES scale is specified in table 7. The INES scale is not applicable to patients, who are rated on the ASN-SFRO[2] scale of significant events affecting one or more radiotherapy patients, and is described in chapter 9.

2. *This scale is designed for communication with the public in comprehensible, explicit terms, concerning radiation protection events leading to unexpected or unforeseeable effects on patients undergoing an external radiotherapy medical procedure.*

GRAPH 5: Events involving safety in NPPs, notified in 2014

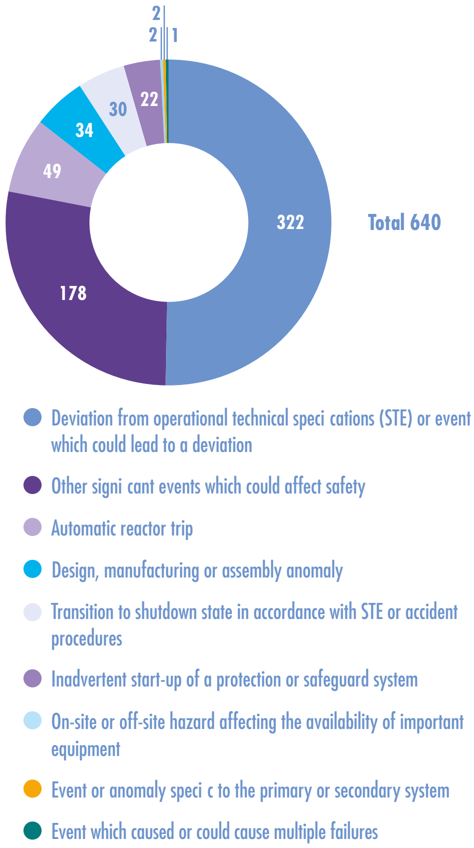


TABLE 7: Rating of significant events on the INES scale between 2010 and 2014

		2010	2011	2012	2013	2014
BNI	Level 0	790	848	920	905	872
	Level 1	94	89	110	103	99
	Level 2	2	1	2	2	0
	Level 3 et +	0	0	0	0	0
	TOTAL BNI	886	938	1 032	1 010	971
NPX (medical and industry)	Level 0	121	81	118	130	157
	Level 1	37	15	33	22	34
	Level 2	1	1	1	2	4
	Level 3 et +	0	0	0	0	0
	TOTAL NPX	159	97	152	154	195
RMT	Level 0	53	25	52	50	60
	Level 1	9	2	6	1	3
	Level 2	0	0	1	0	0
	Level 3 and +	0	0	0	0	0
	TOTAL RMT	62	27	59	51	63
	TOTAL	1,107	1,062	1,243	1,215	1,229

Likewise, the significant events concerning the environment but involving non-radiological substances are not covered by the INES scale.

Such events are classified as "out of INES scale" events.

Graphs 5 to 10 describe in detail the significant events notified to ASN in 2014, differentiating between the various notification criteria for each field of activity.

3.5 Heightening the awareness of professionals and cooperating with the other administrations

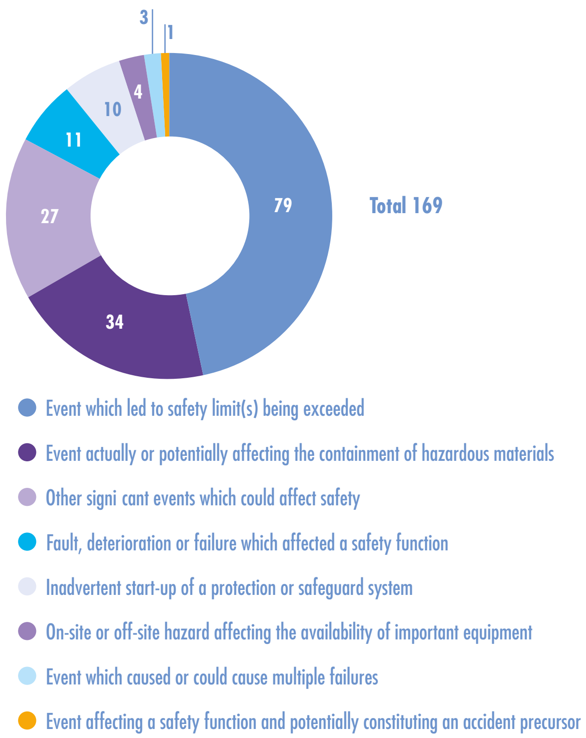
Regulation is supplemented by awareness programmes designed to ensure familiarity with the regulations and their application in practical terms appropriate to the various professions. ASN aims to encourage and support initiatives by the professional organisations who implement this approach by issuing best practice and professional information guides.

Awareness-raising also involves joint actions with other administrations and organisations which oversee the same facilities, but with different prerogatives. One could here mention the labour inspectorate, the medical devices inspectorate by the ANSM, the medical activities inspectorate entrusted to the technical services of the Ministry of Health, or the oversight of small-scale nuclear activities at the Ministry of Defence entrusted to ASN and to the armed forces general inspectorate (CGA).

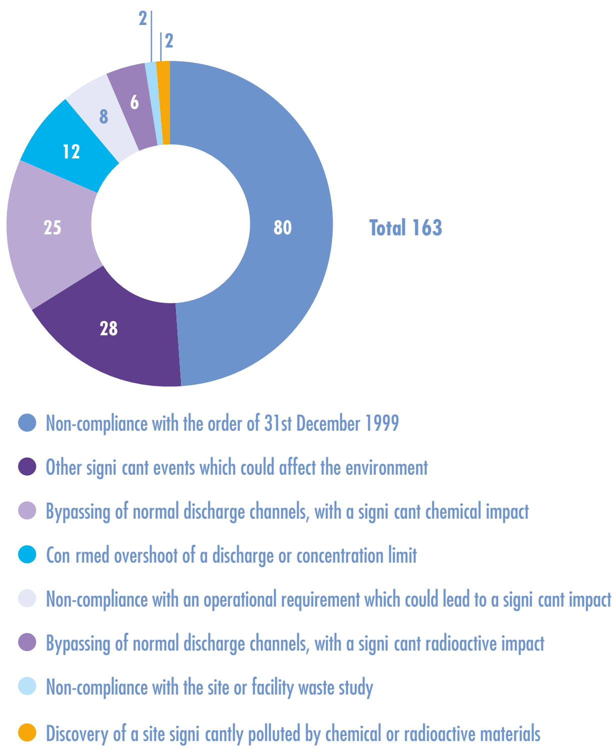
4. MONITORING ENVIRONMENTAL RADIOACTIVITY

In France, many parties are involved in environmental radioactivity monitoring:
- the nuclear facility licensees, who perform monitoring around their sites;
- ASN, IRSN (whose roles defined by Decree 2002-254 of 22nd February 2002 include participation in radiological monitoring of the environment), the Ministries (General Directorate for Health, General Directorate for Food, General Directorate for Competition policy, Consumer Affairs and Fraud control, etc.), the State services and other public players performing monitoring duties nationwide or in particular sectors (foodstuffs for example, monitored by the Ministry responsible for agriculture);
- the approved air quality monitoring associations (local authorities), environmental protection associations and the CLIs.

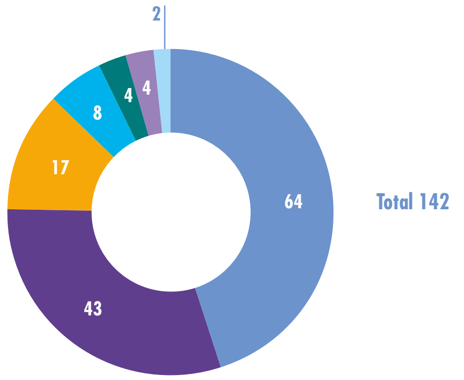
GRAPH 6: Events involving safety in BNIs other than NPPs notified in 2014



GRAPH 7: Significant environment-related events in BNIs notified in 2014

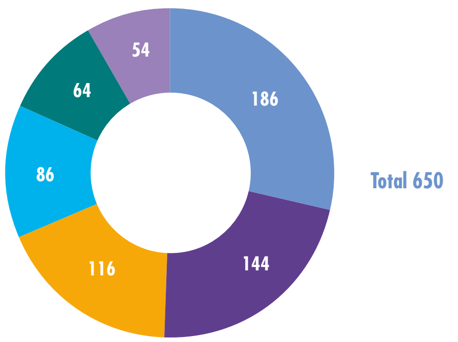


GRAPH 8: Events involving radiation protection in BNIs notified in 2014



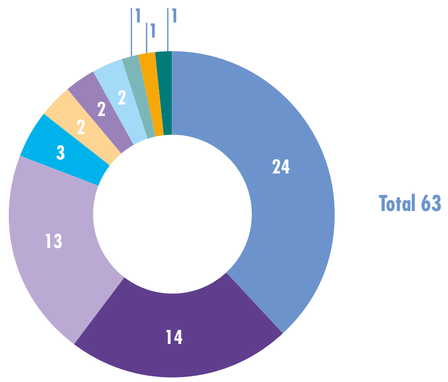
- Other signi cant event which could affect radiation protection
- Signage anomaly or failure to comply with zone access conditions
- Any signi cant deviation concerning radiological cleanness
- Abnormal situation affecting a source with activity higher than the exemption threshold
- One quarter of the annual dose limit exceeded or event capable of leading to such a situation
- Radiological monitoring device inspection interval exceeded
- Operation with a radiological risk performed without analysis or ignoring the ndings of the analysis

GRAPH 9: Events involving radiation protection (other than BNIs and RMT) notified in 2014



- Concerning one or more patients (therapeutic purposes)
- Concerning the general public
- Concerning one or more patients (diagnostic purposes)
- Loss, theft or discovery of radioactive sources or substances
- Concerning one or more workers
- Other event concerning radiation protection

GRAPH 10: Events involving the transport of radioactive substances notified in 2014



- Non-compliance with regulation requirements for the transport of radioactive substances which had actual or potential signi cant consequences
- Any other event liable to affect the safety of transport and considered to be signi cant by the licensee or by ASN
- Non-compliance with one of the regulation limits applicable to the intensity of radiation or to contamination
- Fault, deterioration or failure which affected a safety function, with actual or potential signi cant consequences.
- Hazard resulting either from natural phenomena or from human activities, actually or potentially affecting transport safety
- Inadvertent discovery of a package of radioactive substances from a shipment for which no loss was noti ed
- Event which affected one or more of the barriers placed between the radioactive material and humans, with actual or potential dispersion of these substances or signi cant exposure of persons to ionising radiation
- Con rmed malicious act or attempted malicious act liable to affect transport safety
- Event, regardless of the severity, if liable to lead to erroneous or deliberately misleading interpretations in the media or among the public
- Repetitive event, even if minor, affecting a safety function, for which the cause has not been identi ed or which is liable to constitute an incident precursor

The French national network for environmental radioactivity monitoring (RNM) brings all these players together. Its primary aim is to collate and make available to the public all the environmental measurements made in a regulatory framework on French territory. The quality of these measurements is guaranteed by subjecting the measuring laboratories to an approval procedure.

4.1 European context

Article 35 of the Euratom Treaty requires the member states to establish the facilities necessary to carry out continuous monitoring of the level of radioactivity in the air, water and soil and to ensure compliance with the basic standards of health protection for the general public and workers against the hazards of ionising radiation. All member States, whether or not they have nuclear facilities, are therefore required to implement environmental monitoring arrangements throughout their territory.

By virtue of the provisions of this same Article 35, the European Commission also has the right to access these monitoring facilities, in order to check their operation and effectiveness. During its verifications, the European Commission gives an opinion on the means implemented by the member states to monitor radioactive discharges into the environment and the levels of radioactivity in the environment around nuclear sites and over the national territory.

It gives its assessment of the monitoring equipment and methodologies used, and of the organisational setup.

Since 1994, the commission has carried out the following inspections:
- the La Hague reprocessing plant and Andra's Manche repository in 1996;
- Chooz NPP in 1999;
- Belleville-sur-Loire NPP in 1994 and 2003;
- the La Hague reprocessing plant in 2005;
- the Pierrelatte nuclear site in 2008;
- the old uranium mines in the Limousin *département* in 2010;
- the CEA site at Cadarache in 2011.

4.1.1 The purpose of environmental monitoring

The licensees are responsible for monitoring the environment around their facilities in accordance with individual prescriptions (creation authorisation decree, discharge license or ASN resolution) defining the steps to be taken and their frequency, regardless of any additional arrangements made by the licensees for their own monitoring.

This environmental monitoring:
- helps gives a picture of the radiological and radio-ecological state of the facility's environment through measurement of parameters and substances regulated by the prescriptions, whether or not radioactive, in the various compartments of the environment (air, water, soil) as well as in the various biotopes and the food chain (milk, vegetables, etc.): a zero reference point is identified before the creation of the facility and environmental monitoring enables any changes to be tracked;
- helps verify that the impact of the facility on health and the environment is in conformity with the impact assessment provided for in 6° of I of Article 8 of the decree of 2nd November 2007;
- detects any abnormal increase in radioactivity as early as possible;
- ensures there are no facility malfunctions, including by analysing the ground water and checking licensees' compliance with the regulations;
- contributes to transparency and information of the public by transmitting monitoring data to the RNM.

4.1.2 Content of monitoring

All the nuclear sites in France that produce discharges are subject to systematic environmental monitoring. The nature of this monitoring is proportionate to the potential environmental risks or drawbacks of the facility, as presented in the authorisation file, particularly the impact assessment.

The regulatory monitoring of the BNIs environment is tailored to each type of installation, depending on whether it is a power reactor, a plant or a research facility. The minimum content of this monitoring is defined by the order of 7th February 2012 setting the general rules for BNIs and by ASN resolution 2013-DC-0360 of 16th July 2013 relative to control of nuisance effects and the impact of BNIs on health and the environment.

Depending on specific local features, monitoring may vary from one site to another. Table 8 gives examples of the monitoring performed by an NPP and by a research centre or plant.

When several facilities (whether or not BNIs) are present on the same site, joint monitoring of all these installations is possible, as has for example been the case on the Cadarache and Pierrelatte sites since 2006.

These monitoring principles are supplemented in the individual requirements applicable to the facilities by monitoring measures specific to the risks inherent in the industrial processes they use.

Each year, in addition to sending ASN the monitoring results required by the regulations, the licensees transmit nearly 120,000 measurements to the national network for environmental radioactivity monitoring.

4.2 Environmental monitoring nationwide by IRSN

IRSN's environmental monitoring of the French territory is ensured through measurement and sampling networks dedicated to:
- air monitoring (aerosols, rainwater, ambient gamma activity);
- monitoring of surface water (watercourses) and groundwater (aquifers);
- monitoring of the human food chain (milk, cereals, food intake);
- terrestrial continental monitoring (reference stations located far from all industrial facilities).

It uses several approaches for this:
- continuous on-site monitoring using independent systems (remote-monitoring networks) providing real-time transmission of results. This includes:
  - the Téléray network (ambient gamma radioactivity in the air) which uses a system of continuous measurement monitors around the whole country: The density of this network is being increased around nuclear sites within a radius of 10 to 30 km around BNIs;
  - the hydrotéléray network (monitoring of the main watercourses downstream of all nuclear facilities and before they cross national boundaries);
  - continuous sampling networks with laboratory measurement, for example the atmospheric aerosols radioactivity monitoring network;
- processing and measurement in a laboratory of samples taken from the various compartments of the environment, whether or not close to facilities liable to discharge radionuclides.

Every year, IRSN takes more than 25,000 samples in all compartments of the environment (excluding the remote-measurement networks).

The radioactivity levels measured in France are stable and situated at very low levels, generally at the detection sensitivity threshold of the measuring instruments. The artificial radioactivity detected in the environment results essentially from fallout from the atmospheric tests of nuclear weapons carried out in the 1960s, and from the Chernobyl accident. Traces of artificial radioactivity associated with discharges can sometimes be detected near installations. To this can be added very local contaminations resulting from incidents or past industrial activities, and which do not represent a health risk.

4.3 Measurement quality

Articles R.1333-11 and R.1333-11-1 of the Public Health Code require the creation of an RNM and a procedure to have the radioactivity measurement laboratories approved by ASN. The RNM operating procedures were defined by an ASN resolution (approved resolution 2008-DC-0099 of 29th April 2008).

This network is being deployed for two main reasons:
- to ensure the transparency of information on environmental radioactivity by making the results of this environmental monitoring and information about the radiological impact of nuclear activities in France available to the public;
- to pursue the implementation of a quality assurance policy for environmental radioactivity measurements by setting up a system of laboratory approvals granted by ASN resolution, pursuant to Article l. 592-21 of the Environment Code.

The approvals cover all components of the environment, water, soils or sediments, all biological matrices (fauna, flora, milk), aerosols and atmospheric gases. The measurements concern the main artificial or natural, gamma, beta or alpha emitting radionuclides, as well as the ambient gamma dosimetry (see table 9).

In total, about fifty types of measurements are covered by approvals. There are just as many corresponding inter-laboratory comparison tests. These tests are organised by IRSN in a 5-year cycle, which corresponds to the maximum approval validity period.

4.3.1 Laboratory approval procedure

ASN resolution 2008-DC-0099 of 29th April 2008 specifies the organisation of the national network and sets the approval arrangements for the environmental radioactivity measurement laboratories.

The approval procedure includes:
- presentation of an application file by the laboratory concerned, after participation in an inter-laboratory test (ILT);
- review of it by ASN;
- review of the application files - which are made anonymous - by a pluralistic approval commission which delivers an opinion on them.

The laboratories are approved by ASN resolution, published in its official bulletin.

This resolution in particular obliges BNI licensees to have approved laboratories take the environmental radioactivity measurements required by regulations.

TABLE 8: Example of radiological monitoring of the environment around BNIs

ENVIRONMENT MONITORED OR TYPE OF INSPECTION	CATTENOM NPP (RESOLUTION 2014-DC-0415 OF 16 JANUARY 2014)	AREVA LA HAGUE FACILITY (ORDER OF 10 JANUARY 2003 AMENDED BY THE ORDER OF 8 JANUARY 2007)
Air at ground level	• 4 continuous sampling stations for atmospheric dust on fixed filter with daily measurement of total β activity (β_G) γ spectrometry if $\beta_G > 2$ mBq/m^3 Monthly γ spectrometry on grouped filters per station • 1 continuous sampling station downwind of the prevailing winds, with weekly measurement of atmospheric ^{3}H	• 5 stations continuously sampling atmospheric dust on a fixed filter, with daily measurements of the total α activity (α_G) and total β activity (β_G). γ spectrometry if $\beta_G > 1$ mBq/m^3 Monthly α spectrometry (Pu) on grouped filters per station • 5 continuous sampling stations for halogens on specific adsorbent with weekly γ spectrometry to measure iodines • 5 continuous sampling stations with weekly measurement of atmospheric ^{3}H • 5 continuous sampling stations with bi-monthly measurement of atmospheric ^{14}C • 5 continuous measurement stations for ^{85}Kr activity in the air
Ambient γ radiation	• Continuous measurement with recording: - 4 detectors at 1 km - 10 detectors on the site boundary - 4 detectors at 5 km	• 5 detectors with continuous measurement and recording • 11 detectors with continuous measurement at the site fencing
Rain	1 continuous sampling station under the prevailing winds with bi-monthly measurement of β_G and ^{3}H	• 2 continuous sampling stations including one under the prevailing winds with weekly measurement of α_G, β_G and ^{3}H γ spectrometry of significant α_G or β_G
Liquid discharge receiving environment	• Sampling from the river upstream of the discharge point and in the good mixing area for each discharge Measurement of β_G, potassium (K)* and ^{3}H • Continuous sampling in the river at the good mixing point Measurement of ^{3}H (daily average mixture) • Annual samples from aquatic sediments, fauna and flora upstream and downstream of the discharge point with γ spectrometry, measurement of free ^{3}H and, in fish, organically bound ^{14}C and ^{3}H • Periodic sampling from a stream and in the dam adjoining the site with measurements of β_G, K, ^{3}H	• Daily seawater samples from 2 points on the coast, with daily measurements (γ spectrometry, ^{3}H) at one of these points and for each of the 2 points, α and γ spectometry and β_G, K, ^{3}H and ^{90}Sr measurements • Quarterly seawater samples at 3 points offshore with γ spectrometry and β_G, K, ^{3}H measurements • Quarterly samples of beach sand, seaweed and limpets at 13 points with γ spectometry + ^{14}C measurements and α spectometry for the seaweed and limpets at 6 points • Sampling of fish, crustaceans, shellfish and molluscs in 3 coastal zones of the Cotentin with α and γ spectometry and ^{14}C measurement • Quarterly sampling of offshore marine sediments at 8 points with α and γ spectometry and ^{90}Sr measurement • Weekly to six-monthly sampling of water of 19 streams neighbouring the site, with α_G, β_G, K and ^{3}H measurements • Quarterly sampling of sediments of the 4 main streams neighbouring the site, with γ and α spectometry • Quarterly sampling of aquatic plants from 3 streams neighbouring the site, with γ spectometry and ^{3}H measurement
Groundwater	• Monthly sampling at 4 points, bi-monthly at 1 point and quarterly at 4 points with β_g, K and ^{3}H measurements	• 5 sampling points (monthly check) with α_G, β_G, K and ^{3}H measurements
Water for consumption	• Annual sampling of water intended for human consumption, with β_G, K and ^{3}H measurements	• Periodic sampling of water intended for human consumption at 15 points, with α_G, β_G, K and ^{3}H measurements
Soil	• 1 annual sample of topsoil with γ spectrometry	• Quarterly samples at 7 points with γ spectrometry and ^{14}C measurement
Vegetation	• 2 grass sampling points, including one under the prevailing winds, monthly γ spectrometry and quarterly ^{14}C and C measurements. • Annual campaign for the main agricultural crops, with γ spectrometry, ^{3}H and ^{14}C measurements	• Monthly grass sampling at 5 points and quarterly at 5 other points with γ spectrometry and ^{3}H and ^{14}C measurements, Annual α spectrometry at each point • Annual campaign for the main agricultural crops, with α and γ spectrometry, ^{3}H, ^{14}C and ^{90}Sr measurements
Milk	• 2 sampling points, situated 0 to 10 km from the facility, including one under the prevailing winds, with monthly γ spectrometry, quaterly ^{14}C measurement and annual ^{90}Sr and ^{3}H measurements	• 5 sampling points (monthly check) with γ spectrometry, K, ^{3}H, ^{14}C and ^{20}Sr measurements

α_G = total α ; β_G = total β
** Measurements of total concentration of potassium and by spectrometry for ^{40}K*

4.3.2 The approval commission

The approval commission is the body which, for the RNM, is tasked with ensuring that the measurement laboratories have the organisational and technical competence to provide the network with high-quality measurement results. The commission is authorised to propose approval, rejection, revocation or suspension of approval to ASN. It issues a decision on the basis of an application file submitted by the candidate laboratory and its results in the ILTs organised by IRSN.

The commission presided over by ASN comprises qualified persons and representatives of the state services, laboratories, standardising authorities and IRSN. ASN resolution 2013-CODEP-DEU-2013-061297 of 12th November 2013, appointing candidates to the environmental radioactivity measurement laboratories approval commission, renewed the mandates of the commission's members for a further five years.

4.3.3 Approval conditions

Laboratories seeking approval must set up an organisation meeting the requirements of standard NF EN ISO/IEC 17025 concerning the general requirements for the competence of calibration and test laboratories.

In order to demonstrate their technical competence, they must take part in ILTs organised by IRSN. The ILT programme, which now operates on a five-yearly basis, is updated annually. It is reviewed by the approval commission and published on the national network's website (*www.mesure-radioactivite.fr*).

The ILTs organised by IRSN can cover up to 70 laboratories in each test, including a few foreign laboratories.

To ensure that the laboratory approval conditions are fully transparent, precise assessment criteria are used by the approval commission. These criteria are published on *www.mesure-radioactivite.fr*.

In 2014, IRSN organised four intercomparison tests; 54 ILTs since 2003 cover nearly 50 types of approval. The most numerous approved laboratories (55) are in the field of monitoring of radioactivity in water. About thirty to forty laboratories are approved for measurement of biological matrices (food chain), atmospheric dust, air, or ambient gamma dosimetry. 32 laboratories deal with soils. Although most of the laboratories are competent to measure gamma emitters in all environmental matrices, only about ten of them are approved to measure carbon-14, transuranium elements or radionuclides of the natural chains of uranium and thorium in water, soil and biological matrices.

In 2013, ASN issued 302 approvals or approval renewals. On 1st January 2015, the total number of approved laboratories stood at 62, which represents 826 approvals of all types currently valid.

The detailed list of approved laboratories and their scope of technical competence is available on *www.asn.fr*.

ASN has begun a process to modify ASN resolution 2008-DC-0099 of 29th April 2008. A draft modification was presented to the RNM steering committee and to the laboratories approval commission in 2013 and was opened to the public for consultation. The main modifications envisaged consist in:
- modifying the composition of the steering committee, notably to increase the presence of environmental protection associations;
- creating a new type of approval for health checks on foodstuffs.

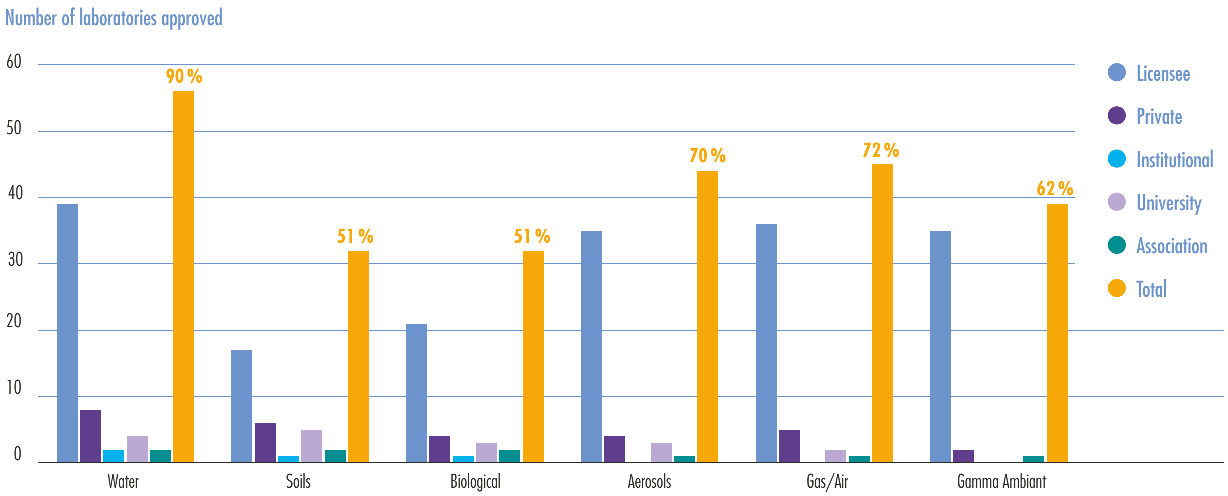
The obligation of accreditation by the French Accreditation Committee (Cofrac), which had been envisaged for certain approval categories, was in the end not adopted. After an initial consultation of all the stakeholders, in particular the associations network, ASN considered that this measure entailed a risk of eventually compromising the diversity of expert opinions. After a further consultation in late 2014, the modification of the resolution was approved by the ASN Commission on 26th February 2015.

TABLE 9: Approval chart and forecast five-year inter-laboratory test (ILT) programme

		TYPE 1			TYPE 2		TYPE 3		TYPE 4		TYPE 5		TYPE 6	
Code	Radioactive measurements category	Sea water	Water		Soil matrices		Biological matrices		Aerosols on filter		Gas air		Ambient environment (soil/air)	
..-01	γ emitting radionuclides > 100 keV		◎	1_01	●	2_01	◎	3_01	◎	4_01	●	5_01		-
..-02	γ emitting radionuclides > 100 keV		◎	1_02	●	2_02	◎	3_02		4_02	●	5_02		-
..-03	Total alpha		◎●	1_03		-		-	◎	4_03		-		-
..-04	Total beta	●	◎●	1_04		-		-	◎	4_04		-		-
..-05	^{3}H	●	◎●	1_05		2_05	◎	3_05		-		Cf. water		-
..-06	^{14}C		●	1_06		2_06	◎	3_06		-	●	Cf. water/Na OH		-
..-07	$^{90}Sr/^{90}Y$		●	1_07	●	2_07	◎	3_07	◎	4_07		-		-
..-08	Other pure beta emitters (Ni-63,...)			1_08	◎ ^{99}Tc	2_08	● ^{99}Tc	3_08		-		-		-
..-09	Isotopes U		◎	1_09	●	2_09	◎	3_09	◎	4_09		-		-
..-10	Isotopes Th			1_10	●	2_10	◎	3_10		4_10		-		-
..-11	^{226}Ra + daughters		◎	1_11	●	2_11	◎	3_11		-		Rn 222 : 5_11		-
..-12	^{228}Ra + daughters		◎	1_12	●	2_12	◎	3_12		-		Rn 220 : 5_12		-
..-13	Isotopes Pu, Am, (Cm, Np)		◎	1_13	◎	2_13	●	3_13	◎	4_13		-		-
..-14	Halogenated gases			-		-		-		-	●	5_14		-
..-15	Rare gases			-		-		-		-	● ^{85}Kr	5_15		-
..-16	Gamma dosimetry			-		-		-		-		-	●	6_16
..-17	Total uranium		◎	1_17	●	2_17	◎	3_17	◎	4_17		-		-

● 1st semester 2015 ◎ 2nd semester 2015 ● 1st semester 2016 ◎ 2nd semester 2016 ● 1st semester 2017 ◎ 2nd semester 2017 ● 1st semester 2018 ◎ 2nd semester 2018 ● 1st semester 2019 ◎ 2nd semester 2019

GRAPH 11: Breakdown of the number of approved laboratories for a given environmental matrix as at 1st January 2015



UNDERSTAND

www.mesure-radioactivite.fr

In order to meet the transparency goal, the RNM launched a website in 2010 to present the environmental radioactivity monitoring results and information on the health impact of nuclear activities in France. In order to guarantee the quality of the measurements, only those taken by an approved laboratory or by IRSN may be communicated to the RNM.

The website is organised around three topics (radioactivity, the national network and the measurements map) and can be used to obtain information about radioactivity (what is radioactivity? how is it measured? what are its biological effects?), about the national monitoring network (operation, network participants, laboratory approval procedure), plus access to a database containing all the radioactivity measurements taken nationwide (almost 600,000 measurements). The RNM management report is also available on it. At the beginning of 2013, IRSN published a report on the radiological state of the French environment for the period 2010 and the first half of 2011. This report was drawn up for the first time using data from the RNM.

ASN considers that the launch of the RNM website is a decisive step forward in terms of transparency. It however considers this to be just a first step in providing the public with environmental radioactivity monitoring information, and will ensure that the general public and web users are consulted about how they would like this website to develop. A panel of users was set up in 2012 to test the website. This feedback will help to ensure that functions and information can be added to the site, enabling the public to understand and interpret the results of the environmental radioactivity measurements transmitted to the RNM.

ASN and IRSN have thus begun to look at ways of developing the RNM website. These changes were presented to the RNM steering committee in November 2014.

5. IDENTIFYING AND PENALISING DEVIATIONS

5.1 Ensuring that penalty decisions are fair and consistent

In certain situations in which the licensee fails to conform to the regulations or legislation, or when it is important that appropriate action be taken by it to remedy the most serious risks without delay, ASN may impose the penalties provided for by law. The principles of ASN's actions in this respect are:
- penalties that are impartial, justified and appropriate to the level of risk presented by the situation concerned. Their scale is proportionate to the health and environmental consequences associated with the deviation detected and also takes account of intrinsic factors relating to the behaviour of the party at fault and external factors relating to the context of the deviation;
- administrative action initiated on proposals from the inspectors and decided on by ASN in order to remedy risk situations and non-compliance with the legislative and regulatory requirements as observed during its inspections.

ASN has a range of tools at its disposal, in particular:
- remarks made by the inspector to the licensee;
- the official letter from the ASN departments to the licensee (follow-up letter);
- formal notice from ASN to the licensee to regularise its administrative situation or meet certain specified conditions, within a given time-frame;
- administrative penalties applied after formal notice.

In parallel with ASN's administrative action, reports can be drafted by the inspector and sent to the public prosecutor's office.

To provide the inspectors with the tools they need to assess the seriousness of the deviations observed and impose appropriate penalties, ASN has drawn up procedures and decision-making tools. These documents provide a structured framework enabling an impartial decision to be reached that is proportionate to the deviation detected, and consistent between all the inspectors.

The decision to take enforcement measures is based on the observed risk for people or the environment and takes account of factors specific to the licensee (history, behaviour, repeated nature of the problem), contextual factors and the nature of the infringements observed (violation of regulations, standards, "rules of good practice", etc.).

The green growth energy transition bill provides for a reinforcement of ASN's oversight resources and powers of sanction, through the following arrangements:
- giving ASN and its inspectors more graduated powers of oversight and sanction (administrative fines, daily administrative payments, possibility of impounding items, taking samples or requiring the deposit of funds, as well as negotiations) appropriate to the nuclear safety and radiation protection issues, in particular with regard to the amounts of any monetary sanctions;
- the creation of a sanctions committee within ASN to implement these new sanctions, in order to comply with the principle of the separation of the investigation and sentencing functions;
- extension of ASN's policing powers to activities important for protection performed outside BNIs by the licensee, its suppliers, contractors or subcontractors.

5.2 An appropriate policy of enforcement and sanctions

5.2.1 For the BNI licensees and entities responsible for the transport of radioactive substances

When ASN's regulatory actions reveal failures to comply with safety requirements, penalties can be imposed on the licensees concerned, after serving formal notice if necessary. Penalties in such cases may consist in prohibiting restart of a plant or suspending operation until the requisite corrective measures have been taken.

If an infringement is observed, the environment code comprises graduated administrative penalties that become applicable after formal notice, as defined in its Articles L. 596-14 to L. 596-22:
- deposit in the hands of a public accountant of a sum covering the total cost of the work to be performed;
- have the work or prescribed measures carried out without consulting the licensee and at its expense (any sums deposited beforehand can be used to pay for this work);
- suspension of operation of the installation or of performance of an operation until the licensee has brought it into conformity.

If the licensee has any observations concerning the penalties it shall present them to the ASN commission before they are applied.

The act also makes provision for interim measures to safeguard security and public health and safety or protect the environment. ASN can therefore:
- provisionally suspend operation of a BNI, immediately notifying the ministers responsible for nuclear safety, in the event of any serious and imminent risk;
- at all times require assessments and implementation of the necessary measures in the event of a threat to the abovementioned interests.

Infringements are written up in reports by the nuclear safety inspectors and transmitted to the public prosecutor's office, which decides on what subsequent action, if any, is to be taken. The environment code makes provision for criminal penalties, detailed in Articles L. 596-27 to L. 596-30; these penalties include fines of €7,500 to €150,000 plus a possible prison term of 1 to 3 years, depending on the nature of the infringement. For legal persons found to be criminally liable, the amount of the fine can reach €1,500,000.

Decree 2007-1557 of 2nd November 2007 concerning BNIs and the regulation of the transport of radioactive substances with respect to nuclear safety, also imposes class 5 fines for infringements as detailed in its Article 56.

With regard to pressure equipment, the manufacturers and approved organisations are considered to be "licensees". Thus, pursuant to the provisions of Chapter VII of Title V of Book V of the Environment Code, which apply to high-risk products and equipment, including pressure equipment, ASN which is in charge of monitoring these items in BNIs, has powers of sanction against manufacturers, approved organisations and licensees. These provisions in particular enable it to order the payment of a fine, plus an additional daily payment applicable until such time as compliance with the formal notice is effective.

In addition to these provisions, which will be supplemented by implementing decrees, the Decree of 13th December 1999 concerning pressure equipment also comprises enforcement measures and sanctions against licensees and manufacturers of pressure equipment. These provisions aim to ban the marketing, commissioning or continued operation of an equipment item and to serve the licensee with formal notice to take all steps to ensure conformity.

5.2.2 For persons in charge of small-scale nuclear activities, approved organisations and laboratories

The Public Health Code makes provision for administrative and criminal sanctions in the event of breach of the radiation protection requirements.

Administrative decision-making powers lie with ASN and can entail:
- temporary or definitive license withdrawals after receiving formal notice;
- interim suspension of an activity (whether licensed or notified) if urgent measures are required to safeguard human health;
- revocation or suspension of any approvals it has issued.

The formal notice prior to revocation of a license (based on Article L.1333-5 of the Public Health Code) concerns implementation of all the requirements of the "ionising radiation" chapter of the legislative part of the Public Health Code (articles L.1333-1 to L.1333-20), regulatory requirements and the stipulations of the license. Temporary or final revocation of the license by ASN must be fully explained in a decision within one month following serving of formal notice.

The formal notices prior to criminal sanctions (based on Article L.1337-6 of the Public Health Code) are served by ASN. They concern the requirements of Articles L.1333-2, L.1333-8 (human exposure monitoring, protection and information measures), L.1333-10 (monitoring of exposure to enhanced natural radioactivity and in premises open to the public) and L.1333-20 (certain implementations of the chapter of the Public Health Code relating to ionising radiation, as determined by decrees).

Infringements are written up in reports by the radiation protection inspectors and transmitted to the public prosecutor's office, which decides on what subsequent action, if any, is to be taken. The Public Health Code makes provision for criminal sanctions as detailed in Articles L.1337-5 to L.1337-9 and range from a fine of 3,750 euros to one year of imprisonment and a fine of 15,000 euros.

5.2.3 For noncompliance with labour law

In the performance of their duties in NPPs, the ASN's labour inspectors have at their disposal all the inspection, decision-making and enforcement resources of ordinary law inspectors. Observation, formal notice, report, injunction (to obtain immediate cessation of the risks) or even shutdown of the worksite, offer a range of incentive and constraining measures for the ASN labour inspectors that is broader than that available to the nuclear safety or radiation protection inspectors.

The labour inspectors have special decision-making powers enabling them to check the employer's disciplinary capability, to protect the general interests from an economic standpoint and to act as arbitrator, if necessary by delegation from the regional directorate for enterprises, competition, consumption, labour and employment (DIRECCTE).

5.2.4 2014 results concerning enforcement and sanctions

As a result of infringements observed, the ASN inspectors (nuclear safety inspectors, labour inspectors and radiation protection inspectors) transmitted 9 infringement reports to the public prosecutor's offices, ten of which were related to labour inspections in the NPPs.

ASN took 13 administrative actions (formal notice, suspension, deposit of sums, etc.) against 8 licensees and managers of nuclear activities. For the first time in 2014, ASN in particular initiated two procedures for the deposit of funds for the performance of work, against the CIS bio international company (see Chapter 13).

TABLE 10: Number of infringement reports transmitted by the ASN inspectors between 2010 and 2014

	2010	2011	2012	2013	2014
Report excluding labour inspection in the nuclear power plants	14	27	12	26	15
Labour inspection report in the nuclear power plants	4	6	11	10	9

5.3 Information about ASN's regulatory activity

ASN attaches importance to coordinating government departments and informs the other departments concerned of its inspection programme, the follow-up to its inspections, the penalties imposed on the licensees and any significant events.

To ensure that its inspection work is transparent, ASN informs the public (both general and specialised) by placing the following on its website *www.asn.fr*:
- inspection follow-up letters for all the activities it inspects;
- approval authorisations or rejections;
- incident notifications;
- the results of reactor outages;
- its publications on specific subjects (*Contrôle* magazine, etc.).

6. OUTLOOK

In 2015, ASN scheduled 1,850 inspections on BNIs, radioactive substances transport operations, activities employing ionising radiation, organisations and laboratories it has approved and activities involving pressure equipment. This number is down by comparison with 2014 owing to a fall in ASN's inspection capacity due to high inspector turnover and the time needed to train the new inspectors.

Continuing the approach used in 2014, ASN will as a priority inspect the activities with potentially high consequences, taking account of the experience feedback from 2014.

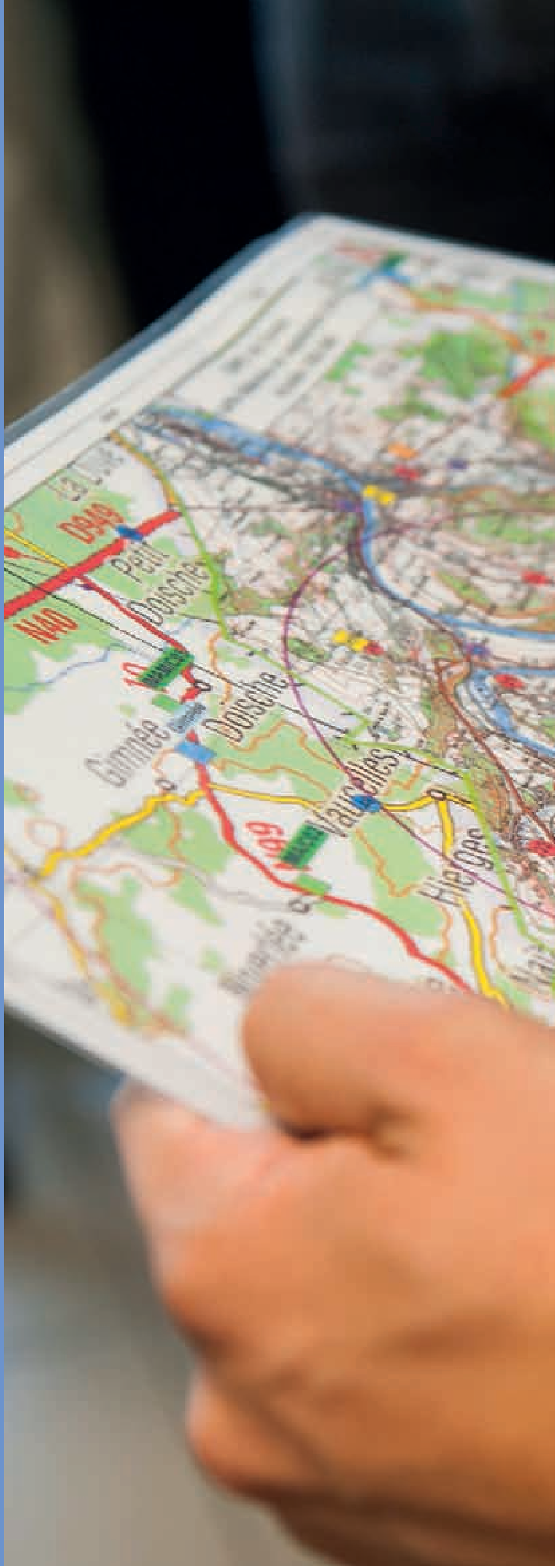
At the same time, ASN will continue to revise the procedures for notification of significant events, taking into account the experimentation of the events notification guide in small-scale nuclear activities and the changes in regulations in the BNI sector.

It will propose changes to the sanctions policy, pursuant to the provisions of the green growth energy transition bill.

In the environmental field, ASN will ensure the effective implementation of the new provisions introduced by the BNI Order and the 16th July 2013 "environment resolution". ASN will publish the resolution modifying the process for the approval of environmental radioactivity measurement laboratories. Work will be started on the renewal of the website of the national environmental radioactivity monitoring network as well as on the remote-notification of self-monitoring data from the licensees.

05

RADIOLOGICAL EMERGENCY AND POST-ACCIDENT SITUATIONS



Nuclear activities are carried out with the two-fold aim of preventing accidents and mitigating any consequences should they occur. Despite all the precautions taken, an accident can never be completely ruled out and the necessary provisions for dealing with and managing a radiological emergency situation must be planned for, tested and regularly revised.

Radiological emergency situations, arising from an incident or accident, which risk leading to the emission of radioactive substances or to a level of radioactivity liable to affect public health, include:
- emergency situations arising at a BNI;
- accidents involving Radioactive Material Transport (RMT);
- emergency situations occurring in small-scale nuclear activities.

Emergency situations affecting nuclear activities can also comprise non-radiological risks, such as fire, explosion or the release of toxic substances.

These emergency situations are covered by specific material and organisational arrangements, which include the emergency plans and involve both the licensee or party responsible for the activity and the public authorities.

The French Nuclear Safety Authority (ASN) is involved in managing these situations, with regard to questions concerning the regulation of nuclear safety and radiation protection and, backed by the expertise of its technical support organisation, the Institute for Radiation Protection and Nuclear Safety (IRSN), it has the following four key duties:
- to ensure and verify the soundness of the steps taken by the licensee;
- to advise the Government and its local representatives;
- to contribute to the circulation of information;
- to act as competent Authority within the framework of the international conventions.

In 2005, ASN set up a Steering Committee to manage the Post-Accident Phase following on from the management of a radiological emergency (CODIRPA). The doctrine concerning the emergency phase exit, transition and long-term periods, was published in November 2012.

1. ANTICIPATING

Four main principles underpin the protection of the general public against BNI risks:
- risk reduction at source, wherein the licensee must take all steps to reduce the risks to a level that is as low as reasonably achievable in acceptable economic conditions;
- the emergency response plans, designed to prevent and mitigate the consequences of an accident;
- controlling urban development around BNIs;
- informing the general public.

1.1 Looking ahead and planning

1.1.1 On-site and off-site emergency plans concerning BNIs

The emergency plans relative to accidents occurring at a BNI define the measures necessary for protecting the site personnel, the general public and the environment, and for controlling the accident.

The On-site Emergency Plan (PUI), prepared by the licensee, is designed to restore the plant to a safe condition and mitigate the consequences of an accident. It defines the organisational actions and the resources to be implemented on the site. It also comprises arrangements for informing the public authorities rapidly. Pursuant to Decree 2007-1557 of 2nd November 2007, the PUI is one of the items to be included in the file sent by the licensee to ASN prior to commissioning of its facility. The licensee's obligations in terms of preparedness and management of emergency situations are determined by the Order of 7th February 2012 setting the general rules for BNIs (Title VII). These obligations will be clarified by an ASN resolution currently under preparation.

The Off-site Emergency Plan (PPI) is established by the Prefect in application of Decree 2005-1158 of 13th September 2005, *"to protect the populations, property and the environment, and to cope with the* *specific risks associated with the existence of structures and facilities whose coverage area is localised and fixed. The PPI implements the orientations of civil protection policy in terms of mobilisation of resources, information, alert, exercises and training".* This decree also stipulates the characteristics of the facilities or structures for which the Prefect is required to define a PPI.

The PPI specifies the initial actions to be taken to protect the general public, the roles of the various services concerned, the systems for giving the alert, and the human and material resources likely to be engaged in order to protect the general public.

The PPI falls within the framework of the ORSEC plan (Disaster and Emergency Response Organisation) that specifies the protective measures implemented in large-scale emergencies. Consequently, beyond the perimeter established by the PPI, the modular and progressive departmental or zone ORSEC plan applies in full.

More broadly, the interministerial directive of 7th April 2005 concerning the actions taken by the public authorities in response to an event leading to a radiological emergency situation sets the framework for the response by the public authorities and the steps they must take if an event could result in a radiological emergency situation leading to activation of the ORSEC or PPI-ORSEC plan, or one of the *"Pirate"*[1] plans.

1.1.2 The ORSEC-TMR plans

The transport of radioactive substances in France represents nearly one million packages of various dimensions and types. The risk varies according to the content.

Pursuant to the international regulations on dangerous goods, those involved in the transport of dangerous goods must take steps appropriate to the nature and scale of the foreseeable hazards, in order to avoid damage or, as applicable, to mitigate the effects. These steps are described in a management plan for events linked to RMT.

To prepare for the possibility of an RMT accident in his *département*, each Prefect draws up a specific ORSEC plan, called the ORSEC-TMR (radioactive materials transport) plan. This plan complies with the interministerial directive of 7th April 2005 and the circular of 23rd January 2004 approving the guide to the drafting of the ORSEC-TMR plans. Faced with the diversity of possible types of transport operations, the ORSEC-TMR plans define the criteria and simple measures enabling the first respondents (Departmental Fire and Emergency Service - SDIS) and law enforcement services in particular) to initiate the first reflex response measures to protect the general public, based on their findings on the site of the accident.

1. *Plans which are part of a larger system of vigilance, prevention, protection and counter-terrorism.*

TO BE NOTED

The "Major nuclear or radiological accident" national response plan.

ASN took part in drafting the new "Major nuclear or radiological accident" national response plan under the supervision of the General Secretariat for Defence and National Security (SGDSN), a department reporting to the Prime Minister. The new plan was published in February 2014 and represents the Government's requirements regarding the safety of facilities and of nuclear transport operations and addresses emergency situations of all types. It supplements the existing local planning arrangements (PUI – on-site emergency plan and PPI – off-site emergency plan) and clarifies the organisation of the national response in the event of a nuclear accident.

This national response plan takes account of changing modelling and measurement technology and is better able to anticipate the possible consequences of an accident, to mitigate them and measure their implications more rapidly. It also includes elements of post-accident doctrine established by the CODIRPA, the international nature of emergencies and the mutual assistance possibilities in the case of an event.

The plan was tested in 2013 during the national exercise at Saint-Laurent-des-Eaux, which simulated an accident in the NPP. The detailed experience feedback from this exercise demonstrated the validity of this plan prior to its publication.

1.1.3 The response to other radiological emergency situations

Apart from incidents affecting nuclear installations or an RMT operation, radiological emergency situations can also occur:
- during performance of a nuclear activity, whether for medical, research or industrial purposes;
- in the event of intentional or inadvertent dispersal of radioactive substances into the environment;
- if radioactive sources are discovered in places where they are not supposed to be.

In such cases, intervention is necessary to put an end to any risk of human exposure to ionising radiation.

ASN, together with the Ministries and stakeholders concerned, drafted Government circular DGSNR/DHOS/DDSC 2005/1390 of 23rd December 2005. This supplements the provisions of the circular of 7th April 2005 and defines the organisation of the State services for radiological emergency situations not covered by an ORSEC, PPI-ORSEC or PirateNRBC (nuclear, radiological, biological, chemical) plan.

Given the large numbers of those who could possibly issue an alert and the corresponding alert channels, all the alerts are centralised in a single location, which then distributes them to the parties concerned: this is the fire brigade's centralised alert processing centre CODIS-CTA (Departmental Fire and Emergency Operations Centre - Alert Processing Centre), that can be reached by calling 18 or 112.

1.1.4 Role of ASN in the preparation and follow-up of emergency plans

Examination of on-site emergency plans for nuclear facilities or activities

ASN reviews the PUIs before authorising the commissioning of BNIs or authorising the possession and utilisation of high-level sealed sources (Article R.1333-33 of the Public Health Code), as well as the management plans for events linked to RMT.

Participation in drafting the off-site emergency plans

Pursuant to the 13th September 2005 decrees concerning the PPI and the ORSEC plan, the Prefect is responsible for preparing and approving the PPI. ASN assists the Prefect by analysing the technical data to be provided by the licensees, in particular the nature and scope of the consequences of an accident, with the help of its technical support organisation, IRSN.

Contingency plans, such as the PPI, identify the general public protection measures that mitigate the health and environmental consequences of any accident. The Prefect decides whether or not to deploy these measures on the basis of the predicted dose that would be received by a one year old child situated in the open air at the time of the accident.

The intervention levels associated with the implementation of general public protection measures in a radiological emergency situation, mentioned in Article R.1333-80 of the Public Health Code, are thus defined by ASN resolution 2009-DC-0153 of 18th August 2009:
- an effective dose of 10 millisieverts (mSv) for sheltering;
- an effective dose of 50 mSv for evacuation;
- an equivalent dose to the thyroid of 50 mSv for the administration of stable iodine.

The predicted doses are those that it is assumed will be received until releases into the environment are brought under control, generally calculated over a period of 24 hours. In the event of doubt concerning the duration of the releases, the time adopted for the calculation does not exceed one week.

The Fukushima Daiichi accident showed that a severe accident can have consequences that affect a radius of several tens of kilometres around an NPP. In France, PPI planning makes provision for civil protection of the population residing within a 10 km radius around the affected reactor in the initial hours of the accident. The effectiveness of this organisation thus requires the preparation and, as applicable, the implementation of measures beyond the PPI perimeter as part of the ORSEC planning process. Such an accident occurring in a European country could affect several other countries simultaneously and thus reinforces the need for effective transboundary coordination (see point 2.2.2). ASN thus considers that it is today essential to continue with the harmonisation effort so that concrete results are achieved to ensure consistent population protection measures across Europe following an accident.

ASN also assists the Ministry of the Interior's General Directorate for Civil Security and Emergency Management (DGSCGC) with a view to supplementing the PPIs concerning aspects relating to post-accident management (see point 1.5).

1.2 Controlling urban development around nuclear sites

The aim of controlling urban development is to limit the consequences of a severe accident for the population and property. Since 1987, this type of approach has been implemented around non-nuclear industrial facilities and it has been reinforced since the AZF facility accident that occurred in Toulouse (south of France) in 2001. The TSN Act, now codified in Books I and V of the Environment Code, enables the public authorities to control urban development around BNIs, by implementing institutional controls limiting or prohibiting new constructions in the vicinity of these facilities.

The urban development control actions entail a division of responsibilities between the licensee, the mayors and the State:
- the licensee is responsible for its activities and the related risks;
- the mayor is responsible for producing the town planning documents and issuing building permits;
- the Prefect informs the mayors of the risks that exist and ensures the legality of the actions by the municipalities;
- ASN supplies technical data in order to characterise the risk, and offers the Prefect its assistance in the urban development control process.

In recent years, urban development pressure in the vicinity of nuclear sites has increased. It is therefore important to incorporate the control of urban development into the management of the nuclear risk. ASN's current doctrine for controlling activities around nuclear facilities only concerns those facilities requiring a PPI and primarily aims to avoid compromising the feasibility of the sheltering and evacuation measures. It focuses on the "reflex" zones of the PPIs, or the rapid-development hazard zones, established in accordance with the Circular of 10th March 2000 and in which automatic measures to protect the general public are taken in the event of a rapidly developing accident.

A Circular from the Ministry for the Environment dated 17th February 2010 has asked the Prefects to exercise greater vigilance over urban development near nuclear installations. This circular states that the greatest possible attention must be paid to projects that are sensitive owing to their size, their purpose, or the difficulties they could entail in terms of protection of the general public in the so-called "reflex" zone. This circular tasks ASN and the DGPR (General Directorate for Risk Prevention) with leading a pluralistic working group to determine the ways and means of controlling activities around nuclear installations.

This working group, which involved the administrations, elected officials, the National Association of Local Information Committees and Commissions (ANCCLI) and the licensees concerned, proposed a draft guide in 2011 for the management of activities around BNIs, based on the following principles:
- to preserve the operability of the emergency plans;
- to favour urban development outside the rapid-development hazard zone;
- to allow controlled development that meets the needs of the resident population.

This draft guide was the subject of an extensive public consultation on the websites of the Ministry for the Environment and of ASN, which led to the introduction of institutional controls, so that the principles of the control of activities are incorporated into land use planning documents.

Since 2006, ASN has issued 600 consultative opinions on construction projects within PPI reflex perimeters, 14% of which were reserved opinions and 11% unfavourable opinions concerning projects considered to be sensitive with regard to implementation of the population protection measures included in the PPIs (sheltering, evacuation, distribution of stable iodine tablets): dense collective housing, shopping centres, schools, leisure parks, retirement homes, kindergartens, etc.

1.3 Organising a collective response

The response by the public authorities to an incident or accident is determined by a number of texts concerning nuclear safety, radiation protection, public order and civil protection, as well as by the emergency plans.

Act 2004-811 of 13th August 2004 on the modernisation of civil protection, makes provision for an updated inventory of risks, an overhaul of operational planning, performance of exercises involving the general public, information and training of the general public, an operational watching brief and alert procedures. Several decrees implementing this act have been issued to clarify it:
- Decree 2005-1158 of 13th September 2005 concerning Offsite Emergency Plans (PPI);
- Decree 2005-1157 of 13th September 2005 concerning the ORSEC plan;
- Decree 2005-1156 of 13th September 2005 concerning the Communal Disaster Contingency Plan (PCS).

The field of radiological emergency situations is clarified in the interministerial directive of 7th April 2005, which constitutes the basis for the organisations adopted by the public authorities and the licensee presented in diagram 1.

Following the Fukushima Daiichi accident, considerable thought was given nationally and internationally to consolidating and, as applicable, improving the response organisation of the public authorities. Indeed, this accident showed that it was necessary to improve preparation for the occurrence of a multi-faceted accident (natural disaster, accident affecting several facilities simultaneously). The response organisations thus put into place must be robust and capable of managing a large-scale emergency over a long period of time. There must be greater anticipation of and preparation for interventions in a degraded radiological situation along with better international relations to enable support to be provided to the country affected.

Thus, at the national level, ASN is closely involved in interministerial work on nuclear emergency management.

At the international level, ASN is taking part in the experience feedback work being done by international bodies such as International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA) and within regulatory authority networks such as the Western European Nuclear Regulators Association (WENRA) or the Heads of the European Radiological protection Competent Authorities (HERCA) (see point 2.2.2).

1.3.1 Local response organisation

In an emergency situation, several parties have the authority to take decisions:
- the licensee of the affected nuclear facilities deploys the response organisation and the resources defined in its PUI (see point 1.1.1);
- ASN has the role of overseeing the actions of the licensee. In an emergency situation, aided by IRSN's assessments, it can at any time ask the licensee to perform assessments and take the necessary actions;
- the Prefect of the *département* in which the installation is located, who takes the necessary decisions to protect the population, the environment and the property threatened by the accident. He takes action according to the PPI and the ORSEC plans. He is thus responsible for coordinating the resources – both public and private, human and material – deployed in the plan. He keeps the population and the mayors informed of events. Through its regional division, ASN assists the Prefect in drafting the plans and managing the situation.
- owing to his role in the local community, the mayor has an important part to play in anticipating and supporting the measures to protect the population. To this end, the mayor of a town included within the area of application of an off-site emergency plan (PPI) must draw up and implement a local safeguard plan to provide for, organise and structure the measures to accompany the Prefect's decisions. The mayor also plays a role in passing on information and heightening population awareness during iodine tablet distribution campaigns.

1.3.2 National response organisation

In the event of a severe accident, an Interministerial Crisis Committee (CIC) is set up. The Ministries concerned, together with ASN, work together to advise both the Prefect at the local level and the Government, within the CIC, on the protective measures to be taken. They provide the information and advice necessary to assess the state of the facility, the seriousness of the incident or accident, its possible developments, and the measures required to protect the general public and the environment.

The main parties concerned and liable to be convened within the CIC, are as follows:
- the Ministry of the Interior;
- the Ministry of Health;
- he Ministry for the Environment;
- the Ministry for Defence: the Defence Nuclear Safety Authority (ASND) is the Competent Authority for regulating the safety of secret BNIs, Military Nuclear Systems (SNM) and defence-related transport operations. A protocol was signed by ASN and the ASND on 26th October 2009 to ensure coordination between these two entities in the event of an accident affecting an activity under the supervision of the ASND and to facilitate the transition from the emergency phase managed by the ASND to the post-accident phase for which ASN is competent (this protocol is currently being revised);
- the General Secretariat for Defence and National Security (SGDSN) tasked with ensuring interministerial consistency of the actions planned in the event of an accident and in scheduling and evaluating exercises. Its role is to coordinate governmental action in radiological or nuclear emergency situations;
- ASN is involved in the management of radiological emergency situations. Its duties are detailed in point 2.1.1.

Other Ministries and administrations or establishments involved (such as IRSN, Météo-France), and the heads of the national nuclear licensees concerned (for example EDF, CEA or Areva) may be summoned as applicable. IRSN and Météo-France act as public expert appraisal organisations in a nuclear emergency situation.

1.4 Protecting the public

The steps to protect the populations that can be taken during the emergency phase, as well as the initial actions as part of the post-accident phase, aim to protect the populations from exposure to ionising radiation and to any chemical and toxic substances that may be present in the releases. These actions are included in the PPI.

1.4.1 General protective actions

In the event of a severe accident, liable to lead to releases, a number of preventive measures can be envisaged by the Prefect in order to protect the general public:
- sheltering and listening: the individuals concerned, alerted by a siren, take shelter at home or in a building, with all openings carefully closed, and wait for instructions from the Prefect broadcast by radio;
- administration of stable iodine tablets: when ordered by the Prefect, the individuals liable to be exposed to releases of radioactive iodine are urged to take the prescribed dose of potassium iodide tablets;
- evacuation: in the event of an imminent risk of large-scale radioactive releases, the Prefect may order evacuation. The populations concerned are asked to prepare a bag of essential personal effects, secure and leave their homes and go to the nearest assembly point.

If radioactive substances are actually released into the environment, steps to prepare for management of the post-accident phase are decided: they are based on the definition of area zoning to be implemented on exiting the emergency phase and including:
- a Population Protection Zone (ZPP) within which action is required to reduce both the exposure of the populations to ambient radioactivity and the consumption of contaminated food, to a level that is as low as reasonably achievable;

- a Heightened Territorial Surveillance Zone (ZST), which is larger and which is more concerned with economic management, within which specific surveillance of foodstuffs and agricultural produce will be set up;
- if necessary, an evacuation perimeter is created within the ZPP, defined according to the ambient radioactivity (external exposure). The residents must be evacuated for a varying length of time depending on the level of exposure in their environment.

1.4.2 Iodine tablets

Administering stable iodine tablets is a means of saturating the thyroid gland and protecting against the carcinogenic effects of radioactive iodines.

The circular of 27th May 2009 defines the principles governing the responsibilities of a BNI licensee and of the State with regard to the distribution of iodine tablets. The licensee has prime responsibility for the safety of its facilities. This circular requires that the licensee finance the public information campaigns within the perimeter of the PPI and carry out permanent preventive distribution of the stable iodine tablets, free of charge, through the network of pharmacies.

In 2009, a national distribution campaign for iodine tablets, supervised by ASN, concerned the populations located within the zone covered by the PPIs around the NPPs operated by EDF. This distribution comprised three phases and led to an overall population coverage of 93%.

Outside the zone covered by PPI, tablets are stockpiled to cover the rest of the country. In this respect, the Ministries for Health and for the Interior decided to create stocks of iodine tablets, positioned and managed by the Health Emergency Preparedness and Response Organisation (EPRUS). In his *département*, each Prefect organises the procedures for distribution to the population, relying in particular on the mayors for this. This arrangement is described in a circular dated 11th July 2011. The Ministry of Health thus ordered the manufacture of 110 million 65 mg tablets, which were shipped to the regional platforms managed by the EPRUS. Pursuant to this circular, the Prefects set up plans for iodine tablet distribution in the event of a radiological emergency situation.

1.4.3 Care and treatment of exposed persons

In the event of a radiological emergency situation, a significant number of people could be contaminated by radionuclides. This contamination could pose problems for care and treatment by the emergency response teams.

Circular 800/SGDN/PSE/PPS of 18th February 2011 specifies the national doctrine concerning the use of emergency and care resources in the event of a terrorist act involving radioactive substances. These provisions, which also apply to a nuclear or radiological accident, aim to implement a unified nationwide methodology for the use of resources, in order to optimise efficiency. They will need to be adapted to the situations encountered.

The "Medical intervention following a nuclear or radiological event" guide, the drafting of which was coordinated by ASN and published in 2008, accompanies DHOS/HFD/DGSNR Circular 2002/277 of 2nd May 2002 concerning the organisation of medical care in the event of a nuclear or radiological accident. It gives all the information that can be of use to the medical response teams in charge of collecting and transporting the injured, as well as to the hospital staff admitting them to health care establishments.

1.5 Understanding the long-term consequences

The post-accident phase concerns the handling over a period of time of the consequences of long-term contamination of the environment by radioactive substances following a nuclear accident. It covers the handling of consequences that are varied (economic, health, social), by their nature complex and that need to be dealt with in the short, medium or even long term, with a view to returning to an acceptable situation.

The conditions for reimbursement for the damage resulting from a nuclear accident are currently covered by Act 68-943 of 30th October 1968, amended, concerning civil liability in the field of nuclear energy. France has also ratified the protocols signed on 12th February 2004, reinforcing the Paris convention of 29th July 1960 and the Brussels convention of 31st January 1963 concerning civil liability in the field of nuclear energy. These protocols and the measures necessary for their implementation are now codified in the Environment Code (Section I of Chapter VII of Title IX of Book V). The green growth energy transition bill (PLTECV) makes provision for the enforcement of these provisions and for new liability thresholds set by the two protocols, without waiting for their ratification by all the signatory States.

Pursuant to the interministerial directive of 7th April 2005, ASN, in association with the ministerial departments concerned, was tasked with establishing the framework, defining, preparing and participating in the implementation of the steps necessary for dealing with post-accident situations following a nuclear accident. In order to draw up the corresponding aspects of doctrine, ASN in June 2005 created the Steering Committee for Managing the Post-Accident Phase (CODIRPA). Post-accident management of a nuclear accident is a complex subject involving numerous aspects and many players. This process should benefit from a pluralistic structure more specifically involving all the stakeholders concerned in post-accident management preparedness.

In November 2012, ASN sent the Prime Minister elements of the doctrine drafted by the CODIRPA, covering the emergency exit, transition and long-term phases, accompanied by an opinion from the ASN Commission. These elements were then posted on *www.asn.fr* and widely distributed at local, national and international levels.

In its opinion, the Commission considers that drafting and publishing the first elements of the doctrine is a first and important step in preparing for post-accident management and underlines the importance of continuing with and intensifying the implementation process.

In 2014, the CODIRPA, chaired by ASN, continued its work, primarily driven by the need to take account of the lessons learned from the post-accident management implemented in Japan in the wake of the Fukushima Daiichi disaster, but also to ensure support for the preparatory work to be organised in the regions. Some questions are also still on hold, pending the outcome of the first phase of the CODIRPA's work and the thought that has so far been given to intermediate scale accidents must be extended to include the management of severe accidents.

In this context, three areas for focus were proposed:
- test and complete the elements of doctrine with respect to the different accident situations;
- assist with regional implementation of the elements of post-accident management;
- take part in international work carried out on the post-accident theme and share and integrate its results.

The new CODIRPA duties will focus on keeping a watching brief and on supporting and analysing the various post-accident preparation processes, with the aim of periodically proposing updates to the doctrine.

These elements were officially laid out in a letter from the Prime Minister on 29th October 2014, giving ASN a new mandate for a five-year period.

For the purposes of this ongoing work, ASN will continue to act as technical secretary and chair of CODIRPA. Two working groups were set up, one concerning long duration releases doctrine, the other concerning the involvement of the regional players in preparing for post-accident management. A network to monitor the experience feedback from post-accident management in Japan was also set up. Furthermore, subjects for which more detailed doctrine is required have already been identified. This more specifically concerns the management of waste and manufactured products, or the development of a radiation protection culture.

TO BE NOTED

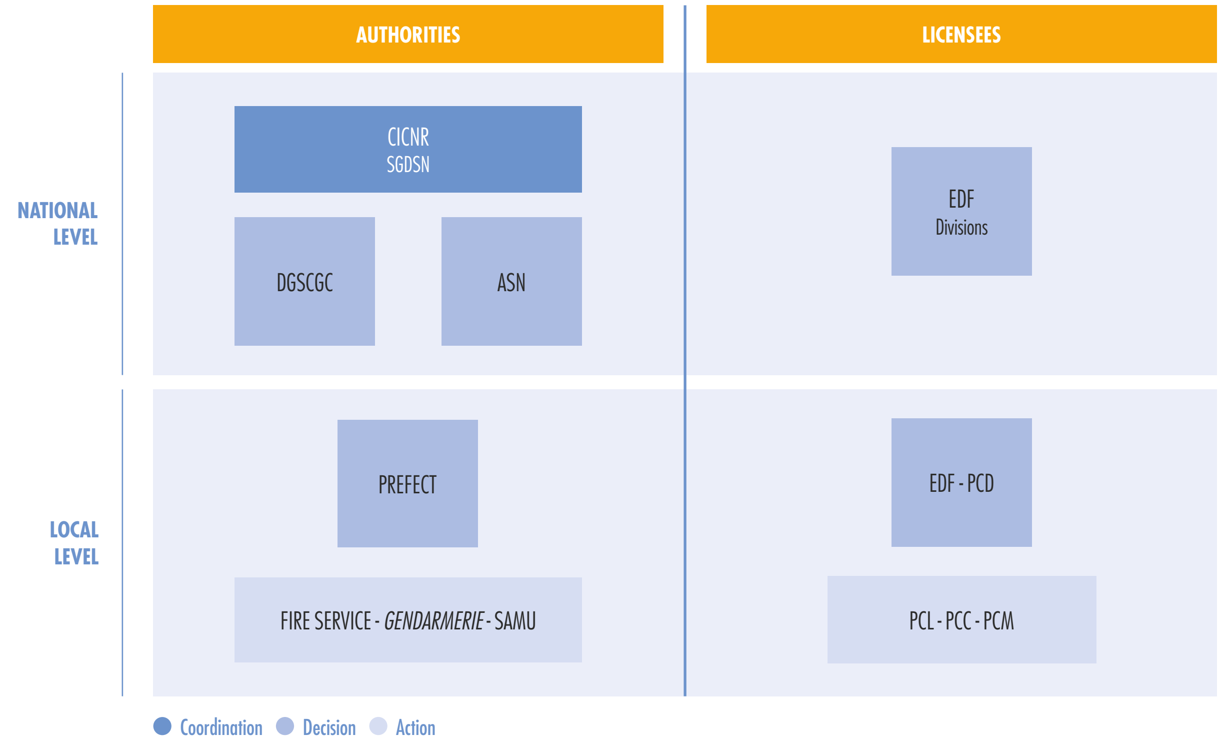
Seminar on the economic assessment of the nuclear accident risk

On 24th October 2014, ASN organised a seminar on the economic assessment of the nuclear accident risk. This pluralistic seminar attracted economists, university lecturers, nuclear licensees, representatives of associations and experts from civil society. The goals of the seminar were to share knowledge about the various economic aspects of the nuclear accident risk and to identify areas for research enabling this knowledge to be developed or improved. The seminar highlighted the following questions:
- how to take account of safety and accident studies and their uncertainties in economic studies?
- how should the economic assessment of the nuclear risk be considered in decisions, more specifically with regard to risk prevention, insurance, or compensation?

The need for the greatest transparency, especially with regard to the data, was underlined by numerous participants.

The seminar report will be released in early 2015 and ASN will initiate the necessary steps to promote the development of research on this subject, nationally and internationally.

DIAGRAM 1: Emergency response organisation in an accident situation affecting a nuclear reactor operated by EDF



CICNR: Interministerial Committee for Nuclear or Radiological Emergencies
SGDSN: General Secretariat for National Defence
DGSCGC: General Directorate for Civil Protection and Crisis management (Ministry of the Interior)

PCD: Command and Decision Post
PCL: Local Command Post
PCC: Supervision Command Post
PCM: Resources Command Post

2. ACTING IN EMERGENCY AND POST-ACCIDENT SITUATIONS

The emergency plans require intervention by many players, whose respective roles and duties must be clearly identified, as must the way they interact, to ensure the proper coordination of their actions. The organisation of each of the players involved in the State's response to a radiological emergency situation, and the way they interact, are essential to the correct management of this type of situation. The roles and organisation of ASN in an emergency situation are thus precisely defined. Coordination with the international authorities is also essential, both bilaterally and internationally.

2.1 Performing all duties in an emergency situation

Owing to their scale, major emergencies require the deployment of a global response by the State, which more specifically involves the departments of the Prime Minister (SGDSN) and the various ministries, in particular the Interior Ministry with responsibility for civil protection. At the local level, the Prefect thus acts as the director of emergency response operations. The "Major nuclear or radiological accident" national response plan was published in February 2014 and addresses emergency situations of all types, covering the entire country, and describes the organisations to be put into place (see box page 173).

2.1.1 ASN roles and duties

In an emergency situation, the responsibilities of ASN, with the support of IRSN, are as follows:
1) to check the steps taken by the licensee and ensure that they are pertinent;
2) to advise the Government and its local representatives;
3) to contribute to the dissemination of information;
4) to act as Competent Authority within the framework of the international Conventions on Early Notification and Assistance.

Overseeing of actions taken by the licensee

As in a normal situation, ASN exercises its roles as the regulatory authority in an accident situation. In this particular context, ASN ensures that the licensee exercises in full its responsibility for keeping the accident under control, mitigating the consequences, and rapidly and regularly informing the public authorities. On the basis of IRSN's assessments, ASN can at any time ask the licensee to perform assessments and take the necessary actions, without substituting itself for the licensee in the technical operations.

Advising the Government and the Prefect

The decision by the Prefect concerning the general public protective measures to be taken in radiological emergency and post-accident situations depends on the actual or foreseeable consequences of the accident around the site. It is the role of ASN to make recommendations to the Government or the Prefect, incorporating the analysis carried out by IRSN. This analysis covers a diagnosis of the situation (understanding of the situation of the installation affected, consequences for humans and the environment) and a prognosis (assessment of possible developments, notably radioactive releases). This advice also concerns the steps to be taken to protect the health of the general public.

Circulation of information

ASN is involved in a number of ways in informing:
- the media and the public: ASN contributes to informing both the media, the general public and the stakeholders in different ways (press releases, press conferences). It is important that this should be done in close collaboration with the other entities which are themselves involved in communication (Prefect, local and national licensee, etc.);
- institutional entities: ASN keeps the Government informed, along with the SGDSN, which is responsible for informing the President of the Republic and the Prime Minister;
- foreign nuclear safety regulators.

Function of Competent Authority as defined by international conventions

The Environment Code provides for ASN to fulfil the role of Competent Authority under the international Conventions on Early Notification and Assistance. As such it collates and summarises information for the purpose of sending or receiving notifications and for transmitting the information required by these conventions to the international organisations (IAEA and European Union) and to the countries possibly affected by radiological consequences on their own territory.

2.1.2 Organisation of ASN

Organising the response to accidents occurring in BNIs

The ASN emergency response organisation set up for an accident or incident in a BNI more specifically comprises:
- at the national level, an emergency centre in Montrouge, consisting of three Command Posts (PC):
  - a "Strategy" Command Post, consisting of the ASN Commission, which could be called on to issue resolutions and impose prescriptions on the licensee of the installation concerned in an emergency situation;
  - a Technical Command Post (PCT) in constant contact with its technical support organisation, IRSN, and with the ASN Commission. Its role is to adopt a stance for advising the Prefect, who acts as the director of contingency operations;
  - a Communication Command Post (PCC), located close to the Technical Command Post. The ASN Chairman or his representative acts as spokesperson, a role which is distinct from that of the head of the Technical Command Post.

  This emergency centre is regularly tested during national emergency exercises and is activated for actual incidents or accidents. It was activated on 18th March 2014 when demonstrators broke into the Fessenheim NPP.
- at the local level:
  - ASN representatives working with and advising the Prefect in his decisions and communications;
  - ASN inspectors present on the site affected by the accident.

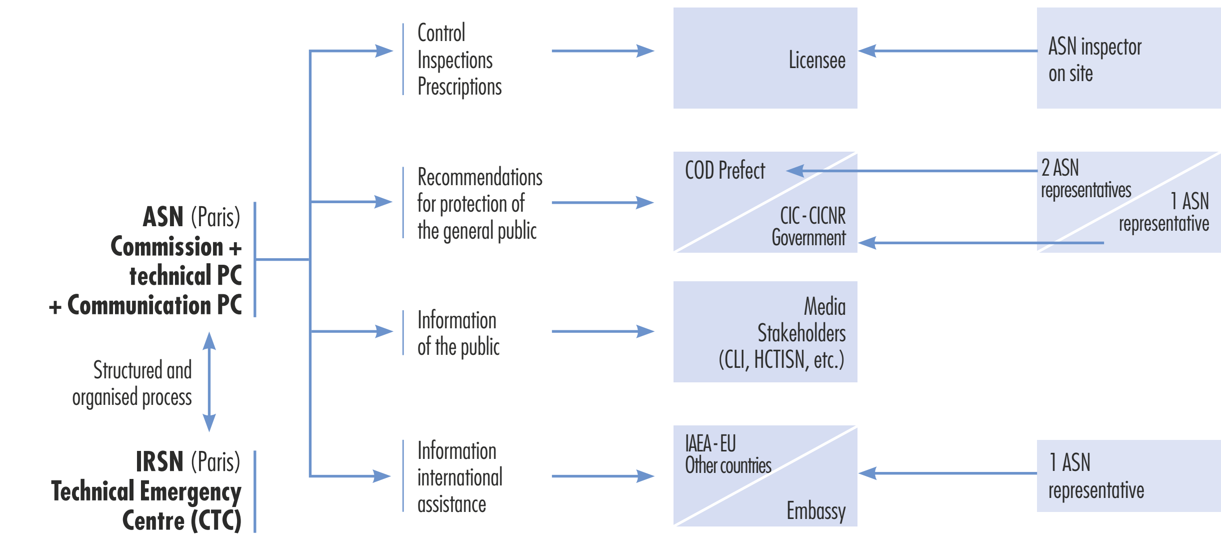
ASN is supported by an analysis team working at the IRSN's Technical Emergency Centre (CTC).

Experience feedback from the Fukushima Daiichi accident also leads ASN to envisage sending one of its representatives, if necessary, to the French embassy in a country in which an accident were to occur.

ASN's alert system allows rapid mobilisation of its staff, for activation of its emergency response centre, as well as those of IRSN. This automatic system sends an alert signal to the staff equipped with appropriate reception devices, as soon as it is remotely triggered by the BNI licensee originating the alert. It also sends out the alert to the staff of the DGSCGC, the French Government's Emergency Management Operational Centre (COGIC) and Météo-France.

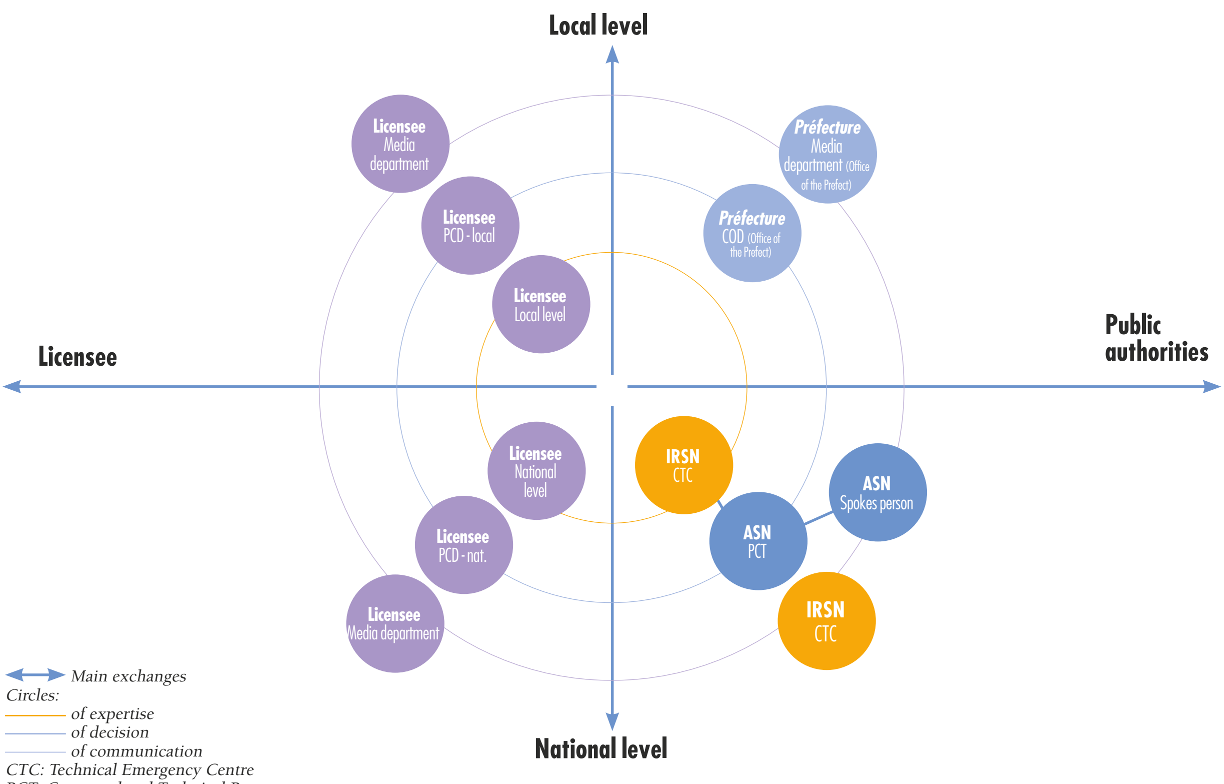
Diagram 2 summarises the role of ASN in a radiological emergency situation. This functional diagram illustrates the importance of the ASN representative to the Prefect, who relays and explains the recommendations being sent by the ASN emergency centre.

DIAGRAM 2: The role of ASN in a nuclear emergency situation



COD: Departmental Operations Centre
CIC: French Inter-ministerial Crisis Committee
CICNR: Inter-ministerial Committee for Nuclear or Radiological Emergencies
CLI: Local Information Committee
HCTISN: High Committee for Transparency and Information on Nuclear Security
PC: Command Post

DIAGRAM 3: Planned safety response



Main exchanges
Circles:
of expertise
of decision
of communication
CTC: Technical Emergency Centre
PCT: Command and Technical Post
PCD: Command and Decision Post
COD: Departmental Operation Centre

Diagram 3 shows the relations between the public authorities, the Government and the safety regulator, the licensees and the technical experts in a radiological emergency situation. These relations are organised around three circles of expertise, decision and communication, within which regular audio-conferences are held. Diagram 3 thus describes the exchanges leading to decisions and orientations concerning the safety of the facility and the protection of the general public as well as the relations between the communication units and the spokespersons of the emergency centres, who ensure that the information sent out to the public and the media is coherent and consistent.

It should be pointed out that these diagrams represent a simplified version of a complex organisation which also involves the ministerial levels.

Organising a response to any other radiological emergency situation

A toll-free radiological emergency telephone number enables ASN to receive calls notifying incidents involving sources of ionising radiation used outside BNIs or during the transport of radioactive substances. It is accessible 24 hours a day, 7 days a week. The information given during the call is transmitted to the locally competent division or to the ASN duty staff outside working hours, who act accordingly. Depending on the seriousness of the accident, ASN may decide to activate its emergency centre in Montrouge. If not, only the ASN local level (regional division concerned) intervenes to perform its Prefect support and communication duties, if necessary calling on the expertise of the national departments. In order to enhance the graduated nature of the ASN response and organisation in the event of an emergency, for situations not warranting activation of the emergency centre, the system has been adapted for the creation of a national level support unit to assist the division concerned. The format and duties of this unit are tailored to each situation.

Once the public authorities have been alerted, the response generally consists of four main phases: care for the individuals involved, confirmation of the radiological nature of the event, securing the zone and reducing the emission and, finally, clean-up.

The Prefect or the mayor coordinates the intervention response teams, taking account of their technical competence, and decides on the protective measures to be taken, on the basis of the plans they have drawn up (ORSEC and PPI for the Prefects, Local Safeguard Plans for the mayors). At the local level, the mayors can also call on the Mobile Radiological Intervention Units (CMIR) of the fire and emergency services.

In these situations, responsibility for the decision and for implementing protective measures lies with:
- the head of the establishment carrying out a nuclear activity (hospital, research laboratory, etc.) who implements the on-site emergency plan specified in Article L. 1333-6 of the Public Health Code (if the risks inherent to the installation so justify) or the owner of the site with regard to the safety of the persons on the site;
- the mayor or Prefect concerning public safety in the domain accessible to the public.

2.2 Ensuring efficient coordination with international authorities

Considering the potential repercussions that an accident may have in other countries, it is important that the information and intervention of the various countries concerned be as well-coordinated as possible. To this end, IAEA and the European Commission offer the Member States tools for notification and assistance in the event of a radiological emergency. ASN made an active contribution to the production of these tools, more specifically the new IAEA tool called USIE (Unified System for Information Exchange in Incidents and Emergencies), which is present in ASN's emergency centre and is tested on the occasion of each exercise.

Independently of any bilateral agreements on the exchange of information in the event of an incident

TO BE NOTED

The HERCA/WENRA approach

During their joint meeting of 22nd October 2014, the HERCA and WENRA associations adopted a joint position aiming to improve management and cross-border coordination in emergency situations. The position of HERCA and WENRA aims, in the event of an accident, to promote the rapid transmission of information between the countries concerned and the consistency of the population protection recommendations issued by the nuclear safety and radiation protection authorities. One essential principle is to align the population protection measures in neighbouring countries with those decided on by the country in which the accident occurred. The proposed approach also aims to address situations, however improbable, which would require urgent population protection measures and for which very little information is available.

HERCA and WENRA thus consider that in Europe:
- evacuation should be prepared up to 5 km around nuclear power plants, and sheltering and ingestion of iodine thyroid blocking (ITB) up to 20 km;
- a general strategy should be defined in order to be able to extend evacuation up to 20 km, and sheltering and ingestion of ITB up to 100 km;

On these bases, each of the European nuclear safety and radiation protection authorities will be initiating discussions with their respective national civil protection authorities with a view to implementing the recommended measures.

or accident with possible radiological consequences, France is committed to applying the Convention on Early Notification of a Nuclear Accident adopted on 26th September 1986 by IAEA and the Euratom decision of 14th December 1987 concerning community procedures for an early exchange of information in the event of a radiological emergency situation. On 26th September 1986, France also signed the convention adopted by IAEA concerning assistance in the event of a nuclear accident or a radiological emergency situation.

Two interministerial directives of 30th May 2005 and 30th November 2005 specify the procedures for application of these texts in France and instate ASN as the competent national Authority. It is therefore up to ASN to notify the events without delay to the international institutions and to the member States, to supply relevant information quickly in order to limit the radiological consequences abroad and finally to provide the Ministers concerned with a copy of the notifications and information transmitted or received.

2.2.1 Bilateral relations

Maintaining and strengthening bilateral relations with neighbouring and other European countries is one of ASN's major priorities.

In 2014, ASN thus continued regular exchanges with its European counterparts concerning the harmonisation of emergency management. Experience feedback from the Fukushima Daiichi accident and the steps taken since then in each country, were at the heart of the discussions. Finally, a procedure specifying transboundary alert and information exchange mechanisms was finalised with Norway.

ASN is continuing to develop bilateral relations in emergency management with many countries, Spain, Switzerland and Japan in particular. Meetings on specific emergency management topics were held with these three countries in 2014. In addition, a high-level member of the Japanese safety regulator, who played an important role during the Fukushima Daiichi accident, attended an ASN emergency exercise as an observer in May 2014 and submitted a number of remarks. He in particular underlined the importance of defining an organisation enabling the highest levels of Government to be kept continuously informed and of testing this organisation during emergency exercises.

Finally, during the course of 2014, the emergency exercises concerning the La Hague and Chooz sites were able to test transboundary information exchanges in the event of an accident.

2.2.2 Multilateral relations

The Fukushima Daiichi accident occupied a substantial amount of time of many of the ASN and IRSN staff, even though it was a remote accident for which the radiological consequences in France would appear to be limited. In addition, ASN's actions were also limited, because it is not its responsibility to monitor the actions of the Japanese licensee.

This accident highlighted the problems that would be encountered by ASN, IRSN, but also their European counterparts, in managing a large-scale accident in Europe. The nuclear safety regulators confirmed the need for mutual assistance mechanisms and have already undertaken international work to improve their response organisations.

Technical command post in the ASN emergency centre during an emergency exercise.

ASN takes part in the IAEA's work to improve notification and information exchanges in radiological emergency situations. ASN is helping to define the strategy concerning international assistance requirements and resources and to set up the Response and Assistance Network (RANET).

ASN also works with NEA and participates in the Working Party on Nuclear Emergency Matters (WPNEM).

At the European level, ASN is a participant in the "Emergencies" working group reporting to the Heads of European Radiological protection Competent Authorities Association (HERCA). It also acts as secretary. This group was tasked with proposing harmonised European actions to protect the general public, on the one hand in the event of an accident in Europe and, on the other, in the event of a more remote accident, in the light of the lessons learned from the Fukushima Daiichi accident. This group also comprises members appointed by the Western European Nuclear Regulators Association (WENRA).

ASN took part in the study carried out by the European Commission on the management of radiological emergency situations, as a member of the French delegation and as the representative of the WENRA "Mutual assistance" sub-group. This study more specifically highlighted major differences between European countries in the definition and implementation of population protection measures.

2.2.3 International assistance

The interministerial directive of 30th November 2005 defines the procedures for international assistance when France is called on or when it requires assistance itself in the event of a radiological emergency situation. For each Ministry, it contains an obligation to keep an up-to-date inventory of its intervention capability in terms of experts, equipment, materials and medical resources, which must be forwarded to ASN. As coordinator of the national assistance resources (RANET database), ASN takes part in the IAEA's work on the operational implementation of international assistance.

France has been called upon several times since 2008 to assist a foreign country in a radiological emergency situation. For example, ASN was again contacted by Peru in 2014 with an assistance request concerning three workers accidentally exposed to a radioactive source in a gamma radiography device.

3. LEARNING FROM EXPERIENCE

3.1 Carrying out exercises

Regularly holding exercises is a means of ensuring that the plans are kept up to date, that they are well-known to those in charge and to the participants at all levels and that the corresponding alert and coordination procedures are effective. The main aim of these nuclear and radiological emergency exercises is to test the planned response in the event of a radiological emergency in order:
- to train those who would be involved in such a situation;
- to implement the various organisational aspects and the procedures stipulated in the interministerial directives and in the emergency plans (PUI, PPI, ORSEC-TMR) or in the Local Safeguard Plans (PCS) and the various conventions;
- to identify possible improvements;
- to test the arrangements envisaged for developing the emergency situations management organisation;
- to develop a general public information approach so that everyone can, through their own individual behaviour, make a more effective contribution to civil protection.

These exercises, which are the subject of an annual interministerial circular, involve the licensee, the ministries, the offices of the Prefect and services of the *départements*, ASN, IRSN and Météo-France. They aim to test the effectiveness of the provisions made for assessing the situation, bringing the installation or the package to a safe condition, taking appropriate measures to protect the general public and ensuring satisfactory communication with the media and the populations concerned. At the same time, the exercises are a means of testing the arrangements for alerting the national and international organisations.

3.1.1 National nuclear and radiological emergency exercises

In the same way as in previous years, and together with the SGDSN, the DGSCGC and the ASND, ASN has prepared a programme of national nuclear and radiological emergency exercises for 2014, concerning BNIs and RMT operations. This programme, announced to the Prefects by the circular of 12th December 2013, took account of the lessons learned from Fukushima Daiichi and the emergency exercises performed in 2013.

Generally speaking, these exercises enable the highest-level decision-making circles to be tested, along with the ability of the leading players to communicate, sometimes with simulated media pressure on them.

Table 1 describes the key characteristics of the national exercises conducted in 2014.

Apart from the national exercises, the Prefects are asked to conduct local exercises with the sites in their *département*, in order to improve preparedness for radiological emergency situations, specifically testing the time needed to mobilise all the parties concerned.

The performance of a national nuclear and radiological emergency exercise, at maximum intervals of five years on the nuclear sites, and an annual exercise concerning RMT, would seem to be a fair compromise between the training of individuals and the time needed to effect changes to organisations.

The exercises enable those involved to build on knowledge and experience in the management of emergency situations, in particular for the 300 or so persons mobilised in the field for each exercise.

For 2014, the objectives chosen in the annual circular of 12th December 2013 concerning the national nuclear or radiological emergency exercises were:
- to carry out an exercise with a free scenario (only the date and place were fixed);
- to carry out a safety exercise with a malicious initiating event;
- during the emergency phase, assuming that a population protection decision had already been taken, to implement actual civil security measures;
- to test aspects of post-accident doctrine on exiting the emergency phase;
- to test the interfacing between the national, *département* and municipality levels of the defence and security zones;
- to perform a long-duration exercise (with staff shift changes);
- to carry out an exercise for which the initiating event is a natural event affecting the site.

ASN is also heavily involved in the preparation and performance of other emergency exercises that have a nuclear safety component and are organised by other players such as:
- its counterparts for nuclear security (HFDS - Defence and Security High Official reporting to the Minister for Energy) or for defence-related facilities (ASND);
- international bodies (IAEA, European Commission, NEA);
- the Ministries (Health, Interior, etc.).

Contamination checks carried out during an exercise in the Koeberg NPP in South Africa, October 2014.

With regard to defence-related facilities, five exercises run by the ASND were organised during the course of 2014, in accordance with the interministerial circular on nuclear and radiological emergency exercises. Pursuant to the ASN/ASND protocol of 26th October 2009, ASN takes part in some of these exercises:

- at the ASND national emergency centre: an ASN representative goes to the ASND's emergency centre to act as the interface between ASN and the ASND, to advise the ASND on aspects relating to the environmental impact of releases, and to prepare for post-accident management of the emergency by ASN;
- at the Prefecture: a representative of the ASN division concerned goes to the Prefecture to advise the Prefect pending the arrival of the ASND's representative.

ASN personnel draw on the experience acquired during these numerous exercises in order to respond more effectively in real-life emergency situations.

3.2 Assessing with a view to improvement

Evaluation meetings are organised immediately after each exercise in each emergency centre and by ASN a few weeks after the exercise. ASN, along with the other players, endeavours to identify best practices and the areas for improvement brought to light during these exercises. These same feedback meetings are organised in order to learn the lessons from any real-life situations that have occurred.

ASN regularly brings all the players together to review best practices to improve the response organisation as a whole. These meetings enable the players to share their experience through a participative approach. At the last meeting, the participants underlined the importance of having scenarios that were as realistic as possible, in real meteorological conditions and that were technically complex enough to be able to provide useful experience feedback.

Some of the points identified will be incorporated into the 2015 interministerial circular, in particular those relating to the training of the technical crews, the inclusion of civil security subjects, while taking account of the topics emerging during the emergency exercises. Other topics will be examined, such as:

- the format of the exercises, with a post-accident part;
- Radioactive Material Transport (RMT) exercises;
- the importance of the international dimension of the exercises.

The exercises, as well as the real situations that occurred, demonstrated the importance of communication in an emergency situation, in particular to inform the public and the foreign regulators sufficiently early and avoid the spread of rumours that could lead to panic among the population, whether in France or abroad.

During the exercises, it became clear that the siren system triggered by the licensees to alert the population did not in all cases cover the entire intervention perimeter. In these conditions, the licensees and EDF in particular, supplemented the existing PPI sirens system by adding a telephone alert system called SAPPRE (System for Population Alert in the Reflex Phase). This additional procedure automatically calls the landlines of the individuals concerned. It has been deployed around all the NPPs.

Finally, in recent years, IRSN has been using a system giving a geographical representation of the environmental radioactivity measurements during exercises and actual situations. This tool, called CRITER, gives a rapid display summarising all the environmental radiological measurements taken, providing decision-makers with a clear view of any radiological impacts.

TABLE 1: National civil nuclear and radiological emergency exercises conducted in 2014

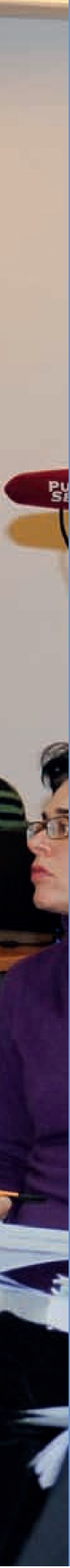
NUCLEAR SITE	DATE OF EXERCICE	FOCUS OF THE EXERCICE	MAIN CHARACTERISTICS
Bugey NPP	28 January	Civil protection	Interfacing between the national, *département*, municipality levels of the defence zone. Post-accident part
Areva/La Hague	29 April	Civil protection	Health aspect. Post-accident part.
Belleville NPP plant	27 May	Nuclear Safety	Inter-*départements* scenario. Shift changes (site).
Civil RMT	26 June	Nuclear Safety	Nuclear safety aspect.
Chooz NPP	16 September	Nuclear Safety	Cross-border cooperation. Interfacing between the national, *département*, municipality levels of the defence zone.
Tricastin NPP	18 November	Nuclear Safety	
Mélox plant	16 December	Civil protection	

4. OUTLOOK

In accordance with the important nuclear emergency duties entrusted to it by the TSN Act, ASN makes an active contribution to the review process currently being carried out by the public authorities following the Fukushima Daiichi accident, with the aim of improving the national radiological emergency organisation. ASN thus actively participates in the work to implement the "Major nuclear or radiological accident" national response plan and will in particular call on the assistance of the Ministry of the Interior and the offices of the Prefects following the publication of the regional implementation guide.

The nuclear safety regulators confirmed the need for continued work internationally to improve the coordination of the respective approaches of each country in an emergency situation. In 2015, ASN will pursue the European initiatives taken with a view to achieving transboundary harmonisation of actions to protect individuals in an emergency situation and to develop a coordinated response by the nuclear safety and radiation protection regulators in the event of a near or remote accident, more specifically through the follow-up to the HERCA/WENRA approach.

The Fukushima Daiichi accident also shows that it is important for the emergency exercises to be able to test the organisation specified in the emergency plans, notably the interfacing between the ORSEC and PPI systems, to ensure that the skills of the stakeholders required in an emergency remain current and to improve transboundary coordination. ASN will ensure that these exercises also have an educational and informative dimension by extensively involving the populations in their preparation and implementing international relations aspects. In particular, a new campaign to inform the populations living in the vicinity of the NPPs, concerning the justification for and correct use of stable iodine tablets will be initiated in 2015, to prepare for the renewal of the tablets distributed in 2009.



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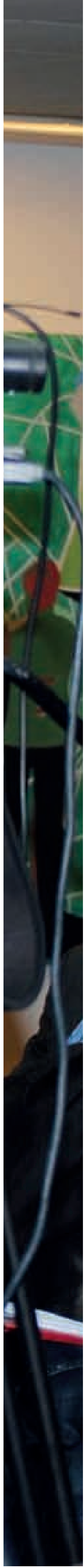
FROM INFORMATION TO TRANSPARENCY AND PARTICIPATION OF THE VARIOUS AUDIENCES



The Act of 13th june 2006 ("TSN Act") relative to transparency and security in the nuclear field considerably tightened the requirement for transparency and the right to information regarding nuclear matters. It defines transparency in the nuclear field as *"the set of provisions adopted to ensure the public's right to reliable and accessible information on nuclear security"* (Article L.125-12 of the Environment Code, formerly Article 1 of the TSN Act).

The provisions regarding transparency shall be developed further when the green growth energy transition bill enters into force.

ASN considers that nuclear subjects are everyone's business and that all citizens should be able to form their own opinions. ASN oversees application of the TSN Act by the stakeholders and actively verifies that the nuclear licensees meet their obligations regarding transparency.

ASN also places great importance on the participation of civil society in subjects relating to nuclear safety and radiation protection, in the spirit of the Aarhus Convention which recommends consultation of the public and stakeholders and information transparency. ASN's actions towards citizens and the development of its information media illustrate its intention to render information concerning nuclear safety and radiation protection ever more accessible to the various audiences.

To be even more effective, ASN uses the results of its annual image and knowledge barometer which enables it to adapt its information policy to its various audiences. In 2014, 62% of the persons questioned stated that they were satisfied with the way in which ASN informs professionals.

As a general rule, ASN endeavours to develop a risk culture by involving citizens. To achieve this it deploys many means, particularly through its public information centre at its head office in Montrouge, and participation in discussions on topical nuclear issues (energy transition, Cigéo project, operating lifetime of nuclear power plants). Thus in 2014, among those people who were aware of ASN's actions and public statements (15% of the French population), the majority appreciated its effectiveness (66%) and underlined the clarity of its message (52%).

The regular relations with the nuclear licensees and the development of relations with the users of ionising radiation in industry and the health sector also contribute to inform the professionals. A seminar dedicated to the regulations of Basic Nuclear Installations (BNIs) organised in 2014 enabled nuclear professionals to understand the changes in requirements in order to achieve progress in nuclear safety. Knowledge of ASN within this informed public was 5% up on the preceding year.

In 2014 ASN implemented proactive communication efforts targeting the media and the institutional audiences. Each year, ASN presents its Report on the state of nuclear safety and radiation protection in France to Parliament and develops its relations with the members of parliament and the local elected officials.

It also supports the action of the local information committees (CLI) to promote transparency.

1. DEVELOPING RELATIONS BETWEEN ASN AND THE PUBLIC

1.1 Opening to the public at large and development of a risk culture among citizens

ASN wishes to develop a nuclear risk culture and considers that citizens must be involved in the subjects relating to nuclear safety and radiation protection.

In order to meet this requirement, ASN has several means at its disposal and develops an ambitious and transparent communication policy, by delivering information in the field of nuclear safety and radiation protection that is as reliable and as accessible as possible.

1.1.1 The ASN information centre

The role of the ASN Information Centre is to inform the public as a whole on nuclear safety and radiation protection: it deals with the demands addressed to ASN by the various stakeholders (technical questions, requests for administrative documents, environmental information, dispatching of publications, document searches). It responded to nearly 2,000 requests from varied audiences in 2014.

The centre also has more than 3,000 documents concerning the fields of nuclear safety and radiation protection which are available for consultation, as well as administrative documents (public inquiry files, impact studies and annual reports from the licensees). The public has access to all the ASN publications and can consult the French and international publications produced by various stakeholders (CLIs, nuclear licensees, IRSN - Institute of Radiation Protection and Nuclear Safety - and other technical experts, learned societies, professionals, non-governmental organisations – NGOs).

Information sheets prepared by ASN provide synthetic and educational information on the broad subjects of nuclear safety and radiation protection for all audiences: *"The taking of stable iodine in the event of a nuclear accident"*; *"The principles of radiation protection"*; *"Nuclear or radiological: which term should you use?"*, *"Quantities and units in radiation protection"*; *"The French nuclear fuel cycle"*; *"Nuclear emergency situations"*; *"Radon"*. They are particularly suited to the needs of the general public. A new information sheet on the transport of radioactive substances was added to the collection in 2014.

The information centre also hosts temporary pedagogical exhibitions concerning nuclear safety and radiation protection. These exhibitions, which are free of charge and open to everyone, are of particular interest to school groups. In 2014, the centre hosted the exhibitions *"X-rays, radioactivity, radiation protection… Quite a history!"* and then *"Nuclear safety?A key issue!"* (see box on next page).

The Public Information Centre at ASN in Montrouge.

1.1.2 The ASN/IRSN exhibition

For some twenty years now, ASN and IRSN have jointly developed a travelling educational exhibition designed to inform the general public about the risks associated with ionising radiation.

A new ASN/IRSN exhibition on the theme of "the risk culture" was completed at the end of 2014. One of the aims of this exhibition is to explain the risks involved in using radioactivity and the implications for humans and the environment.

The exhibition comprises ten sequences which can be used in a modular fashion. During the year an abridged version was presented to the public in about fifteen high schools and at the ASN Information Centre. The aim is to bring the exhibition to life at the grass-roots level, notably in the municipalities in areas subject to off-site emergency plans (PPI)[1], in areas concerned by the radon risk, in schools and medical establishments, etc.

TO BE NOTED

Nuclear safety? A key issue!

As from June 2014, the information centre hosted the exhibition entitled *"Nuclear safety? A key issue!"* Designed by ASN and IRSN, the exhibition features explanatory display panels taken from the ASN/IRSN exhibition (see point 1.1.2), documentary films and an animated reactor model to enable visitors to discover the principles and effects of radioactivity, to learn how nuclear power plants function and the way in which they are monitored.

In addition to visiting the exhibition, school groups were able to attend keynote presentations and radiation protection awareness-raising workshops led by ASN specialists. 310 people visited this exhibition in 2014.

1.1.3 Relations with the French National Education Authority

ASN continued to strengthen its interchanges with the school environment and pursue its objective of developing the nuclear risk culture with teachers and pupils in 2014. Several operations were deployed at local and national levels.

ASN renewed its support of the "Radiation protection workshops", an operation organised by the Nuclear Protection Evaluation Centre (CEPN) and the Franche-Comté *département*'s "Pavillon des sciences" science centre which brings together French and European high schools to work on educational projects relating to radiation protection. The Bordeaux and Nantes divisions of ASN accompanied three schools in their work on mining tailings and nuclear emergency situations. The Lyon division took part in the international radiation protection meetings held at CERN in April 2014, focusing in particular on the subject of the accumulation of radiation doses through medical imaging.

ASN sponsored the 2014 edition of the competition for the best student dissertation on risk management, organised by the specialist magazine *Préventique* (prevention and protection technologies), and was part of the competition jury.

ASN continued its partnership with the chemistry department of the École Normale Supérieure (ENS) engineering school by contributing pedagogical resources to its website: *http://culturesciences.chimie.ens.fr*. Following on from the themes of iodine and medical uses of radioactivity, ASN and the ENS are working on radon for 2015.

ASN also renewed its partnership with the French Institute for Major Risks and Environmental Protection Instructors (IFFO-RME), a network of risk specialists with experience of working in the school environment.

It contributed in particular to the production of an educational booklet on radon intended for secondary school pupils. It also contributed to the travelling Gafforisk exhibition *"Radioactivity and nuclear risks"*. Lastly, the ASN head office hosted the annual meeting of the "major risks" regional coordinators on May 22nd and 23rd, 2014.

The Science Festival

For the second year running, ASN participated in the "Fête de la science" (science fair) which took place in Autumn 2014.

During this event, high school pupils visited the ASN Information Centre where they were given guided tours of the *"Nuclear safety? A key issue!"* exhibition, keynote presentations and practical workshops. This enabled them to take their first radioactivity measurements, discover radiation protection means and understand the role of ASN.

1. Specific contingency plan drawn up by the State and addressing the risks associated with the existence and operation of specific installations or structures.

1.1.4 The *www.asn.fr* website

In 2014, some 540,000 people visited the ASN website at *www.asn.fr,* the main information vector for the public.

ASN reorganised the content of its website to make the information more readily accessible to its various audiences. Links to oversight documents (incident notifications, inspection follow-up letters, position statement letters, reactor shutdown notices) are now available from the site homepage, alongside ASN opinions and resolutions, information notices and publications, educational content (films, dossiers, etc.), as well as public consultations, etc. The website provides sections tailored to the needs of professionals, who have access to current topics specific to their sector of activity and legal and regulatory information appropriate for their practices.

With the aim of ensuring that the information published on *www.asn.fr* is educational and understandable for the layman, most of the content is accompanied by computer graphics and videos, accessible from the home page. In 2014, ASN put on line several videos relating to the seminar devoted to the BNI regulations, attended by the nuclear licensees, the public authorities and ASN, as well as videos on the first inter-CLI interchange seminar held at the General Council of the Drôme *département* in October 2014.

Other subjects and ASN positions received audiovisual coverage in 2014 and were also communicated in the social media, such as the resolution concerning the situation of a radioactive waste silo at La Hague (December 2014) and the international workshop on radon (October 2014).

In 2014, ASN continued to involve the public widely in the decision-making process (see point 2.2):

In order to inform the international public as well, ASN has continued to develop the English version of its website, *www.french-nuclear-safety.fr*, by proposing information notices, press releases and a variety of specific editorial content, in particular concerning the stress tests and the French National Radioactive Material and Waste Management Plan (PNGMDR).

1.1.5 The social networks

The content of the ASN website is available on mobile equipment (digital tablets, smartphones, etc.) and on the main social media. In 2014, ASN used Twitter to give its news the widest possible dissemination. Its subscribers, whose numbers increased significantly in 2014, are informed of the events in which the Commission and Director General's Office participate. ASN's Google+ and Facebook pages are open to content from other nuclear safety and radiation protection stakeholders, such as

The ASN website and its Twitter account.

ASN's foreign counterparts. Lastly, ASN continued to develop its network of users on Dailymotion, YouTube, Viadeo and LinkedIn in 2014.

1.2 ASN and the professionals: advancing the safety culture

ASN wishes to reinforce the professional public's knowledge of the regulations and the technical, organisational and human aspects of the culture of nuclear safety and radiation protection.

ASN maintains regular relations with the nuclear licensees and also develops relations with the users of ionising radiation in the industrial and health sectors.

As such, and supplementing the new website intended for the professionals, *http://professionnels.asn.fr,* ASN produces publications intended specifically for the professionals. It organises and takes part in numerous symposia, seminars and meetings in order to raise the awareness of professionals to the responsibilities and to the implications of radiation protection, to make known the regulations, to promote their application and to encourage the notification of significant events and experience feedback.

1.2.1 Disseminate the regulations and promote their implementation

ASN considers that having clear regulations based on the best safety standards is an important factor for improving the safety of BNIs. Over the last few years it has thus undertaken a major overhaul of the technical and general regulations applicable to BNIs.

The BNI Order of 7th February 2012 constitutes the cornerstone of a regulatory framework applicable to all BNIs and which has been substantially reinforced and is in conformity with the best international practices.

ASN guides for concrete application of decisions

The ASN guides give recommendations, suggest the means ASN considers appropriate for achieving the objectives set by the regulations, share methods and good practices resulting from experience feedback from significant events.

Seven of these guides relate to the implementation of the BNI Order and its decisions. They concern the annual public information report, the protection of BNIs against external flooding, nuclear pressure equipment, the management of sites potentially polluted by radioactive substances, the determining of the perimeter of a BNI and conformity deviations. Other guides are to be published, notably on management of the criticality risk, emergency situations, the design of pressurised water reactors (PWR), the qualification of calculation codes, reactor fuels, reactor outages for maintenance and fuel reloading.

These guides can be consulted on the *http://professionnels.asn.fr* website organised by field of activity (nuclear installations, medical, veterinary, industrial activities, transport of radioactive substances, approval, controls and measurements). The site also gives access by sector to the regulatory texts and the ASN printed forms. It highlights the experience feedback from the inspections and the analysis of significant event notifications through various ASN publications and presentations given at the professional seminars.

Seminars to explain and discuss the difficulties in applying the order

In view of the implications of the regulations applicable to BNIs, on 21st March 2014 ASN held a seminar intended for nuclear players to present the principles of the order and its decisions. In the discussions with the professionals, the emphasis was placed on the implications in terms of operating practices.

Nearly three hundred participants represented the licensees and the outside contractors working in the BNIs, who are also concerned by the regulations. Many members of the CLIs were also present.

This national seminar was followed by a regional discussion seminar held in Caen on 19th September 2014 to answer the questions of the BNI licensees of Normandy and Brittany raised by the implementation of the BNI Order. All the licensees of the region were present, namely Areva NC, Andra's Manche repository, the Ganil, the EDF nuclear power plants of Paluel, Penly and Flamanville, and the site of the EPR under construction.

These seminars provided the opportunity to study in greater depth the operational problems encountered by the licensees on the ground: defining the elements and activities important for protection, fields covered by the integrated management system, characterisation of deviations. The ASN division cast some light on the texts supported by concrete examples and put the regulatory objectives into perspective.

A file in* Contrôle*, the reference technical magazine

ASN also explained the main advances resulting from overhaul of the regulations in its magazine *Contrôle,* published in its new layout in March 2014. Issue 197 thus goes back over the various steps that led to the development of the new regulations and gives a forum to the players concerned by its implementation.

"Advances in the general technical regulations applicable to BNIs" seminar held on 21st March 2014 in Paris.

TO BE NOTED

Contrôle magazine

Contrôle magazine has been taking stock of the major technical issues concerning nuclear safety and radiation protection since 1994, and today it is distributed to more than 10,000 subscribers in France (national and local elected officials, media, HCTISN-High committee for transparency and information on nuclear safety, CLIs, associations, licensees, administrations, private individuals) and abroad (nuclear safety regulators).

Its aim is to give an in-depth review of the technical and scientific subjects relating to nuclear safety and radiation protection, based on the diversity of the points of view of the experts who are asked to express themselves in complete transparency in its columns.

In 2013 ASN gave *Contrôle* magazine a major editorial revamp after consulting its readers through a questionnaire. The aim of this revamp was to reinforce its position as a reference technical magazine while at the same time meeting the expectations of a more diversified readership.
This is why in its new presentation *Contrôle* is now organised around three separate headings – "Analysis", "Feedback" and "Focus" – which confront the opinions and question the results of the technique and research from the viewpoint of the current topics.

1.2.2 Encourage the noti cation of signi cant events and experience feedback

The notification of significant events is a key factor in strengthening the safety and radiation protection culture.

The *www.vigie-radiotherapie.fr* portal, launched jointly by ASN and the ANSM (French National Agency for Medicines and Health Products Safety), facilitates the submission of notifications relating to radiation protection and the monitoring of incidents in radiotherapy. This aid gives access to the regulatory references and notification criteria. It enables an event to be notified to the competent authorities rapidly by means of a single form.

ASN publishes the twice-yearly bulletin "*Healthcare safety – Building momentum for progress*", co-signed by the SFRO (French Society for Radiation Oncology), the SFPM (French Society for Medical Physics) and the AFPPE (the French Association of Electroradiology Paramedical Staff). Sent by post to 180 radiotherapy centres in France, the bulletin highlights the progress and experience sharing approach initiated by the radiotherapy centres to enhance health care safety. Six issues have so far been published and translated into English, on the subjects of patient identification, the treatment preparation session, analysis of significant radiation protection events, events to be notified to ASN, in vivo dosimetry and wrong-side errors.

In 2014 a complementary information sheet entitled "Experience feedback" was created in agreement with the learned societies. It alerts professionals about significant events notified to ASN to prevent them from recurring in other radiotherapy centres. The aim of this sheet is to inform the centres rapidly and to incite reflection as part of their risk analysis actions.

1.2.3 The professional events

ASN also develops its relations with the professionals by organising symposia or participating in events organised by professionals. These events are also opportunities for ASN to share ideas and experience with its foreign counterparts.

The ASN divisions reaching out to professionals in the small-scale nuclear sector

In the medical sector, the ASN regional divisions joined forces to promote the principles of radiation protection and dose optimisation with the professionals of interventional radiology in Paris (16th March) and Lille (18th September), nuclear medicine in Orleans (4th June) and radiotherapy in Marseille (7th November).

The Lyon division also brought together the industrial radiography professionals of the Rhône-Alpes and Auvergne regions on 2nd December, continuing the proactive prevention approach engaged in 2010 with the establishing of a charter of good practices. A total of 43 companies have signed the charter and undertaken to ensure increased preparation and coordination between the industrial players and greater formalisation of the safety rules.

Conferences in the medical and radiation protection sector

The campaign to raise awareness in the control and optimisation of doses in medical imaging began in 2012 and was continued in 2014.

ASN met paramedical electroradiology personnel at the AFPPE congress (15th-17th May), the medical imaging professionals at the French Radiology Days (JFR, 17th-20th October), the physicians specialised in oncology, radiotherapy and brachytherapy at the SFRO (French Society for Radiation Oncology) congress (15th -18th October) and the persons competent in radiation protection at the PCR days of the SFRP (French Society for Radiation Protection) (13th-14th November).

The prime aim of the discussions with professionals is to enhance their knowledge of the regulations that are applicable to them. In addition to the annually-updated guide to the regulations concerning medical and dental radiology, sheets were issued in 2014 on the regulatory and normative references in industrial radiography and on the design rules for installations in which X-rays are present (ASN Resolution 2013-DC-0349).

The professional trade fairs of 2014 also gave ASN the opportunity to assess the situation of the inspections (interventional radiology, computed tomography, radiotherapy, mobile radiography for equine veterinary surgeons) and to share the lessons learned from the analysis of the significant radiation protection events. A poster highlighting the progress of the deployment of the treatment quality and safety management process was presented at the SFRO congress.

ASN's contribution to improving international nuclear safety and radiation protection in the world

ASN contributed to the discussions between radiation protection experts following the Fukushima Daiichi accident at the international conference of International Atomic Energy Agency (IAEA) held in Vienna from 17th to 21st February 2014. It presented the main conclusions of the work of the Steering Committee for the management of the post-accident phase of a nuclear accident or radiological emergency situation (CODIRPA) on the post-accident situation, published in November 2012.

ASN also played an active role in sharing international radiation protection experience at the 4th European congress of the International Radiation Protection Association (IRPA) held in Geneva from 23rd-27th June). The event was attended by more than 600 scientists and radiation protection professionals from 48 countries. ASN presented three posters to make known the recommendations formulated jointly with the SFPM relative to the needs for medical physicists, the lessons learned from significant radiation protection events in the medical sector between 2007 and 2013, and the current state of knowledge about individual radiosensitivity.

1.3 ASN and the media

ASN maintains regular relations with the regional, national and foreign media throughout the year.

ASN supervisors had regular meetings and contacts with the media during 2014 to keep the journalists informed of the latest news concerning nuclear safety and radiation protection in France.

The subjects the most frequently broached included the green growth energy transition bill, the continuation of operation and the life time of the nuclear reactors, decommissioning, and the Cigéo project. On several occasions Pierre-Franck Chevet, the ASN Chairman, presented the priorities and the issues of nuclear safety in the context of the debate on the green grown energy transition.

In the area of patient radiation protection, the functioning of the radiotherapy centres, ASN's recommendations in terms of improvement of treatment safety, the optimisation of doses received by patients and practitioners in medical imaging aroused the interest of the journalists.

Numerous interviews and coverage in the field enabled the media to understand the different steps involved in ASN's regulatory work and to inform their audience about the steps taken to ensure the safety of nuclear facilities and the safety of medical treatments.

The press also questioned ASN regularly on its status, its means of functioning, its power to sanction and its independence.

Throughout the year, ASN also hosted numerous international media wanting details on ASN's functioning, its news and the events occurring in France, and to discuss various subjects relating to nuclear safety and radiation protection with ASN.

Lastly, in 2014 the ASN press service managed the media attention raised by incidents that occurred in the nuclear facilities.

TO BE NOTED

Press conferences

In 2014 ASN organised twenty-one national and regional press conferences. These regular information meetings with the media enable ASN to present its activities relating to nuclear safety and radiation protection.

Institutional meetings also took place during the year.

On 28th January, ASN presented its wishes for the New Year to about thirty journalists from the national and international press. During this event, Pierre-Franck Chevet – the Chairman of ASN, and Jean-Christophe Niel – the Director-General, presented a review of ASN, its development, its relations with its international counterparts and its strategic priorities for the coming year.

On 16th April, ASN organised a press conference attended by about forty journalists to present its Report on the state of nuclear safety and radiation protection in France in 2013.

This conference aroused the interest of the national media. The regional divisions of ASN subsequently organised nineteen regional conferences to present the results of their activity during the year to their region and inform the media of the issues at stake for ASN.

Press conference to present the ASN Annual Report in Montrouge on 16th April 2014.

1.4 ASN's relations with elected officials and institutional bodies

ASN organises discussions with the institutional audience to report on its activity and duties and forges relations with them in order to be more effective in carrying out its duties.

ASN took part in several hearings in 2014 concerning the green growth energy transition bill (PLTECV) and answered numerous questions from parliament members at the National Assembly and the Senate.

It was more specifically heard by the Board of Inquiry chaired by François Brottes relative to the past, present and future costs of nuclear energy, the service life of the reactors and various economic and financial aspects of the production and sale of nuclear-generated electricity.

The members of parliament also heard ASN on the financing of the oversight of nuclear safety, the Fessenheim NPP and the budget bill for 2015.

Pierre-Frank Chevet was heard by the Senate's European Affairs Commission in May on the revision of the "safety" directive.

Alongside these hearings, ASN met many national and regional elected officials to discuss themes relating to nuclear safety and radiation protection, incidents affecting nuclear installations, and radiation protection in the medical field.

On 15th April, ASN also presented its report on the state of nuclear safety and radiation protection in France to the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST). This report, which constitutes the reference document on the state of the activities regulated by ASN in

France, is submitted each year to the President of the Republic, to the Government and to the Parliament. It is also sent out to nearly 2,000 addressees: heads of administrations, local elected officials, licensees and heads of regulated activities or facilities, associations, professional trades unions, learned societies, private individuals and so on.

Lastly, every two months ASN publishes the *Lettre de l'Autorité de sûreté nucléaire* (Letter from the Nuclear Safety Authority). This letter provides a summary of the important topical issues and information relative to ASN decisions and actions, including on the international front. It can be consulted and downloaded from *www.asn.fr* or sent by electronic mail on subscription; as at 31st December 2014 there were more than 5,200 subscribers to this information letter.

GREEN GROWTH ENERGY TRANSITION BILL

This bill reinforces transparency in the nuclear field, particularly by explicitly giving ASN the mission of stating its opinion on the state of nuclear safety and radiation protection in its annual report.

TO BE NOTED

Participation of ASN in the 19th Mayors and Local Authorities Exhibition

ASN participated for the second time in the Mayors and Local Authorities Exhibition held from 25th to 27th November 2014, with the aim of giving local elected officials greater insight into its role, its duties and its positions. Nearly 300 people visited its stand.

The elected officials met national and local representatives of ASN to discuss varied themes, notably the life time of the nuclear power plants and their oversight, the management of emergency situations, the risks associated with radon in the home and means of protecting against them, radiation protection of the general public and patients. The elected officials confirmed the importance they assign to ASN's role as a provider of information.

ASN would like to increase its regular exchanges with local elected officials in order to provide them with the operational information they need with regard to nuclear safety and radiation protection.

It is also attached to the participation of civil society in subjects related to nuclear safety and radiation protection.

Mayors and Local Authorities Exhibition held in Paris on 25th, 26th and 27th November.

1.5 International cooperation in the field of communication

ASN invests itself on the international scene to promote experience feedback and the sharing of best practices for informing the public.

In 2014, ASN's Communication and Public Information Department (DCI) continued its participation in the communication working group coordinated by Nuclear Energy Agency (NEA). In this context, it organised an international workshop with varied stakeholders (media, NGOs, CLIs) on 9th April 2014 to discuss the quality of the information disseminated by the nuclear safety authorities.

The DCI took part in two cooperation missions financed by the European Commission for the Moroccan and Vietnamese authorities to help them establish an information policy that complies with the best standards (see chapter 7).

The DCI was also regularly requested by its peers to present its communication actions. In 2014, this concerned the Belgian, Chinese, Korean, Emirati and Polish authorities.

1.6 The ASN staff and information

The ASN intranet, OASIS, is the prime vector for internal information, providing staff with documents relative to the life of ASN and its activities. OASIS is also the interface for the ASN information system which organises the documentary base covering the main professional processes within ASN.

The magazine *Transparence*, created in 2010, is issued three times per year to all ASN staff and to targeted external audiences such as the operational partners, the CLIs, members of parliament, and engineering school students.

The ASN activity report is intended for ASN personnel. It is now published in electronic format and is accessible to all personnel on the ASN intranet. This document, which was issued in 2008, highlights information on subjects ranging from training or social dialogue to the quality management system and financial resources.

Training in communication and media relations

With the aim of issuing high-quality, clear and understandable information, ASN offers its staff training in spoken and written communication and emergency management, tailored to their various responsibilities.

ASN spokespersons prepare themselves for public speaking and communication with the media, notably during emergency exercises with simulated media pressure (see chapter 5).

Training in written communication is provided for all the ASN inspectors.

Preparation for emergency situations

Article L. 592-32 of the Environment Code confers upon ASN the following duty in emergency situations: *"inform the public of the state of safety of the installation that is the cause of the emergency situation [...] and any discharges into the environment and the risks they present for human health and for the environment"*.

ASN must in particular be capable of responding to media queries should a nuclear event occur. In 2014, four emergency exercises included simulated media pressure from journalists, designed to assess and strengthen ASN's reactivity to the media, as well as the consistency and quality of the messages put across by the various stakeholders, licensees and public authorities, both nationally and locally (see chapter 5).

2. REINFORCING THE RIGHT TO INFORMATION AND PARTICIPATION OF THE PUBLIC

The legislative and regulatory provisions relative to nuclear activities, which have been progressively reinforced over the last few years, give the general public wide access to information.

ASN ensures application of these measures, which are binding on itself as well as on the licensees subject to its oversight, and endeavours to facilitate interchanges between all the stakeholders.

2.1 Information provided by the licensees

The main licensees of nuclear activities operate a proactive public information policy.

They are also subject to a number of legal obligations, either general, such as the environmental report required by the Commercial Code for joint stock companies, or specific to the nuclear sector.

The latter are presented below.

2.1.1 The annual report for informing the public drawn up by the BNI licensees

All BNI licensees must establish an annual report on their situation and the steps they take with respect to nuclear safety and radiation protection (Article L. 121-15 of the Environment Code).

The writing of these reports is covered by ASN recommendations provided in a guide published in 2010.

Each year, ASN analyses the reports drawn up by the licensees. For the year 2013, as in the preceding years, the results were positive on the whole: the reports were produced on time and complied with the obligations of the Environment Code. Furthermore, the design of these documents has been gradually improved to make them more easily understood by the general public.

The reports are generally available on the licensees' websites and are often presented to the CLIs.

the lines for improvements remain the placement into perspective of the data and presentation of public information actions carried out by the BNIs.

2.1.2 Access to information in the possession of the licensees

With entry into force of the TSN Act, the nuclear field has a unique system of public access to information.

Pursuant to Articles L. 125-10 and L. 125-11 of the Environment Code, the licensees are required to communicate to anyone who so requests, the information in their possession concerning risks linked to exposure to ionising radiation that could result from this activity and the safety and radiation protection measures taken to prevent or mitigate these risks or this exposure.

There are provisions for protecting public safety and commercial and industrial secrecy.

The right to information concerning nuclear safety and radiation protection is today in force with regard to BNI licensees and to those in charge of radioactive material transport operations, provided that the quantities are higher than the thresholds set in the Act.

The conditions under which this right will be extended to other nuclear activities that so warrant remain to be defined.

The Commission for Access to Administrative Documents (CADA)

The procedures governing disputes following a refusal to communicate information are similar to those applicable under the general regime for access to information concerning the environment: in the event of refusal by a licensee to communicate information, the applicant can refer the matter to the Commission for Access to Administrative Documents (CADA), an independent administrative authority, which gives its opinion on whether the refusal is justified. Should the interested parties not follow the opinion of the CADA, the dispute would be taken before the administrative jurisdiction which would rule on whether or not the information in question should be communicated. ASN is heavily committed to the implementation of this right, and monitors its application.

The number of referrals to CADA still remains extremely limited.

ASN therefore continues to regularly encourage the public to make use of this right to information.

GREEN GROWTH ENERGY TRANSITION BILL

This bill reinforces the licensees' obligations regarding the provision of information:

- people living near BNIs must now regularly be informed at the licensee's expense; the information shall concern the nature of accident risks, the possible consequences, the safety measures and the action to take (an equivalent system is already applicable around hazardous industrial facilities that are subject to the "Seveso" European directive);
- the BNI licensees' obligations to provide information shall be extended to all aspects concerning public health and safety and protection of nature and the environment.

2.2 Public consultation about projected decisions

Article 7 of the Environment Charter embodies the principle of participation of any citizen in the framing of public decisions having an impact on the environment (see chapter 3).

This principle is applicable to a large proportion of the decisions taken by ASN or in which it is involved.

2.2.1 Consultation of the general public on draft statutory resolutions having an impact on the environment

Article L. 120-1 of the Environment Code provides for a procedure of public consultation via the Internet on draft regulatory texts having an impact on the environment.

ASN has decided to apply this widely. Consequently, all ASN draft statutory resolutions concerning BNIs, including those relating to nuclear pressure equipment, are considered as having an impact on the environment and are therefore subject to public participation. The same approach is applied for the statutory resolutions relative to the transport of radioactive substances that ASN may have to adopt.

ASN's statutory resolutions relating to radiation protection are also submitted to public participation if they concern activities involving significant discharges into the environment, or producing a significant quantity of waste or causing significant nuisance for the neighbourhood or representing a significant accident hazard for the nearby residents and the surrounding environments.

Lastly, although they are not of a statutory nature, some ASN guides are also subject to the same procedure.

An indicative list of the scheduled consultations on draft statutory resolutions and guides having an impact on the environment is updated every three months on the *www.asn.fr* website.

The public participation procedure consists in posting the draft statutory resolution on *www.asn.fr* for at least 21 days to give the public the opportunity to express their observations.

A synthesis of the remarks made, indicating those taken into account and a document setting out the reasons for the resolution are published on *www.asn.fr* at the latest on the date of publication of the resolution. During the year 2014, six draft statutory resolutions and one draft guide thus underwent public consultation.

2.2.2 Consultation of the general public on draft individual resolutions having an impact on the environment

The individual resolutions on nuclear safety and radiation protection can form the subject of several public consultation procedures which are presented below.

The public inquiry

In application of the Environment Code (TSN Act) and the Decree of 2nd November 2007, the BNI creation authorisation and final shutdown and decommissioning authorisation procedures form the subject of a public inquiry. Since 1st June 2012, an experiment instituted by Decree 2011-2021 of 29th December 2011, the results of which will be assessed in 2017, involves making available by electronic means the files of projects that are subject to a public inquiry and which could affect the environment. The BNIs, whether for their creation or their decommissioning, are included in this experiment.

Three public inquiries were held in 2014 on BNI creation, modification or decommissioning projects, and one public inquiry on the introduction of active institutional controls on the site of a former BNI.

GREEN GROWTH ENERGY TRANSITION BILL

This bill stipulates for nuclear power reactors undergoing their periodic safety review that the measures proposed by the licensee to increase the safety of its facility and to correct any observed anomalies shall be subject to a public inquiry before ASN finally decides on its prescriptions; these measures will be applicable in particular to any continuation of reactor operation beyond forty years.

The posting of projects on the ASN website

The individual resolutions that are not subject to public inquiry and which could have a significant effect on the environment are made available for consultation on the Internet. For the ASN resolutions, these are notably individual prescriptions applicable to BNIs, the authorisation to commission a BNI or the delicensing of a decommissioned BNI, as well as authorisations for small-scale nuclear activities that could produce effluents or waste.

The consultation concerns the draft resolution and, for resolutions adopted on request, the application file. The consultation is open for at least fifteen days on *www.asn.fr*.

During the year 2014, 151 draft individual resolutions were thus posted for public consultation on *www.asn.fr*.

Disclosure of the files by the licensee

Before setting up the general procedure for consultation via the Internet, a procedure for file disclosure by the licensee was instituted for any project to modify a BNI or its operating conditions that could lead to a significant increase in its water intakes or environmental discharges (while being of insufficient scale to warrant a public inquiry procedure). This procedure is governed by Article L. 593-15 of the Environment Code and II of Article 26 of the decree of 2nd November 2007, and ASN Resolution 2013-DC-0352 of 18th June 2013. It now supplements the general consultation procedure via the ASN website.

This procedure was used twice in 2014.

2.2.3 Consultation of particular bodies

The BNI authorisation procedures also provide for obtaining the opinion of the General Council, the municipal council and the CLIs (see point 2.3.1). The CLIs also have the possibility of being heard by the ASN Commission before it issues its opinion on the draft authorisation decree submitted to ASN by the Minister responsible for Nuclear Safety.

The CLI and the CODERST (Departmental Council for the Environment and for Health and Technological Risks) are consulted on the draft ASN prescriptions concerning water intakes, effluent discharges into the surrounding environment and the prevention or mitigation of detrimental effects of the installation for the public and the environment.

2.2.4 Progress to be consolidated

ASN ensures that these consultations enable the public and the associations concerned to express their views, in particular by verifying the quality of the licensee's files and by developing the CLI's resources so that they can express an independent opinion on the files (in particular thanks to the possibility of consulting experts other than those of the licensee and ASN).

ASN also endeavours to ensure that the public has information that is as extensive as possible in compliance with the limits on the communication of environmental information provided for in Articles L. 124-1 to L. 124-6 of the Environment Code, in particular to protect public safety or commercial and industrial confidentiality.

The framework of the public consultation has greatly evolved over the last few years. The first efforts consisted in rigorously applying the new rules. It is now necessary to examine how to improve the practical conditions of these consultations to make them more effective aids to public participation.

2.3 The other actors in the area of information

2.3.1 The BNI local information committees (CLI)

Operating framework

The CLIs have a general duty of monitoring, information and consultation concerning nuclear safety, radiation protection and the impact of nuclear activities on humans and the environment with regard to the installations of the site(s) that concern them.

The operating framework of the CLIs is defined by Articles L. 125-17 to L. 125-33 of the Environment Code and by Decree 2008-251 of 12th March 2008 relative to the CLIs for the BNIs.

The CLIs, whose creation is incumbent upon the President of the General Council, comprise various categories of members: representatives of General Councils, of the municipal councils or representative bodies of the groups of municipalities and *conseils régionaux* (Regional Councils) concerned, members of Parliament elected in the *département*, representatives of environmental or economic interest protection associations, employee and medical profession union organisations, and qualified personalities. The representatives of Government departments, including ASN, and of the licensee have an automatic right to participate in the work of a CLI, in an advisory capacity.

The CLIs are chaired by the President of the General Council or by an elected official from the *département* designated by him for this purpose.

The CLIs receive the information they need to function from the licensee, from ASN and from the other Government departments. They may request expert assessments or have measurements taken on the installation's discharges into the environment.

The CLIs are financed by the regional authorities and by ASN. ASN devotes about one million euros per year to the financial support of the CLIs and their federation. Within the framework of its reflection on the financing of the oversight of nuclear safety and radiation protection, ASN has again suggested to the Government the application of the provision of the TSN Act to add to the budget of the CLIs with association status (there are about ten of them) with a matching contribution of funds from the BNI tax; however, this provision has not yet been implemented.

ASN support is not restricted simply to financial aspects. ASN considers that the good functioning of the CLIs contributes to safety. ASN also aims to ensure that the CLIs receive information that is as complete as possible. It also invites CLI representatives to take part in inspections. Within the present framework, only the access right to facilities by ASN inspectors can be enforced upon the licensees, therefore the participation of observers from CLIs is subject to the agreement of the licensees.

ASN encourages BNI licensees to facilitate CLI access - as early as possible - to the procedure files for which the opinion of the CLIs will be required, so that they have sufficient time to develop a well-founded opinion. Similarly, ASN considers that the development of a diversified range of expertise in the nuclear field is essential if the CLIs are to be able to base their opinions, when needed, on the work of experts other than those called on by the licensee or ASN itself.

GREEN GROWTH ENERGY TRANSITION BILL

This bill plans for diverse provisions concerning the CLIs:
- their right to address all questions within their competence without referral to a higher authority will now be explicitly written in the act;
- the CLIs will also be able to visit the installations, either for a general presentation of their functioning or following an incident or accident to obtain an explanation of the causes and effects of the event;
- all the CLIs must also hold at least one public meeting per year;
- lastly, the composition of the CLIs in *départements* situated on a national border shall be supplemented to ensure better representation of the neighbouring countries concerned.

All BNI sites now have a CLI, except for the Ionisos facility in Dagneux in the Ain *département*.

The Cadarache CLI merged with the ITER CLI at the end of 2014.

There are thus 35 CLIs governed by the TSN Act. To this must be added the local information and monitoring committee (CLIS) of the Bure underground laboratory (Meuse *département*), created pursuant to Article L. 542-13 of the Environment Code, along with about fifteen information committees created around defence-related nuclear sites, pursuant to Articles R.1333-38 and R.1333-9 of the Defence Code. For the Valduc site (Côte-d'Or *département*), there is also an advisory structure with association status: the Valduc information exchange structure (SEIVA).

Conference-debate "Nucléaire et territoires" (Nuclear issues and regions) in Valence on 10th October 2014.

CLI activity

The activities of the CLIs take the form of plenary meetings, some of which are open to the public (about a third of the CLIs hold public meetings), and work involving specialised commissions.

The annual public information report drawn up by the licensee is presented to the CLI. Any significant events are also usually presented to the CLI.

About ten CLIs were consulted about licensees' projects. The CLIs are moreover always informed of the launching of public consultation procedures by ASN. Some ten CLIs have also had appraisals carried out, as allowed by the TSN Act, for example during the reactor ten-yearly outage inspections or in the form of environmental analysis campaigns.

About thirty CLIs have a website or have pages on the site of the local authority that supports them. Nearly half the CLIs publish a newsletter (sometimes an insert in the newsletter of the municipality).

The CLIs can have special advisers, generally on a part-time basis. They are members of staff of the local authorities or, for those CLIs with association status, employees of the association itself. If these special advisers are in place, this clearly helps the CLIs adopt a more proactive attitude.

In 2014, ASN informed the CLIs regularly about the files concerning the nuclear facilities. Among the actions undertaken, a member of the Paluel-Penly CLI attended the in-depth inspection of the Paluel site as an observer, invited by ASN with the agreement of EDF. Other CLIs such as those of Gravelines, Soulaines and ITER also took part in ASN inspections, at varying frequencies according to the availability of their members.

More detailed information on the action of some of the CLIs is given in chapter 8.

TO BE NOTED

Seminar for the Rhône Valley CLIs

On 10th October 2014 in Valence (Drôme *département*), Didier Guillaume, Chairman of the General Council and member of the Senate for the Drôme, and Pierre-Franck Chevet, Chairman of ASN, organised for the first time an inter-CLI seminar bringing together participants from the Rhône Valley. The attending elected officials, associations, public authorities, licensees and media held discussions on the theme of "Nuclear issues and regions". The seminar introduced a new way of developing the nuclear risk culture with the CLIs.

TO BE NOTED

26th Conference of Local Information Committees

The 26th Conference of Local Information Committees brought together 200 participants on 10th December 2014 in Paris at the initiative of ASN and in partnership with ANCCLI.

As in the previous years, the conference brought together around the CLI representatives, representatives of the General Councils and the prefectures of *départements* with CLIs, the Government departments concerned, associations and nuclear installation licensees.

The morning was devoted to "topical questions" with presentations by ASN and the ANCCLI, and lively exchanges with the floor.

In the afternoon, two successive round tables were held on the theme of "Continuing nuclear reactor operation after the 4th periodic safety review" and "Population protection in the event of a nuclear accident: working towards European harmonisation? ".

2.3.2 National Association of Local Information Commissions and Committees (ANCCLI)

The TSN Act provides for the constitution of a federation of CLIs, and the Decree of 12th March 2008 sets forth certain provisions that this federation must adhere to.

This federation is the National Association of Local Information Commissions and Committees (ANCCLI), chaired by Jean-Claude Delalonde.

The activity of ANCCLI in 2014

In 2014, the ANCCLI comprised 37 CLIs, with more than 3,000 representatives of civil society, including 1,500 elected officials.

In 2014, ANCCLI organised more than 50 meetings of its various bodies (administrative council, annual general meeting, scientific committee, advisory committees, special advisors club, consultative committee) and took part in more than 100 events organised by its partners (ASN, IRSN, European Union, etc.), which represents roughly one meeting every two days and bears witness to the strong commitment of the volunteer members of the CLIs and ANCCLI.

Today in the field of nuclear activities ANCCLI is an actor in its own right. In 2014 ANCCLI was audited by the Parliamentary Board of Inquiry on the costs of the nuclear process, by Mr Berson – member of the Senate – on the financing of the CLIs, by Mr Lecerf – member of the Senate – on the links and actions to put in place between ANCCLI and the HCFDC (French High Committee for Civil Defence), by Mr Plisson – member of the National Assembly – on the green growth energy transition bill (proposal of several draft amendments by ANCCLI), by Mr Le Déaut – member of the National Assembly – on the safety of nuclear facilities and drones.

The ANCCLI authorities

The ANCCLI comprises a number of bodies, which continued their work in 2014.

The ANCCLI scientific committee

It comprises independent and unpaid experts from various backgrounds.

In 2014 it carried out expert appraisals at the request of the CLIs (opinion on the files relative to discharges and water intakes for the Bugey CLI and the Fessenheim CLIs) and actions at the request of the ANCCLI (writing of a guide on the analysis of applications for modifications to water intakes and environmental discharge authorisations submitted by BNI licensees and a collection of questions to ask as part of the periodic safety reviews).

A guide is also being prepared on the off-site emergency plans and emergency exercises.

In 2014 the scientific committee published *"Methods of monitoring the environment - theoretical considerations and environmental monitoring by the licensee and the CLIs"*.

The ANCCLI officers' club

Created in 2011, the CLI officers' club strengthens the close ties that have been forged between the CLIs on the one hand and between the CLIs and the ANCCLI on the other, in order to share best practices, facilitate information exchange, share certain examinations, pool studies and transmit local difficulties to the national bodies. ASN, IRSN and the licensees are now invited to each meeting.

In 2014 the Officers' Club issued an assessment of the ANCCLI/Nogent-sur-Seine CLI/EDF pilot action (licensee's answers to the ASN inspection letters) and examined how the process engaged at Nogent-sur-Seine could be transposed to all the CLIs.

The Club also set up an internal "Cross-border CLIs" working group (WG). A first meeting was held in June on the population protection measures in cross-border areas. It resulted in the sharing of good practices. Recommendations were issued on the basis of the exchanges of experience.

Lastly, in the context of this group some CLIs wanted the ANCCLI to be present in their region. The ANCCLI travelled in 2014 to the region of Saint-Laurent-des-Eaux (hydrogen study), to the Monts d'Arrée, to Paluel/Penly and the Drôme (CLIGEET - CLI for the major energy infrastructures of Tricastin, FBFC - Société franco-belge de fabrication de combustibles).

The ANCCLI Advisory Committees

The ANCCLI set up various "advisory committees" comprising members of CLIs or the ANCCLI.

Thus, in 2014 the "Post-accident and regions advisory committee" (GPPA) worked with IRSN on the assessment of the OPAL pilot action and will deploy the tool for the interested CLIs (Cadarache, Blayais, Gravelines, etc.). Representatives of the SGDSN (General Secretariat for Defence and National Security) came to present the National radiological emergency plan and a regional approach to emergency preparedness and post-accident situations by the General Council of the Loiret *département*. The group plans to write a white paper on the "post-emergency/post-accident" themes.

In 2014, the Advisory Committee on "Radioactive materials and waste" (PNGMDR) continued, in partnership with IRSN and the Bure CLIS, the dialogue on the ILW-HLW-LL (intermediate level – high-level long-lived waste). Furthermore, the group engaged a reflection on "reversibility " in order to issue recommendations in view of the future act on reversibility. A white paper will be drawn up on this subject for the CLIs in 2015.

The Advisory Committee on Safety was reactivated in 2014. To begin with, the major issues associated with the continuation of reactor operation were listed. The most important questions were communicated to ASN, IRSN and the licensee.

The ANCCLI set up a new Advisory Committee on Decommissioning in 2014. This group will work on the final shutdown (MAD) and decommissioning (DEM) procedures, informing the public, the impact on safety in all its forms, the impacts on the region (the outcome of the site, retraining of the personnel, etc.).

Symposia, seminars and training

In 2014, the ANCCLI organised three training/awareness-raising seminars in partnership with IRSN for the members of the CLIs (waste, decommissioning, post-accident situations, etc.). The ANCCLI also took part in two seminars organised by ASN on current regulatory issues and the economic evaluation of the nuclear risk. Lastly, on 10th October 2014 the chairman of the ANCCLI attended a seminar organised by the CLIs of the Drôme *département* in partnership with ASN and the General Council of the Drôme.

Communication at ANCCLI

The ANCCLI completely overhauled its communication strategy in 2014.

The ANCCLI now has an institutional brochure which it sends to all its partners and which represents its "identity card" (its origins, its duties, where it is located, its work, its added value, etc.).

A new logo has been created to enhance the visibility of the ANCCLI with the signature *La sûreté nucléaire, parlons-en !* (Nuclear safety, let's talk about it!).

The website has also been revamped. Visitors can now navigate on the ANCCLI website more intuitively with their smartphones or tablets.

Communication actions have been increased (survey "Informing the French about nuclear power", press release on the off-site emergency plan, the "drones affair", the ageing of nuclear power plants) and widely covered by the national and local press.

ANCCLI partnerships

The ANCCLI has very regular interchanges with ASN and participates in several of its working groups (PNGMDR, CODIRPA, RNM, COFSOH, childhood leukaemia, advisory committees of experts, etc.). The ANCCLI and ASN work together each year on the preparation of the annual CLI conference.

The ANCCLI and IRSN have been cooperating very closely for more than ten years. Its members participate in many working groups (steering and research committee, board of directors, pilot action baptised "permanent IRSN representative in the CLIs"). Three meetings of the monitoring committee were held in 2014 and a process of exchange and discussion on the periodic safety reviews and the extension of reactor life times has been initiated.

European cooperation

At the European level, the ANCCLI takes part in various European events (E-Track, Eagle, ENEF, etc.).

The ACN initiative launched by ANCCLI

The Aarhus Convention and Nuclear (ACN) is an initiative launched in 2008 by the ANCCLI and the European Commission with the aim of progressing with the practical implementation of the Aarhus Convention in the nuclear field. Some fifteen member countries participate in it.

This initiative, the first phase of which ended in March 2013, is continuing under the name ACN2. A round table will be organised in 2015 on the theme of the emergency phase.

The NTW initiative launched by ANCCLI

Nuclear Transparency Watch (NTW) is a European network created in 2013 to promote transparency in nuclear activities and the effective participation of the public in the nuclear sector in order to improve the decisions concerning nuclear safety and the protection of health and the environment. It is chaired by Michèle Rivasi, Member of European Parliament, while Jean-Claude Delalonde is vice-chairman. NTW supports national and local initiatives and the civil society organisations that share these objectives. Two working groups were set up in 2014, one on civil protection and disaster and emergency services, the other on the ageing of nuclear power plants in Europe.

2.3.3 High Committee for Transparency and Information on Nuclear Security

The High Committee for Transparency and Information on Nuclear Security (HCTISN) created by the TSN Act is a body that informs, discusses and debates on nuclear activities, their safety and their impact on health and the environment.

The HCTISN comprises forty members appointed by decree for six years. They include:
- two MPs appointed by the National Assembly and two Senators appointed by the Senate;
- six representatives of the CLIs;
- six representatives of environmental protection associations and approved health system users associations;
- six representatives of persons in charge of nuclear activities;
- six representatives of representative employee labour organisations;
- six "qualified personalities" chosen for their scientific, technical, economic or social competence, or for their information and communication expertise, including one appointed by the Government, three appointed by OPECST, one by the Academy of Science and one by the Academy of Moral and Political Sciences;
- the ASN Chairman, an IRSN representative and four representatives of the ministries concerned.

The Chairman of the High Committee is appointed by the Prime Minister from among Members of Parliament, representatives of the Local Information Committees and public figures chosen for their competence.

The first term of office of the HCTISN, chaired since its creation on 28th February 2008 by Henri Revol, former member of the Senate for the Côte-d'Or *département* and former chairman of the OPECST, ended on 28th February 2014. An assessment of the work carried out by the HCTISN over this period was drawn up. Going back over the different activities and work carried out by the HCTISN since its creation in 2008, this document highlights the salient results and progress made by the Committee in transparency and information in the nuclear field.

This assessment, along with all the opinions and reports of the HCTISN and all the elements presented and discussed at the plenary meetings, can be consulted on *www.hctisn.fr*.

ASN considers that the HCTISN plays an important consultation role at the national level. It regretted the interruption of its work in 2014.

2.3.4 IRSN

IRSN reports on its activities in its bilingual (French-English) annual report. This document is officially communicated to IRSN's supervisory ministers, as well as to the HCTISN, the French High Public Health Council (HCSP) and the Working Conditions Guidance Council (COCT). It is also available to the general public via the IRSN's website.

IRSN also implements a policy of information and communication that is consistent with the objectives agreement signed with the Government. In 2014 IRSN made public all the results of its research and development programs, with the exception of those concerning defence. In accordance with the transparency approach initiated jointly with ASN in 2010, IRSN published on its website at *www.irsn.fr* more than 61 technical opinions produced and some ten reports produced at the request of ASN.

The work on the design of the new ASN/IRSN exhibition for the general public concerning nuclear risks continued during the year. This exhibition has been deployed in its pilot form in thirteen high schools during emergency exercises (Chooz, Charleville-Mézières) and at major events such as the *Assises nationales des risques* (National conference on risks) or the Mayors' exhibition. It has also been presented to the public during the *Fête de la science* (Science Festival) and at the open day of the Tournemire tunnel, in which IRSN conducts research for the geological disposal of nuclear waste. It has also been permanently showing at the ASN information centre since Autumn 2014.

Furthermore, throughout the year 2014, IRSN maintained its readiness to answer questions from the media and the public, an area were the demand is growing strongly given the wealth of news concerning the nuclear field.

3. OUTLOOK

In 2015, ASN will contribute actively to the implementation of the provisions reinforcing transparency in nuclear matters within the framework of the green growth energy transition bill.

ASN will further develop its information actions targeting the general public in order to make the technical subjects it presents clearer and more accessible. It will thus continue its approach to popularise and facilitate the understanding of the information in its publications, with the aim of playing a more educational role with its various audiences, in particular by increasing the number of videos available on *www.asn.fr*.

It will continue to enhance transparency on the subjects under its responsibility, together with the other players and stakeholders.

ASN will also improve the conditions to allow members of the public to express their opinion on the draft regulatory texts on *www.asn.fr*. The setting up of new exhibitions on nuclear safety and radiation protection in its public information centre, the strengthening of ties with schools and the national education authority, the creation of new information media for the populations situated in off-site emergency plan (PPI) zones around the nuclear installations are all actions designed to make the various audiences more aware of the culture of risk and questions concerning nuclear safety and radiation protection.

In 2015 ASN will coordinate the preparation of the campaign scheduled for 2016 to inform and distribute iodine tablets to the populations living near EDF power plants. The aim of the campaign is to inform the citizens of the nuclear risk, of all the appropriate protection measures and in particular the taking of iodine tablets.

ASN will continue its interchanges with elected officials and stakeholders. It will continue its participation in the debates on nuclear safety and radiation protection.

ASN will also organise a consultation with stakeholders on the first results of the procedures enabling the public to participate in the development of its resolutions.

ASN will continue to support CLI activities. It will continue its actions towards the Government and Parliament to give the CLIs the means they need.

07
INTERNATIONAL RELATIONS

ASN's international role has been recognised since its creation and its legitimacy is underpinned by the legislative provisions of the Environment Code[1]. ASN considers that the development of its international relations is essential to promoting a high level of safety worldwide, while consolidating its competence and its independence.

Even if nuclear safety and radiation protection remain a national prerogative, they are increasingly a part of an international move towards sharing and harmonisation of knowledge and practices. A country will therefore seek to benefit from the experience of other countries in order to improve its expertise. Moreover, a significant nuclear accident or event occurring in one country can affect other, sometimes remote countries, as was the case with the Chernobyl and Fukushima Daiichi accidents. A country cannot therefore ignore what is happening beyond its borders.

ASN's international action concerns two key issues: on the one hand, identifying and promoting best practices in terms of nuclear safety and radiation protection and, on the other, should an accident occur, informing and being informed and being able to react rapidly.

1. ASN OBJECTIVES IN EUROPE AND WORLDWIDE

The regulatory context has changed in Europe in recent years with the adoption of European Directives in the fields of nuclear safety and radiation protection.

These directives set the objectives to be met by the Member States of the European Union, with transposition into their legislative and regulatory frameworks. In coordination with the French administrations concerned, ASN thus actively participates in drafting and revising directives concerning its fields of activity.

In the construction of this legal corpus, the European Commission is assisted by ENSREG (European Nuclear Safety Regulators Group) a group comprising experts from the European Commission and from the Member States of the European Union (the national delegations are made up of heads of saftey regulators and representatives from the Ministries for the Environment and Energy, each group representing half the members).

The safety regulators have also set up associations in which their heads are represented, such as WENRA (Western European Nuclear Regulators Association) and HERCA (Heads of the European Radiological protection Competent Authorities). These are informal discussion forums focusing on reaching joint positions on the leading nuclear safety and radiation protection issues, experience feedback and the harmonisation of rules and practices.

For several decades now, outside Europe, international cooperation has been intensified under the supervision of organisations such as International Atomic Energy Agency (IAEA), a UN agency founded in 1957, and the OECD's Nuclear Energy Agency, created in 1958. IAEA and NEA are the most important inter-governmental organisations in the field of nuclear safety and radiation protection. One of the key activities of IAEA is to draft international nuclear safety and radiation protection standards. NEA is an ideal forum for the exchange of information and experience, leading to identification of the best practices that the Agency wishes to promote. ASN participates actively in the work being carried out within these international organisations.

1. *Article L.592-28 of the of Environment Code states that* "ASN sends the Government its proposals to define the French position in international negotiations in the fields of its competence" *and that* "it participates, on request by the Government, in the French representation in the bodies of international organisations and of the European Communities competent in these fields". *Article L.59233 also states that* "To implement international agreements or European Union regulations relative to radiological emergency situations, ASN is empowered to warn and inform the Authorities of third States or to receive their warnings and information". *These legislative arrangements underpin the legitimacy of ASN's international actions.*

In the aftermath of the Chernobyl accident (26th April 1986), the international community negotiated a number of conventions for preventing accidents linked to the use of nuclear power and mitigating their consequences should they occur[2]. These conventions are based on the principle of a voluntary undertaking on the part of the States (who alone remain responsible for the facilities situated on their territory) and entail no sanctions in the event of any failure to meet their obligations. France is a contracting party to these conventions, with IAEA being the depository and acting as secretary.

Finally, ASN collaborates with numerous countries under bilateral agreements, which can be governmental agreements (more particularly with neighbouring countries) or administrative arrangements. Bilateral relations allow direct exchanges on topical subjects and the rapid implementation of cooperation measures. They also prove to be extremely useful in the event of emergency situations, hence the will to increase interactions with our European neighbours.

In short, ASN's international actions can be divided into four parts, as presented in the diagram below.

1.1 Giving priority to Europe

Europe is the priority of international action by ASN, which thus aims to contribute to building two hubs, one for nuclear safety and the safe management of waste and spent fuel and the other for radiation protection.

With regard to nuclear safety, ASN contributes to two major institutions for European harmonisation: ENSREG and WENRA.

ENSREG was created in 2008 and has led to a political consensus on european directives concerning nuclear safety in June 2009, followed by spent fuel management and waste in July 2011. This institution also took part in a process to revise the Nuclear Safety Directive proposed by the European Commission in 2013, following on from the review further to the Fukushima Daiichi accident. Each safety regulator then provided technical advice to its government responsible for the negotiations in Brussels, until its revision on 8th July 2014.

ASN ACTION on the international stage

2. The Convention on early notification of a nuclear accident (signed in 1986), the Convention on assistance in the case of a nuclear accident or radiological emergency (signed in 1987), the Convention on Nuclear Safety (signed in 1994) and the Joint Convention on the safety of spent fuel management and the safety of radioactive waste management (signed in 1997).

ENSREG also played a key role in initiating, performing and defining the conclusions of the stress tests. It is now responsible for the follow-up to this unique exercise, in particular for the implementation of the national action plans with a view to application of the recommendations defined in 2012. For performance of the stress tests, ENSREG relied on the specifications drafted by WENRA.

Created in 1999 and acting as the technical support organisation for ENSREG, WENRA is an informal club specifically for the heads of the safety regulators, basing its work on experience sharing by safety regulators with a view to harmonising safety rules for reactors and waste management facilities.

In the field of radiation protection, the HERCA association has been a part of the European scene since 2007 and benefits from a number of advantages: regular meetings between the heads of radiation protection authorities outside any formal institutional framework, the desire to harmonise national approaches and increase European cooperation in the field of radiation protection.

After seven years, the HERCA association has become a key radiation protection player in Europe, and can already claim tangible progress in the harmonisation of regulations and practices.

1.2 Cooperation in the fields of nuclear safety and radiation protection worldwide

ASN multiplies its initiatives to share nuclear safety and radiation protection best practices and regulations outside Europe.

Within IAEA, ASN thus actively participates in the work of the Commission on Safety Standards (CSS) which drafts international standards for the safety of nuclear installations, waste management, the transport of radioactive substances and radiation protection. Although not legally binding, these standards do constitute an international reference, including in Europe. They are also the documentary reference standards for the international audits overseen by the Agency. They in particular include the Safety Regulator Audit Missions (IRRS, Integrated Regulatory Review Service) the development of which is being supported by ASN, along with OSART (Operational Safety Review Team) audits of nuclear power plants in operation.

ASN also contributes to safety harmonisation work by actively participating in the Multinational Design Evaluation Programme (MDEP) the aim of which is joint evaluation by safety regulators of the design of new reactors, including the EPR. This programme was initiated in 2006 by ASN and the United Nations Nuclear Regulatory Commission (NRC) and currently comprises 14 regulatory bodies. Its aim is harmonisation of the safety objectives, codes and standards associated with the safety evaluation of new reactors.

In the field of radiation protection, ASN is a stakeholder in various international review forums such as UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) or ICRP (International Commission on Radiological Protection). ASN considers that, through their publications, these organisations contribute to the protection of the exposed persons, whether patients in the medical sector or specific categories of workers.

2. RELATIONS WITH THE EUROPEAN UNION

2.1 European Union

ASN has always considered that a move towards European harmonisation of nuclear safety principles and standards was necessary, provided that this reflects and materialises the preparatory work done by the regulatory bodies and between regulatory bodies and licensees.

2.2 The Euratom Treaty

The treaty creating the European Atomic Energy Community (Euratom) was signed in 1957 and has led to the harmonised development of a strict oversight regime for nuclear safety (see Chapter 7) and radiation protection (see Chapter 3). In an order dated 10th December 2002 (Case. C-29/99 Commission of European Communities versus EU Council), the EU Court of Justice, ruling that no artificial boundary could be created between radiation protection and nuclear safety, recognised the principle of the existence of community competence in the field of safety, as in the field of management of radioactive waste and spent fuel. ASN actions are aimed at developing this new field of community competence, although of course not forgetting radiation protection activities.

2.3 European Nuclear Safety Regulators Group

ASN plays an active role in the work of ENSREG with the aim of reinforcing how nuclear safety and the safety of radioactive waste and spent fuel management are dealt with at a European level. Four working groups were created, devoted to the safety of installations, to the safe management of radioactive waste and of spent fuel, to transparency in the nuclear sector and to international cooperation (outside the European Union).

On 26th April 2012, one year after the Fukushima Daiichi NPP accident, a joint statement by ENSREG and the European Commission marked the end of the stress tests conducted on the European nuclear power plants (NPP). This statement emphasised the need to implement an overall action plan to make sure that these stress tests are followed by safety measure improvements, at the national level, and that these measures are implemented in a consistent manner.

This ENSREG overall action plan more specifically required that the nuclear safety regulator of each member country publish a national action plan by the end of 2012, with each of them being assessed during a seminar bringing together the safety regulators concerned. This seminar took place in April 2013. A further exercise to follow up the recommendations of the stress tests has been scheduled.

The safety regulators were thus urged to update their action plan by the end of 2014 in preparation for a European peer review that will end with a seminar organised by ENSREG in the spring of 2015.

ENSREG will also be organising the third edition of the Conference on Nuclear Safety in Europe in Brussels, on 29th and 30th June 2015. This conference presents the current safety picture in Europe.

2.4 The European directive on the safety of nuclear installations

The Council 2009/71/Euratom Directive of 25th June 2009 aims to establish a Community framework to ensure nuclear safety within the European Atomic Energy Community and to encourage the Member States to guarantee a high level of nuclear safety.

Since that date, the European Union has remedied the absence of European nuclear safety legislation, even though with the Euratom Treaty and for more than fifty years, the European Union has had one of the most advanced legislations in the nuclear field. The text also has the advantage of making its provisions binding through their transposition to the legislation of the twenty-eight Member States.

On 22nd July 2011, on the basis of existing acts and decrees, France complied with its obligations under this present directive.

As required by the 2009 directive, France sent the European Commission a first national report on the implementation of the present directive in late July 2014. The preparation of this national report was entrusted to ASN. In addition to ASN, this involved the main French administrations concerned, as well as the licensees of the nuclear facilities targeted by the present directive (in particular NPP reactors, fuel cycle facilities and research reactors).

Under the mandate given by the heads of State and Governments in March 2011, asking the European Commission to look at the necessary changes to the European safety legal framework following the Fukushima Daiichi accident, it stated that it intended to propose a revision of the 2009 directive and to involve ENSREG in this process in early 2013.

During the negotiations in Brussels, ASN issued an opinion expressing its satisfaction with the clear progress with respect to the existing Directive of 25th June 2009, applicable to the entire European Union.

ASN stressed the following points:
- strengthening the provisions concerning transparency and involvement of the public;
- definition of safety objectives for nuclear facilities, covering all steps in their operation and taking account of the conclusions of the last meeting of the contracting parties to the Nuclear Safety Convention;
- obligation to conduct ten-yearly safety reviews of the facilities, which is one of the recommendations to come out of the European stress tests conducted following the Fukushima Daiichi accident.

ASN however underlined the fact that the new European nuclear safety framework, which the European Council and Parliament wanted to see implemented, could only be a true success in the long run if this framework:
- avoids creating any ambiguity concerning responsibility for the oversight of nuclear safety;
- further reinforces the institutional independence of the safety regulators, over and above the functional separation, with these regulators more specifically being legally independent from the authorities in charge of energy policy;
- were to make provision for a joint mechanism in Europe for reviewing safety problems, under the responsibility of the safety regulators, with peer review and monitoring and with the results being made public;
- were to ensure the consistency of the measures taken by the Member States for managing a radiological emergency situation in Europe.

The revised European Union Directive was adopted on 8th July 2014 and took account of the vast majority of the text improvements pointed out by ASN. It makes provision for increased powers and independence of the national safety regulators, sets an ambitious safety objective for the entire Union (based on the baseline safety requirements used by WENRA) and establishes a European system of peer reviews on safety topics (fire risk and flooding for example). It also establishes national periodic safety assessments and provisions concerning preparedness for interventions in an emergency situation. It also reinforces the transparency requirements and provisions concerning education and training. During the negotiations, ASN endeavoured to promote France's position in favour of these measures, which significantly strengthen the Community's nuclear facilities safety oversight framework. However, European legislation does not yet enshrine in law the institutional independence of the safety regulators.

2.5 The European directive on the management of spent fuel and radioactive waste

On 19th July 2011, the Council of the European Union adopted a directive *"establishing a community framework for the responsible and safe management of spent fuel and radioactive waste"* (Directive 2011/70/Euratom). The adoption of this directive is a major event and one that helps strengthen nuclear safety within the European Union, by making the Member States more accountable for the management of their spent fuel and radioactive wastes.

This directive is legally binding and covers all aspects of the management of spent fuel and radioactive waste, from production up to long-term disposal. It recalls the prime responsibility of the producers and the ultimate responsibility of each Member State for ensuring the management of the waste produced on its territory, ensuring that the necessary steps are taken to guarantee a high level of safety and to protect the workers and the public from the dangers of ionising radiation.

It clearly defines obligations concerning the safe management of spent fuel and radioactive waste and requires each Member State to adopt a legal framework covering safety issues, stipulating:
- the creation of a competent regulatory authority with a status such as to guarantee its independence from the producers of waste;
- the definition of authorisation procedures involving authorisation requests examined on the basis of the safety cases required from the licensees.

The directive regulates the drafting of the national spent fuel and radioactive waste management policies to be implemented by each member State. It in particular specifies that each member State has to adopt a legislative and regulatory framework designed to implement national radioactive waste and spent fuel management programmes. The directive also contains provisions concerning transparency and participation of the public, the financial resources for management of spent fuel and radioactive waste, training, self-assessment obligations and regular peer reviews. It officially determines the ultimate responsibility of each member State for the management of its radioactive waste and specifies the possibilities with regard to export for disposal of this waste. These aspects constitute major advances in reinforcing the safety and accountability of spent fuel and radioactive waste management in the European Union.

2.6 The European "Basic Safety Standards" Directive

The new Euratom 2013/59 Directive, known as the BSS (Basic Safety Standards) Directive on basic radiation protection standards, was adopted by the Council of the European Union on 5th December 2013. The Member States have a period of 4 years in which to transpose this new Directive following its publication.

This directive takes account of the ICRP recommendations and brings the European framework into line with the IAEA's new basic standards.

In November 2013, with the agreement of the Government, ASN took the initiative of setting up the transposition committee for this new directive, for which it now acts as coordinator and technical secretary. The committee decided that its first working priority would be the legislative changes to be made to the Public Health Code (see Chapter 3).

2.7 The Euratom Treaty European working groups

ASN also participates in the work of the Euratom Treaty committees and working groups:
- Scientific and Technical Committee (STC);
- Article 31 experts group (basic radiation protection standards);
- Article 35 experts group (checking and monitoring radioactivity in the environment);
- Article 36 experts group (information concerning regulation of radioactivity in the environment);
- Article 37 experts group (notifications concerning radioactive effluent discharges).

Thus in 2014, the Article 31 experts group approved the following documents:
- European guidelines for a study aimed at collecting information on the collective doses linked to patient exposure to ionising radiation during medical imaging and at implementing the extension of the procedures stipulated in European radiation protection guide 154 published by the European Commission in 2008;
- European guidelines on ACCIRAD (Guidelines on a Risk Analysis of Accidental and Unintended Exposures in Radiotherapy).

The experts also discussed measures of use for supporting the transposition and implementation of the new radiation protection Basic Safety Standards Directive (BSS Directive).

Finally and again under the supervision of the Article 31 advisory committee, a seminar on 18th November 2014 in Luxembourg was devoted to the Fukushima Daiichi accident.

2.8 The Western European Nuclear Regulators Association (WENRA)

WENRA has since its creation followed clearly defined objectives:
- to provide the European Union with independent expertise for examining nuclear safety and regulatory issues in the countries applying for membership of the European Union. This first objective was successfully achieved on the occasion of the EU expansions of 2004 and 2007.
- to develop a common approach to nuclear safety and regulation, in particular within the European Union. Then to commit to transposing the jointly decided reference levels into the national regulations.

For this second objective, WENRA set up two working groups to harmonise the safety approaches, with a view to ensuring continuous improvement in the fields of:
- reactor safety (Reactor Harmonisation Working Group - RHWG).
- radioactive waste, the disposal of spent fuel, decommissioning (WGWD - Working Group on Radioactive Waste and Decommissioning).

In each of these fields, the groups defined the reference levels for each technical topic, based on the IAEA's most recent standards and on the most demanding approaches adopted within the European Union. In 2008, in addition to continuing the work already under way, WENRA initiated new work concerning safety objectives for new reactors (adopted in November 2010).

In 2014, after making a technical contribution to the specifications of the stress tests, WENRA reinforced the baseline safety requirements for new reactors and existing reactors, in order to take account of the lessons learned from the Fukushima Daiichi accident.

2.9 Association of the Heads of the European Radiological Protection Competent Authorities (HERCA)

The existence of a European regulatory base for radiation protection, leaving each country a certain freedom of movement in integrating European rules into their national legislation, has led to differing transpositions in this field.

ASN is convinced that if progress is to be made on harmonisation in Europe on the topic of radiation protection, close collaboration must be organised between the heads of European Authorities with competence for radiation protection. HERCA, the association of the Heads of European Radiological Protection Competent Authorities was created in 2007 for this purpose.

Five working groups are currently studying the following topics:
- workers and the dosimetric passport;
- justification and optimisation of the use of sources in the non-medical field;
- medical applications;
- preparation and management of emergency situations.
- veterinary applications.

A dedicated group was also set up in 2014 to analyse the role that HERCA could play in the transposition process for Directive 2013/59 (BSS) (see point 2.6).

On 11th and 12th June 2014, in Vilnius, the Lithuanian radiological safety regulator (RSC - Radiacines Saugos Centras) hosted the thirteenth meeting of the HERCA association. Forty representatives from 23 countries examined the results of the work done by the five HERCA working groups, in the presence of the European Commission acting in the capacity of observer. This meeting approved the following:
- an approach for improved transboundary coordination of protection measures during the first phase of a nuclear accident;
- an information document about lamps containing very small amounts of radioactive substances;
- a position statement on the use of portable dental radiography equipment;
- a position statement on the application of the justification principle for patient exposure in medical imaging diagnosis.

The 14th HERCA meeting was held in Stockholm, on 21st and 22nd October 2014. The heads of the authorities from 22 European countries attended (plus the European Commission in the capacity of observer). The conclusions of the group dedicated to the transposition of the BSS, were presented and approved.

UNDERSTAND

Actions to improve coordination of protection measures in the event of a nuclear accident

The Fukushima Daiichi accident had a major impact on the work being done by the various multilateral forums looking at the prevention and management of a nuclear emergency. HERCA thus developed an approach aiming to implement more coherent measures to protect the populations living in the vicinity of a nuclear facility if an accident were to occur in Europe, but also outside the European continent.

This approach was tested during an exercise in 2013 and was presented to the main forums, both European (2nd ENSREG conference, the Euratom Treaty Article 31 committee, etc.) and international (NEA, IAEA). This was then joined by WENRA in 2014 and is now known as the HERCA-WENRA approach.

It should also act as the basis for application of Article 99 of the new Euratom 2013/59 - BSS Directive on international cooperation in the preparedness for and management of emergency situations outside the damaged site.

In addition, HERCA and WENRA joined forces in January 2014 to create a joint working group which proposed "reflex" measures to be taken in the event of a severe accident in which the authorities would have very little information about the status of the facility affected (scenario similar to that of the accident which struck the Fukushima Daiichi NPP).

This group brought together 21 experts from the safety and radiation protection authorities of 14 different countries, under the chairmanship of ASN Commissioner Philippe Jamet. They reached a consensus on the positions presented to HERCA and WENRA on 22nd October 2014 at an extraordinary meeting held in Stockholm. The conclusions of this group are presented in Chapter 5 point 1.1.2 concerning radiological and post-accident situations.

Collaboration between HERCA and WENRA will continue in this field in 2015.

During this meeting, the following were approved for the medical field:
- a position statement with recommendations on the transposition and application of the provisions regarding medical justification in the new BSS Directive;
- a document on the importance of training and education in dose optimisation when using scanners for medical purposes.

HERCA also approved an action plan concerning its role in the transposition of the BSS Directive. These measures primarily concern the emergency situations and medical fields. Other measures concern radon, radiation protection education and training, or non-medical imaging.

Finally, in 2014, HERCA supported and took part in the joint initiative by ASN and the NRPA (Norwegian Radiation Protection Authority) to organise a workshop on radon action plans. A second workshop, organised on this topic by Switzerland, should take place in 2015 as part of the HERCA action plan on the transposition of the BSS Directive.

Finally, ASN also has an influence on the review work currently being carried out in Europe and, on 4th June 2014, hosted the annual meeting of the European Radioprotection Authority Network (ERPAN), which is different from HERCA and deals with its own working topics. This was an opportunity for ASN to present the work in progress concerning patient radiation protection training in France. ASN used this network to launch two surveys: one concerning interventional radiology, the other concerning the use of Lutetium in nuclear medicine units.

TO BE NOTED

Justi cation of medical imaging procedures: meeting between the European radiation protection authorities and the main stakeholders

On 26th September 2014, HERCA organised a multipartite meeting in Brussels on the topic of medical imaging procedures and the justification process. Twelve organisations took part in this meeting and welcomed the HERCA initiative, recognising the importance of the exposure justification principle. Each of these organisations undertook to contribute to improving the justification for medical imaging examinations, by identifying specific questions concerning the organisation of the various stakeholders. The purpose of these efforts is to avoid unnecessary procedures during which the patients would be subjected to unjustified exposure to ionising radiation.

HERCA concluded that the steps taken individually by the national radiation protection authorities, or in fact by any individual stakeholders, would only have limited results. By offering a platform for collaboration through multipartite meetings, HERCA aims to ensure that the steps taken or envisaged by the various contributors are transparent, compatible with each other and, preferably, complementary. When taken as a whole, they will cover all the identified requirements.

2.10 ASN participation in the Euratom 7th framework R&D programme

In 2014, ASN continued its involvement as a partner in the European SITEX and PREPARE projects, run as part of the Euratom 7th R&D Framework Programme (FP).

- SITEX (Sustainable Network for Independent Technical Expertise for Radioactive Waste Disposal): the main purpose of this two-year project is to develop a common view on the part of regulatory bodies and their technical support organisations concerning the process for appraising and authorising the creation and operation of a geological repository, in order to support the national programmes under way in several European countries. Another objective of SITEX is to initiate dialogue between the regulators and the "IGD-TP" agencies platform, devoted to the geological disposal of waste (Andra – the French national agency for radioactive waste management – is a member). ASN is represented on the SITEX programme by its Waste, Research facilities and Fuel Cycle facilities Department.
- PREPARE (Innovative Integrated Tools and Platforms for Radiological Emergency Preparedness and Post-Accident Response in Europe): this project, started in 2013 for a period of three years, concerns emergency situations and post-accident management in the field of the transport of radioactive substances. It is the subject of a European call for bids and brings together industry, various competent authorities and various research centres. ASN is represented in this project by the Transport and Sources Department.

2.11 Assistance programmes under the INSC

Following the collapse of the Soviet bloc, the Munich G7 summit in July 1992 defined three priority areas for assistance to the countries of eastern Europe in the field of nuclear safety:

- contribution to improving the operating safety of existing reactors;
- provision of funding for short-term improvements to the least safe reactors;
- improvement in the organisation of safety regulation, making a clear distinction between the responsibilities of the different entities concerned and reinforcing the role and competence of national nuclear regulatory bodies.

In this context, Europe rapidly set up nuclear safety cooperation instruments to ensure that the nuclear facilities in the former Eastern Bloc countries met the IAEA safety standards. There then followed a succession of instruments as the geographical coverage of this cooperation expanded. Since 2007, the Instrument for Nuclear Safety Cooperation (INSC) has been the tool used for all countries outside the European Union, even if geographical priority is given to the countries bordering the European Union.

The concrete assistance provided by ASN via the INSC primarily took the form of help to nuclear safety regulatory bodies. Thus in 2014, ASN took part in regulatory assistance projects in China, Ukraine, Vietnam and Morocco.

Regulation (Euratom) 237/2014 of the European Parliament and the Council, dated 13th December 2013, revised the instrument for nuclear safety cooperation for the period from 1st January 2014 to 31st December 2020 with a budget envelope of 225.3 million euros, owing to European budget restrictions (this envelope was 524 million euros between 2009 and 2013).

Moreover, regulation (EU) 236/2014 of the European Parliament and of the Council, dated 11th March 2014, laid out common rules and procedures for the implementation of the Union's instruments for financing external actions. The objectives of the new instrument include the goals of:

- supporting the promotion and implementation of stricter nuclear safety and radiation protection standards in nuclear facilities and of radiological practices in third-party countries;
- supporting the drafting and implementation of responsible strategies for ultimate disposal of spent fuel, for waste management, for decommissioning of facilities and for cleanout of former nuclear sites.

In order to improve the deployment of the INSC for the new period, the European Commission now consults ENSREG for the definition of the strategy to be adopted to support the third-party countries.

These actions are supplemented by other international technical assistance programmes, in accordance with resolutions adopted by the G8, or those run by IAEA, to improve nuclear safety in third party countries, and which are funded by contributions from donor States and the European Union.

3. MULTILATERAL INTERNATIONAL RELATIONS

3.1 International Atomic Energy Agency (IAEA)

International Atomic Energy Agency (IAEA) is a United Nations organisation based in Vienna. It comprises 162 Member States. The IAEA's activities are focused on two main areas: on the one hand, the control of nuclear materials and non-proliferation and, on the other, all activities related to the peaceful uses of nuclear energy. In this latter field, two IAEA departments are tasked on the one hand with developing and promoting applications of radioactivity, nuclear energy in particular, and on the other with the safety and security of nuclear facilities and activities.

In September 2011, the IAEA Board of Governors approved an action plan prepared by the agency's secretariat. The main aim of this plan is to reinforce safety worldwide, taking account of the first lessons learned from the Fukushima Daiichi accident. This plan identified 12 main actions, themselves comprising targeted measures implemented by the agency's secretariat and by the Member States.

These include reinforcing the IAEA's activities involved in maintaining a high level of nuclear safety (definition of safety standards, use of peer review instruments such as IRRS, OSART, revision of international Conventions on nuclear safety, accident notification and assistance to countries affected by an accident, etc.).

IAEA is focusing its work on the following fields:

- **Revision and consolidation of the safety standards,** describing the safety principles and practices that the vast majority of Member States use as the basis for their national regulations.

This activity is supervised by the Commission on Safety Standards (CSS) set up in 1996. The CSS consists of 24 highest level safety regulator representatives, appointed for four years and chaired since early 2012 by the Director General of the Czech regulatory body, Dana Drabova. In 2014, the CSS held its 35th and 36th meetings. ASN's deputy Director General, Jean-Luc Lachaume, was the French representative on this commission.

The CSS coordinates the activities of four committees tasked with supervising the drafting of documents in four areas: NUSSC (NUclear Safety Standards Committee) for installations safety, RASSC (RAdiation Safety Standards Committee) for radiation protection, TRANSSC (TRANsport Safety Standards Committee) for the safe transport of radioactive materials and WASSC (WAste Safety Standards Committee) for safe radioactive waste management. France, represented by ASN, is present on each of these committees, which meet twice a year. It should be noted that the ASN representative on the NUSSC, Fabien Féron, was appointed chairman of this committee in 2011 and that his three-year mandate was renewed in 2014. Representatives of the relevant French organisations also participate in the work of the technical groups drafting the documents.

In order to improve the incorporation of aspects relative to nuclear safety and security, a specific Nuclear Security Guidance Committee (NSGC) was created, similar to those which already exist for safety, with an official interface being set up between the "safety" and "security" committees. In the longer term, expansion of the scope of the CSS to "security" subjects which overlap the field of safety, is being envisaged.

- **The rise in the number of audit missions** requested from IAEA by the Member States and their increased effectiveness.

The IRRS and OSART missions belong to this category. These missions are performed using the IAEA safety standards as the reference, which confirms the international benchmark status of these standards.

ASN is in favour of holding these peer reviews on a regular basis, with widespread dissemination of their results. It is worth noting that, through the provisions of the 2009 European directive on the safety of nuclear facilities, the member countries of the European Union are already subject to periodic and mandatory peer reviews of their general nuclear safety arrangements.

The IRRS missions are devoted to analysing all safety aspects of the activities of a regulatory authority. In 2014, ASN took part in several IRRS missions, in Switzerland, Jordan, Cameroon and the Netherlands respectively, plus the follow-up mission to Slovenia.

ASN received an IRRS mission in 2006 (plus a mission to follow-up the recommendations of this initial review) and hosted a second one in France from 17th to 28th November 2014. On this occasion, twenty-nine auditors examined the French system of nuclear safety oversight.

The OSART missions are carried out by a team of experts from third party countries who, for two to three weeks, assess the safety organisation of the nuclear power plants in operation. The actual implementation of the recommendations and suggestions put forward by the team of experts is verified during a follow-up mission, 18 months after the visit by the experts. The 26th OSART mission to France (in other words one OSART mission per year) took place from 7th to 23rd October 2014, at the Flamanville nuclear power plant. As with the previous missions, the concluding report was published on www.asn.fr. The entire French NPP fleet has now undergone at least one OSART mission.

From 24th November to 9th December 2014, France also hosted a corporate OSART mission. This mission was performed at the request of ASN and its aim was to obtain an objective assessment of the operational safety of the entire fleet operated by EDF, paying particular attention to overall management by the licensee, the technical support provided to the various sites and internal safety oversight. This is the second mission of this type conducted by IAEA around the world.

- **Regional training and welcoming trainees.** ASN responds to other requests from the IAEA secretariat, for example to take part in regional radiation protection training, primarily for French-speaking countries. Two ASN representatives thus took part as trainers in a source security and safety regulation and monitoring course, held in Tunisia from 15th to 19th December 2014. Through the IAEA's grant and study trip programmes, ASN hosted an intern from the Romanian safety regulator for a week in April 2014.

- **Harmonisation of communication tools.** ASN remains closely involved in the work on the INES (International Nuclear and radiological Event Scale).

In order to contribute to the harmonisation of the use of the INES scale when communicating about an event, IAEA published guidelines in October 2014. These guidelines, which include lessons learned from the Fukushima Daiichi accident, also comprise an appendix which gives advice on how to use the INES scale in the event of an evolving severe accident.

In 2006, at France's request, a working group on the rating of radiation protection events involving patients was set up. This field is one that is not covered by the existing INES scale and in which France, thanks to the experience it has acquired with the ASN-SFRO scale, is closely involved.

In July 2012, a draft technical document was produced, proposing a method for rating radiation protection events involving patients that is consistent with the INES rating methodology. Starting in February 2013, this method was tested for eighteen months by a small group of countries. In October 2014, the consolidated methodology was presented to all the countries using the INES scale. The document will be made available to all the countries in early 2015 for an expanded test phase.

Generally speaking, ASN is closely involved in the various actions carried out by IAEA, providing significant support for certain initiatives, notably those which were developed following the Fukushima Daiichi accident. ASN will thus have taken part in three of the five working groups drawing up the full report on the Japanese accident, coordinated by the Agency's secretariat and which should be presented in 2015. Furthermore, ASN Commissioner Philippe Jamet took part in the group tasked with drafting said report.

Finally and still under the supervision of IAEA, ASN also participated in the RCF (Regulatory Cooperation Forum) chaired by Jean-Luc Lachaume. This forum aims to bring those safety regulators in countries adopting nuclear energy for the first time into contact with the safety regulators of the major nuclear countries, so that their needs can be identified and the required support can be coordinated, to ensure that fundamental nuclear safety objectives can be met (independence of the regulator, appropriate legal and regulatory framework, etc.).

3.2 OECD's Nuclear Energy Agency (NEA)

NEA, created in 1958, now counts 31 member countries from Europe, North America and the Asia-Pacific region. Its main role is to assist the member countries in maintaining and developing the scientific, technological and legal bases essential for safe, environmentally-friendly and economic utilisation of nuclear energy.

During the course of 2014, NEA continued its analysis of experience feedback from the Fukushima Daiichi accident, both through its working groups and at specific seminars. For example, NEA is currently working on organising an international seminar devoted to the topic of safety culture, scheduled for the spring of 2015. It will take account of the conclusions and recommendations of the report entitled "The Fukushima Daiichi Nuclear Power Plant Accident: OECD/NEA Nuclear Safety Response and Lessons Learnt", published in September 2013, summarising the steps taken by the member countries and defining working priorities for the coming years.

This report is available on the NEA website: *www.oecd-nea.org/pub/2013/7161-fukushima2013.pdf*

Within NEA, ASN takes part in the work of the Committee on Nuclear Regulatory Activities (CNRA), chaired since December 2012 by Jean-Christophe Niel, the ASN Director General, the Committee on Radiation Protection and Public Health (CRPPH), the Radioactive Waste Management Committee (RWMC), and other working groups of the Committee on the Safety of Nuclear Installations (CSNI).

In 2014, the CNRA supervised the work of these four working groups covering a variety of fields (Working

Group on Operating Experience, Working Group on Inspection Practises, Working Group on Public Communication and Working Group on the Regulation of New Reactors).

It also set up working groups specifically for the following topics:
- "Defence in depth": chaired by Jean-Luc Lachaume, ASN Deputy Director General. This group is currently drafting a specific green paper, scheduled for publication in the spring of 2015;
- "Safety culture": this group is looking at the safety culture characteristics within the safety regulators and will publish a specific green paper in the summer of 2015.

ASN also chairs a technical group devoted to inspection practices (WGIP – Working Group on Inspection Practices), which is in particular developing a programme of observation of inspections conducted in the various member countries. An inspection should thus be organised in France in the autumn of 2015.

The WGIP activities include the organisation of an international seminar in the United States from 7th to 10th April 2014 concerning inspection practices during reactor outages, reactive inspections and integration of the initial lessons learned from the Fukushima Daiichi accident with regard to the definition of inspection programmes.

More information about NEA/CNRA activities can be found at the following address:
www.oecd-nea.org/nsd/cnra/

3.3 The Multinational Reactor Design Evaluation Program

The MDEP (Multinational Design Evaluation Programme), created in 2006, is an international cooperative initiative to develop innovative approaches for pooling the resources and know-how of the regulatory bodies, which have responsibility for regulatory assessment of new reactors. The key goal of this programme is to contribute to the harmonisation and implementation of safety standards.

At the request of the regulatory bodies which are members of the MDEP, NEA is responsible for the technical secretariat of this programme. An ASN staff member is seconded to NEA to help with this task.

Members of the MDEP programme

2014 was marked by the official membership of the Turkish safety regulator (TAEK - *Türkiye Atom Enerjisi Kurumu*). TAEK thus joined the thirteen national safety regulators which are already members of this programme (AERB - India, ASN - France, CCSN - Canada, FANR - United Arab Emirates, NNR - South Africa, NNSA - China, NRA - Japan, NRC - United States, NSSC - South Korea, ONR - United Kingdom, RTN - Russian Federation, SSM - Sweden, STUK - Finland).

Organisation of the MDEP

The broad outlines of the work achieved within the MDEP are defined by its Strategy Committee and implemented by the Steering Technical Committee. This work is performed by working groups which meet periodically on specific projects; the Design Specific Working Groups (DSWG) for nuclear reactors and the Issue Specific Working Group (ISWG) for specific technical subjects.

The DSWG groups devoted to the EPR reactor (comprising the safety regulators of China, the United States, France, Finland, India, Sweden and the United Kingdom), to the AP1000 reactor (comprising the safety regulators of Canada, China, the United States, the United Kingdom and Sweden) and the APR1400 reactor (comprising the safety regulators of South Korea, the United Arab Emirates, United States and Finland), were supplemented in 2014 by a group devoted to the VVER reactor (in which the safety regulators of Finland, India, Russia and Turkey in particular take part) and a group devoted to the ABWR reactor (safety regulators of the United States, Finland, Japan, Sweden and the United Kingdom).

Three ISWG groups are working on harmonising the multinational inspection of nuclear component manufacturers (Vendor Inspection Cooperation Working Group - VICWG), on standards and codes for pressure vessel components (Codes and Standards Working Group - CSWG), and on design standards for digital I&C (Digital Instrumentation and Control Working Group - DICWG).

MDEP activities

In addition to the periodic meetings of the various working groups, the MDEP organised the 3rd conference on the evaluation of new reactor designs in Washington from 14th to 15th May 2014.

This conference, the closure session of which was chaired by the ASN Chairman Pierre-Franck Chevet, and Alison Macfarlane, chair of the American Nuclear Regulatory Commission (NRC) and President of the MDEP, attracted about 150 representatives of national safety regulators, international organisations (IAEA, WANO - World Association of Nuclear Operators, Nuclear Energy Institute, etc.) and industrial firms from the nuclear sector in seventeen countries. This conference enabled the safety regulators who are members of MDEP, including ASN, to present the progress of the work carried out under the programme and enabled industrial firms to review their activities, in particular those linked to the new reactors, as well as the actions and future development of the MDEP.

At its annual meeting, held in Washington in March 2014, the MDEP Strategy Committee validated the working programmes of the various technical groups for the coming years, which in particular include monitoring the start-up of the EPR and AP1000 reactors currently under construction around the world.

The MDEP's 2013 activity report was published in April 2014, providing information about the MDEP's work to the stakeholders, i.e. the regulatory authorities not participating in the MDEP, the nuclear sector industry and the general public.

The MDEP made sure to maintain its interaction with the nuclear industry by organising specific meetings with the designers and the CORDEL group - Cooperation in Reactor Design Evaluation and Licensing - of the World Nuclear Association (WNA).

3.4 International Nuclear Regulators' Association (INRA)

The International Nuclear Regulators' Association comprises the regulatory bodies from Germany, Canada, South Korea, Spain, the United States, France, Japan, the United Kingdom and Sweden. This association is a forum for regular and informal discussions concerning nuclear safety issues (each member presents its latest national news and its positions on international issues). It meets twice a year in the country holding the presidency, with each country acting as president for one year in turn (Germany in 2014 and France in 2015).

In 2014, the association's work was marked in particular by a number of subjects:
- stabilisation of the situation on the Fukushima Daiichi site and post-accident management;
- preparation for the diplomatic conference in order to revise the Convention on Nuclear Safety;
- the use of international instruments (in particular the IRRS and OSART audits) made available by IAEA;
- the decommissioning of nuclear installations.

3.5 The Association of nuclear regulators of countries operating French designed nuclear power plants (FRAREG)

The FRAREG (FRAmatome REGulators) association was created in May 2000 at the inaugural meeting held in Cape Town at the invitation of the South African nuclear regulator. It comprises the nuclear safety regulators of South Africa, Belgium, China, South Korea and France.

Its goal is to facilitate transfer of operating experience gained from regulation of the reactors designed or built by the same supplier and to enable the nuclear regulators to compare the methods they use to handle generic problems and evaluate the level of safety of the Framatome type reactors they regulate.

The 7th meeting of the FRAREG association was held in France in 2013. The next is scheduled for 2015 in Belgium.

3.6 The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) was created in 1955. It examines all scientific data on radiation sources and the risks this radiation represents for the environment and for health. This activity is supervised by the annual meeting of the national representations of the Member States, comprising high-level experts, including two ASN Commissioners, Margot Tirmarche and Michel Bourguignon.

The UNSCEAR reports cover a variety of topics such as risks other than cancers, taking account of the uncertainty of the dose received and its impact on the incidence of cancers. An advisory committee was thus set up to study the exposure levels and the foreseeable effects for the general population and the workers caused by the accident in the Fukushima Daiichi NPP. This advisory committee presented its conclusions in October 2014.

3.7 The Committee on Radiation Protection and Public Health

From 21st to 23rd May 2014, ASN took part in the 72nd meeting of the NEA's CRPPH. This committee, which consists of radiation protection experts, is recognised worldwide and works in close cooperation with the other international organisations active in the field of radiation protection (ICRP, IAEA, European Commission, World Health Organisation (WHO), UNSCEAR).

More information about NEA/CRPPH activities can be found at the following address:
www.oecd-nea.org/rp/crpph.html

3.8 The International Commission on Radiological Protection (ICRP)

The ICRP is a Non-Governmental Organisation (NGO) created in 1928 for the purpose of assessing the state of knowledge on the effects of radiation in order to identify their implications with regard to the radiological protection rules to be adopted. The ICRP analyses the results of the research work carried out around the world and examines the work of other international organisations, such as in particular that of UNSCEAR. It issues general recommendations on the protection rules and exposure levels not to be exceeded, intended more particularly for the regulatory bodies.

Margot Tirmarche and Michel Bourguignon were appointed to the International Commission on Radiological Protection in 2013. Margot Tirmarche is also a member of the "Radiation Effects" Committee, while Michel Bourguignon is a member of the "Protection in Medicine" Committee.

In 2014, ASN hosted two meetings of the ICRP: from 1st to 3rd September, the meeting of Committee 3 on Protection in Medicine and, from 30th June to 3rd July, a meeting of the working group on the health effects of exposure to alpha emitters, more specifically plutonium and uranium.

4. INTERNATIONAL AGREEMENTS

ASN acts as the national point of contact for the two conventions dealing specifically with nuclear safety (the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent fuel Management and on the Safety of Radioactive Waste Management). ASN is also the competent authority for the two conventions dedicated to the operational management of the possible consequences of accidents (the Convention on the Early Notification of a Nuclear Accident and the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency).

4.1 The Convention on Nuclear Safety

The Convention on Nuclear Safety is one of the results of international discussions initiated in 1992 in order to contribute to maintaining a high level of nuclear safety worldwide. This convention sets a certain number of safety objectives and defines appropriate measures for achieving them. France signed it on 20th September 1994, the date on which it was opened for signature at the IAEA General Conference, and approved it on 13th September 1995. The Convention on Nuclear Safety came into force on 24th October 1996. As at 31st December 2014, it had been ratified by 77 States.

ASN considers this convention to be a major tool in reinforcing nuclear safety. The areas covered by the convention have long been part of the French approach to nuclear safety.

The convention makes provision for review meetings by the contracting parties every three years, to develop cooperation and the exchange of experience. Several months before the review meeting is held, each contracting party is required to submit a national report describing how it intends to meet the obligations of the convention. This report is then subjected to a peer review ahead of the review meeting, which involves the contracting parties asking questions about foreign national reports and answering questions about their own. During the meeting, the contracting parties present their national reports and take part in discussions, which can then raise additional questions. A summary report, drawn up by the meeting chairman and made public, presents the progress achieved and any difficulties that subsist.

In France, ASN acts as the national point of contact for the Convention on Nuclear Safety. It coordinates all the preparatory phases prior to the review meetings, in close collaboration with the entities concerned. ASN also devotes considerable resources to participation in the review meetings, so that it is present at the various presentations and discussions.

Since 1999, six review meetings of the Convention on Nuclear Safety have been held. The sixth review meeting was held from 24th March to 4th April 2014 at the IAEA headquarters in Vienna. André-Claude Lacoste, ASN Chairman until 2012, chaired this three-yearly meeting, attended by 69 of the 77 "contracting parties" to the convention.

This review meeting comprised two parts. During the first week, each contracting party presented its national report. That of France was presented on 27th March 2014 by Jean-Christophe Niel. An intervention by EDF's general inspector for nuclear safety and radiation protection, Jean Tandonnet, gave the licensee's viewpoint on a certain number of subjects. The main salient points and issues for nuclear safety in France were identified and validated by the participants after a question-and-answer session. This primarily concerned maintaining the level of competence (human and financial resources) at the licensees' and regulators', the operating life of the NPPs, or the periodic safety reviews.

During the second week, traditionally set aside for plenary session discussions, the contracting parties approved the revision of the convention guides (result of the work done by the working group set up following the extraordinary meeting of the Convention on Nuclear Safety in August 2012).

The contracting parties also voted in favour of organising a diplomatic conference (held on 9th February 2015) to review a proposal by the Swiss Confederation to amend the text of the convention. This amendment aims to strengthen the convention by incorporating more ambitious safety objectives for the future reactors and using these same objectives as the benchmark for improving the safety of existing reactors as far as is reasonably achievable. It should be noted that the Member States of the European Union unanimously supported the organisation of this conference.

Three years after the accident in the Fukushima Daiichi NPP, this meeting was also an opportunity to review the steps taken by the contracting parties to integrate the lessons learned from this event. While considering that the steps taken in each country have led to an overall improvement in the safety of nuclear facilities, the contracting parties recalled the importance of continuing to take account of experience feedback from this accident.

Finally, several subjects of common interest were identified during the discussions, such as the harmonisation of emergency plans and intervention measures in the various countries, building on the results of the peer reviews and strengthening international cooperation. They could be the subject of a specific review at the next meeting of the contracting parties in 2017.

Sixth CNS review meeting at IAEA - Vienna, from 24th March to 4th April 2014. Foreground: Philippe Jamet, ASN Commissioner and Marion Paradas, Ambassador, France's permanent representative to the United Nations Office and international organisations in Vienna.

4.2 The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management

The "Joint Convention" as it is often called, is the equivalent of the Convention on Nuclear Safety (CNS) for management of the spent fuel and radioactive waste produced by civil nuclear activities. France signed it on 29th September 1997 and it entered into force on 18th June 2001. As at 31st December 2014, there were 69 contracting parties.

The French proposal to set up a mechanism for comparing the review rules for the Joint Convention and those for the Convention on Nuclear Safety, to ensure that they are consistent, was adopted and put into practice. Furthermore, at the proposal of the United States, additional meetings designed to ensure follow-up between the review meetings will be organised. An interim meeting was held in April 2013, to continue to examine how to improve the review process.

The fifth review meeting of the Joint Convention will take place on 11th May 2015 and Philippe Jamet will be vice-chairman.

In the run-up to this meeting, ASN is coordinating the preparation and submission of France's national report in 2014.

4.3 The Convention on Early Notification of a Nuclear Accident

The Convention on Early Notification of a Nuclear Accident came into force on 27th October 1986, six months after the Chernobyl accident. It had 117 contracting parties as at 31st December 2014.

The contracting parties agree to inform the international community as rapidly as possible of any accident leading to uncontrolled release into the environment of radioactive material likely to affect a neighbouring State. A system of communication between the States is thus coordinated by IAEA. Exercises are periodically organised between the contracting parties.

4.4 The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency

The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency came into force on 26th February 1987. As at 31st December 2014, there were 111 contracting parties.

Its purpose is to facilitate cooperation between countries if one of them were to be affected by an accident with radiological consequences. This convention has already been used on several occasions for irradiation accidents due to abandoned radioactive sources. Within this context, France's specialised services have notably already taken charge of treating victims of such accidents.

4.5 Other conventions linked to nuclear safety and radiation protection

Other international conventions, the scope of which does not fall within the remit of ASN, may be linked to nuclear safety.

Of particular relevance is the Convention on the Physical Protection of Nuclear Material, the purpose of which is to reinforce protection against malicious acts and against misappropriation of nuclear materials. The convention came into force on 8th February 1987. It had 145 contracting parties in 2014.

Additional information on these conventions may be obtained from the IAEA's website: *www-ns.iaea.org/conventions/*

5. BILATERAL RELATIONS

ASN collaborates with numerous countries through bilateral agreements, which can take the form of governmental agreements (such as with Germany, Belgium, Luxembourg and Switzerland) or administrative arrangements between ASN and its counterparts (about twenty). ASN intends to share its best practices and conversely to understand the methods used elsewhere in the approach to safety. The activities of ASN and its counterparts vary according to the safety and radiation protection topics which emerge nationally (legislation, safety topics, incidents, inspection approach, etc.).

5.1 Staff exchanges between ASN and its foreign counterparts

Better understanding how foreign nuclear safety and radiation protection regulators actually function is a way to learn pertinent lessons for the working of ASN itself and enhancing staff training. One way to achieve this goal is to develop the staff exchange system.

Provision is made for several types of exchange:
- very short term actions (a few days) are a means of offering our counterparts a chance to take part in peer-observation of inspections and nuclear and radiological emergency exercises. In 2014, more than forty inspection peer-observations in the field of nuclear safety and radiation protection were organised. ASN inspectors observed the performance of inspections in nuclear power plants, notably in Belgium, South Korea, the United States, Finland and Switzerland, while foreign inspectors (Belgian,

Swedish and Swiss) took part in inspections in French NPPs. Numerous inspection peer-observations also concerned radiation protection in the medical and industrial sectors, notably in Belgium, Switzerland and France. Moreover, fifteen experts from safety regulators took part in emergency exercises in France in 2014 as observers;
- short-term assignments (2 weeks to 6 months) aimed at studying a specific technical topic;
- long-term exchanges (about one to three years) for immersion in the working of foreign nuclear safety and radiation protection regulators. Whenever possible, this type of exchange should be reciprocal.

For many years, ASN and the ONR (Office for Nuclear Regulation) have engaged in long-term staff exchanges. Since April 2013, ASN's Waste Facilities, Research Facilities and Fuel Cycle Department has hosted an inspector from the United Kingdom's Office for Nuclear Regulation (ONR). The mission of this inspector, initially scheduled to last two years, concerns fuel cycle facilities and more specifically their maintenance and ageing. Conversely, since June 2014, an ASN staff member has been seconded to ONR, to join the Sellafield programme for a period of three years. This programme is one with major implications for the ONR in the coming years, in some respects very similar to those being encountered in France with the fuel reprocessing facilities (for example La Hague).

An ASN engineer has been seconded to the Spanish safety regulator (CSN - Consejo de Seguridad Nuclear) since February 2014, working in the division responsible for radiological emergencies.

In August 2013, the secondment of an ASN staff member to the American safety regulator began for a period of three years. He is more specifically working in the field of social, human and organisational factors. ASN and NRC are currently preparing the secondment of a member of the American regulator to France, for a period of one year, as of the first quarter of 2015.

Staff exchanges are also organised with international organisations. For instance, a member of ASN has been working at IAEA since autumn 2010, in the team tasked with organising Integrated Regulatory Review Service (IRRS) assignments. Finally, ASN is seconding two of its staff to NEA, on the one hand to contribute to the work of the MDEP technical secretariat and, on the other, to assist the safety department.

These staff exchanges or secondments are a means of enhancing ASN practices. The experience, acquired over nearly ten years now, indicates that inspector exchange programmes make a significant contribution to stimulating bilateral relations between nuclear safety and radiation protection regulators.

It is also worth underlining the appointment of representatives of foreign safety regulatory bodies to the Advisory Committees of Experts. ASN has adopted this practice, which enables experts from other countries not only to take part in these advisory committees, but also occasionally to act as Chair or Deputy Chair. The participation of experts from European countries in the advisory committees devoted to the stress tests also confirms ASN's openness to the expertise and critical eye of foreign experts.

5.2 Bilateral cooperation between ASN and its foreign counterparts

Bilateral relations between ASN and its foreign counterparts are built around an approach that integrates nuclear safety and radiation protection for each of the countries with which ASN maintains relations. The following can be offered as examples:

Emergency exercise in Koeberg (South Africa).

South Africa

2014 confirmed the renewal of technical exchanges between ASN and its South African counterpart, the National Nuclear Regulator (NNR).

The annual bilateral meeting was held in June 2014 in Cape Town. It discussed the post-Fukushima Daiichi measures taken by the safety regulators, ten-yearly inspections, radioactive waste management, and the production of radiopharmaceutical isotopes.

In October 2014, two ASN staff members were invited to observe the emergency exercise held at the Koeberg NPP, which comprises two nuclear reactors.

In addition, numerous separate discussions took place on the sidelines of the multilateral meetings to cover subjects such as ASN's use of a technical support organisation, or the question of steam generator renewal.

Germany

The 4th Franco-German Commission for nuclear facility safety issues *(Deutsche-Französische Kommission für Fragen der Sicherheit kerntechnischer Einrichtungen* - DFK) was held in May 2014 in Bonn. This annual meeting enabled the two delegations to present topical matters related to nuclear safety and radiation protection, as well as the annual reviews concerning the safety of the Fessenheim and Cattenom NPPs in France and Neckarwestheim and Philippsburg in Germany.

The representatives of the four thematic working groups set up by the DFK also presented their work.

Belgium

ASN enjoys long-standing and regular relations with its Belgian counterpart, AFCN (Federal agency for nuclear regulation), and Bel V, its technical support organisation, on a variety of subjects (power and research reactors, cyclotrons, radiation protection in particular in the medical field, radon, transport, etc.).

In addition to the periodic meetings to discuss the safety of nuclear facilities (two meetings a year) and transport (one meeting a year), three AFCN inspectors met ASN from 15th to 19th May 2014 to discuss the oversight of the construction of research reactors and were able to observe an inspection carried out on the RJH reactor construction site at CEA Cadarache. At the invitation of AFCN, ASN's Lille division also took part in a roundtable on industrial radiography held in Belgium on 23rd October 2014 and, at the request of AFCN, two ASN inspectors took part in an inspection on the site of the IRE (national radionuclides institute) in Fleurus, Belgium, on 23rd October 2014.

As in previous years, several cross-inspections were organised with ASN's Belgian counterparts, whether on the topic of NPPs or in the field of small-scale nuclear activities.

The annual meeting of the Franco-Belgian steering committee, co-chaired by Pierre-Franck Chevet and Jan Bens, Director General of AFCN, was held on 24th January 2014. The Belgian delegation visited the facilities of the CEA Saclay centre the previous day.

China

ASN and its Chinese counterpart, NNSA (National Nuclear Safety Administration), renewed their overall nuclear safety and radiation protection cooperation agreement in 2014, expanding the scope of this agreement to include radioactive waste management and fuel cycle facilities. The specific cooperation agreement on the EPR was also extended by five years.

Commissioner Philippe Jamet also went to China to take part in the ceremonies to celebrate the 30th anniversary of NNSA. On this occasion, a bilateral meeting with Vice-Minister Li Ganjie was an opportunity to review current and future actions.

The ASN Lyon division has also enjoyed close relations with the NNSA's Guangdong division for several years (see Chapter 8).

Under the Instrument for Nuclear Safety Cooperation, the European Commission issued a call for bids to support China in its move to improve its nuclear safety regulatory framework. ASN set up a consortium comprising the nuclear safety regulators from Spain (CSN) and Finland (STUK - *Säteilyturvakeskus*), plus the technical support organisations from France (IRSN), Germany (GRS - *Gesellschaft für Anlagen und Reaktorsicherheit)* and Belgium (Bel V), in order to respond to this call for bids from the European Commission.

The kick-off meeting took place in Beijing on 26th and 27th February 2014. This programme comprises six areas for work: firstly, the aim is to support NNSA and its technical support organisation the NSC (Nuclear Safety Center) in their NPP reactor authorisation assessment procedures. The second goal is to help them perform these assessments in complete independence from the operator. The other areas for work are: improving the evaluation procedures for new technologies (of particular importance because China is currently building new reactors), flood protection in the NPPs and the development of operating experience feedback analysis. Finally, the aim will be to reinforce the safety culture at our counterparts.

South Korea

A delegation of inspectors from ASN's Bordeaux division went to South Korea in September 2014 as part of an inspector exchange programme initiated in 2013. The meeting with the inspectors from the Kori regional office of the Korean safety regulator, the NSSC (Nuclear Safety and Security Commission), concerned inspection practices during reactor outages and ageing management practices. This mission was also an opportunity to hold meetings with the NSSC divisions in Seoul and visit the facilities of the KINS (Korea Institute of Nuclear Safety) in particular the premises of the international nuclear safety school and those of the radiological emergency centre.

The ASN and NSSC delegations fully intend to continue with this type of exchange in the coming years. The Bordeaux division has also established cooperative arrangements with the NSSC over the past two years (see Chapter 8 giving a regional round-up of nuclear safety and radiation protection).

The United Arab Emirates

In 2014, within the framework of bilateral cooperation with the safety regulator of the Emirates (FANR - Federal Authority for Nuclear Regulation):
- ASN welcomed a member of staff from the FANR on 27th May, to take part in a Flamanville emergency exercise as an observer;
- ASN welcomed an FANR delegation on 18th and 19th September, for discussions concerning transparency and public communication.

Furthermore, on the sidelines of the IAEA General Conference, on 16th September 2014, an ASN delegation led by Commissioner Philippe Jamet, met William D. Travers, Director General of the FANR, to review cooperation between the two entities.

Spain

In 2014, the technical divisions of the two entities discussed a number of topics, including:
- taking part in emergency exercises,
- exchanges of best practices in the field of radiotherapy in France and Spain.

A respective presentation of the risk analysis tools and the ways and means of applying these tools was given in Madrid in December 2014. On this occasion, ASN was able to take part in a meeting on 10th December with all the radiotherapy centres, the aim of which was to review experience feedback on the implementation by the centres of the risk assessment approaches.

The next meeting of the steering committee of the two safety regulators is scheduled for March 2015.

United States

2014 was marked by the presentation by Jean-Christophe Niel at a public meeting of the American Nuclear Regulatory Commission in NRC headquarters on 31st July. At the request of the NRC, Jean-Christophe Niel presented the main steps taken in France to take account of the experience feedback from the accident which occurred in the Fukushima Daiichi NPP.

In 2014, the two regulators maintained a high level of cooperation covering a number of topics. The following should in particular be mentioned:
- on 13th and 14th March, an ASN staff member took part in a workshop held at the headquarters of the American regulator on integration of the flooding risk;

Public meeting of the NRC Committee on post-Fukushima Daiichi measures.

Presentation by Jean-Christophe Niel, ASN Director General. NRC headquarters (Washington), 31st July 2014.

ASN-NRC steering committee, from left to right: John Hopkins, Senior Project Manager (NRC), Philippe Jamet, ASN Commissioner, Mark Satorius, Executive Director for Operations (NRC), Jean-Christophe Niel, ASN Director General and Jean-Luc Lachaume, ASN Deputy Director General - Montrouge, 28th May 2014.

- from 9th to 12th September, a delegation comprising three ASN staff members went to the United States to discuss the environmental monitoring inspection practices of the two regulators and to observe an inspection on the site of the Peach Bottom NPP (Pennsylvania);
- in April and September, in France, ASN met NRC experts in charge of monitoring fuel cycle facilities and managing the back-end of the fuel cycle;
- from 14th to 18th July, in the United States, an ASN staff member also met representatives of the Environmental Protection Agency (EPA) to discuss the topic of polluted sites and soils.

These actions are coordinated by the steering committee, co-chaired by Jean-Christophe Niel and Marc Satorius, his American counterpart. The last meeting was held at ASN headquarters in May 2014.

The chairs of the two regulatory bodies, Pierre-Franck Chevet and Alison Macfarlane also met on several occasions during international conferences, more specifically during the RIC (Regulatory Information Conference) in March 2014 and at the conference held in May 2014 by the MDEP.

The Russian Federation

Under the terms of the bilateral cooperation between the Russian safety regulator Rostekhnadzor (RTN) and ASN, an action protocol was decided on in 2011. The following measures were taken in 2014:

- a delegation of staff from ASN and EDF, led by Jean-Christophe Niel, went to Moscow on 15th and 16th July to continue to share the lessons learned from the stress tests performed on the NPPs in France and Russia. The Russian delegation comprised representatives of RTN and the operator, Rosenergoatom (REA). This was the third quadripartite meeting on this subject. The discussions were frank and open and compared the practices in the two countries. The actions identified in the two countries, in the aftermath of Fukushima Daiichi, are currently being implemented;
- on the occasion of the above-mentioned quadripartite seminar, a bilateral meeting was held between RTN and ASN. On 15th July, ASN took part in the emergency exercise at the Kola NPP. An emergency exercise was held on 16th December 2014 in the Melox plant, involving staff from ASN and RTN. Furthermore, in order to plan the outlines of the bilateral cooperation programme for 2015 and 2016, a working programme was discussed, concerning on the one hand cross-inspections in the medical and research reactors fields and, on the other, exchanges regarding NPP decommissioning.

In addition, during the IAEA general conference, on 16th September 2014, Pierre-Franck Chevet and Alexiev Aleshin (recently appointed Director of RTN) met for the first time. They expressed their desire to continue and indeed build further on this cooperation. Among the subjects tackled, they expressed an interest in devoting a Franco-Russian seminar to “BNI shutdown and decommissioning” operations. This is an issue with which the two authorities will shortly be faced.

Finland

There has been longstanding cooperation between ASN and its Finnish counterpart STUK, especially in the area of the management of waste and of spent fuel. But cooperation has been significantly enhanced in recent years owing to the construction of an EPR type reactor at the Finnish site of Olkiluoto (see chapter 12 point 2.12.3).

Japan

Under the arrangements between ASN and its Japanese counterpart, the NRA (Japan's Nuclear Regulation Authority), a bilateral steering committee meeting was held in Tokyo on 1st and 2nd October 2014. The delegation led by Philippe Jamet met the NRA Chairman Shunishi Tanaka, and several other commissioners, including Satoru Tanaka who took up his post in September 2014. The particularly warm exchanges notably concerned the measures linked to the restart of Japan's reactors and the situation on the site of the Fukushima Daiichi NPP, the monitoring of implementation of "post-Fukushima" measures in France and the handling of component ageing. This meeting was followed by a visit to the damaged Tepco plant in Fukushima Daiichi.

Since 2010, the ASN Lyon division has maintained regular relations with the Japanese safety regulator, NRA, and its technical support organisation, JNES (Japan Nuclear Energy Safety Organisation – see Chapter 8).

Norway

A meeting between ASN and NRPA was held in Montrouge in 2014, under the cooperation agreement signed by ASN and NRPA in December 2011.

This meeting was an opportunity to finalise the details concerning the organisation of a radon workshop from 30th September to 2nd October (see Chapter 9). In the field of the response to emergency situations, an early notification agreement in the case of an accident was signed by the two authorities. The draft protocol was tested during an emergency exercise concerning the La Hague waste reprocessing site in May 2014.

Netherlands

At the initiative of the Dutch safety regulator (KFD - *KernFysische Dienst),* a tripartite ASN-KFD-AFCN meeting was organised in The Hague in September 2014. The ASN Lille division is closely involved in ASN cooperation with the KFD (see Chapter 8).

United Kingdom

ASN and the British Office for Nuclear Regulation (ONR) have cooperated for many years and the arrangement has been enhanced and improved over time. In September 2013, a new cooperation and information exchange agreement was signed by ASN and the ONR. This agreement was supplemented in September 2014 by a cooperation protocol to more precisely define the nature of the cooperative work between the two entities and to define a certain number of working groups for improved oversight of the work performed jointly. For example, with regard to the post-Fukushima actions, ASN and the ONR expressed an interest in examining the steps taken by the licensees of the La Hague and Sellafield facilities (see Chapter 13).

Sweden

Under the cooperation and information exchange agreement signed by ASN and its Swedish counterpart, the SSM *(Strål Säkerhets Myndigheten)* in September 2013, the ASN Orleans division welcomed an SSM delegation in October 2014 (see Chapter 8) to enable the Swedish inspectors to examine the post-Fukushima Daiichi measures taken on the Dampierre site.

Switzerland

ASN enjoys long-standing and regular relations with its Swiss counterpart, the IFSN (Federal nuclear safety inspectorate) on a variety of subjects (safety of nuclear facilities, radiation protection in the medical field, preparedness for and management of emergency situations, transport, etc.).

In addition to periodic meetings on transport and preparedness for emergency situations, the two

Visit by ASN and the Swiss safety regulator to the Bugey NPP, September 2014.

authorities met in Switzerland on 24th March to discuss the regulations in force regarding legionella in NPP cooling systems and ASN met the Federal office for public health on 8th and 9th July to discuss the terms of the Radium Diagnostic Operation.

The 25th annual meeting of the Franco-Swiss nuclear safety and radiation protection committee, co-chaired by Pierre-Franck Chevet and Hans Wanner, Director General of the IFSN, was held on 4th September 2014 in Lyon. The decision was more specifically taken to initiate exchanges on the monitoring of geological disposal sites and to work on organising staff exchanges.

The meeting was followed by a visit to the Bugey NPP, during which the organisation of the FARN (nuclear rapid intervention force) was presented.

Ukraine

Throughout the year 2014, ASN assisted the Ukrainian safety regulator (SNRIU - State Nuclear Regulatory Inspectorate of Ukraine) through the INSC. ASN notably helped SNRIU and its technical support organisation to develop a programme of inspections involving safety indicators.

In 2013, during a visit by the ASN delegation headed by Commissioner Philippe Jamet, several areas for work were defined, such as: ASN support for the project aiming to position the safety regulator institutionally in Ukraine, support for analysis of the safety file concerning the construction of a fuel fabrication plant, discussions on protection of the populations against radon risks and finally on post-accident management in order to enable ASN to benefit from experience feedback from management of the Chernobyl accident. However, owing to the political crisis in Ukraine and changes in the management at SNRIU, this programme will need to be updated in 2015.

5.3 ASN bilateral assistance

In 2014, at their request, ASN had contacts with several safety regulators in countries looking to find out about the safety measures to be implemented (creation of a nuclear safety regulatory and oversight infrastructure).

In line with its policy, ASN responds to these requests as part of its bilateral actions with the safety regulator of the country concerned, in addition to instruments that are either European (EU Instrument for Nuclear Safety Cooperation - INSC) or international (IAEA's Regulatory Cooperation Forum - RCF). The purpose of this cooperation is to enable the beneficiary countries to acquire the safety and transparency culture that is essential for a national system of nuclear safety and radiation protection oversight. Nuclear safety oversight must be based on national competence and ASN consequently only provides support for the establishment of an adequate national framework and advises the national safety regulator, which must retain full responsibility for its oversight of the nuclear facilities. It pays particular attention to countries acquiring technologies of which it has experience in France. This approach is that which was adopted by the growth and activity bill, subject to confirmation when it is adopted in 2015.

ASN considers that developing an appropriate safety infrastructure takes at least fifteen years before operating a nuclear power reactor can begin in good conditions. For these countries, the goal is to set up a legislative framework and an independent and competent safety regulator with the financial and human resources it needs to perform its duties and to develop capacity in terms of safety, safety culture and oversight of radiological emergency management.

In 2014, ASN had contacts with the following safety regulators:

Poland

A bilateral meeting took place in Paris between ASN and its Polish counterpart, the PAA (*Panstwowa Agencja Atomistyki* or National Atomic Energy Agency) on 4th July 2014. On the occasion of this meeting, various safety topics were discussed: the steps in the power reactor operations licensing process, cooperation policy with the safety regulator technical support organisations, the policy of public communication and transparency.

Turkey

ASN signed a cooperation agreement with the Turkish safety regulator TAEK on 27th January 2014 and a first bilateral meeting was held on 22nd May 2014 in order to organise the cooperation between the two authorities and take account of the requests from TAEK, more specifically concerning the safety assessment of an ATMEA type reactor, the construction of which is being envisaged for the Sinop site on the shores of the Black Sea.

Pierre-Franck Chevet met his counterpart during the IAEA General Conference on 15th September 2014, in order to continue with the exchanges between the two authorities and establish a cooperation programme for 2015.

TABLE OF AREAS OF COMPETENCE of the main civil nuclear activity regulating authorities*

COUNTRY/ SAFETY AUTHORITY	STATUS			ACTIVITIES						
	ADMINIS-TRATION	GOVERNMENT AGENCY	INDEPENDENT AGENCY	SAFETY OF CIVIL INSTALLATIONS	RADIATION PROTECTION			SECURITY (PROTECTION AGAINST VANDALISM AND MALICIOUS ACTS)		TRANSPORT SAFETY
					BNI	OTHER INSTALLATIONS	PATIENTS	SOURCES	NUCLEAR MATERIALS	
EUROPE										
Germany/ BMU + Länder	•			•	•	•	•	•	•	•
Belgium/ AFCN		•		•	•	•	•	•	•	•
Spain/CSN			•	•	•	•	•	•	•	•
Finland/ STUK		•		•	•	•	•	•	•	•
France/ASN			•	•	•	•	•	•***		•
United Kingdom/ ONR		•		•	•			•	•	•
Sweden/SSM		•		•	•	•	•	•	•	•
Switzerland/ ENSI			•	•	•				•	•
OTHER COUNTRIES										
Canada/CCSN			•	•	•	•	•	•	•	•
China/NNSA	•			•	•	•		•	•	•
South Korea/ NSSC		•		•	•	•			•	•
United Sates/ NRC			•	•	•	•	•	•	•	•**
India/AERB		•		•	•	•	•	•	•	•
Japan/NRA	•		•	•	•	•	•	•	•	
Russia/ Rostekhnadzor	•	•		•	•			•	•	•
Ukraine/ SNRIU	•	•		•	•	•		•	•	•

** Schematic, simplified representation of the main areas of competence of the entities (administration, independent agencies within government or independent agencies outside government) responsible for regulating nuclear activities in the world's nuclear countries.*
*** National transports only.*
**** Currently being allocated.*

Vietnam

In 2014, ASN ran an assistance programme in Vietnam through the Instrument for Nuclear Safety Cooperation (INSC), in order to develop its safety, safety culture and monitoring capacity. This assistance project, which started in 2012, is scheduled to last for three years, ending in 2015.

ASN is also involved in assistance to Vietnam via the RCF, the forum for exchanges between safety regulators, created under the aegis of IAEA. In this context, a meeting was held on 10th April 2014 in Brussels, with a view to facilitating the sharing of experience between regulators and rationalising the assistance given to those countries looking to develop nuclear energy.

6. OUTLOOK

In 2015, ASN will be aiming to promote WENRA safety objectives for new and existing reactors, internationally.

ASN will continue its work to develop the European approach to radiation protection. Both at a European and international level, ASN will continue its involvement in radiation protection and will continue to put across its message concerning the need to limit patient doses in medical imaging and to optimise doses in general. It will remain active on the subject of radon and will discuss its practices in this respect with its counterparts.

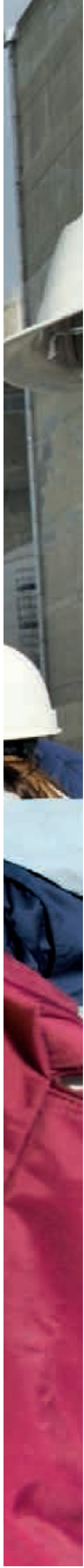
Following on from the lessons to be learned from the Fukushima Daiichi accident, a review has been initiated on the European approach to the prevention and management of a nuclear accident. The approach proposed by HERCA and WENRA is promising, as underlined by the numerous positive references in the "ENCO" report, published by the Commission in May 2014, on the subject of European coordination of emergency situations. WENRA and HERCA succeeded in defining a number of joint key principles which should enable decisions to be harmonised and resources to be shared in the case of a nuclear accident on a scale such as that at Fukushima Daiichi. This approach constitutes the basis for a European approach to preparedness for emergency situations.

Internationally and over and above considerations regarding the technical specifications linked to the Fukushima Daiichi accident (protection against external hazards, reinforced reactor containment integrity, consideration of social, organisational and human factors – SOHF, etc.), ASN will continue to disseminate the following messages:
- there is a before and after Fukushima Daiichi. At least ten years will be needed before we have learned all the lessons from the Fukushima Daiichi accident and understood all the technical and SOHF implications;
- we must combat the tendency of Governments to minimise what happened in Fukushima Daiichi and the conclusions that need to be drawn for their own situation.

In 2015, ASN aims to focus primarily on several events:
- the 5th review meeting of the Joint Convention will be a key date in the international safety calendar and will demand extensive mobilisation on the part of ASN;
- ASN has already coordinated the update of France's national action plan, produced further to the ENSREG recommendations following the stress tests (2011-2012) and will take part in the second peer review of the national plans, scheduled from 20th March to 2nd April 2015;
- as during the 2011 and 2013 editions, ASN will play an active part in preparing and organising the third ENSREG safety conference on 29th and 30th June 2015;
- in addition to these events, ASN will be maintaining its day to day policy of international cooperation and will continue with its "structural" relations with other safety regulators, taking the form of cross-inspections, internships and personnel exchanges.

08
REGIONAL OVERVIEW OF NUCLEAR SAFETY AND RADIATION PROTECTION

THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION:



Asn has 11 regional divisions through which it carries out its regulatory responsibilities nationwide and in the Overseas France and Territorial Communities.

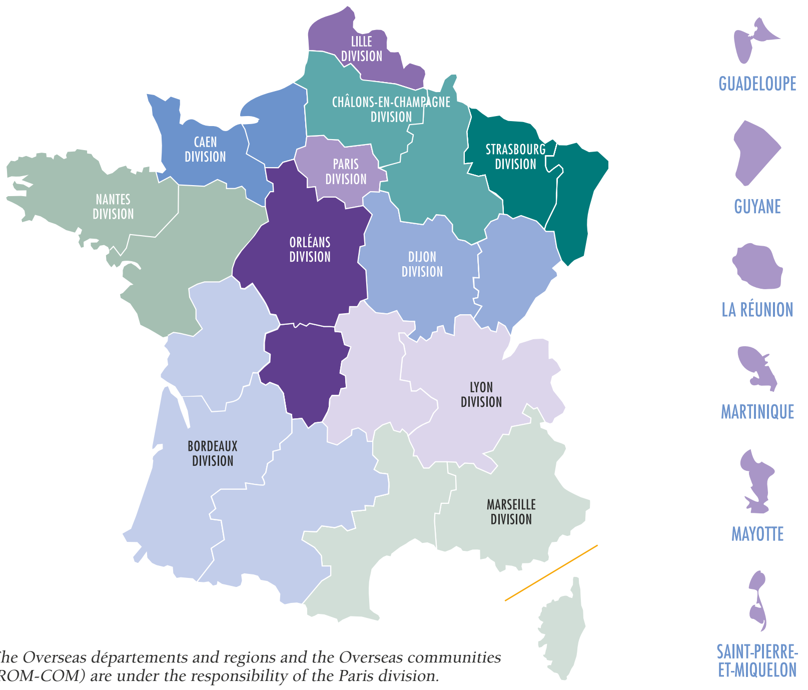
The activities of the ASN regional divisions are carried out under the authority of the regional ASN representatives (see chapter 2 - point2.3.2).

The ASN divisions carry out direct inspections on the Basic Nuclear Installations (BNIs), on radioactive substances transport and on small-scale nuclear activities and investigate most of the licensing applications submitted to ASN by the nuclear activity licensees within their regions. The divisions check application within these installations of the regulations relative to nuclear safety and radiation protection, to pressure equipment and to installations classified on environmental protection grounds (ICPEs). They ensure the labour inspection in the nuclear power plants.

In radiological emergency situations, the divisions assist the Prefect[1] of the *département*, who is responsible for protection of the public, and check the measures taken on the site by the licensee to make the installation safe. To ensure preparedness for these situations, they take part in preparing the emergency plans drafted by the Prefects and in periodic exercises.

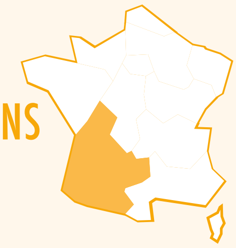
The ASN divisions contribute to the public information duty. They for example take part in the meetings of the Local Information Committees (CLIs) of the BNIs, and maintain regular relations with the local media, elected officials, associations, licensees and local administrations. The purpose of this chapter is, in addition to ASN's overall assessment of nuclear safety and radiation protection for each major activity and main licensee, to present an assessment of the situation observed by the ASN divisions. Each section addresses the nuclear safety and radiation protection aspects of the nuclear facilities on the sites in a particular region. It also provides insight into the local issues and identifies certain initiatives that are particularly representative of ASN's regional action, particularly in terms of communication and cross-border relations.

THE REGIONAL ORGANISATION of ASN



** The Overseas départements and regions and the Overseas communities (DROM-COM) are under the responsibility of the Paris division.*

1. *Government representative at local* (département) *level.*



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE AQUITAINE, POITOU-CHARENTES AND MIDI-PYRÉNÉES REGIONS REGULATED BY **THE BORDEAUX DIVISION**

The Bordeaux division is responsible for regulating nuclear safety, radiation protection and the transport of radioactive substances in the 17 *département*s of the Aquitaine, Poitou-Charentes and Midi-Pyrénées regions.

As at 31st December 2014, the workforce of the Bordeaux division stood at 22 officers: 1 regional head, 2 deputy heads, 15 inspectors and 4 administrative officers, under the authority of the ASN regional representative.

The activities and installations to regulate in Aquitaine, Poitou-Charentes and Midi-Pyrénées comprise:

- the Blayais NPP (4 reactors of 900 MWe);
- the Civaux NPP (2 reactors of 1,450 MWe);
- the Golfech NPP (2 reactors of 1,300 MWe);
- 23 external radiotherapy departments;
- 10 brachytherapy departments;
- 26 nuclear medicine departments;
- 150 interventional radiology departments;
- 150 tomography devices;
- about 6,900 medical and dental diagnostic radiology devices;
- about 1,500 veterinary diagnostic radiology devices;
- 32 industrial radiology companies;
- 600 industrial and research equipment items.

In 2014, ASN carried out 179 inspections in the Aquitaine, Poitou-Charentes and Midi-Pyrénées regions, comprising 59 inspections in the area of nuclear safety in the Blayais, Civaux and Golfech NPPs, 7 inspections in the transport of radioactive substances and 113 inspections in small-scale nuclear activities.

ASN carried out 38 days of labour inspections in the nuclear power plants.

Ten events rated level 1 on the INES scale were notified by the nuclear installation licensees in these regions in 2014. In the small-scale nuclear activities in these regions, 2 significant events of level 2 and 5 significant events of level 1 on the INES scale were notified to ASN. Moreover, ASN reclassified at level 2 on the INES scale 1 event that had been rated level 1 in 2103. Added to these are the events concerning radiotherapy patients, which included 2 events rated level 2 on the ASN-SRFO scale and 12 events rated level 1.

Within the framework of their oversight duties in south-west France, the ASN inspectors issued one violation report.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Blayais nuclear power plant

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Blayais NPP is, on the whole, in line with its general assessment of EDF's performance.

ASN noted the smooth running of the four reactor outages, including the 10-year outage of reactor 3 which is still in progress. It nevertheless considers that improvements are required in the management of the dynamic and static containment of radioactive substances. ASN considers that the integrity of the first barrier is satisfactory on the whole. It considers nevertheless that the site must make progress in the utilisation of the equipment that contributes to its responsiveness.

As in 2013, ASN noted deviations in the field of maintenance. Failures were discovered during the preparation of maintenance operations and during equipment requalification phases following their maintenance, caused in particular by incomplete or incorrect operational documentation.

With regard to environmental protection, ASN notes the plant's rigorous monitoring of the chemical and radiochemical status of the environment of the installation. It does nevertheless consider that progress must be made to limit refrigerant leaks.

With regard to radiation protection, ASN notes the good dosimetric results obtained during the 10-year outage with replacement of the steam generators of reactor 2 which ended in mid-February 2014. It does however consider that the site must remain vigilant regarding the activities with potentially high dosimetric consequences which formed the subject of several significant radiation protection event notifications in 2014.

Civaux nuclear power plant

ASN considers that the nuclear safety and environmental protection performance of the Civaux NPP is on the whole in line with ASN's general assessment of EDF and that the site's radiation protection performance stands out positively with respect to the said general assessment.

Although operating rigour has improved compared with the previous year, ASN notes that certain operating and maintenance activities have led to inappropriate actions caused by work preparation deficiencies, notably during the restarting of reactor 1 following its scheduled outage for maintenance and refuelling. Similarly, improvements are required in spare parts management to avoid the postponement of maintenance operations.

In the area of radiation protection, ASN notes satisfactory implementation of radiation protection rules on the work sites and efforts made with regard to collective dosimetry management.

In the area of the environment protection, ASN considers the organisation defined and implemented by the site for the control of risks associated with the proliferation of legionella and amoebae to be satisfactory. The site must nevertheless remain vigilant regarding the checks and the means it implements to ensure the integrity of the systems that contribute to environmental protection.

Golfech nuclear power plant

ASN considers that the nuclear safety and environmental protection performance of the Golfech NPP is on the whole in line with ASN's general assessment of EDF and that the site's radiation protection performance stands out positively with respect to the said general assessment.

Compared with 2013, ASN notes a distinct deterioration in the surveillance by the control room teams and numerous deviations in application of the operational control baseline requirements for the installations.

The year 2014 was marked by a particularly busy schedule of maintenance operations. The scheduled shutdown for the 10-year outage of reactor 2 went smoothly on the whole, particularly regarding the requalification operations of the main primary system and of the reactor building containment. The scheduled outage of reactor 1 was extended due to unforeseen events, but also because of deficiencies in maintenance and operation. ASN considers that on the whole the site must improve its tracking of maintenance operations, in both their preparation and their monitoring, and in particular those operations carried out by outside contractors using their own maintenance documentation. Improvements are also required in the recording of deviations.

With regard to radiation protection, the site maintains satisfactory results in collective dosimetry and radiological cleanliness of the installations.

With regard to environmental protection, an action plan to improve the condition of the demineralisation station is required. The site must also remedy the deviations in the servicing or operating control of certain equipment items which have led to accidental spillages of hazardous substances within its facilities.

Labour inspection in the nuclear power plants

ASN has conducted inspections on the activities involving an asbestos risk, particularly during maintenance periods in reactor outages. Several failures to meet regulatory obligations were observed. The labour inspectors also conducted inspections on the regulatory verifications of the facilities and work equipment and continued the actions begun in 2013 on the lifting equipment. The corrective action plans established by the licensees are still to be carried through to completion. Lastly, inquiries were carried out when workplace accidents occurred.

1.2 Radiation protection in the medical field

Radiotherapy

The inspection of the radiotherapy departments in 2014 continued to verify the application of the ASN resolution relating to the quality and safety of radiotherapy treatments. On completion of the fourteen inspections it carried out, ASN considers that in 2014 the treatment centres continued their efforts in the implementation of quality management systems. ASN nevertheless observed difficulties in carrying out and keeping up to date the analysis of the potential risks for the patients.

ASN verified that the controls for which the radiotherapists and medical physicists are responsible at all stages in the treatment of patients undergoing external-beam radiotherapy are performed and correctly recorded. ASN has observed that these controls are on the whole implemented in the centres it inspected in 2014. ASN also focused on verifying the adequacy of the resources devoted to medical radiation physics, the relevance of the medical physics organisation plan and the performance of the quality controls. Its assessment of these areas is satisfactory on the whole.

ASN considers moreover that the occupational radiation protection measures are correctly applied in the radiotherapy departments.

Interventional radiology

ASN continued its inspections in the field of interventional radiology and the use of X-rays in the operating theatre. Seventeen centres were inspected on this theme in 2014. Preliminary explanations were given concerning the application of ASN resolution 2013-DC-0349 relative to the implementation of French standard NFC 15-160. With regard to patient radiation protection, ASN endeavoured to check the dispensing of training in patient radiation protection, the presence of radiographers and performance of the quality controls of the devices used.

With regard to occupational radiation protection, ASN systematically examined the means of worker dosimetric monitoring, performance of the technical radiation protection controls, performance of the work place analyses and the relevance of the zoning of the premises. As in 2013, ASN observes that operating theatre practitioners rarely comply with the regulations, particularly with regard to dosimetric and medical monitoring. An event rated level 2 on the INES scale was notified in 2014 concerning a practitioner's repeated exceeding of the maximum annual dose of 20 millisieverts set by the regulations.

Nuclear medicine

ASN continues to inspect each nuclear medicine department every three years. It maintains its positive assessment of the integration of the measures designed to ensure the patient and worker radiation protection.

ASN inspection in the nuclear medicine department of the Mont-de-Marsan hospital centre, May 2014.

Progress is nevertheless required in the management of radioactive effluents. One incident relating to the uncontrolled discharge of radioactive effluents into the public sewerage network was notified in 2014 and rated level 1 on the INES scale. Another incident notified in 2013 and rated level 1 on the INES scale was reclassified as level 2 in 2014 following a reassessment of the quantity of radionuclides discharged into the sewerage network. These two incidents highlight the poor control of the state of the effluent discharge systems and inadequate surveillance.

During its inspections, ASN also endeavoured to verify that the centres fulfilled the regulatory obligations concerning the transport of radioactive substances, particularly with regard to the package conformity verifications at reception and dispatch. ASN considers that the centres must make further progress in this respect.

Computed Tomography

In 2014, ASN inspected seven computed tomography centres, one of which using teleradiology. For five of the centres, ASN observed practices that were on the whole satisfactory with regard to worker and patient radiation protection and optimisation of doses delivered to patients. For the remaining two centres however, there is considerable room for improvement in the implementation of the regulatory radiation protection requirements.

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

ASN continues regular inspections of industrial radiology activities, which have major radiation protection implications.

During the eleven inspections it carried out in this sector in 2014, ASN observed progress on the areas of scheduling and performance of internal technical controls of radiation protection, the maintenance of industrial radiography devices and the conformity of protected bunkers dedicated to industrial radiography. The general organisation of personnel radiation protection, particularly with regard to training, dosimetric and medical monitoring of the personnel exposed to ionising radiation, remains satisfactory even if a few deviations are observed in these areas from time to time.

ASN considers however that the delimiting of the operation zone around industrial radiography work sites and the signalling of vehicles transporting radiology devices and the securing of these devices must be improved.

In addition, ASN observes disparities in worker preparedness for emergency situations. Two incidents involving jamming of a gamma radiography source occurred in south-west France in 2014 and were notified to ASN. The first took place on 11th June in Pau (Pyrénées-Atlantique *département*). The poor management of this incident led to a worker being exposed beyond the regulatory limits. The second incident occurred on 31st October 2014 in Vielle-Saint-Girons (Landes *département*). It was managed correctly and did not result in abnormal exposure of the personnel (see chapter 10).

ASN notes that the overall volume of work-site gamma radiography services dropped in south-west France in 2014 and that several local service providers have decided to stop this activity. ASN moreover authorised the commissioning of two additional protected bunkers in 2014. ASN considers that the contractors continue to make excessive use of on-site gamma radiography services instead of having the examinations performed in protected bunkers, which are still too few in number.

Universities and research centres

ASN considers that the research laboratories on the whole comply with the radiation protection requirements concerning training and the dosimetric and medical monitoring of personnel exposed to ionising radiation. Furthermore, the radiation doses received by the workers remain at a very low level.

Nevertheless, the laboratories must improve their internal technical controls of radiation protection and their management of radioactive sources and contaminated waste.

ASN has endeavoured to verify that the universities meet their commitments, especially Toulouse University with regard to the disposal of expired sources and contaminated waste. Some progress has been noted but the actions engaged must continue in 2015.

Veterinary

In 2014, ASN continued its administrative regularisation campaign in south-west France with the equine veterinary clinics in possession of mobile diagnostic radiology machines. The possession and use of these devices is subject to licensing under the Public Health Code and many clinics did not hold this license, granted by ASN. The majority of the veterinary clinics have now regularised their situation.

At the end of 2014, ASN presented the results of this campaign to the Regional Councils of the Order of Veterinary Surgeons and in 2015 it will continue its collaboration with them in the regularisation of veterinary surgeons who are subject to declaration.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

ASN carried out nine inspections concerning the transport of radioactive substances by NPPs and small-scale nuclear activity licensees in south-west France in 2014. It also examined the transport activity when performing inspections at other users of radioactive sources.

In the area of small-scale nuclear activities, ASN observes that the measures for managing radioactive substance transport operations are incomplete. A dedicated management system still has to be put in place. The training of the personnel involved must be increased. The process for verifying the conformity of packages before shipment or on reception must be improved. The security protocols required by the regulations to govern the loading and unloading of radioactive substance packages are too rarely drawn up.

ASN observes that on the whole, the radioactive substance reception and shipment process in the NPPs is well managed. However, the training of the personnel concerned must be improved. The provisions relative to the transport of hazardous goods within site boundaries provided for by the Ministerial Order of 7th February 2012 setting out the general rules relative to basic nuclear installations have been partially deployed and must be consolidated in 2015.

2. ADDITIONAL INFORMATION

2.1 International action

In 2014, a delegation of inspectors from the Bordeaux division travelled to South Korea for a week of informal discussions with the South-Korean safety authority (NSSC - Nuclear Safety and Security Commission) and its technical support organisation (KINS - Korean Institute of Nuclear Safety). The ASN inspectors accompanied their counterparts during an inspection conducted at the Kori NPP (in the south of the country). They had the opportunity to exchange views on the inspection practices and methods, transparency and communication with the public, and emergency situation preparedness and management.

2.2 Informing the public

Press conferences

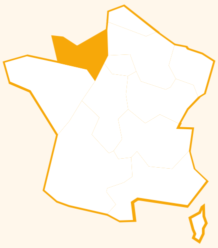
ASN held press conferences in Toulouse on 4th June 2014 and in Bordeaux on 10th June 2014 to present the state of nuclear safety and radiation protection in the Aquitaine, Poitou-Charentes and Midi-Pyrénées regions.

Work with the CLIs

The Bordeaux division supported the work of the three CLIs in south-west France by participating in their annual general meetings and several technical committee meetings.

The CLIs sent observers who attended several inspections carried out by ASN's Bordeaux division.

The Golfech CLI in particular was involved in the inspections carried out during the second 10-year outage of reactor 2 of the Golfech NPP.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE BASSE AND HAUTE-NORMANDIE REGIONS REGULATED BY **THE CAEN DIVISION**

The Caen division regulates nuclear safety, radiation protection and the transport of radioactive substances in the five *départements* of the Basse and Haute-Normandie regions. The Caen division also regulates the Brennilis NPP in the Bretagne region, which is undergoing decommissioning.

As at 31st December 2014, the workforce of the Caen division stood at 25 officers: 1 regional head, 3 deputy heads, 17 inspectors and 4 administrative officers, under the authority of the ASN regional representative.

The regulated activities and facilities in Normandie and Bretagne comprise:

- the EDF NPPs at Flamanville (2 reactors of 1,300 MWe), Paluel (4 reactors of 1,300 MWe) and Penly (2 reactors of 1,300 MWe);
- the Flamanville 3 EPR reactor construction site;
- the Areva NC spent nuclear fuel reprocessing plant at La Hague;
- the Andra Manche repository;
- Ganil National Large Heavy Ion Accelerator (Caen);
- the Brennilis NPP (Finistère *département*) undergoing decommissioning;
- 8 radiotherapy centres (21 machines);
- 3 brachytherapy departments;
- 11 nuclear medicine departments;
- 62 computed tomography departments;
- 35 interventional radiology departments;
- 750 medical diagnostic radiology devices;
- 1,400 dental diagnostic radiology devices;
- 18 industrial radiography companies;
- 250 industrial and research devices (including a cyclotron for the production of radionuclides);
- 6 head offices and 19 agencies of organisations approved for radiation protection controls.

ASN carried out 145 inspections of nuclear facilities in Normandie and Bretagne in 2014:
- 64 inspections on fuel cycle and research facilities, and facilities undergoing decommissioning, including the Areva NC site at La Hague, the Manche repository, the Ganil and the Brennilis NPP undergoing decommissioning;
- 60 inspections in the EDF nuclear power plants in operation at Flamanville, Paluel and Penly;
- 21 inspections of EDF on the construction site of the Flamanville 3 EPR reactor.

In addition, 77 days of labour inspection were carried out on the NPPs and the Flamanville 3 site.

ASN also carried out 57 inspections in small-scale nuclear activities in Normandie in 2014.

Nineteen events rated level 11 on the INES scale were notified by nuclear installation licensees of the Normandie and Bretagne regions in 2014. In addition, 8 events rated level 1 on the ASN-SFRO scale were notified by the heads of radiotherapy departments in the Normandie region. The inspections conducted in 2014 by ASN resulted in 3 violation reports being drawn up and submitted to the competent public prosecutors.

1. ASSESSMENT BY DOMAIN

1.1 Nuclear installations

Areva NC plant at La Hague

ASN considers that the situation of the Areva NC plants in La Hague is satisfactory with regard to nuclear safety, personnel exposure and compliance with the limits of discharges into the environment.

ASN considers that the projects to recover the legacy waste stored on the site must be a priority for the licensee. In 2014, ASN supplemented the regulatory framework governing these projects by a resolution specifying the deadlines for the various operations and the conditions for providing periodic information on their progress. ASN notes that Areva NC was unable to continue the vitrification of type UMo fission products in 2014 owing to delays in the installation of a new specific vitrification crucible. In 2014, as part of the follow-up to a compliance notice issued in March 2013, ASN checked the execution of the work to reinforce the monitoring of the environment in the vicinity of silo 130 and to install systems for mitigating the consequences of a potential leak from this silo. As a general rule, ASN will remain attentive to the continuation of Areva NC's legacy waste recovery projects which, after successive delays, should now run to the prescribed schedules.

Substantial decommissioning operations were started in the UP2-400 plant in 2014. ASN draws the attention of Areva NC to the necessary rigour in keeping the decommissioning framework requirements up to date and in the operational management of the waste in the units concerned. In 2014, Areva NC completed the disassembly of the old equipment situated above the HAO silo and undertook the construction of the unit intended for the recovery of the legacy waste stored in this silo. In a resolution dated 2nd December 2014, ASN complemented the requirements concerning the content of the complete decommissioning application files for BNIs 33 and 38 expected in 2015, and set additional prescriptions relative to the safety of the decommissioning operations of the three BNIs of the UP2-400 plant.

ASN noticed serious shortcomings in the application of the regulations applicable to nuclear pressure equipment on the site, which had led it to issue a compliance notice in 2013. ASN notes that the licensee has deployed substantial means to meet the regulatory requirements, but that the work started must be continued. In September 2013, ASN authorised the partial commissioning of an extension of the site's vitrified waste storage facilities. Further extensions are already being considered to supplement these storage capacities in the years to come.

ASN has undertaken a revision of the prescriptions regulating the La Hague site's water intakes and discharges. The revision project submitted for consultation in 2014 basically consists in maintaining the prescriptions of the orders in effect while taking into consideration the future upgrading of the site's steam plant and reinforcing the applicable regulatory requirements following entry into effect of the order of 7th February 2012. Areva NC moreover submitted two applications in September 2014 leading to considering the modification of prescriptions regulating the site's discharges of krypton-85 and those relating to the decommissioning operations.

ASN notes a lowering of Areva NC's targets for deployment of the "pre-job briefing" in 2014, which consists in having the workers identify the points requiring particular attention a few minutes before carrying out the operations. ASN considers that the pre-job briefing is a useful means of preventing the occurrence of certain deviations or events.

ASN observes a notable reduction in the number of significant events notified in 2014 but considers that given the nature of some of them, Areva NC must maintain its vigilance and exercise all necessary rigour in the experience feedback process.

Flamanville NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Flamanville NPP is, on the whole, in line with ASN's general assessment of EDF's performance.

In 2014, ASN observed an improvement in the site's integration of the EDF national documentation relative to equipment qualification in the light of the safety analyses, and this must be continued. ASN also considers that the site must continue to catch up a longstanding and substantial backlog of maintenance work.

With regard to reactor operation and control, ASN considers that the site's performance remains satisfactory on the whole but requires greater rigour in its activities, particularly the organising of the periodic equipment checks and the implementation of reliability-enhancing practices during the operational control operations. ASN also considers that prevention of the explosion risk on the gas storage yards must be improved.

The inspection of reactor outages in 2014 reveals occasional deviations in the quality of maintenance work, calling for reinforcing of work reliability and of the oversight of outside contractors.

With regard to radiation protection, in 2014 the site deployed the "EVEREST" project which significantly changes conditions of access to controlled areas.

During the outages of the two reactors, ASN observed that the overall radiological exposure of the workers was satisfactorily controlled.

ASN observes that the organisation set up by the site for environmental protection and waste management enables the corresponding requirements to be satisfied on the whole.

Paluel NPP

From 3rd to 7th November 2014, eight ASN inspectors conducted an in-depth inspection of the Paluel NPP to examine the preparation and operational management of the maintenance activities, in view of the third 10-year outage of reactor 2, which will take place in 2015.

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Paluel NPP is, on the whole, in line with ASN's general assessment of EDF's performance.

ASN considers that in 2014, the site confirmed its progress in the areas of reactor operation and management, in radiation protection and in control of the fire risk.

On the occasion of the in-depth inspection, ASN took positive note of the site's preparatory work for the large-scale maintenance operations planned in 2015, which results in particular in the deployment of EDF's computerised technical management system; ASN nevertheless noted that the site must significantly improve its integration of the results of the analyses carried out by the NPP's department tasked with performing an independent safety verification. ASN considers that the site must reinforce its safety culture and provide appropriate supervision of the less experienced workers, in a context of heavy demand on its resources to prepare the third 10-year outages which will run until 2018.

In 2014, the control of the maintenance operations during outages, which were of moderate scale, resulted in better compliance with the forecast reactor outage durations. ASN nevertheless considers that the monitoring of outside contractors and quality control of the maintenance operations still require vigilance, particularly in view of the deviations observed further to deficiencies in the performance of such operations.

With regard to environmental protection, ASN continues to detect leaks of refrigerant gases from equipment whose replacement is accounted for in a national EDF schedule. ASN considers that the management of the number of radioactive waste packages in the course of manufacture must be improved.

ASN inspection at the Paluel NPP, November 2014.

Penly NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Penly NPP is, on the whole, in line with its general assessment of EDF's performance.

The year 2014 was marked by the 10-year outages of reactor 2 and the intermediate maintenance outage of reactor 1 during which many maintenance operations were performed; the complete requalification of the main primary system of reactor 2 and the leak test of its containment were carried out successfully. ASN considers that the two outages ran satisfactorily, even if the monitoring of outside contractors during maintenance work requires significant improvement.

With regard to reactor management and operating rigour, ASN considers that the site's performance is satisfactory on the whole but showing a slight downward trend, as revealed by several significant events notified by the site. ASN considers that improvements are required in the preparation of operational activities and the implementing of reliability-enhancing practices, and that additional measures to maintain skills are necessary in a context where experienced employees are reaching the age of retirement.

With regard to radiation protection, ASN considers that the site's performance is satisfactory even if the occasional deviations observed require the teams to remain vigilant about the defined framework for each operation, the monitoring of radiation protection equipment and the control of access to controlled areas.

ASN considers that the site's environmental protection organisation can be further improved and that the corrective actions undertaken must be carried through to completion to ensure rigorous operation and maintenance of the systems for collecting and retaining liquid effluents, especially those containing tritium.

Labour inspection in the nuclear power plants

ASN continued its inspection actions concerning subcontracting, situations of illegal lending of labour, the working time of employees of EDF and of certain subcontractors and the conditions of health and safety during maintenance and construction work.

Particular attention was moreover paid to the working conditions of the workers. With regard to radiation protection, the inspectors checked deployment of the "EVEREST" project at Flamanville, which significantly changes conditions of access to controlled areas. The inspections carried out during interventions in hot environment at the beginning of the reactor shutdown periods revealed that the sites were insufficiently prepared, should a person suffer an accident in certain areas of difficult access.

Construction of the Flamanville 3 EPR reactor

After issue of the authorisation decree and the building permit, construction work began on the Flamanville 3 reactor in September 2007.

A predominant part of the activities in 2014 concerned mechanical assemblies, particularly the reactor primary circuit, the electrical installations and the performance of the commissioning tests (see chapter 12, point 3.3). With regard to civil engineering, the prestressing of the reactor building internal containment has begun. ASN carried out a specific inspection of these operations, and examined worker radiation protection, protection of the environment and preparation for reactor operation.

ASN considers that the organisation set up by EDF remains satisfactory on the whole, but with varying effectiveness in 2014 depending on the areas inspected.

With regard to the prestressing of the internal containment, which began in summer 2014, EDF informed ASN in July of two deviations that occurred during the first operations. EDF suspended the prestressing activities as a precautionary measure pending determination of the causes of the deviations and preparation of a corrective action plan. ASN carried out a first reactive inspection to check that EDF was identifying the root causes of the deviations encountered, then a second inspection when activities resumed in order to check that the identified corrective actions were properly implemented. ASN considers that the organisation set up by EDF at the start of the internal containment prestressing operations was insufficient, but that EDF responded appropriately when the deviations occurred and drew lessons from them as appropriate for the resumption of the activities.

On completion of the inspection of the first commissioning tests of the pumping station equipment, ASN notes that the process for defining the safety criteria to be verified during the commissioning tests has not be established at this stage and that consequently, EDF must repeat some of these tests in order to satisfy the applicable regulatory requirements. ASN nevertheless considers that the organisation set up by EDF for the preparation and performance of the start-up tests is satisfactory. ASN will remain attentive to the proper performance of the preliminary tests which shall be followed by the tests of all the reactor systems.

Given the reactor commissioning times announced by EDF, ASN continues to watch over the protection of the equipment already installed, which it considers satisfactory on the whole.

In anticipation of the future operation of the reactor, ASN was attentive to the development of the operating documentation in 2014. ASN considers that the organisation implemented by EDF in this area is satisfactory. ASN will reinforce its oversight in 2015 to ensure that the EDF entity tasked with the future operation of the Flamanville 3 reactor is suitably prepared.

ASN fulfils the labour inspection duties on the Flamanville 3 construction site. In 2014 the inspectors continued in particular to check that the companies working on the construction site complied with the provisions relative to the work equipment, including the machines used on the site.

The inspectors answered questions asked directly by the employees. ASN is also continuing its work on the conditions of secondment of foreign workers.

Andra's Manche repository

ASN considers that the state and the operation of the Manche repository are satisfactory and notes as a favourable step that the renovation work on the infiltration water collection network was carried out in 2014. ASN considers that Andra must continue its efforts to eliminate the infiltrations of water at the edge of the membrane intended to ensure the water-tightness of the storage volume. An interim review of the modifications to the repository cover is to be presented by 2015.

ASN also remains attentive to the steps taken by Andra to ensure control of the land, with the prospect of reducing the gradient of the embankments, particularly to the north and east of the repository.

ASN notes that Andra is continuing the tritium measurements using the methods of the study that began in 2012 with a view to obtaining a better understanding of the hydrogeological mechanisms involved. As concerns the maintaining of the repository memory, Andra must continue its work to prioritise the detailed data with a view to proposing a new version of the synthesis by 2016.

Ganil (National Large Heavy Ion Accelerator)

ASN considers that the Ganil licensee continues on the whole to satisfactorily manage the construction work of phase 1 of the Spiral 2 installation, for which the authorisation decree was published in 2012. The licensee must continue its operations monitoring, in accordance with the regulatory provisions.

In 2014 ASN completed the examination of the first periodic safety review of the installation since it was commissioned in 1983. At the end of this process, the licensee made several commitments to bring the installation into compliance with the applicable safety baseline requirements and the regulations in effect. An ASN resolution will govern this continuation of operation in 2015. ASN has inspected several technical improvements made to the existing Ganil facilities in the area of protection against the fire hazard. ASN considers that the licensee must still improve the actions taken to ensure compliance with the requirements of the order of 7th February 2012 and start implementing the action plan resulting from the periodic safety review.

ASN notes that Ganil has adapted its organisation to deal with these mobilising files concomitantly.

The Brennilis NPP undergoing decommissioning

ASN considers that in 2014, EDF continued the decommissioning operations authorised by Decree 2011-886 of 27th July 2011 on the Monts d'Arrée site under generally satisfactory conditions of safety.

ASN examined the treatment operations of the land situated around the former liquid effluent treatment plant. ASN also inspected the installation of the climatic protection and the containment chamber that will be used to allow the forthcoming demolition of the remaining civil engineering infrastructures of the former liquid effluent treatment plant.

ASN moreover inspected the decommissioning operations of the first heat exchangers consisting of eight cylinders situated in the reactor containment. The cutting-up operations entered into an industrial phase in 2014.

ASN considers that the site's organisation for radiation protection and the monitoring of outside contractors on the work sites are satisfactory. On the other hand, ASN considers that EDF must pay particular attention to the management of the liquid radioactive waste storage capacities in the site's storage facility.

1.2 Radiation protection in the medical field

Radiotherapy

In 2014, ASN started a new two-year inspection cycle covering all the radiotherapy departments in Normandie; an annual inspection is carried out in departments with identified points requiring particular vigilance. The inspections conducted in 2014 revealed the maintaining of a real process to improve the rigour, organisation and traceability of interventions and the implementation of management systems to ensure the quality and safety of treatments. Nevertheless, in spite of the increased staffing in the majority of the radiotherapy centres, a small number of the centres in Normandy still suffer staff shortages or instability, particularly concerning medical physicists and sometimes radiation oncologists. These difficulties hinder the progress initiatives and led ASN in 2013 to ask one of the centres concerned to take immediate corrective action. This centre was subject to tightened monitoring by ASN in 2014, revealing an improvement in the situation which must be continued and consolidated. Consequently, ASN will continue its tightened monitoring in 2015.

Interventional radiology

ASN has maintained its tightened inspections in the interventional radiology services. The activities in these facilities entail risks for both patients and workers, and these risks must be duly controlled. The inspections carried out revealed a contrasting situation and many areas for improvement, particularly with regard to the training and qualification of the staff using the equipment, equipment quality controls, staff personal protection equipment, medical monitoring of non-salaried workers (private practitioners in particular), or the optimisation of practices in this sector.

ASN notes that radiation protection is generally better integrated in the rooms dedicated to interventional radiology than in the operating theatres.

Nuclear medicine

In 2014, ASN inspected a quarter of the nuclear medicine departments in Normandie. The inspections revealed a satisfactory situation, although a few areas for improvement remain in the coordination of the prevention measures for outside contractors and taking account of radiation exposure of workers' extremities (hands).

Computed Tomography

ASN continued its inspections of computed tomography departments in 2014. In the light of these inspections, occupational radiation protection appears to be satisfactory in general. ASN considers that patient radiation protection measures are still somewhat variable and are often based on the use of the optimisation procedures specified by the machine manufacturers. The level of involvement of medical physicists varies from one department to another; increasing their involvement could help to optimise practices. The use of Magnetic Resonance Imaging (MRI) techniques when indicated as an alternative remains limited due to the low availability of MRI scanners.

1.3 Radiation protection in the industrial sector

Industrial radiology

The control of industrial radiology remains a priority for ASN, which carried out unannounced night-time inspections on work sites in 2014. Depending on the companies, these inspections brought to light a widely contrasting picture of the way the risk of worker exposure to ionising radiation is taken into account. Although work conditions are improving on the whole, ASN observes that some companies are having difficulty making progress.

ASN informed the public prosecutor of one unacceptable situation discovered during an unannounced night-time inspection.

At the same time, ASN continued, in collaboration with DIRECCTE (Regional Directorate for Enterprises, Competition, Consumption, Labour and Employment) of Haute-Normandie and CARSAT (Retirement and occupational health insurance fund) of Normandie, its promotion of good practices with the signatories of the charter of good practices in industrial radiography in Haute-Normandie. At present, some thirty companies, ordering customers and radiology companies have signed this charter.

Polluted sites and soils

In March 2013 work was undertaken jointly by Andra as part of its public service remit (see Chapter 16) and the EPF (Public Land-management Corporation) of Normandie to complete the decontamination and to rehabilitate the industrial site of Etablissements Bayard, situated in Saint-Nicolas d'Aliermont in the Seine-Maritime *département*. Etablissements Bayard was specialised in the production of pendulum clocks and alarm clocks between 1867 and 1989. From 1949 until the workshops closed in 1989, the site produced and used luminescent paint based first on radium-226, then on tritium. The traces of contamination that remained after the initial decontamination work carried out in the 1990's do not represent a risk for public health or the environment.

In 2014, ASN continued to assist DREAL (Regional Directorate of the Environment, Planning and Housing) of Haute-Normandie with operations tracking. ASN considers that the work went satisfactorily, particular with regard to the characterisation, sorting and interim storage of the waste on the site. Demonstration of compliance with the clean-out thresholds and production of a final mapping are prerequisites for the rehabilitation of the land as an open-air public space with car-parking areas.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

ASN considers that the regional consigners involved in the transport of radioactive substances are generally progressing in terms of safety. Nuclear medicine units, however, must further improve their integration of the requirements of the ADR regulations, particularly when re-shipping packages.

With regard to shipments of radioactive substances from BNIs in Normandie, ASN considers that on the whole the requirements specific to these operations are satisfied. During its NPP inspections, ASN nevertheless detected shortcomings in keeping the shipping files of gamma radiography devices up to date. ASN moreover reiterated the importance of the consignors complying with the requirements concerning the blocking and securing of the packages, particularly waste packages, and keeping evidence to demonstrate the quality of the measures taken.

In 2014, ASN continued checking the progressive implementation in the La Hague site facilities of the new regulatory requirements applicable to on-site transport operations.

2. ADDITIONAL INFORMATION

2.1 International action

Given that EPR reactors are being built on the sites of Olkiluoto in Finland and Flamanville in France, the ASN Caen division is participating in the close cooperation between ASN and STUK, the Finnish nuclear regulator.

In January and April 2014, ASN inspectors went to Olkiluoto to discuss work progress and the experience feedback acquired, particularly for the oversight of the containment leak-tightness test.

ASN also took part in a seminar organised by International Atomic Energy Agency (IAEA) in the United Arab Emirates to share the approaches implemented internationally for the development of the regulations and the oversight of the NPP commissioning tests.

ASN closely followed the OSART (Operational Safety Review Team) mission conducted by IAEA from 2nd to 23rd October to review the EDF activities concerning the reactors in operation at the Flamanville NPP; these review missions are carried out by contributors from foreign nuclear licensees.

Within the framework of the IRRS (Integrated Regulatory Review Service) peer review conducted by IAEA at ASN (see box on page 87), two IAEA experts observed the performance of an inspection on the La Hague site devoted to the implementation of optimisation of radiological exposure of workers.

2.2 Informing the public

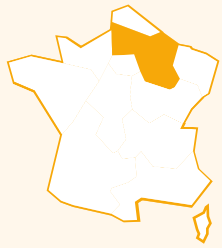
Press conferences

In 2014, ASN held three press conferences on the situation of nuclear safety and radiation protection, in Caen, Rouen and Rennes - the latter was organised jointly with the Nantes division.

Work with the CLIs

ASN took part in various annual general meetings of the CLIs of Normandie and Bretagne. ASN was informed of the decision taken by certain associations to no longer sit on the CLIs of La Hague, Flamanville and the Manche Repository after having suspended their participation since November 2013. At the annual general meetings of the CLIs, ASN presented more specifically its assessment of the safety of the nuclear installations concerned, its approach concerning the possible continuation of operation of the power reactors beyond their fourth periodic safety review, the prospects relating to the deep geological disposal of nuclear waste and the new regulations applicable to BNIs. ASN also presented the files for which the opinions of the CLIs had been requested and answered the questions raised by the CLIs. On invitation from ASN and with the agreement of EDF, a member of the Paluel-Penly CLIN (N standing for nuclear) attended the in-depth inspection of the Paluel site as an observer.

THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE PICARDIE AND CHAMPAGNE-ARDENNE REGIONS REGULATED BY THE **CHÂLONS-EN-CHAMPAGNE DIVISION**



The Châlons-en-Champagne division is responsible for regulating nuclear safety, radiation protection and the transport of radioactive substances in the seven *départements* of the Champagne-Ardenne and Picardie regions.

As at 31 December 2014, the workforce of the Châlons-en-Champagne division stood at thirteen officers: one regional head, two deputies to the regional head, eight inspectors and two administrative officers, under the authority of an ASN regional representative.

The activities and facilities to regulate in Champagne-Ardenne and Picardie comprise:

- the Chooz A NPP (currently being decommissioned);
- the Chooz B NPP (two reactors of 1,450 MWe);
- the Nogent-sur-Seine NPP (two reactors of 1,300 MWe);
- the low and intermediate-level short-lived radioactive waste repository (CSA) located at Soulaines-Dhuys in the Aube *département*;
- Andra's underground research laboratory in Bure, in preparation for the creation of a geological repository for high-and medium-level long-lived radioactive waste;
- 12 radiotherapy centres;
- 3 brachytherapy centres;
- 12 nuclear medicine centres;
- 57 tomography devices;
- about 55 interventional radiology departments;
- about 2,500 medical and dental diagnostic radiology devices;
- about 150 veterinary practices registered with ASN;
- about 300 licensed industrial activities, with more than half of the licenses being for possession of devices to detect lead in paint;
- about ten research laboratories, mainly situated in the universities of Champagne-Ardenne and Picardie.

In 2014, ASN carried out 114 inspections, of which 44 were in the nuclear facilities (EDF nuclear power plants, radioactive waste disposal facilities), 65 in small-scale nuclear activities and 5 in the transport of radioactive substances.

ASN also ensured 25 days of labour inspection in the nuclear power plants.

During 2014, seven significant events rated level 1 on the INES scale were notified by nuclear installation licensees. In the small-scale nuclear activities, 1 significant event of level 2 and 5 significant events of level 1 on the ASN-SFRO scale were notified to ASN.

The ASN inspectors issued one violation report and ASN served a compliance notice on the Nogent-sur-Seine NPP to bring its deviation processing system back into conformity.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Nogent-sur-Seine NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Nogent-sur-Seine NPP is, on the whole, in line with its general assessment of EDF performance.

The periodic test planning process must be reinforced. ASN effectively notes that the responsibilities of the persons involved, the planning aids and the documents used for this purpose warrant being improved.

ASN considers that the Nogent-sur-Seine site has made progress in the areas of in-service monitoring of the nuclear pressure equipment and maintenance. The reactor outages went more smoothly than in the preceding years. ASN nevertheless notes some shortcomings in the preparation of the activities, and occasional failures of the workers to take ownership of the documentation.

The risk control measures relating to fire are satisfactory on the whole, even if improvements can be made in the management, control and monitoring of the fuel storage areas.

ASN has observed an improvement in the deviation handling process after sending the compliance notice to the site on 16th January 2014. These efforts must be confirmed over the long term.

ASN noted good performance in radiation protection for the year 2014, partly linked to the relatively low intensity of maintenance activities.

Lastly, with regard to the environment, ASN notes the site's commitment to reducing its effluent volumes but a lack of robustness in its organisation to prevent uncontrolled chemical discharges into the environment and lateness in restoring the conformity of certain sumps for collecting potentially radioactive effluents.

Chooz NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Chooz NPP is in line with its general assessment of EDF performance.

ASN notes an increase in the number of significant safety events linked to management of the reactors. ASN still notes the persistence of system alignment and equipment padlocking errors as well as deficiencies in rigour in individual behaviour responses. ASN observes potential vulnerability in the renewal of skills of personnel responsible for the operation of the facilities.

ASN still notes difficulties in communication between departments in the treatment of jobs and deviations requiring multidisciplinary skills. Increased attention should be paid to the analysis of the safety impact of the deviations or anomalies on the facilities.

ASN notes that the measures intended to guarantee a good level of radiological cleanliness during maintenance activities can also by improved.

Lastly, ASN considers that the environmental performance of the Chooz site is in line with its general assessment of EDF. The licensee has integrated the lessons learned from the discharges of sulphuric acid into the river Meuse. Nevertheless, the preparation and oversight of the activities that mobilise the equipment useful for protection of the environment must still be improved.

Labour inspection in the nuclear power plants

ASN has continued its oversight of the conditions of health and safety and subcontracting in the maintenance and operation of the Chooz B and Nogent-sur-Seine power plants and in decommissioning of the Chooz A installations. ASN considers that the organisation of working times can still be improved.

The health and safety measures taken by the licensee are satisfactory in the majority of cases, but ASN still finds that the risk analyses prior to maintenance operations are insufficient and that the working conditions do not always minimise the risks for the personnel.

Lastly, the year 2014 was marked by the occurrence of two serious workplace accidents at the Chooz B NPP during operations carried out on electrical installations.

The Soulaines-Dhuys waste repository and the Bure laboratory

ASN considers that operation of the CSA repository is satisfactory, in line with the previous years.

ASN notes that in 2014, Andra started the modification work on the package inspection facility aiming to allow on-site performance – in addition to the non-destructive tests already carried out (visual, radiological, dimensional, gamma spectrometry checks) – of X-ray imaging inspections, tritium degassing checks and destructive tests (core sampling of low level packages). ASN is favourable to the idea of Andra acquiring its own high-performance inspection resources to ensure the quality of the packages received in its facilities.

The commissioning of this facility, planned for 2016, will require ASN approval.

Visit of the underground laboratory at Bure in September. 2014.

Furthermore, in the light of experience feedback from the operation of the disposal facilities, ASN has given its agreement for the modification of their design and conditions of utilisation for the construction of tranche 9, whose commissioning is planned for early 2016.

ASN considers that works conducted by Andra in the underground laboratory at Bure continued in 2014 with a good standard of quality comparable with that of the preceding years.

Chooz A reactor undergoing decommissioning

Decommissioning of Chooz A reactor is continuing. The steam generators have been removed and ASN gave its agreement in 2014 for the dismantling of the reactor vessel in accordance with the provisions of the decree authorising the decommissioning operations. The preparation of this work began in December 2014 and will continue in 2015.

With regard to the environment and nuclear safety, ASN considers that the decommissioning operations are being carried out satisfactorily.

In the area of radiation protection, ASN still observes deficiencies in the monitoring of outside contractors, particularly with regard to the prevention of internal contamination risks. The efforts demanded of the licensee in this area in 2014 must be continued.

1.2 Radiation protection in the medical field

Radiotherapy

ASN inspected eight of the twelve centres in 2014. These inspections confirmed the positive trends regarding the deployment of quality management systems. Measures to improve the risk analyses and work procedures must nevertheless be pursued, particularly when implementing new treatment techniques.Likewise, the significant events notified to ASN in 2014 show that the reflections on the verification steps before and during treatments must be continued so that these steps fully cater for the risks of potential errors. The centres must also make progress in defining the quality objectives so that they are firstly more in line with treatment safety and secondly, can be verified (measurable indicators and quantified associated objectives).

An event rated level 2 on the ASN-SFRO scale was notified by the Jean Godinot Institute in Reims concerning a wrong-side error which remained undetected during ten sessions of a treatment that initially comprised twenty-five sessions.

Interventional radiology

Following in line with the measures undertaken since 2009, ASN performed eleven inspections focusing on operating theatres and certain specific activities such as interventional cardiology in 2014. With regard to operating theatres, very varied situations have been observed, most of which require efforts in personnel training and the inspection of machines. Progress is also required in the monitoring of doses delivered to patients, firstly to optimise the treatment protocols, and secondly to define rules and conditions for post-operative patient care.

Nuclear medicine

ASN inspected five of the twelve centres in 2014. These inspections show that radiation protection is duly taken into account. Improvements are nevertheless required in some centres with regard to occupational exposure and the management of contaminated effluents. Likewise, certain reflections on patient radiation protection must be continued (identity monitoring, optimisation of computed tomography acquisitions associated with scintigraphy procedures).

Computed Tomography

ASN carried out seven inspections in 2014, stepping up the examination of the patient radiation protection measures taken by the centres. The reason for this is that CT examinations represent a significant source of exposure to ionising radiation in the French population. It has been found that patient radiation protection is a genuine concern in the centres, taken into account notably in the choice of new equipment and resulting in the majority of cases in compliance with the diagnostic reference levels for the most common examinations. Progress in the optimising of certain protocols nevertheless still seems possible on the basis of a better analysis of patient exposure data.

Increased involvement of medical physicists could contribute to progress in this respect.

ASN moreover carried out an inspection relating to teleradiology in order to check the measures implemented to comply with the principle of justification of the procedures in this particular context.

Conventional radiology

In September 2014, ASN carried out an inspection campaign involving thirteen radiology centres situated in the Somme and Aisne *départements*. The purpose of the campaign was to assess compliance with the regulatory requirements in this sector of activity through random inspections. Considered on the whole, the majority of the centres duly comply with these requirements. Several centres must nevertheless better analyse worker and patient exposure data in order to identify any necessary optimisation measures.

1.3 Radiation protection in the industrial sector

Industrial radiology

Given the radiation protection implications, particularly during gamma radiography operations, ASN continued to perform a large number of inspections of industrial radiography activities, four of which were unannounced inspections on the work site. Further progress is still required in this area in the prior organisation of the work sites, compliance with safety procedures and preparedness for incident situations.

Devices for detecting lead in paint

The real estate diagnosis professionals use devices containing a radioactive source in their inspections to detect lead in paint. More than five hundred professionals have thus been licensed by ASN in Champagne-Ardenne and Picardie. Although the radiation protection risks involved in this activity remain low, it is governed by regulatory requirements with which compliance must be verified. ASN therefore inspected thirty-six professionals in this sector in 2014, asking them to communicate various inspection documents.

These steps enabled numerous deviations relating to the performance of radiation protection controls to be corrected.

1.4 Nuclear safety and radiation protection in the transport of radioactive substances

In 2014, in the area of small-scale nuclear activities, ASN carried out three inspections of radiopharmaceutical product transporters. These inspections revealed no notable shortcomings with respect to the regulations governing the transport of radioactive substances. Two inspections were carried out on internal transport operations on the Chooz and Nogent sites; they highlighted the need to pay greater attention to personnel training and to the monitoring of outside contractors involved in these activities.

1.5 Radiation protection of the public and the environment

Polluted sites and soils

Continuing in line with the preceding years, ASN contributed – along with decentralised government services and Andra – to the study of the treatment of legacy radioactive pollution resulting from operation of the former Orflam-Plast plant in Pargny-sur-Saulx (Marne *département*). The post-operational clean-out operations that began in 2010 were on the whole completed by the end of 2014.

2. ADDITIONAL INFORMATION

2.1 International action

The division continued to maintain regular relations with the Belgian nuclear regulator, the AFCN. The cross-inspections continued in small-scale nuclear activities and in the field of nuclear safety on the sites of Chooz and Tihange (Belgium).

The division took part in the meetings of the Franco-Belgian management committee and of the Franco-Belgian working group on safety, in the round-table on reactor decommissioning held in Brussels on 23rd September 2014 and the meeting of the Franco-Luxembourg committee.

The division participated in the preparatory meetings held in May and June 2014 at the IAEA head office (in Vienna) in view of the fifth review meeting of the convention on the management of radioactive waste and spent fuel, scheduled for 11th to 22nd May 2015.

2.2 Informing the public

Press conference

ASN held a press conference in Châlons-en-Champagne on 26th May 2014 to present the state of nuclear safety and radiation protection in the Champagne-Ardenne and Picardie regions.

Work with the CLIs

ASN took part in meetings of the Chooz, Nogent-sur-Seine and Soulaines CLIs.

During these meetings, ASN presented its assessment of the safety of the regional nuclear installations and its action on the sites, the national and local follow-ups to the Fukushima accident (ASN resolution of 21st January 2014 relative to the "hardened safety core" for the EDF reactors), the ASN resolutions concerning the NPPs (resolutions relative to BNI modifications, fire, etc.) and the Cigéo project. ASN gave the Chooz CLI a presentation of the report of the IAEA OSART's mission conducted on the Chooz site from 18th June to 4th July 2013 and made public on 31st January 2014.

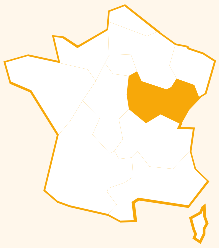
The CLI of the Soulaines repository operated by Andra continued the radioactivity measurement campaign around the repository (natural environment, fauna) which began in 2012. The Chooz CLI continued its public information action (publication of an information bulletin for the local population) and has started a process of reflection in the area of social, organisational and human factors. The Nogent CLI has continued the experimental process of examining EDF's replies to the on-site inspection follow-up letters sent by ASN, which it began in 2013.

ASN also attended annual general meetings, meetings of the board and of the commissions of the Bure CLIS (Local Information and Monitoring Committee), with a view to contributing to informing the local populations. It more specifically kept track of the various expert appraisals of the geothermal potential of the Bure region subsoil requested by the CLIS.

2.3 The other significant events in the Champagne-Ardenne and Picardie regions

Emergency situation preparedness

As part of major risk prevention, ASN participated in the national emergency exercise held on 16th September 2014 with the Chooz NPP; the Belgian authorities were involved in the exercise. This exercise led the Prefect of the Ardennes *département* to update the off-site emergency plan for the Chooz NPP at the beginning of 2015.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE BOURGOGNE AND FRANCHE-COMTÉ REGIONS REGULATED BY **THE DIJON DIVISION**

The Dijon division regulates nuclear safety and radiation protection in the eight *départements* of the Bourgogne and Franche-Comté regions.

As at 31st December the workforce of the Dijon division stood at 6 officers: 1 regional head, 4 inspectors and 1 administrative officer, under the authority of a regional representative.

The activities and installations to regulate in Bourgogne and Franche-Comté comprise:

- 8 external radiotherapy departments (19 accelerators, 2 contact radiotherapy devices);
- 3 brachytherapy departments;
- 14 nuclear medicine departments;
- 42 interventional radiology departments;
- 49 computed tomography devices;
- about 700 medical diagnostic radiology devices;
- about 1,100 dental diagnostic radiology devices;
- 310 industrial and research facilities.

In 2014, ASN carried out 53 inspections in the Bourgogne and Franche-Comté regions, of which 50 concerned small-scale nuclear activities and 3 the transport of radioactive substances.

Thirty significant events involving small-scale nuclear activities were notified to the division. Among the notified events, 1 was rated level 2 on the INES scale and 1 was rated level 1.

1. ASSESSMENT BY DOMAIN

1.1 Radiation protection in the medical field

External-beam radiotherapy and brachytherapy

In 2014, ASN inspected five of the eight radiotherapy centres situated in the Bourgogne and Franche-Comté regions. Five of the centres were inspected for their external-beam radiotherapy activity and three for their brachytherapy activity, which was being newly introduced in one of the centres.

Particular attention was paid to departments implementing new innovative techniques to ensure that a quality management system was in place before starting the treatments.

ASN considers that the situation is satisfactory on the whole. It observes that the large majority of the centres have a treatment quality and safety management system that on the whole complies with the regulatory requirements. The situation nevertheless remains contrasted in Franche-Comté where, since 2011, radiotherapy is organised through a single university hospital centre whose departments are divided between two sites – Besançon and Belfort-Montbéliard. The departments in these two locations were inspected in 2014. The situation differs between the sites, with significant progress being required on the Besançon site with regard to quality assurance management and compliance with the regulatory requirements defined by ASN. Considering that the progress made in 2014 is still insufficient, ASN will maintain tightened monitoring of this centre in 2015.

The radiotherapy centres have all put in place a system for detecting significant events that could affect the health of patients and workers and for notifying ASN of them. ASN considers that the events detection process is satisfactorily applied by all the centres.

Interventional radiology

In 2014, ASN carried out nine inspections of centres that use image intensifiers in the operating theatre. The situation remains contrasted.

As a general rule, occupational radiation protection is correctly catered for. Some progress has been observed despite that fact that the persons competent in radiation protection (PCR) are not given nearly enough time to fulfil their duties. The radiation protection of private practice surgeons must be improved in certain private centres, notably by implementing prevention plans.

With regard to patient radiation protection, some centres have made efforts in training, but the majority of users of image intensifiers in operating theatres have not yet received this regulatory training, nor have they been made aware of the different technical possibilities regarding the use of the devices. Further progress can be made in the optimisation of doses delivered to patients, particularly due to the absence of radiographers in the operating theatre and insufficient use of medical physicists.

Nuclear medicine

ASN inspected three nuclear medicine units in 2014, one for the first time since its commissioning visit in 2011. In the majority of cases the administered activities are below the diagnostic reference levels (DRL).

ASN observes that the units with a robust medical radiation physics organisation have a more complete procedure for the optimisation of injected activities. One of the inspected units has moreover started a professional practice assessment (PPA) process further to its certification by the HAS (French National Authority for Health).

Thirteen units out of fourteen have performed the initial or periodic external quality control required by the AFSSAPS decision of 25th November 2008. This control enabled the units to upgrade their internal quality controls and more specifically to acquire the benchmarking sources that were lacking for their performance.

ASN licensed three units in the Bourgogne and Franche-Comté regions to use radium-223 (Xofigo®) for the treatment of prostate cancer bone metastases. These are units which have radioactive iodine (RAI) therapy rooms and have therefore been licensed by the ARS (regional health agency) to perform healthcare activities involving the treatment of cancers using radionuclides in unsealed sources.

Computed Tomography

During the inspections carried out in 2014, ASN focused more specifically on the conditions of practice of teleradiology.

ASN has observed that the conditions of practise of teleradiology are quite satisfactory and comply with the main recommendations of the Guide to good professional and ethical usage of teleradiology produced by the Professional Radiology Council and the French National Council of Physicians. In this respect, ASN observes that the implementation of this technique is systematically formalised through an agreement or a contract between the centres and the teleradiologists, and that the patient's informed consent to the use of teleradiology is always obtained. Furthermore, the recommendations of the guide concerning the technical means of exchange to be put in place to allow the transmission of images and medical data are applied and these means are operational.

Out of the twenty-five signification radiation protection event notifications received by ASN in 2014, ten come from computed tomography departments. Five of these events concerned the performance of examinations on pregnant women who were unaware of their pregnancy.

1.2 Radiation protection in the industrial and research sectors

ASN continued its inspections of industrial radiography activities in 2014. It conducted an inspection campaign with twelve building diagnostics experts using radioactive sources for detecting lead in paint and inspected two holders of equipment used for physical inspections (thickness measurements, density measurements).

Industrial radiology

The inspections in the area of industrial radiology targeted one service provider company, one organisation specialised in the training of industrial radiographers and several companies performing own-account radiographic or fluoroscopy inspections.

ASN observes that on the whole the profession knows and complies with the essential regulatory requirements.

Nonetheless, in certain cases the category A classification of radiographers using a protected bunker or booth seems over-evaluated, given their job analysis. ASN has asked the heads of the organisations concerned to envisage a category B classification allowing the implementation of quarterly dosimetric monitoring, more appropriate for the low doses to which this type of personnel is usually exposed.

Utilisation of ionising radiation sources for checking physical parameters

The two inspections conducted in this area revealed situations where integration of the regulatory radiation protection requirements could be improved. These situations can be partly explained by the lack of involvement or the absence of a PCR in the organisation. Nevertheless, the external radiation protection controls by an approved organisation are carried out and reveal no risk of worker exposure beyond the regulatory limits.

Devices for detecting lead in paint

ASN conducted an inspection campaign on entities holding devices containing a sealed radioactive source used for detecting lead in paint in the context of building diagnostics. About 150 entities are listed under this activity in the Bourgogne and Franche-Comté regions.

These inspections were carried out in mid-April in a semi-unannounced manner (notice given by telephone a few days beforehand) in twelve entities. The inspections essentially concerned the radiation protection of users, the storage conditions and transport of the devices. ASN observes a situation that is satisfactory on the whole but certain points can be improved.

Some of the regulatory requirements are known and satisfied, such as the training of a PCR in about 80% of the cases, the performance of risk analyses, the drawing up of safety instructions and the shipping documents necessary for transport. In line with the low level of radiation protection risk involved in using these devices, the job analyses always conclude that the users can be considered unexposed. The storage conditions are compliant in 80% of the cases.

Nevertheless, progress is required in the external and internal technical controls which are only performed correctly in 30% and 10% of the cases respectively (controls complete and carried out at the regulatory frequency) and the deviations detected during the controls are only duly dealt with in 36% of the cases. Moreover, 45% of the inspected establishments must have their administrative licenses updated.

1.3 Nuclear safety and radiation protection in the transport of radioactive materials

The inspections carried out by ASN in 2014 revealed no problem situations in the transport of radiopharmaceutical products and transport operations ensured by the holders and users of industrial devices containing radioactive sources (gamma ray projectors in particular).

They confirmed the improvements observed over the last few years in the conditions of performance of transport operations, in document management and in the verification of the safety equipment.

This being said, greater compliance with some of the requirements of the gamma ray projector transport package (Cegebox) approval certificate is necessary, particularly those concerning closure of the Cegebox and the exhaustiveness of the pre-shipping checks.

1.4 Radiation protection of the public and the environment

Radon

The Dijon division took part in the pluralistic radon initiative in Franche-Comté put in place by IRSN (Institute of Radiation Protection and Nuclear Safety) in 2011 with the aim of making the radon risk known to the regional authorities and to the building trade professionals in particular. The awareness-raising actions continued in 2014, with a radon module for the students of the Montbéliard Civil Engineering IUT (University Institute of Technology), an information day organised by the DREAL (Regional Directorate for the Environment, Planning and Housing) for construction technicians, and training provided at the national centre of the regional public service for the regional authorities' technical departments. A measurement campaign was conducted in 300 private homes in the Montbéliard urban agglomeration with 30 homes displaying a radon concentration higher than 400 becquerels per cubic metre (Bq/m^3). Forty-five radon measurements were taken by the medical advisor for the house environment as part of the home diagnostics she carries out for patients suffering from allergies, and three of these revealed concentrations exceeding 400 Bq/m^3.

In joint agreement between ASN's Dijon division and the ARS of Franche-Comté, the authorities who have not yet carried out radon screening in schools are currently being chased up. The two organisations have moreover met representatives of the academy of Besançon to keep them informed of the educational establishments with problems. The same procedure will be initiated with the ARS of Bourgogne and the academy of Dijon in 2015.

The former uranium mining sites

A prefectural order of 7th April 2011 instructed Areva to conduct a study on the "Bauzots" site at Issy l'Evêque with the aim of enhancing the knowledge and characterisation of the waste and mining waste rock stored there. The method chosen by Areva to comply with this demand was presented to the CLIS in February 2012.

The boreholes necessary for characterisation of the disposal were drilled in early 2012 and a full assessment of the analyses of the materials stored on the site was provided by Areva in mid-2013.

This assessment is currently being examined and Areva provided additional information in the second half of 2014.

Reuse of mining waste rock

The national plan of action for the former uranium mines provides for Areva to inventory the sites of reuse of mining waste rock and then to treat any areas in which incompatibility in the use of the ground is identified. The generic methodology to use to determine the areas to treat and the actions to take is based on typical exposure scenarios chosen according to the observed usages of the ground and "guideline values" for equivalent added annual dose.

In the Bourgogne region, the Saône-et-Loire and Nièvre *départements* are concerned by the reuse of mining waste rock.

The programme can be divided into three broad phases:
- aerial overflight to identify radiological disturbances;
- inspection on the ground of the identified areas to confirm the presence of waste rock;
- processing of areas of interest incompatible with the land usage.

On completion of the first two phases, Areva drew up municipal booklets in 2014 giving the results of the inventory. The booklets contain a map of the municipality listing the reuse sites and the ground inspection sheets:
- six municipal booklets and sixteen sheets have been drawn up for the Nièvre *département*;
- six municipal booklets and forty-two sheets have been drawn up for the Saône-et-Loire *département*;

The national action plan provides for the inventory result to be made available for public consultation so that people can comment upon it, particularly with regard to its exhaustiveness. Meetings to inform the mayors concerned were held on 3rd October 2014 in Château-Chinon (Nièvre *département*) and 13th October 2014 in Sanvignes-les-Mines (Saône-et-Loire *département*) in preparation for this consultation. The consultation was open to the public until 31st December 2014, but comments received after this date will nevertheless be taken into account.

Areva will be responsible for analysing and, where necessary, taking into account with complete transparency, the observations and questions collected, under the oversight of the State departments. Areva will then complete the inventory of sites on which mining waste rock has been used and will produce a file of the works required for any sites whose condition is deemed incompatible with the land usage.

In addition to this, twenty-seven sites have been identified as having to undergo a complementary radon diagnosis in the Bourgogne region. Dosimeters were distributed at the end of 2014 and their measurement results will be examined by ASN in 2015.

In 2015, the Dijon division of ASN will continue monitoring the actions that will be implemented further to the results of the public consultation and any complementary checks that might be necessary, particularly as regards any remediation work.

2. ADDITIONAL INFORMATION

2.1 Informing the public

Press conference

On 20th May 2014, ASN held a press conference in Dijon on the status of nuclear safety and radiation protection in the Bourgogne and Franche-Comté regions.

Valduc local information committee (CLI)

A structure providing a forum for discussion and information on the CEA Valduc centre (SEIVA) has existed since 1996. This structure, which is funded chiefly by the *conseil général* (General Council) of the Côte-d'Or and ASN, more particularly informs the public of the impact of the Valduc centre's activities, insofar as the subjects addressed do not concern confidential aspects covered by its classification as a Secret Basic Nuclear Installation.

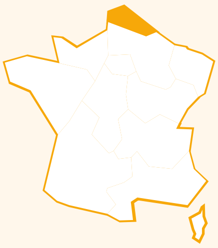
ASN took part in the SEIVA's annual general meeting and a meeting of the environment commission which was held on 9th April 2014 in Moloy.

2.2 The other notable events

Emergency situation preparedness

The Dijon division took part in the national emergency exercise concerning the CEA Valduc centre, held on 13th February 2014. The main aims of this exercise were to test the alerting and communication procedures and the command chain, to manage the media pressure and to train all the players in responding to a major event.

The exercise revealed in particular a fast response to the triggering of the alert on the part of the services concerned and effective cooperation between the various players involved in taking contamination measurements and samples. Lines for progress were nevertheless identified, chiefly with regard to the organisation of functioning of the Prefecture operations centre and prioritisation of the services to contact to set up the emergency centre more rapidly.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE NORD - PAS-DE-CALAIS REGION REGULATED BY **THE LILLE DIVISION**

The Lille division is responsible for regulating nuclear safety, radiation protection and the transport of radioactive substances in the two départements of the Nord - Pas-de-Calais region.

As at 31st December 2014, the workforce of the Lille division stood at 17 officers: 1 regional head, 2 deputy heads, 12 inspectors and 2 administrative officers, under the authority of an ASN regional representative.

The activities and installations regulated by the Lille division include:

- the EDF Gravelines NPP (6 reactors of 900 MWe);
- the SOMANU (NUclear MAintenance Company - Areva) site in Maubeuge (Nord département);

Installations and activities using ionising radiation in the medical, industrial and research sectors:

- 12 external radiotherapy departments;
- 2 brachytherapy departments;
- 17 nuclear medicine departments;
- 65 interventional radiology departments;
- 91 tomography devices;
- 1 organisation using blood product ionisers;
- 1 cyclotron producing fluorine-18.
- about 3,000 medical and dental diagnostic radiology devices;
- 200 veterinary diagnostic radiology devices;
- 24 industrial radiology companies;
- about 1,500 industrial devices;
- 32 research units.
- 4 approved organisation agencies.

In 2014, ASN's Lille division carried out 131 inspections in the Nord - Pas-de-Calais region, comprising 29 inspections in the Gravelines NPP, 2 in Somanu (Société de maintenance nucléaire), 95 in small-scale nuclear activities and 5 in the field of transport of radioactive substances.

ASN also carried out 11 days of labour inspection in the Gravelines NPP.

The division was notified of 102 significant events, 67 occurring in BNIs and 35 in small-scale nuclear activities. Among the notified events in BNIs, 5 in the Gravelines NPP were rated level 1 on the INES scale. In the small-scale nuclear activities, out of the 35 notified events, 5 were rated 1 on the INES scale, to which can be added 3 events concerning radiotherapy patients. In early 2015 ASN was informed of an event concerning patients which was provisionally rated 2+ on the ASN-SFRO scale.

On 15th April 2014, ASN gave the Gravelines NPP formal notice to inspect and repair the storage tanks for effluents from the reactor primary and secondary systems before 31st December 2015. The ASN inspectors also issued two violation reports.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Gravelines NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Gravelines NPP is, on the whole, in line with its general assessment of EDF's performance.

With regard to reactor operation, ASN considers that the site's performance has evolved positively with respect to 2013 through heightened awareness and the will to undertake improvements. Nevertheless, some weaknesses are identified in the reliability of practices, operating rigour and the application of instructions.

With regard to maintenance, ASN considers that the site has made progress with the general condition of some items of equipment of the facilities. The efforts must be continued on the other corrosion-sensitive equipment items due to their seaside location and their ageing. The site must improve the performance and inspection of maintenance operations as these aspects have caused numerous quality deficiencies which can render unserviceable some equipment items that are important for safety.

With regard to environmental protection, ASN gave the Gravelines site formal notice to inspect and repair the storage tanks for effluents from the reactor primary and secondary systems before 31st December 2015. Furthermore, ASN considers that the site must continue its efforts to remedy the spillages of hazardous or radioactive substances in the storage tank leak retention structures and to finish the renovation programme for the NPP's liquid effluent treatment facilities.

With regard to emergency situation management, ASN considers that the site must redress the shortcomings in the applicability of certain response procedures and the periodic verification and management of equipment and emergency management rooms.

With regard to radiation protection, ASN notes recurrent shortcomings in the control of access to some radiological areas.

Progress is also required in the organisation of gamma radiography work, radiological cleanliness and the protection of workers on work sites presenting specific hazards.

With regard to health and safety, ASN has detected a lack of training of workers on sites involving work at height using ropes, which led the labour inspector to suspend work on one site for the time necessary to provide the training. Dealing with a leak of 1200 litres of a toxic product within the site required significant precautions, which ASN verified during an unannounced inspection. There have been no serious accidents, although safety deviations have sometimes been noted on the work sites.

In 2014, EDF continued the programme of the third ten-yearly outage inspections of the Gravelines NPP on reactor 4. ASN examined the results of the inspections of reactor 1 which displayed cracks in a bottom-mounted instrumentation penetration of the reactor. These inspections did not reveal any development of these defects and their final repair is scheduled for 2016.

ASN has examined the detailed substantiations provided by EDF concerning the impact of operation of the future methane terminal in Dunkerque on the safety of its facilities. ASN will state its decision on this file in 2015, as part of the prescriptions concerning the continuation of operation of the site's reactor 1.

ASN inspection at the Gravelines NPP, February 2014: inspection of an effluent tank.

Somanu – Société de Maintenance Nucléaire (nuclear maintenance company) in Maubeuge

ASN considers that operation of Somanu's facilities is satisfactory on the whole. Progress has been made in the area of radiation protection in the last few years. The efforts in this respect must be continued in a context of intense operating activity. The licensee must also remain attentive to maintain its performance in the areas of safety, the environment and the transport of radioactive substances. In addition to this, ASN considers that Somanu must improve its tracking of the inspections and periodic testing of equipment important for the protection of interests (Article L. 593-1 of the Environment Code), the handling of deviations and the management of the transport of radioactive substances.

ASN will remain attentive to the corrective actions implemented and to compliance with the provisions of the BNI Order of 7th February 2012. It will also keep a close watch over the formalisation and compliance with the deadlines for the replies for the ongoing files and the development of the dosimetric data concerning the personnel of Somanu and of outside companies.

In the first half of 2014, three significant events were notified, two concerning the ventilation of the installation and one the transport of radioactive substances. This is the same number as in 2013.

ASN will give an opinion in 2015 after completing the examination of the installation's periodic safety review file and it will examine the request to modify the gaseous discharges limits of the installation's creation authorisation decree.

1.2 Radiation protection in the medical field

Radiotherapy

Twelve radiotherapy centres in the Nord - Pas-de-Calais region are subject to ASN oversight. These centres use twenty-nine accelerators, most of which are recent, and highly innovative techniques. In 2014, ASN observes the continuation of a real drive for progress in the rigour, organisation and traceability of the interventions. The implementation of the quality approach within the establishments is continuing in a satisfactory manner, but varies from one centre to another.

ASN carried out 13 inspections in the radiotherapy departments in 2014. These inspections were more specifically focused on aspects relative to the organisation of the centres, implementation of the quality management system and management of the skills of the personnel involved in treatment delivery.

The situation with regard to medical physicist numbers is now satisfactory on the whole. ASN carried out a campaign of unannounced inspections on a number of radiotherapy centres during the summer of 2014. The aim of this campaign was to verify the required minimum presence of radiotherapists and technical personnel (physicists and technologists) during the treatments.

All the centres have put in place procedures for recording and analysing adverse events. However, ASN notes a loss of momentum in the recording and analysis of adverse and precursory events and the number of notifications of significant radiation protection events (ESR), which remains relatively low.

Regarding the application of quality assurance to the patient care process, the progress observed with respect to the applicable regulatory provisions is satisfactory.

The patient management process for radiotherapy treatments is covered by documented procedures which are correctly applied on the whole but should be consolidated by using tools to verify command of the processes. Nevertheless, ASN was informed of an identity error event that occurred at the Lille CHRU (regional hospital university centre) at the end of 2014. This event has been provisionally rated level 2+ on the ASN-SFRO scale.

As far as document management is concerned, the use of specific computerised tools has enabled the fluidity and reliability of the applicable documentation to be greatly improved. Points requiring improvement chiefly concern the hazards analysis procedure which is not sufficiently mastered due to insufficient investment in terms of work and training units.

ASN notes the growing use of innovative technologies allowing, among other things, greater precision in the treatments (image-guided radiotherapy, for example).

The centres must conduct an in-depth reflection on how this can be fully embraced by the teams.

Two brachytherapy centres in the Nord - Pas-de-Calais region are subject to ASN oversight. ASN notes that the steps taken by the brachytherapy centres to ensure treatment quality and safety are not as advanced as in the radiotherapy departments. Furthermore, improvements are still required in worker radiation protection and the management of sources waiting to be taken back. Lastly, one significant radiation protection event in 2014 highlighted the needs for improvement in emergency situation management.

Interventional radiology

Interventional radiology encompasses invasive, diagnostic and therapeutic medical procedures, guided with the aid of ionising radiation. ASN carried out six inspections in interventional radiology, particularly in operating theatres. Progress in the wearing of personal protective equipment by workers has been noted. ASN has however identified areas requiring improvement, notably the wearing of dosimeters – by practitioners in particular, training in radiation protection of workers and patients, and the optimisation of doses delivered to patients.

In 2014 ASN conducted inspections in interventional radiology on the basis of a study carried out in 2013 on the centres in the region that perform procedures in operating theatres and dedicated rooms. This study served to enhance knowledge of the interventional radiology activity in the region, to study the current practices for protecting patients and personnel against ionising radiation, and to gain a better understanding of the medical specialities as a whole and the major implications of radiation protection for the personnel and the patients.

On 18th September 2014, about one hundred interventional radiology professionals attended a seminar held in Lille on the risks and responsibilities associated with radiation protection in interventional radiology. This seminar was organised jointly by ASN, the Regional order of physicians and the French Society of Radiology.

In widespread use today, medical imaging has evolved considerably over the last few years. It involves two-pronged radiation protection risks, concerning the exposure of the practitioner, which can be significant, and exposure of the patient, particularly during long or repeated procedures. The survey carried out by ASN on interventional radiology procedures in the Nord - Pas-de-Calais region in 2014 revealed a large margin for progress to ensure better prevention of these risks.

Nuclear medicine

ASN conducted nine inspections in nuclear medicine in 2014. ASN considers that the integration of radiation protection is still progressing too slowly. ASN notably wishes to see progress in occupational radiation protection, more particularly in the precise analysis of the work practices and radiological zoning and in the management of liquid effluents. ASN notes that the centres are introducing dose tracking and optimisation measures as part of patient radiation protection.Lastly, ASN notes that when license applications are submitted, knowledge of the initial situation of the facilities is sometimes incomplete, making it difficult to assess the impact of the planned modifications.

Computed Tomography

ASN continued its oversight of computed tomography facilities in 2014 by conducting seven inspections. These inspections revealed that the rules relative to the occupational radiation protection are known and on the whole applied satisfactorily. Nevertheless, ASN considers that improvements must still be made, notably by giving the persons competent in radiation protection (PCR) sufficient time to fulfil their duties, by formalising to a greater extent the radiation protection technical controls and the information to be given to personnel from outside contractors, and by making the doctors comply with the radiation protection rules.

With regard to patient radiation protection, ASN notes improvements in the optimisation of doses delivered to patients; these efforts must be continued.

1.3 Radiation protection in the industrial, research, and polluted sites and soils sectors

Industrial radiology

In 2014, ASN carried out 11 inspections in area of industrial radiology. These inspections revealed continuing improvement in the organisation of radiation protection in the companies, particularly in worker monitoring, which remains satisfactory. Unannounced work site inspections continued to be carried out: ASN still notes shortcomings in the application of the radiation protection rules, particularly in the defining, signalling and oversight of the work area.

ASN was notified of two ESRs in gamma radiography in 2014, one caused by the jamming of a radioactive source due to the rupture of the plug of the gamma ray projector.

ASN, in partnership with the DIRECCTE (Regional directorate for companies, competition, consumption, work and employment) and the CARSAT (Retirement and occupational health insurance fund), has instituted a charter of good practices in industrial radiography. This charter, which aims to optimise the use of ionising radiation in this activity sector, has been signed by 21 industrial radiography companies as well as ordering customers in the region. A monitoring committee has been set up and meets regularly. A survey carried out in 2013 with the ordering customers, the service providers and their radiographers provided an assessment of the contribution of this charter to work practices and the areas requiring continued efforts. Twenty-four companies use industrial radiography in the region.

In 2015 ASN will take part in actions to enhance the ordering customers' awareness of radiation protection rules.

Universities and research laboratories

Thirty-two research units hold and use ionising radiation sources in the Nord - Pas-de-Calais region. The research activity is characterised by the wide variety of ionising radiation sources used and by the ongoing regularisation of situations with respect to the regulations. The ASN oversight duties have led to six inspections in 2014, in particular on the subjects of occupational radiation protection and the management of radioactive waste and effluents.

ASN notes that the entities carrying out public research activities are currently involved in an improvement drive aiming to achieve a satisfactory standard of radiation protection. ASN notes difficulties in the regularisation of certain activities, in compliance with the requirements of the Public Health Code and in the notification of ESRs. The particular events mainly concern the discovery of radioactive sources and their management. ASN closely monitors the steps to remove the sources and radioactive waste stored in certain universities.

Lastly, ASN plans to organise an awareness-raising initiative for the public research professionals in 2015.

Devices for detecting lead in paint

A one-off campaign of inspections of certain holders of radioactive devices for detecting lead in paint was carried out in the Nord - Pas-de-Calais region in 2014.

ASN has inventoried about 210 holders of devices in Nord - Pas-de-Calais who, given the low risks involved in their activities, are not subject to systematic and periodic inspections on the ground. However, in order to assess how radiation protection is taken into account and make the profession aware of the regulatory provisions, a one-off campaign of inspections of twenty device holders was carried out between May and August 2014. These inspections revealed no shortcomings that could call into question the radiation protection of workers or the public, nor any deterioration or improvement with respect to the situation found during a similar operation in 2008. They mainly revealed noncompliance with regulations, including licensing deficiencies, the absence of technical controls or noncompliance with their required frequencies, failure to verify fire extinguishers, and deviations from the regulations relative to the transport of radioactive substances (signalling, securing, etc.).

ASN has moreover also observed that in two cases, the activity of the radioactive source loaded in the device was no longer sufficient to provide reliable measurements. The Departmental department of protection of the public and the Departmental department of territories and the sea, with competence for fraud prevention and the habitat, have been informed.

1.4 Nuclear safety and radiation protection in the transport of radioactive substances

Five inspections were carried out in nuclear installations and in small-scale nuclear activities in the Nord - Pas-de-Calais region in 2014. These inspections did not reveal any major deviations from the regulations.

In the area of small-scale nuclear activities, the inspections were carried out notably on a radiopharmaceutical supplier departing to make a delivery and in a technical inspection company.

1.5 Radiation protection of the public and the environment

Polluted sites and soils

ASN continued its action to set up radiological monitoring of the sites in collaboration with the DREAL (Regional Directorate for the Environment, Planning and Housing). ASN has also put forward prescriptions relative to radiation protection of the general public to the Prefect with the aim of implementing institutional control over the PCUK wasteland site of Wattrelos.

2. ADDITIONAL INFORMATION

2.1 International action

In 2014, the Lille division continued its international activities, particularly with the Belgian nuclear safety authority, for mutual sharing of experience in the field of nuclear safety and radiation protection. The exchanges focused in particular on the comparison of the measures implemented in the nuclear power plants following the Fukushima accident and on inspections in small-scale nuclear activities.

Twelve joint inspections were carried out in nuclear facilities, in the industrial and medical environment. The Lille division of ASN took part in a round table in Brussels organised by the AFCN for industrial radiology professionals.

The Lille division also established contacts with the Dutch safety authority. The aim is to share experience in the field of nuclear safety by organising cross-inspections in 2015.

Lastly, two members of the Lille division staff followed a training course on the IRRS missions at IAEA in

Vienna with a view to participating in assessment missions in 2015.

2.2 Informing the public

Press conferences

In 2014 ASN held two press conferences on the status of nuclear safety and radiation protection, one in Lille, the other in Dunkerque.

Work with the CLIs

ASN has kept the Local Information Committees (CLI) of the Gravelines NPP and Somanu in Maubeuge regularly informed about the files in progress in the two nuclear facilities. More specifically, the CLI of the Gravelines NPP was involved in one ASN inspection. The CLI has also been regularly informed about the performance of the third 10-year inspection of the Gravelines NPP reactor 4. It continued the expert appraisal work in relation to the periodic safety reviews of the Gravelines NPP reactors.

ASN's Lille division took part in the working group meetings organised by ANCCLI (the national association of local information committees) and IRSN on the periodic safety reviews and the operating lifespan of the nuclear reactors.

Public information actions

The Lille division of ASN, in partnership with IRSN, ran an information stand on nuclear safety and radiation protection at the National Conference on Technological Risks held in Douai on Thursday 16th October 2014.

The Lille division was also invited to contribute to the radiation protection workshops and to support the work of the pupils of the Lycée de l'Europe high school in Dunkerque in the area of radiotherapy.

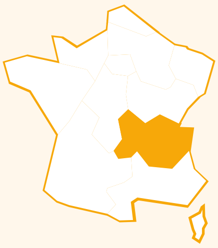
2.3 Other notable events

Emergency situation preparedness

ASN was involved as part of the preparation for the nuclear exercise scheduled at the Gravelines NPP on Tuesday 10th February 2015. Coordinated by the Nord region prefecture, the administrative departments concerned participate in the definition of the objectives of this exercise which aim more specifically to test the measures to protect the population and establishments receiving the public, particularly schools, provided for in the off-site emergency plan, the preparedness of the industrial plants in the vicinity of the NPP and certain provisions of the doctrine for the management of post-nuclear-accident situations.

The Lille division of ASN also participated – with the representatives of the government departments of the Nord defence zone – in the meetings devoted to the presentation of elements of the doctrine for post-nuclear-accident management and to the national response plan to a major nuclear or radiological accident.

Lastly, the Lille division of ASN was involved in the sessions for training firemen in the management of the radiological risk, in the national emergency response organisation and the rules governing the transport of radioactive substances.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE RHÔNE-ALPES AND AUVERGNE REGIONS REGULATED BY THE **LYON DIVISION**

The Lyon division regulates nuclear safety, radiation protection and the transport of radioactive substances in the twelve *départements* of the Rhône-Alpes and Auvergne regions.

As at 31st December 2014, the workforce of the Lyon division stood at 36 officers: 1 regional head, 3 unit heads, 27 inspectors and 5 administrative officers, under the authority of the ASN regional representative.

The activities and installations to regulate in the Rhône-Alpes and Auvergne regions comprise:

- the NPPs at Bugey (4 reactors of 900 MWe), Saint-Alban (2 reactors of 1,300 MWe), Cruas-Meysse (4 reactors of 900 MWe) and Tricastin (4 reactors of 900 MWe) operated by EDF;
- the Areva FBFC nuclear fuel fabrication plants in Romans-sur-Isère;
- the nuclear fuel cycle plants operated by Areva and situated on the Tricastin industrial platform;
- the operational hot unit at Tricastin (BCOT) operated by EDF;
- the high flux reactor in the Laue-Langevin Institute (ILL) in Grenoble;
- the Activated Waste Packaging and Storage Facility (Iceda), under construction on the Bugey nuclear site operated by EDF;
- the Superphénix reactor undergoing decommissioning at Creys-Malville, and its auxiliary installations;
- reactor 1 undergoing decommissioning at the Bugey NPP operated by EDF;
- the Ionisos irradiation facility in Dagneux;
- the nuclear fuel fabrication plant and pelletising unit in Veurey-Voroize operated by Areva SICN, undergoing decommissioning;
- the reactors and plants of CEA (French Alternative Energies and Atomic Energy Commission) in Grenoble, undergoing decommissioning;
- the CERN international research centre located on the Swiss-French border;
- small-scale nuclear activities comprising:
  - 22 radiotherapy departments (6 of which practice brachytherapy);
  - 23 nuclear medicine departments;
  - 150 interventional radiology departments;
  - 120 users of scanners;
  - 150 users of medical diagnostic radiology devices;
  - about 5,000 users of dental diagnostic radiology devices;
  - 700 users of veterinary diagnostic radiology devices;
  - 20 users of gamma radiography devices;
  - 200 users of X-ray generators;
  - 50 users of unsealed radioactive sources;
  - 200 users of lead detectors;
  - 20 users of gamma ray densitometers.

In 2014, ASN conducted 399 inspections in Rhône-Alpes and Auvergne regions. 115 of these inspections were carried out in the four nuclear power plants. 166 inspections were carried out in the small-scale nuclear activities sector, 90 inspections concerned the other nuclear facilities overseen by the Lyon division, and 28 inspections concerned the transport of radioactive materials.

In addition, ASN totalled 47.5 days of labour inspection on the four nuclear power plants of the Rhone valley and the Creys-Malville site in 2014.

338 significant events were notified by the BNI licensees of the Rhône-Alpes region in 2014. Among these events, 40 were rated level 1 on the INES scale.

In the small-scale nuclear activities sector in the Rhône-Alpes and Auvergne regions, of the 69 significant events notified to ASN, 25 in the medical field were rated level 1 on the ASN-SFRO scale, and 1 event was rated level 1 on the INES scale.

ASN was notified of 16 significant events relating to the transport of radioactive substances in the Rhône-Alpes and Auvergne regions. Among these events, 2 were rated level 1 on the INES scale.

With regard to BNIs, ASN issued 2 compliance notice resolutions. One concerned the conformity of certain leak retention structures of the Areva site at Romans-sur-Isère, while the other concerned the monitoring of nuclear pressure equipment of the high flux reactor in the Laue-Langevin Institute.

In addition to this, ASN issued 15 individual resolutions concerning BNIs, including 1 requiring EDF to step up its monitoring and presence in the field during activities important for protection at the Bugey NPP.

The ASN inspectors issued one violation report. ASN was in regular contact with the public prosecutors, notably in the context of the appearance of EDF before the criminal court of Bourgoin-Jallieu on 3rd September 2014 for failure to comply with an ASN compliance notice issued for the Creys-Malville site.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Nuclear power plants

Bugey NPP

ASN considers that the performance of the Bugey NPP in nuclear safety remains slightly below its assessment of EDF as a whole, but urges the site to continue and consolidate the positive trend observed in the second part of the year.

After a downturn in operating rigour during 2013 and early 2014, the Bugey NPP has shown signs of progress in complying with the operating technical specifications, particularly with regard to the periodic tests and the configuring of systems. EDF must however improve the monitoring performed by the control room operators, reinforce its control of maintenance operations and ensure that the progress observed in 2014 continues over the long term.

With regard to maintenance, ASN considers that it is vital for EDF to ensure the quality of the maintenance work performed on the Bugey NPP over the long term.

In line with the outages of 2013, several events that occurred while restarting the reactor at the end of the first outage of the 2014 campaign revealed unsatisfactory maintenance work carried out further to technical anomalies. ASN required the Bugey NPP to increase its presence in the field and its monitoring actions during maintenance activities through Resolution 2014-DC-0434 of 10th June 2014. During the subsequent outages of the NPP reactors, ASN checked compliance with the abovementioned resolution and the improvement in EDF's organisational provisions.

With regard to environmental protection, ASN considers that the organisation of the NPP stands out positively with respect to the general assessment of EDF: the teams are experienced and of the right size. The preventive cleaning work on the steam generators carried out on reactor 5 has taken environmental protection into account highly effectively. EDF has moreover implemented a programme for inspecting the pipes carrying radioactive and hazardous fluids following the detection of the abnormal presence of tritium measured on the Bugey NPP site in 2012 and 2013.

With regard to worker protection, ASN considers that the organisation of the Bugey NPP falls short of the performance of EDF as a whole. The site has registered unsatisfactory results in radiation protection, which have resulted in several notable events in a context of understaffing of the department responsible for radiation protection. The Bugey NPP has not made improvements in health and safety since 2013, and accident frequency is somewhat higher than the average for the NPPs, even if there have been no serious accidents. This point must be made an action priority in 2015.

Saint-Alban/Saint-Maurice NPP

ASN considers that the nuclear safety performance of the Saint-Alban/Saint-Maurice NPP is, on the whole, in line with the general assessment of the EDF plants.

After experiencing difficulties at the end of the 2000's, the improvement observed by ASN in 2013 at the Saint-Alban/Saint-Maurice NPP was confirmed in 2014. The site has more specifically made progress in system configuring. ASN also notes that the site has improved its operating rigour, thanks in particular to the embracing of rigorous compliance with procedures by the personnel. The licensee must however make further progress with pre-activity risk analysis and in the performance of the periodic in-service tests.

ASN inspectors at the Bugey NPP, November 2014.

As far as maintenance is concerned, ASN notes that from the safety aspect, the reactor 1 outage for scheduled maintenance and refuelling was an overall success.

ASN considers that the environmental protection performance of the Saint-Alban NPP is, on the whole, in line with the general assessment of the EDF plants. ASN notes that the efforts made by EDF over the last few years to reduce its operating discharges bore fruit in 2014. EDF must however take priority action to improve the management of the leak retention structures situated in the effluent treatment building. Several events that occurred in this area in 2014 have shown that EDF did not sufficiently learn the lessons from the events that occurred in this area in 2008.

With regard to worker protection, ASN considers that the performance of the Saint-Alban NPP stands out positively with respect to its assessment of EDF as a whole. Despite disparities observed in the field, the dosimetry results obtained by EDF during the reactor outage were satisfactory on the whole. Furthermore, the results with regard to health and safety at work improved in 2014 and no serious accidents occurred during the year.

Cruas-Meysse NPP

ASN considers that the nuclear safety performance of the Cruas-Meysse NPP in 2014 is, on the whole, in line with the general assessment of the EDF plants.

Since 2012, ASN has been keeping a close watch on the licensee's command of the system configuring activities, and more generally its control over the quality of operation of the facilities. Although ASN notes some progress in this respect, the licensee reported a large number of operating quality deficiencies during 2014. ASN moreover notes that at the end of the two major outages in 2014, namely the partial inspection of reactor 4 during which the steam generators were replaced, and the ten-yearly outage of reactor 3 – the site's first ten-yearly outage within the framework of the third periodic safety reviews – the restarting operations were on the whole well-handled from the nuclear safety aspect.

With regard to maintenance, ASN also notes that the site on the whole managed successfully the outages of 2014. ASN notes in particular that the site had few unforeseen technical difficulties, but those that did arise were in general well managed. The site must however make progress in its preparation of maintenance work and the control of maintenance quality deficiencies. ASN also noted deviations in the monitoring of activities contracted to outside companies.

ASN considers that the environmental protection performance of the Cruas-Meysse NPP falls short of its general assessment of the EDF fleet. ASN notes that the year 2014 revealed shortcomings in the rigour of waste management, storage area utilisation and discharge management. This was materialised in particular by the notification of about three times as many significant events for the environment as in the preceding years. The site must focus its efforts on the environmental culture of its teams and on compliance with the associated regulatory requirements. The unsatisfactory management of waste in the facility also puts a strain on fire risk prevention due to the inadequate management of the fire loads.

With regard to worker protection, ASN considers that the performance of the Cruas-Meysse NPP is in line with its general assessment of EDF, given the quantity of maintenance operations carried out in 2014. Although the results for radiation protection remain satisfactory on the whole, the site continues to show vulnerabilities in worker access to areas displaying high radiological risks. Furthermore, ASN considers that the level of radiological cleanliness during the ten-yearly outage of reactor 3 was not satisfactory. With regard to working health and safety, ASN observes that after encouraging results concerning workplace accidents early in the year, their frequency and seriousness got worse beginning in the summer. Moreover, labour relations on the site remain complex despite the improvements noted in the last few years.

Tricastin NPP

ASN considers that the nuclear safety performance of the Tricastin NPP on the whole matches the general assessment of the EDF plants, as it has done over the last two years.

The conditions of performance of the periodic tests were again the cause of too many significant safety events in 2014. Similarly, the Tricastin site has not made improvements in the strict compliance with the implementation of the compensatory measures associated with temporary operating modifications. ASN also detected a weakness in fire risk prevention in 2014.

With regard to maintenance, ASN notes that the Tricastin NPP's performance in the management of reactor outages remains good on the whole. Despite a few unforeseen technical difficulties linked to quality deficiencies in work performance discovered during the start-up phases, ASN considers that the 2014 outage campaign was well managed on the whole. The last ten-yearly outage after thirty years of operation of the Tricastin NPP was carried out in 2014.

ASN considers that the environmental protection performance of the Tricastin NPP is in line with the general assessment of the EDF plants. ASN notes the site's efforts to reduce and control discharges, but several deviations involving liquid spillages or overflows revealed shortcomings in the operation of the facilities.

During inspections, ASN has verified EDF's compliance with ASN Resolutions 2012-DC-0264 and 2013-DC-0371 issued in 2012 and 2013 following the discovery of deviations on certain liquid effluent storage systems and concerning the abnormal presence of tritium in the geotechnical containment detected in 2013.

In addition, on 9th January 2015, ASN checked compliance with some of the requirements of Resolution 2011-DC-0227 issued following the third periodic safety review of the Tricastin NPP reactor 1, aiming to protect the NPP against a flood flow of 13,700 m^3/s.

With regard to worker protection, although the performance of the site on the whole is in line with the general assessment of the EDF plants, ASN notes that the results for 2014 are down compared to 2013. Several radiation protection events occurred in 2014, notably one concerning the irradiation of a worker which exceeded one quarter of the annual regulatory limit, showing the need for the site to reinforce its radiation protection culture and its organisation, and to bring renewed purpose to the operating documents. With regard to health and safety, although the quantitative results are satisfactory, ASN has noted accidents involving burns, and "near-accidents" which revealed shortcomings in key areas such as padlocking and lifting.

Fuel cycle installations

Areva FBFC – Nuclear fuel fabrication plants in Romans-sur-Isère (Drôme *département*)

ASN has tightened its vigilance over Areva FBFC since the end of 2013. It notes that in 2014 the licensee took the first steps to improve safety and reinforce the human and material resources devoted to safety. Nevertheless, several long-term actions will not be put in place until 2015 and many conformity deviations still have to be corrected.

The licensee was summoned to a hearing by the ASN Commission on 11th February 2014. Following this hearing, ASN asked Areva FBFC to produce a safety improvement plan designed to more specifically adress improvements in the control of the criticality risk, the operating rigour and the meeting of commitments, particularly concerning the facility reinforcements planned for during Areva FBFC's previous periodic safety reviews. The Director-General of ASN visited the site on 14th May to tell the Areva teams what was expected of them.

ASN carried out an in-depth inspection of safety management and operating rigour from 24th to 28th November. This inspection showed that Areva FBFC has initiated several actions to improve safety management and operating practices on the site, particularly with regard to the inspection and verification of the nuclear activities. ASN will be attentive to the deployment of these actions in 2015.

ASN has moreover given Areva FBFC formal notice through ASN Resolution 2014-DC-0418 of 4th February 2014 to carry out work on the site's effluent treatment station to bring it into conformity and at the same time to verify the conformity of all site's leak retention structures.

With regard to the fuel manufacturing facility for the research reactors (ex-Cerca), following the detection of conformity deviations by the licensee in 2014, ASN asked the licensee to conduct an in-depth analysis of the facility's operating organisation.

ASN will continue to maintain tightened vigilance over the site in 2015 until it has been able to measure a lasting improvement in operating rigour and the conformity of the site's facilities.

Nuclear fuel cycle plants situated on the Tricastin industrial platform (Drôme *département*, Vaucluse *département*)

In 2012, Areva submitted an organisational modification of its Tricastin nuclear site to ASN as part of the "Tricastin 2012" project. ASN authorised this modification on 22nd October 2013 on condition that additional requirements were taken into account. This modification consists in mutualising the logistics, laboratories, utilities, effluents and waste and safety, security and environment activities on Areva's Tricastin platform.

ASN is keeping a particularly attentive watch to ensure that these mutualisation steps lead to an improvement in the practices and quality of work, and do not result in a disorganisation, even transient, of activities important for protection, particularly concerning the fluorination plants (formerly Comurhex).

ASN conducted an unannounced inspection campaign on the nuclear facilities of the Areva Tricastin site on 27th and 28th May 2014 on the theme of the management of subcontracted activities on the Areva platform. During this inspection, ASN observed that the "safety" organisation was functional but required consolidation, particularly to clarify the scopes of action of the operational departments and the organisation of the "operational safety" teams made available to the licensees.

ASN moreover observed during the inspection that the logistics activity did not comply with certain conditions of the ASN agreement. Areva will have to deploy an action plan enabling it to ensure that the mutualisation is harmonised and optimised.

Areva NC – TU5 and W plants in Pierrelatte (Drôme *département*)

ASN considers that the level of safety of Areva NC, for BNI 155 and the ICPE W, has improved in 2014, but that the licensee must reinforce the rigour of the transport and handling of the uranium hexafluoride (UF_6) containers, in view of the increase in the occurrence of events relating to these activities since 2012.

Control of the containment of radioactive substances has improved, as much in the operating phases as during the technical outages. The licensee has more specifically started to put in place provisions for the containment of the pipes for pneumatic conveying of uranium-bearing material in powder form. During the revising of the requirements that govern operation of the W plant, ASN required putting in place lasting containment measures before 31st December 2016.

In addition, in accordance with the decisions taken by ASN subsequent to the lessons learned from the Fukushima Daiichi accident, Areva NC completed the construction in 2014 of a new entirely contained hydrofluoric acid (HF) storage unit which improves risk prevention during HF transfer operations. ASN remains vigilant regarding the commissioning conditions for this unit.

Areva NC – Formerly Comurhex - Fluorination plant in Pierrelatte (Drôme *département*)

Areva NC took over operation of BNI 105 and the Pierrelatte conversion ICPEs from its Comurhex subsidiary on 1st January 2014.

ASN considers that the licensee's operating rigour has remained at a generally satisfactory level despite the occurrence in 2014 of several events relating to control of the first containment level and radiological cleanliness. The licensee must moreover improve compliance with the baseline requirements for the control of discharges.

ASN has observed that the first preparatory operations for the definitive shutdown of the BNI had not been carried out with sufficient rigour. ASN is moreover waiting for additional information for the final shutdown and decommissioning authorisation application file.

With regard to the ICPEs, Areva NC has asked ASN for authorisation to continue operating the plants beyond 10th July 2015. ASN has started to examine this request and has reminded Areva NC that continued operation could only be considered if the level of safety of these installations was improved through implementation of the technological risk prevention plan approved in 2012, and integration of the experience feedback from the Fukushima Daiichi accident.

Eurodif Georges Besse – Uranium enrichment plant in Pierrelatte (Drôme *département*)

In 2014, Eurodif Production continued implementation of the Eurodif (Prisme) project for intensive rinsing followed by venting, which mainly involves repeatedly rinsing the gaseous diffusion circuits with chlorine trifluoride (ClF_3), a toxic and dangerous substance which allows the extraction of virtually all the residual uranium deposited in the barriers of the UF_6 diffusers in preparation for decommissioning of the facility.

The rinsing operations must be completed before the end of 2015. Due to technical difficulties, the gaseous diffusion circuit venting operations started behind schedule at the end of 2014.

ASN observed in 2014, as in 2013, that the safety standards of Eurodif Production had to be improved, particularly regarding compliance with baseline safety requirements, operational rigour and modification management.

In 2014, further to events concerning the management of the ClF_3 and at the request of ASN, Eurodif Production engaged an action plan to reinforce its organisation and a review of the conformity of the facilities and of the operating practices with the general operating rules.

The licensee has put into service a facility for treating legacy pollution of the ground water by chlorinated solvents, but ASN has had to ask for reinforcement of the measures to protect the treatment facility against accidental pollutions.

In 2015, ASN will maintain tightened vigilance over compliance with the baseline safety requirements of the facility and the conditions of implementation of the Prisme project operations; it will also start examining the final shutdown and decommissioning authorisation application file.

SET Georges Besse II – Uranium enrichment plant in Pierrelatte (Drôme *département*)

The Georges Besse II plant displayed a satisfactory standard of safety in 2014. The licensee must nevertheless remain vigilant over the control of the criticality risk, particularly for subcontracted operations.

The gradual entry into production of the North unit continued satisfactorily.

After a prerequisite relating to a defect in the coating of the ovens for receiving the uranium containers was lifted, ASN authorised commissioning of the reception, sampling and packaging unit (REC 2) through its Resolution 2014-DC-0461 of 7th October 2014.

Socatri – Company operating a clean-up and recovery installation – Bollène plant (Vaucluse *département*)

ASN considers that the standard of safety of Socatri's facilities is fairly satisfactory, but that the licensee's organisation can be further improved with regard to compliance with the periodic test frequencies and the handling of nonconformities.

With regard to environmental protection, ASN has checked compliance with the provisions of the resolutions of 16th July 2013 relative to the conditions and limits of the facilities' discharges into the environment. These provisions are well applied on the whole, even though the licensee still has to detail some of its planned inspections.

Following the periodic safety review of BNI 138, ASN issued Resolution 2014-DC-0439 on 8th July 2014 imposing fourteen additional requirements on Socatri, aiming primarily at reinforcing the resistance of the buildings to external hazards and the management of the criticality risk. ASN will remain attentive to the licensee's management of its commitments so that it meets the corresponding deadlines to the best possible extent.

Installations undergoing decommissioning

Superphénix reactor at Creys-Malville (Isère *département*)

ASN considers that the operating rigour of the Creys-Malville site licensee has improved in 2014 and that the decommissioning operations are carried out with rigour. The licensee must however ensure that the deviations detected through the maintenance plans or periodic tests are addressed within acceptable times.

After having carried out an inspection in this area in 2013 that revealed unsatisfactory results, in 2014 ASN verified EDF's compliance with the formal notice it had issued in 2012 to reinforce the means of emergency situation management. The site must nevertheless remain vigilant with the training and maintaining of skills of the outside contractors who might have to receive the external emergency response teams.

Bugey NPP reactor 1 undergoing decommissioning

ASN considers that reactor 1 decommissioning is proceeding under generally satisfactory conditions of safety.

The decommissioning work outside the reactor vessel continued in 2014.

CEA centre reactors and plants in Grenoble (Isère *département*)

ASN considers that in 2014 the safety of the decommissioning and post-operational clean-out of the CEA facilities was satisfactory.

In 2014, ASN verified achievement of the clean-out objectives for the Siloé research reactor and the active materials analysis laboratory (LAMA) in preparation for the delicensing of the waste zoning of these facilities. This verification led ASN to make additional requests concerning the LAMA and to authorise delicensing of Siloé in January 2015.

The significant radiation protection event involving the incidental exposure of a worker in 2013 on the LAMA clean-out work site was downgraded to level 1 on the INES scale following the analysis of the event.

CEA is continuing the clean-out of the effluent and waste treatment plant (STED), for which certain conditions are still subject to ASN approval.

The other industrial and research facilities

High flux reactor in the Laue-Langevin Institute (ILL) in Grenoble (Isère *département*)

ASN considers that the standard of safety of the ILL is satisfactory on the whole, even if the independence of the safety organisation must be consolidated.

The ILL reactor was shut down until August 2014 on account of the work to reinforce reactor safety, which began in 2013 as part of the experience feedback from the Fukushima Daiichi accident. ASN considers that the work has continued under satisfactory conditions, particularly with regard to monitoring of the workers, but the ILL must improve the traceability of works monitoring.

ASN also gave the ILL formal notice through Resolution 2014-DC-0451 of 22nd July 2014 to comply with the regulatory periodic inspection requirements applicable to the reactor nuclear pressure equipment. ASN is currently examining the technical substantiations transmitted by the licensee to comply with this resolution.

The Activated Waste Packaging and Interim Storage Installation (Iceda) at Bugey (Ain *département*)

The ICEDA was licensed by the Decree of 23rd April 2010. On 13th December 2011, the building permit for the installation was cancelled by a judgement of the administrative court of Lyon. The construction work on this BNI has been at a standstill since that date. The administrative appeals court of Lyon cancelled the judgement of 13th December 2011 in its Order of 4th December 2014 and EDF plans resuming the construction work in 2015.

ASN carries out annual inspections to check that the stopping of the work has no impacts on the safety of the future installation.

Ionisos irradiator in Dagneux (Ain *département*)

ASN considers that the industrial irradiator operated by the company Ionisos in Dagneux displayed a satisfactory standard of safety in 2014, even if it can be improved, particularly as regards compliance with the baseline safety requirements.

ASN also notes that despite the provisions of the Environment Code, the Dagneux nuclear site does not have a CLI (local information committee).

EDF BCOT – Operational hot unit on the Tricastin site in Bollène (Vaucluse *département*)

ASN considers that the level of safety of the BCOT is satisfactory. The licensee must however improve the monitoring of the radioactive substance transport activities.

CERN – Accelerator and Research Centre (Geneva)

In 2014, CERN's activities were severely affected by the prolonged technical outage for the purpose of consolidating the interconnections between the superconducting magnets in order to allow operation of the Large Hadron Collider (LHC) accelerator at higher power in 2015. ASN checked the running of the maintenance and modification work sites during a joint visit with the OFSP (Swiss Federal Office of Public Health).

ASN and the OFSP are jointly examining the site's nuclear waste management study and the safety file for a new linear accelerator, Linac 4, built at CERN.

A protocol for notifying and sharing information concerning significant events and their classification on the INES scale between the organisations (CERN, ASN, OFSP) has also been drawn up.

1.2 Radiation protection in the medical field

Radiotherapy

In 2014, ASN carried out 15 inspections in the 22 radiotherapy centres in the Rhône-Alpes and Auvergne regions.

ASN's inspections focused in particular on the management of treatment safety and quality, preparation of the treatments, the control of patient positioning during treatment and the implementation of the professional practices evaluation process. Particular attention was also devoted to centres that implement innovative technologies, those whose staffing levels are considered potentially vulnerable, and those that are behind schedule with the implementation of the quality assurance system.

The results of these inspections show that all centres have taken organisational steps since 2009 to implement a quality assurance approach to improve the delivery of treatments to patients. These quality assurance systems are now increasingly used on a daily basis by all the personnel in the centres as part of a process for continuous improvement of quality of medical care.

The radiotherapy centres have all put in place a system for detecting significant events. In the majority of cases, these events concern a patient over one or a few treatment sessions and have no expected clinical consequences. ASN was notified of 36 events in 2014, and is making sure that the centres concerned draw the appropriate lessons from these events.

ASN carried out one unannounced inspection in the radiotherapy sector in the Rhône-Alpes and Auvergne regions during the summer vacation period to check that the safety rules are applied despite the reduced staff numbers.

ASN did not observe any shortcomings concerning the presence of medical physicists during this inspection.

Interventional radiology

In the light of the 17 inspections carried out in 2014, ASN considers that the patient and worker radiation protection practices must be further optimised in interventional radiology. Large disparities were observed between departments and although progress has been observed in the rooms dedicated to interventional radiology, especially with regard to training, the same cannot be said for the operating theatres. The optimisation of doses delivered to patients and received by personnel is not yet sufficiently developed. Medical physicists are still too rarely assigned to this activity. The training of practitioners in good patient and staff radiation protection practices must be continued.

Nuclear medicine

The 5 inspections carried out in 2014 reveal that radiation protection of workers, patients and the public is on the whole taken into account in the nuclear medicine facilities in the Rhône-Alpes and Auvergne regions. Improvements are nevertheless required in the updating of the working environment analyses for exposed workers, in the management of radioactive effluents and in the analysis of events.

Computed Tomography

During the 14 inspections ASN conducted in computed tomography facilities in the Rhône-Alpes and Auvergne regions in 2014, one of which was carried out in a centre performing teleradiology examinations, ASN verified that the centres have undertaken a process to optimise the doses delivered in the computed tomography procedures. This process must be continued and developed, particularly by generalising the involvement of medical physicists in this area.

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

ASN considers that radiation protection of workers is taken into account relatively satisfactorily in the industrial radiology sector in the Rhône-Alpes and Auvergne regions.

The inspections carried out in 2014 indeed revealed no significant regulatory non-conformities, even if improvements are still required in defining the radiological zoning before work site operations, in the conformity of the analyses of working environments or the performance of internal radiation protection controls of the sources and devices.

Further to the signing of a charter of good practices in industrial radiology in 2010, ASN and its partners held a seminar for all the charter signatories on 2nd December 2014. The discussions during the seminar focused in particular on the good practices to apply on work sites to optimise the doses received by the workers, the alternative techniques to gamma radiography, and the action to take in the event of source jamming. The seminar also provided the opportunity to invite new companies that use industrial radiography to sign the charter.

Inspection campaign in the agri-food sector

Between 1st July and 22nd November 2014, ASN conducted a campaign of unannounced inspections in 22 industrial companies working in the agri-food sector in the Rhône-Alpes and Auvergne regions and holding at least one device generating ionising radiation (X-rays). These devices are generally used to check there are no foreign bodies in the foodstuffs. ASN thus assessed the way in which the regulations relative to worker radiation protection are applied in these companies. This campaign enabled, among other things, the professionals to be made aware of the measures to implement and to review any difficulties they have encountered. During this campaign, the ASN inspectors observed that the measures taken to protect the workers are generally relatively satisfactory. However, some companies use devices that are not declared to ASN. These noncompliant administrative situations must be regularised without delay.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

ASN carried out 21 inspection operations in the area of radioactive substance transport in the Rhône-Alpes and Auvergne regions in 2014. Firstly, 17 inspections were carried out on the premises of nuclear installation licensees, in nuclear medicine departments and in technical inspection companies (gamma radiography, gamma densitometry, lead detection). During these inspections, ASN checked the organisation put in place by the licensees to comply with the regulations relative to the transport of radioactive substances and the operations relative to the shipping and reception of packages in these installations. Secondly, four roadside inspection operations were carried out in collaboration with other State services (Dreal, customs, gendarmerie). These roadside inspections were carried out as random checks at motorway toll barriers and resulted in the sending of three inspection follow-up letters.

ASN's inspections in 2014 revealed no situations giving cause for concern in the Rhône-Alpes and Auvergne regions. Progress has been made in the transport of packages "not subject to approval" used to transport the least hazardous radioactive substances which represent the majority of radioactive substance transport operations in France.

1.5 Radiation protection of the public and the environment

Radon

In 2014 ASN continued its inspections to verify compliance with the regulations relating to management of the radon risk in facilities open to the public in the Rhône-Alpes and Auvergne regions. It met the four General Councils of the *départements* with priority classification for the management of the radon risk in the Rhône-Alpes and Auvergne regions which had not been met in 2013, these General Councils being responsible for the management of this risk in the public secondary schools.

ASN found that situations varied from one *département* to another. Generally speaking, radon measurements have been taken in secondary schools to identify those that require remedial work. Work has been carried out in several schools to reduce the radon content. This work must nevertheless be continued and further radon content measurements must be taken to assess its effectiveness. During these meetings ASN also pointed out that that the radon screening campaigns must be repeated every ten years, whatever the result of the preceding campaign.

In addition to this, in 2014 ASN, the eight prefectures (local government) and the two regional health agencies (ARS) concerned launched a survey of the eighty largest municipalities situated in the priority *départements* and in this context, met the technical departments of the four large towns of the Rhône-Alpes and Auvergne regions to check their management of the radon risk in primary schools and kindergartens. ASN will draw the lessons from this survey in 2015.

Polluted sites and soils

In 2014, ASN monitored the continuation of the clean-out operations on two sites in the Rhône-Alpes region (in Annemasse and Lyon) where traces of radium had been found. The clean-out of these two sites should be completed in 2015.

Former mining site of Saint-Priest-la-Prugne (Loire* département*)

In 2014, ASN issued an opinion to the Rhône-Alpes Dreal concerning the file for the redevelopment of the Saint-Priest-la-Prugne site. ASN considers that this redevelopment project, which provides for removal of the barrier behind which mining waste rocks are stored and replacement of the hydraulic cover by a solid cover, would secure the site over the long term. Areva must however still introduce some technical clarifications into its file which must be submitted to the opinion of a third-party expert.

In addition to this, ASN notes that the work undertaken by Areva to identify and treat the mining waste rocks situated around the former Saint-Priest-la-Prugne mine has fallen behind schedule. ASN expects Areva in 2015 to meet its commitments of several years ago by starting waste rock removal work.

2. ADDITIONAL INFORMATION

2.1 International action

The Lyon division continued its bilateral exchanges with the Japanese and Chinese nuclear safety authorities concerning inspection practices and measures implemented further to the Fukushima Daiichi accident.

A presentation of the Japanese authority's reorganisation was given and a team of inspectors visited the Fukushima Daiichi nuclear site. The Fukushima Daiichi accident follow-ups in France were presented to the Chinese authority.

In 2014, the Lyon division continued its bilateral exchanges with the Swiss safety authority by receiving the Franco-Swiss commission which brings together the Swiss and French safety authorities on the questions of nuclear safety and radiation protection of the installations in the two countries. The Lyon division also hosted an inspector from the Swiss authority who took part in two inspections conducted by the Lyon division on the Bugey and Tricastin NPPs.

Lastly, within the framework of the multilateral actions, the Lyon division represents ASN in the inspection practices working group of the Nuclear Energy Agency (NEA) of the Organisation for Economic Cooperation and Development (OECD). As such, it participated in a seminar held in the United States and attended by the twenty-two countries represented in this working group to share best practices in inspection methods.

As a general rule, these exchanges allowed the sharing of best practices in the methods for overseeing those responsible for nuclear facilities.

Within the framework of the IAEA's IRRS mission to conduct the peer-review of ASN (see box on page 87), experts from IAEA observed a nuclear safety inspection of the high flux reactor of the Laue-Langevin Institute in Grenoble and the performance of the Tricastin nuclear site's off-site emergency plan exercise.

2.2 Informing the public

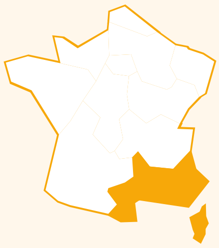
Press conference

ASN held one press conference on 29th April 2014 in Lyon on the state of nuclear safety and radiation protection in the Rhône-Alpes and Auvergne regions and the French follow-up to the Fukushima Daiichi nuclear accident.

Work with the CLIs

All nuclear facilities in the Rhône-Alpes region, apart from the Ionisos irradiator in Dagneux (Ain *département*), have a Local Information Committee (CLI). These CLIs, whose activity has developed considerably since 2009 through the coordination and realisation of technical studies, all held meetings in 2014.

ASN and the General Council of the Drôme *département* organised an inter-CLI seminar held on 10th October 2014. This major event, which brought together all eleven CLIs of the Rhône valley for the first time, enabled the elected officials, the representatives of associations, the public authorities, the licensees and the press to interchange on the theme of the seminar: "Nuclear energy and regions". This initiative aims to promote the sharing and development of the nuclear risk culture in the Rhône valley, which comprises a large number of nuclear installations.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE PROVENCE-ALPES-CÔTE-D'AZUR, LANGUEDOC-ROUSSILLON AND CORSE REGIONS REGULATED BY **THE MARSEILLE DIVISION**

The Marseille division regulates nuclear safety, radiation protection and the transport of nuclear substances in the 13 départements of the Provence-Alpes-Côte-d'Azur (PACA), Languedoc-Roussillon and Corse regions. As at 31st December 2014, the workforce of the division stood at 19 officers: 1 regional head,1 deputy head, 13 inspectors and 4 administrative officers, under the authority of the ASN regional representative.

The activities and installations to regulate comprise:

- 27 Basic Nuclear Installations:

Cadarache (Bouches du Rhône département*):*
- CEA Cadarache research centre (20 BNIs);
- ITER.

Marcoule (Gard département*):*
- MÉLOX plant;
- CEA Marcoule research centre (Atalante and Phénix BNIs);
- Centraco plant;
- Gammatec ioniser.

Narbonne (Aude département*):*
- certain storage areas of the Comhurex Malvési facility that will constitute the Ecrin facility.

Marseille (Bouches du Rhône département*):*
- Gammaster ioniser.

- Numerous small-scale nuclear activities and the approved organisations:

Medical field:
- 6 brachytherapy departments;
- 21 external radiotherapy departments;
- 28 nuclear medicine departments;
- 180 interventional radiology departments;
- 155 tomography devices;
- about 2,500 medical diagnostic radiology devices;
- about 4,500 dental diagnostic radiology devices.

Research field:
- some 130 laboratories possessing radiation sources.

Industrial field:
- 2 cyclotrons producing radioisotopes;
- 14 head offices and 8 branch offices of industrial radiography companies;
- some 180 industrial organisations possessing radiation sources;
- 460 users of lead detectors;
- some 60 veterinary surgeons using diagnostic radiology devices.

ASN-approved laboratories and organisations, including:
- 5 laboratories approved for taking environmental radioactivity measurements;
- 10 organisations approved for radiation protection controls who have their head office in the PACA and Languedoc-Roussillon regions.

In 2014, ASN carried out 219 inspections in the PACA, Languedoc-Roussillon and Corse regions, of which 85 were in BNIs, 127 in small-scale nuclear activities and 7 in the area of the transport of radioactive substances.

The division was notified of 149 significant events, of which 50 occurred in BNIs, 91 in small-scale nuclear activities and 8 in the area of the transport of radioactive substances. Among the events notified for the BNIs, 3 events were rated level 1 on the INES scale, none at level 2. In the small-scale nuclear activities, no events were rated level 2 on the INES scale, 6 were rated level 1, to which can be added the events concerning radiotherapy patients, among which no events were rated level 2 on the ASN-SRFO scale and 8 events were rated level 1. In the transport of radioactive substances, all the notified events were rated level 0 on the INES scale.

ASN took 2 compliance notice decisions in the small-scale nuclear sector, one concerning the sustainable radiation protection improvement project of the Timone hospital nuclear medicine department, the other on the lessons to be learned by the company Applus RTD concerning an irradiation incident in 2012 caused by the jamming of a gamma radiography source.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Cadarache site

CEA Cadarache centre

ASN considers that the senior management of the centre has remained well involved in safety management and in the in-house verifications. ASN underlines the scale of the definitive shutdown and decommissioning operations of old installations and the retrieval and packaging of legacy waste, whether in progress or planned for the coming years.

ASN notes significant progress in the monitoring of outside contractors, the management of inspections and periodic tests and the in-service monitoring of pressure equipment, and considers that CEA must continue its efforts in these areas. ASN also notes the progress made in the integration of social, organisational and human factors (SOHF), the organisation of maintenance and fire protection and external hazards. Progress is however required with regard to the management of padlocking, the use of temporary instructions and equipment requalification after maintenance work.

The organisation of worker radiation protection remains robust. ASN underlines the fast response of the radiation protection department of CEA Cadarache following the discovery of a puncture in a respiratory protection mask. ASN has also observed effective implementation of monitoring of dosimetry at the extremities. ASN nevertheless notes that CEA is planning organisational changes in radiation protection and will ensure that it maintains a robust organisation in 2015.

With regard to the lessons learned from the Fukushima accident, ASN is pleased to note the removal of the fissile material that was stored in the storage and handling building of the Masurca facility, as its earthquake resistance had been deemed inadequate. Moreover, in January 2015 ASN issued two resolutions detailing the additional requirements relative to the setting up of a hardened core of robust material and organisational provisions, firstly covering the centre, secondly targeting more specifically the RJH reactor under construction. These resolutions more specifically set the levels of external hazard risks to consider in the dimensioning of the hardened core equipment, the submission of study complements, the setting up of an organisation to ensure local back-up for long-term management of an emergency situation for the 31st December 2015, and the construction of new emergency situation management premises designed in particular for the «hardened core» earthquake for 30th September 2018.

Furthermore, in view of the conclusions of the 10-year periodic safety review of the EOLE and Minerve reactors, ASN has, through ASN Resolution 2014-DC-0466 of 30th October 2014, made continuation of operation of the facilities subject to compliance with the prescriptions relative to the reinforcement of the buildings to ensure their earthquake resistance and removal from storage of the fuel with no planned use. ASN considers that any operation of the facilities beyond 2019 can only be envisaged with more extensive reinforcement of the facility against earthquakes.

ASN continued its inspections on the Jules Horowitz Reactor (RJH) construction site, and considers that the project is managed with rigour and that the site is well organised and clean. With regard to the Cabri reactor, the year 2014 was marked by the performance of various restarting tests necessary before reactor divergence which should take place in 2015. The inspections carried out in 2014, which more specifically concerned the SOHF's and the meeting of commitments, led to requests for improvements, but did not reveal any major malfunctions.

ASN considers that the measures taken by CEA on the ATPu and the LPC further to the compliance resolution of 19th February 2013 concerning the monitoring of the industrial operator Areva NC and the management of skills relating to the safety of decommissioning are satisfactory. In 2015 ASN will ensure that resumption of the decommissioning activities by CEA following the departure of Areva NC is managed under satisfactory conditions.

With regard to waste management, the resumption of operation on trench T2 of the radioactive waste storage yard (BNI 56) is welcomed by ASN, as the repackaging and removal of this legacy waste is a priority. With regard to the other facilities, ASN detects several weak signals in the management of the storage areas and the monitoring of waste packaging. The link between the BNI safety files and the centre's waste analysis must also be clarified.

As concerns the management of radioactive effluents, ASN is examining the modifications in discharge and effluent transfer limits and the conditions of environmental monitoring that the licensee wants to implement, taking into account the malfunctions detected in 2012 in particular. CEA informed ASN in 2014 that it intended definitively stopping pumping the slightly contaminated groundwater situated under BNI 56. ASN did not identify any objections but nevertheless underlines the importance of complying with the schedule for removal from storage of the waste contained in the pits that caused this contamination and complying with the water table monitoring provisions.

In addition to this, 2014 was marked by an event relating to a tightness defect on an inspection hatch in the pipeline carrying industrial effluents from the Pégase facility to the effluent treatment plant. Although ASN considers that the measures put in place by CEA are satisfactory, it nevertheless emerged that the sharing of responsibility between departments had contributed to the event and that complementary action should be undertaken to prevent and detect this type of event.

ASN takes positive note of the commissioning of Agate, the new effluent treatment plant, in the first half of 2014 as the liquid effluent treatment units of the STED facility (BNI 37) has stopped functioning.

Lastly, in the area of transport, ASN considers that the CEA Cadarache centre has taken the necessary measures for the on-site transport of hazardous goods to comply with the provisions of the BNI order. The baseline requirements of the facilities must integrate these changes.


ASN inspection on the construction site of the RJH reactor, February 2014.

ITER

The construction work continued in 2014, notably with the laying of the upper foundation raft of the Tokamak complex, completed on 27th August 2014. Pouring of the concrete of the central zone of this foundation raft, initially planned for April 2013, was postponed several times because of difficulties encountered by the licensee in the design, the sizing and above all the production of the prior safety case. After submitting several successive versions of the safety case file and holding numerous technical discussions, approval was given by ASN Resolution 2014-DRC-028511 of 10th July 2014.

The first constituent equipment items of the facility were delivered to the site in 2014 and others are currently being manufactured. In July 2014, ASN carried out an inspection in Russia on the monitoring of the outside contractors concerned by the design and manufacture of electrical equipment for protecting coils.

This year, ASN again notes the licensee's transparency in the discussions and controls and considers that project organisation and safety are satisfactory. ASN also notes that improvements have been made in the monitoring of the chain of outside contractors. ASN nevertheless wishes to see further improvements in the monitoring of and compliance with the requirements defined for certain contractors and considers that the licensee must continue its oversight efforts to control the entire chain of outside contractors, which is made complex by the international nature of the project. The development of a common safety culture and ensuring that all the outside contractors embrace the French regulations remains a major line of improvement for this licensee.

In 2014, the licensee was required to produce numerous complements of information and safety cases further to the examination of its creation authorisation application. These elements are currently being examined by ASN and others are expected at later dates. ASN will be particularly attentive to the quality of the required demonstrations and justifications, as well as to compliance with the associated submission deadlines. With regard to the lessons learned from the Fukushima accident, ASN considers that the licensee's approach with regard to the ITER stress tests is satisfactory. The licensee must nevertheless submit complementary studies before 30th June 2015.

Marcoule platform

ASN has received the licensee's responses to the in-depth inspection of waste and effluent management on the Marcoule platform carried out in June 2013. The responses are satisfactory on the whole and will form the subject of additional checks in 2015. ASN is also continuing its examination of the modifications to the effluent discharge and transfer limits and the environmental monitoring methods on the platform, which should be concluded in 2015. ASN considers that the licensees must coordinate themselves to step up public information with regard to the risks associated with the health and environmental impact of the all the facilities of the platform.

Areva NC's Mélox plant

ASN considers that Areva NC meets its commitments on the whole, whether they concern dealing with significant events or deviations, responding to inspections, or implementing modifications further to ASN examination. However, the licensee has had to be chased up several times with regard to the quality of its responses to inspections or its analyses of in-service events.

ASN notes improvements in the taking into account of radiation protection and criticality issues and in the oversight of subcontracted operations. ASN will nevertheless remain vigilant in these matters.

The condition of the containment barriers and operating rigour are judged satisfactory. The robustness of the first barrier remains a priority, with continuation of the improvements regarding containment failures, the effectiveness of radiological protection and workstation ergonomics.

Lastly, with regard to the 10-year periodic safety review of the facility and the lessons learned from the Fukushima accident, ASN did not identify any factor opposing the continuation of operation of the facility and prescribed the application of measures to improve radiation protection and management of the criticality risk through ASN Resolution 2014-DC-0440 of 15th July 2014, and in January 2015, prescribed additional requirements relative to the setting up of a hardened safety core of robust material and organisational measures.

CEA Marcoule centre

ASN considers that safety management of the civil BNIs at the CEA Marcoule centre is satisfactory on the whole. The inspections of the management of the centre and of the two civil BNIs, Atalante and Phénix, revealed no significant deviations. ASN nevertheless reminded management that it must ensure that all the entities concerned - BNIs and joint departments - comply more strictly with the procedures applicable to the centre as a whole.

It emerges from the three cross-cutting inspections performed by ASN in 2014 that the centre has improved its emergency management, with a new emergency management building in particular, and that the consequences of external hazards such as earthquakes or fires are satisfactorily assessed.

With regard to the lessons learned from the Fukushima accident, in January 2015 ASN issued two resolutions specifying the additional requirements relative to the setting up of a hardened safety core of robust material and organisational measures covering firstly the centre as a whole and secondly targeting the Phénix NPP more specifically.

ASN has delivered a specific agreement to the Phénix NPP allowing the unloading of the fuel assemblies, a key step in decommissioning preparation. The Phénix decommissioning project underwent a public inquiry from 10th June to 17th July 2014, concomitantly with that for the creation of the Diadem facility intended for the storage of irradiating and decommissioning waste, including that from Phénix. ASN will adopt a position regarding these two inquiries in 2015.

Lastly, ASN is pleased to note the commissioning in the Atalante facility of the C7 shielded chain, redeveloped to optimise the packaging of the solid low- and medium level waste, and the commissioning – after lifting the last reservations – of the C8 shielded chain connected to the new aqueous effluents networks and of the hydrothermal oxidation process for treating active solvents.

Centraco plant

Since 2009, ASN has tightened its oversight of the Centraco installation and considers that the licensee must continue to progress in the development of a safety culture and in its operating rigour. ASN noted certain improvements in these areas in 2014. ASN nevertheless expects improvements in the management of equipment necessary for emergency management, in the monitoring of outside contractors and the formalising of certain skills.

In June 2013, Socodei informed ASN of its desire to restart the smelting furnace which has been shut down since the fatal accident of 12th September 2011.

Without interfering with the ongoing legal procedure which should determine the responsibilities in this accident, ASN has, through Resolution 2014-DC-0391 of 14th January 2014, set Socodei new prescriptions to improve the safety of the facility, prevent the risk of another accident and detail the conditions that must be satisfied before restarting the smelting furnace. ASN has authorised the first starting tests through a resolution of 23rd September 2014 and will give its decision in 2015 on the restarting of the smelting furnace.

Alongside this, in view of the conclusions of the 10-year periodic safety review, ASN has not identified any factor opposing the continuation of operation of the facility, with the exception of the smelting furnace, and has prescribed the performance of complementary studies through ASN Resolution 2014-DC-0446 of 17th July 2014. The periodic safety review of the smelting furnace and the adjacent premises is examined separately, as part of the examination of the application for authorisation to restart the smelting furnace.

The year 2014 has revealed improvements in the operation of the facility, but further efforts must be made in emergency management, in operation, in drawing lessons from events and above all the taking into account of SOHFs. ASN is particularly attentive to this latter point in the examination of furnace restarting, which should be concluded in 2015.

Gammatec ioniser

The licensee commissioned the facility at the beginning of 2014. ASN conducted two inspections in 2014 to check the first operations performed by the licensee and ascertain that the experience of the first months of operation had been fed back.

ASN considers that improvements are required in the licensee's organisation, particularly in terms of radiation protection. The first loading of a source in the experimental bunker revealed an inadequacy in the design of the bunker's biological protection. At the end of October 2014 ASN agreed to the addition of biological protections to remedy this situation, and their installation will be completed in early 2015.

Écrin (Comurhex Malvési site)

The examination of the creation authorisation application is continuing and will be completed in 2015. ASN is pursuing its oversight of the facility and notes that substantial development work is planned with a view to limiting the environmental impact of the site as a whole.

The safety implications remain limited, with a low health risk associated with the dispersion of radionuclides. ASN notes that the site is subject to close monitoring of the environmental contamination. ASN does however underline that the waste stored in the BNI will ultimately have to be disposed of in accordance with the safety requirements in effect.

Gammaster ioniser

ASN considers that safety is properly ensured in general in the Gammaster facility, but it wants to see improvements in the development of a safety culture and in the management and monitoring of deviations.

ASN also considers that the licensee must be particularly attentive to the control of fire risks and handling risks.

1.2 Radiation protection in the medical field

Radiotherapy

ASN performed fifteen inspections in radiotherapy and brachytherapy in 2014. ASN considers that the implementation of systems for managing treatment quality and safety is satisfactory on the whole. ASN nevertheless maintains its vigilance as the majority of centres are gradually introducing new treatment techniques such as intensity modulated radiotherapy, arc therapy, etc.

Although medical physicist staffing levels can still be improved, most of the centres inspected were able to demonstrate that their internal organisation enables the presence of a medical physicist to be guaranteed throughout treatment duration and that the rest of the personnel are familiar with their centre's internal processes. ASN nevertheless notes that the majority of the centres do not sufficiently oversee their operation in degraded situations.

ASN summoned one centre that was late in deploying its quality management system and had not met some of its commitments.

The division organised the fourth inter-regional awareness-raising day for health professionals on the theme of safety in radiotherapy, held in Marseille on 7th November 2014. The proceedings of this day are available on *www.asn.fr*. ASN considers that this initiative to share experience and good practices between professionals provides the opportunity to remind the radiation protection actors that their quality management system is intended to ensure the quality and safety of patient treatments and rallies the teams to optimise treatments.

Interventional radiology

ASN carried out twelve inspections in interventional radiology in 2014. It finds that progress has been made on the whole, but highlights inadequacies and disparities in the implementation of radiation protection in the centres. The medical personnel must better integrate the regulatory requirements with regard to radiation protection.

ASN considers that there is undeniable progress in patient radiation protection, which was completely ignored by some centres just a few years ago.

Inspection of the hospital centres has revealed the need to monitor them particularly closely, given the occupational radiation protection risks in view of the number of workers exposed and the fact that certain practitioners perform a large number of procedures that expose their extremities. On the other hand, it was found that the small centres with operating theatres have a good grasp of occupational radiation protection.

Nuclear medicine

ASN carried out nine inspections in nuclear medicine in 2014. ASN confirms the clearly positive development in the grasp of radiation protection in the nuclear medicine departments inspected in 2014. Their efforts with respect to the content of the radioactive waste and effluents management plan must nevertheless be continued. This plan is the entry point for setting up preventive monitoring measures on the pipes carrying radioactive effluents. ASN notes moreover that several nuclear medicine departments are carrying out major works, even relocations in some cases, which should result in lasting improvements in radiation protection.

The year 2014 was marked by the follow-ups to the file concerning the nuclear medicine department of the Timone hospital in Marseille. ASN notes that the work to divert or repair certain pipes has helped to improve the situation observed previously. The department nonetheless was the subject of a new significant event involving the presence of slightly radioactive wastewater in the hospital stormwater drainage network. ASN considers it necessary for that hospital to implement long-term measures. On 30th June 2014, ASN gave the department formal notice to submit a detailed file presenting its project for lasting improvement in radiation protection. Following this formal notice, the AP-HM (Public Assistance - Marseille Hospitals) finally clarified its project and will relocate part of the department to the site of Conception hospital. ASN will continue to monitor the effective implementation of this project in 2015.

Computed Tomography

ASN carried out 8 inspections in computed tomography in 2014, one of them unannounced, in teleradiology. ASN considers that the situation is satisfactory on the whole, as it was in 2013. ASN notes in particular that the culture of notifying significant events is now well established in this activity.

ASN considers that patient and worker radiation protection is well taken into account on the whole, even if there is room for progress in the coordination of prevention with outside companies and private practitioners and the taking into account of interventional procedures in the working practices analyses.

Dental radiology

ASN carried out a targeted campaign of thirty two inspections in dental radiology in 2014. Two major lines of improvement emerge from it, namely training in occupational radiation protection and the implementation of prevention plans.

These inspections confirmed the vital role of the persons competent in radiation protection (PCR). The PCRs manage a large number of dental surgeries and prepare standard documents which they then adapt to each structure.

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

ASN carried out twelve inspections in industrial radiology in 2014. The inspections revealed situations that are satisfactory on the whole, with work sites properly organised in compliance with the majority of the regulatory requirements and integrating good radiation protection practices. Moreover, few anomalies were detected with regard to document compliance, radiographer qualifications or transport documents.

Following the irradiation incident in June 2012 caused by the jamming of a gamma radiography source in a refinery at Fos-sur-Mer, ASN notes that the company Applus RTD has still not been able to adequately carry out the adequate experience feedback procedure. ASN is still waiting for the expert appraisal that this company is to carry out on the equipment concerned and in 2014 it gave Applus RTD formal notice to continue the analysis of this event.

Universities and laboratories or research centres

ASN carried out eight inspections of research facilities in 2014. ASN has observed progress in the management of radioactive sources in the inspected universities over the last few years. It nevertheless considers that the players must continue their efforts on the subjects relating to radiation protection and the management and removal of radioactive waste, which includes legacy waste.

Progress is to be made in the organisation of radiation protection. The facilities must consolidate the tasks of the PCR in particular.

The risks and compliance with the regulations with regard to radiation protection appear to be significantly better integrated by the research units that depend on industrial companies. The regularisation of the licenses held is continuing on the main university centres in particular.

In order to have a cross-cutting view of all the facilities of the INRA (French National Institute for Agricultural Research) site in Montpellier, ASN carried out an in-depth inspection of radiation protection in the research laboratories that allowed the verification of seven licensees to possess sealed and unsealed sources. The general assessment of ASN on completion of the in-depth inspection is positive. ASN underlines that the involvement of the site's prevention department and the PCRs of each laboratory plays a determining role in the smooth functioning of this organisation.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

ASN continued its verifications in the area of transport in 2014 by carrying out seven inspections of varied players: BNIs, hospitals, research centres, small transport companies and ports. The inspected transport companies on the whole comply with the regulations relative to the inland transport of dangerous goods.

ASN also considers that the regulations are correctly applied in the BNIs and the industrial sector of small-scale nuclear activities. Progress is nevertheless required in the training of the personnel involved.

In the medical sector, on the other hand, ASN considers that the regulations are still insufficiently known.

With regard to significant events concerning the transport of radioactive substances, the seven transport events in 2014 above all concerned damage to packages or packaging contamination.

1.5 Radiation protection of the public and the environment

Radon

ASN carried out five inspections in Corse du Sud (south Corsica), one of the thirty-one priority *départements* targeted by the Ministerial Order of 22nd July 2004 which provides for radon screening and risk management in places opened to the public.

The results are on the whole satisfactory and show that this issue is taken into consideration by the elected officials since the public schools inspected had indeed undergone radon measurements by an approved organisation and where necessary, aeration or ventilation had been used to lower the radon concentration.

Polluted sites and soils

ASN has continued to check the identification and securing of sites contaminated by radioactive substances.

Discussions were held in 2014 with the prefecture of the Var and the town council of Bandol on the management of old sites polluted with radium situated in this municipality.

With regard to the Ganagobie site contaminated with carbon-14 and tritium as a result of the activity exercised by the company Isotopchim from 1987 to the end of 2000, ASN monitored the steps taken by Andra and the DREAL during 2014 with a view to removing the radioactive waste present on the site and is continuing its reflections on the future of the site.

ASN should moreover continue its discussions with the prefecture of the Aude *département* and INRA in 2015 concerning the Pech Rouge site contaminated with strontium-90.

Mining sites

ASN conducted a radiation protection inspection campaign on the former Lodève mining sites in late 2014, to assist the other State departments. With regard to the development work of the Michel Chevalier Regional Business Park (PRAE) on the site of the municipality of Bosc (Hérault *département*), ASN noted the compliance with the provisions for radiation protection of the workers and the neighbouring residents. ASN also took part in the site's CLIS (local information and monitoring committee). At the same time, ASN is continuing its participation in the analysis of the environmental assessments of Areva.

2. ADDITIONAL INFORMATION

2.1 International action

In 2014 the division hosted inspectors from the Belgian safety authority which were able to share ASN's inspection experience in research reactor construction sites.

The division also stepped up its exchanges with the United Kingdom safety authority after having seconded one of its staff members to it.

2.2 Informing the public

Press conferences

ASN held three press conferences in Marseille, Montpellier and Nice in May 2014, on the status of nuclear safety and radiation protection, followed by questions from the media concerning more specifically the monitoring of outside contractors by the ITER organisation and the follow-ups to ASN's action concerning the nuclear medicine department of the Timone hospital in Marseille (AP-HM).

Work with the CLIs

The Marseille division continued to support the CLIs in 2014 by participating in several dozen meetings of the CLIs of Cadarache, ITER and Gard-Marcoule, and by making contributions at several public meetings organised by the CLIs. ASN underlines the dynamism of these CLIs on the national scale.

A notable initiative undertaken by the General Council in 2014 was the merging of the Cadarache and ITER CLIs. This initiative should be concluded in 2015.

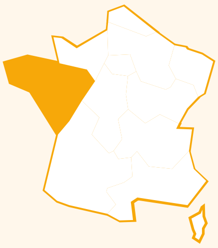
2.3 The other notable events

Emergency situation preparedness

ASN was mobilised in two civil emergency exercises, one concerning the Mélox plant, the other the transport of radioactive substances in the Vaucluse *département*. The division also participated in an emergency exercise concerning the Istres air base. The mobilisation of the various players involved enabled the lessons to be fully drawn from these exercises and in particular certain good practices such as that good organisation on the ground and the good listening capacity of the decision-makers.

Emergency situation management

The division was called six times on the toll-free number for reporting radiological emergencies, four calls being in the Provence-Alpes-Côte d'Azur region and two in the Languedoc-Roussillon region. Although these reports did not involve significant risks, the division maintains its contacts with the mobile radiological intervention units (CMIR).



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE PAYS DE LOIRE AND BRETAGNE REGIONS REGULATED BY THE NANTES DIVISION

The Nantes division is responsible for regulating nuclear safety, radiation protection and the transport of radioactive substances in the 9 *départements* of the Pays de la Loire and Bretagne regions.

As at 31st December 2014, the workforce of the Nantes division stood at 11 officers: 1 regional head, 1 deputy head, 7 inspectors and 2 administrative officers, under the authority of the ASN regional representative.

The activities and facilities to regulate in the Pays de la Loire and Bretagne regions comprise:

- the NPP of the Monts d'Arrée site*;
- the Ionisos irradiator in Sablé-sur-Sarthe;
- the Ionisos irradiator in Pouzauges;
- Installations and activities using ionising radiation in the medical, industrial and research sectors:
  - the medical services: 16 radiotherapy centres (17 locations), 9 brachytherapy units, 19 nuclear medicine departments, 85 sites practising interventional radiology activities, 115 computed tomography scanners, and approximately 5,000 medical and dental radiology machines;
  - industrial and research uses: 50 industrial radiology companies, including 10 gamma radiography contractors, about 750 licences for industrial and research equipments, including more than 300 users of devices to detect lead in paint;
  - 9 agencies for radiation protection technical controls, 7 organisations for radon checks and 4 head offices of laboratories approved for taking environmental radioactivity measurements.

**The Monts d'Arrée site (Brennilis NPP currently being decommissioned) is regulated by the ASN Caen division.*

In 2014, ASN's Nantes division carried out 125 inspections, of which 2 were in BNIs, 117 in small-scale nuclear activities and 6 in the transport of radioactive substances.

The ASN inspectors issued 4 violation reports.

The division was notified of fifty-four significant events, 1 occurring in BNIs and 53 in small-scale nuclear activities. The one event notified in the BNIs was rated level 1 on the INES scale, while among the events notified in the small-scale nuclear activities, 1 was rated level 2 on the INES scale and 3 were rated level 1; added to this were 20 events in radiotherapy, of which 13 were rated level 1 on the ASN-SFRO scale.

ASN inspection in the Guingamp hospital centre.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

The company Ionisos operates two industrial irradiation facilities used chiefly for two applications: product sterilisation (essentially medical equipment, and to a lesser extent foodstuffs) and the treatment of plastic materials to improve their mechanical characteristics.

Following the significant incident of June 2009 relative to the untimely opening of the irradiation cell access door on the Pouzauges site, the licensee implemented the transient technical measures demanded by ASN. After receiving ASN's approval of the safety study concerning technical improvements in the overall management of access to the cell in April 2012, Ionisos submitted the modification files to reinforce the management of access to the irradiation cell for the Pouzauges facility in November 2013 and for the Sablé-sur-Sarthe facility in June 2014. Work has been carried out for the two approved files; ASN has requested additional information for four other files. Only one of these four files, currently being examined, has been provided by Ionisos in December 2014. The licensee must take care to meet the set deadlines for submitting the files or requested additional information.

Two inspections conducted in 2014 served to examine compliance with the facility's baseline safety requirements and assess the progress in the implementation of the provisions of the Order of 7th February 2012 setting out the general rules for BNIs. It emerges that the licensee has continued its work on defining the elements important for protection and the activities important for protection.

The conditions of requalification of the container handling block and tackle in the irradiation unit following its return to service have been reviewed to make them compliant with the regulatory provisions. The incomplete requalification of the block and tackle had been notified in 2013 at ASN's request. The inspectors also observed a few deviations relative to the performance of periodic equipment tests and the verification of the handling crane used during the transport container loading and unloading operations. ASN therefore considers that the licensee must continue its efforts in the detection of deviations.

Finally, the licensee will submit to ASN the periodic safety review reports for the Sablé-sur-Sarthe installation in June 2015 and for the Pouzauges installation in December 2016. The methodology presented for the production of these documents was judged satisfactory in April 2014 subject to the integration of several additional elements such as proof of the exhaustiveness of the list of elements important for protection and the associated requirements, and the possible developments of the external risks (seismic risk, etc.) since the initial design.

1.2 Radiation protection in the medical field

Radiotherapy

The technical and organisational changes (relocations, groupings) undertaken by the radiotherapy centres in the Bretagne and Pays de la Loire regions over the last few years are continuing while preserving the regional meshing of their locations. In this context, ten of the sixteen radiotherapy centres in the Bretagne and Pays de la Loire regions were inspected in 2014.

All the radiotherapy centres in the Bretagne and Pays de la Loire regions meet the criteria relative to the control of treatment planning and delivery. All of the centres have deployed a treatment quality and safety management initiative. Whereas this management initiative showed some delays in deployment in the Bretagne region until 2013, the efforts made by the Bretagne centres in 2014 have corrected them.

Among the continuous improvements that ASN has observed for several years now in treatment safety, it is noteworthy that the quality assurance initiative continues to progress in 2014:
- inspections show a growing control and facilitation of the quality management system by the operational supervisors appointed in each centre;
- the main steps in the treatment of patients are described in procedures specifying the required actions and the responsibilities.

Likewise, ASN observes that the centres define in finer detail their specified requirements for stopping or resuming a treatment and are formalising increasingly well their procedures for internal delegations between professionals of a given service.

With regard to the identification and management of adverse events, all the centres have a system for managing and analysing such events that could occur during the radiotherapy treatment process. The retrospective analyses of events still remain succinct, and must still be taken to greater depth in nearly 40% of the centres.

Moreover, the analyses of risks for patients, provided for by ASN Resolution 2008-DC-103, are completed or nearing completion in all the centres.

The centres that are most advanced in formalising these analyses are moreover starting to use their conclusions to establish action plans for implementing the identified improvement measures.

Finally, the efforts made in the last few years to recruit medical physicists, dosimetrists and physical measurement technicians enable all the centres to ensure the presence of at least one medical physicist during the treatment periods each day while freeing medical radiation physics time for the deployment of new treatment techniques.

Interventional radiology

Further to the regional survey conducted in 2013 with the health centres of the Bretagne and Pays de la Loire regions with a view to refining the knowledge of interventional radiology activities, ASN decided to give a strong regional priority to these inspections in 2014. Sixteen centres were thus inspected in 2014 (compared with nine in 2013) and this drive will be continued in the next few years, especially 2015, with the inspection target set at 22 centres.

The findings remain relatively similar to those of the previous years, with occupational radiation protection generally being better catered for than patient radiation protection. In this latter domain, there is still much room for improvement, whether in the presence and involvement of medical physicists or the defining of dose levels for risky or iterative procedures, procedures for detecting deterministic effects and specific monitoring of patients having undergone this type of procedure. With regard to occupational radiation protection, continued efforts are required in the quantification of doses and protection of the lens of the eyes and the extremities of health professionals. Training on the whole is still insufficient, both in occupational radiation protection and patient radiation protection. The inspector-physicians of the ARS (regional health agency) of Bretagne participated in several inspections in this area.

Furthermore, the analysis of the data collected during the abovementioned survey was finalised in 2014 and enabled a multiyear inspection programme to be established with a view to inspecting at least once all the centres in the two regions and then adapting the inspection frequency according to the overall volume of activity and the types of specialities. The centres practising interventional neurology and interventional cardiology, subject to ARS licensing, shall be inspected at least every three years as from 2016.

Nuclear medicine

Six nuclear medicine units were inspected in 2014. ASN observed improvements in occupational radiation protection, with the drafting of radiation protection inspection programmes, changes in the organisation of radiation protection through the appointment of representatives within the units. The inspectors have also noted a development in the integration of patient radiation protection, notably through the creation of experience feedback committees in nuclear medicine, the application of justification for medical procedures and the verification of dosimetric measurements, for which comparison with the Diagnostic Reference Levels (DRL) enables the doses administered to patients to be reduced.

Continued efforts must be made, particularly as regards the performance of exhaustive in-house radiation protection checks, the integration of the regulatory requirements concerning the management of contaminated effluents and waste and the updating of the risk assessments, zoning and job analyses.

Lastly, greater rigour is required in the implementation and tracking of training in occupational and patient radiation protection.

Computed Tomography

Eight centres were inspected in 2014, and two among these inspections were in teleradiology. Emphasis was placed more particularly on patient radiation protection. The regulations applicable in this area were well applied on the whole by five of the inspected centres, unlike the last centre in which numerous deviations were recorded. Dose monitoring of the personnel is ensured in all the inspected centres, the quality controls of the facilities have been carried out and protocols have been developed to optimise the doses delivered to patients. Efforts must however still be made with regard to the display of instructions and rule of access to controlled zones, the writing of the job analyses, the training in occupational radiation protection and the coordination of prevention measures when several medical teams are involved.

Conventional and dental radiology

Between March and August 2014, ASN conducted an inspection campaign in twelve medical radiology centres in the Mayenne *département* (hospital centres, radiology centres, rheumatologists, etc.). This campaign involved two stages: a documentary survey followed by inspections.

The lessons learned from this survey reveal practices that are highly satisfactory on the whole, in the areas of both worker and patient radiation protection. Progress must nevertheless be made with regard to the completeness of the external technical checks in radiation protection, the external quality controls of the radiology devices and the training of the professionals in patient radiation protection. Six medical radiology centres had to regularise their situation after having omitted to declare the changing or addition of radiology devices.

Four inspections carried out in Mayenne revealed a small number of regulatory deviations in terms of zoning, instructions, quality controls and radiation protection checks, and procedure reports.

Over the same period, ASN conducted a similar campaign with 221 dental surgeries of the Côtes-d'Armor.

The lessons learned from this survey reveal contrasting practices, particularly with generally satisfactory compliance with the regulatory requirements for occupational radiation protection, unlike patient radiation protection where there is significant room for progress, particularly in the performance of the quality controls of radiology devices.

Eighteen inspections targeting the dental surgeries "in principle the least well-positioned" revealed numerous regulatory deviations such as: the fitting out of the premises in almost 90% of the dental surgeries inspected, the radiation protection technical checks, the materialisation of zoning, the display of instructions and the quality controls in 80% of them, and the administrative situation in more than 70% of them.

This inspection campaign led to the regularisation of the administrative situation of 27 of the 34 dental surgeries that did not have a notification certificate. Another 22 dental surgeries had to correct their notification (relocation, addition of radiology devices, etc.). A regularisation request was therefore sent in early August to the 29 dental surgeries whose situation was not in order. The list of these dental surgeries was also sent to the CPAM (Primary sickness insurance fund) of the Côtes-d'Armor in order to initiate, where necessary, the stopping of the reimbursement of the procedures carried out in these surgeries in accordance with the provisions of the French social security code. By the end of 2014, seventeen of these surgeries had regularised their situation.

A synthesis of these inspections was presented to the departmental council of the national order of dental surgeons in the presence of representatives of the professional unions in order to raise their awareness of the lines of progress.

Actions to inform the professionals

The Nantes division of ASN made contributions during training courses dispensed to medical radiation technologists, occupational physicians and hospital personnel.

ASN also made two appearances at the EHESP (French School of Public Health), firstly to present ASN to all the students who are destined to work in the Government departments, and secondly during a technical training course relating to nuclear medicine during the statutory training course for Public Health Inspection Pharmacists (PHISP).

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

Nine inspections were carried out in 2014, enabling all the gamma radiography professionals of the Pays de la Loire and Bretagne regions to be inspected over a period of three years. ASN notes that the inspected organisations on the whole satisfy the regulatory requirements concerning the organisation of radiation protection, operator training, the monitoring of exposed workers and equipment maintenance.

Progress nevertheless remains to be made in the in-house and externalradiation protection checks, particularly following reception, maintenance or reloading of the devices, and in terms of the analysis of doses received by workers, bringing exposure bunkers into conformity and setting up operation zones on work sites.

The incidental exposure of a radiographer from the company SGS Qualitest Industrie when performing radiographic exposures on an industrial site during the night of 17 to 18 April 2014 was rated level 2 on the INES scale on account of the failure of several lines of defence. Several essential radiation protection procedures were not applied, notably with regard to controlled area entry instructions (see chapter 10).

Universities and laboratories or research centres

Four inspections were carried out in the field of public research in 2014, which means that ASN has inspected more than 83% of the organisations in this sector over the last nine years. ASN observes the continuing regularisation of administrative situations, and strong involvement of the persons competent in radiation protection (PCR), enabling practices to be turned towards techniques that reduce personnel exposure, and even techniques that avoid using radioactive sources. Progress is still expected with regard to the waste and effluent management plans, the tracking of source and waste inventories and the formalising and performance of the periodic in-house and external radiation protection checking programmes. Performance of the in-house radiation protection checks is nevertheless starting to improve following the regulation reminders addressed to the licensees.

Devices for detecting lead in paint

Five inspections of holders of devices for detecting lead in paint were carried out in 2014. These inspections resulted in the regularisation of several irregular administrative situations. Moreover, numerous deviations from the applicable requirements regarding radiation protection and the transport of radioactive substances were recorded, including more particularly the absence of fire extinguishers and of the radiation protection checks of devices. Finally, under the justification principle, the inspectors found several cases of deviations with the manufacturer's specified replacement frequency for the radioactive source in order to guarantee measurement reliability.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

Ten inspections were carried out on the transport of radioactive substances in small-scale nuclear activities.

Two inspections were carried out at Brest airport when an air delivery of radiopharmaceutical products was made. The inspection of the air transport conditions revealed the use of an inappropriate package for this type of transport. With regard to the road transport company that took charge of the package on its arrival, no notable deviation from the regulations was recorded.

Two other inspections were carried out in healthcare centres that receive and send radioactive sources. The finding is that progress remains to be made in the training of personnel and formalising the activities relating to transport (writing a quality assurance programme governing the transport of radioactive substances, writing procedures).

Six inspections were carried out on the industrial sector (transport of gamma ray projectors and gamma ray densitometers). These inspections revealed shortcomings in package marking and labelling. The general conditions of securing packages or closing containers were also found to be sub-standard in several cases.

1.5 Assessment of radiation protection of the public and the environment

Radon

ASN has participated in the town of Nantes's radon screening campaigns in dwellings since 2009. These campaigns form the subject of two public meetings, the first ending with the issuing of dosimeters to the inhabitants of the districts concerned by the campaign, and the second at which the measurement results are returned and remediation actions are proposed. In 2014, as in the preceding years, the Nantes division made contributions during these information meetings.

Moreover, within the framework of the Pays de la Loire region's Regional Health and Environment Plan (PRSE2) coordinated by the DREAL and the ARS, the Nantes division is a member of the steering committee of an initiative whose aim is to update an information brochure on radon in the Pays de la Loire and to create a guide to the development of training modules to teach building industry professionals about the radon issue.

Mining sites

ASN carried out two inspections on the former mining sites in the region, the first in the Côtes-d'Armor in Bretagne and the second on a Pays de la Loire site, as part of the monitoring of the actions defined by the MEEDDM/ASN circular of 22nd July 2009. ASN also took an active part in the information and discussion meetings organised by the offices of the Prefects of the Morbihan, Côtes-d'Armor, Loire-Atlantique and Vendée *départements* on the subject of the former uranium mines.

ASN is continuing its participation in the analysis of Areva's environmental assessments of the former mining sites of the two regions in collaboration with the DREALs (Regional Directorate for the Environment, Planning and Housing) of the Bretagne and Pays de la Loire regions. At the same time, ASN is keeping a watchful eye on the progress of the actions carried out by Areva in the inventorying of radiologically marked areas around the former mining sites and sites in the public domain where uranium mining tailings are reused and in the search for disposal routes for the materials resulting from the remediation work, such as the Écarpière site in Loire-Atlantique.

The first work sheets associated with places where mining waste rock has been reused have thus been analysed jointly by the services of the DREAL and ASN. The resulting remediation actions are monitored jointly.

2. ADDITIONAL INFORMATION

2.1 International action

On the international front, the Nantes division contributed to a training course organised by IAEA in Tunisia on the effective and lasting regulatory control of sources of ionising radiation with the heads of the African radiation protection authorities.

The Nantes division also participated in the IRRS follow-up audit in Slovenia and an expert appraisal mission in the United Kingdom.

2.2 Informing the public

Press conferences

In 2014, ASN held two press conferences in Nantes and Rennes on the state of nuclear safety and radiation protection.

Work with the CLIs

ASN's Nantes division participated in the meetings of the CLIs for the Ionisos nuclear facilities, held in Sablé-sur-Sarthe on 29th October 2014 and in Pouzauges on 14th October 2014.

Public information actions

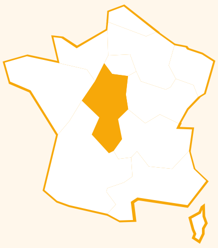
Lastly, as in 2012, the Nantes division of ASN played an active role in the organisation of the "Radiation protection workshops" by accompanying two Loire-Atlantique high schools.

2.3 The other notable events

Emergency situation preparedness

The Nantes division of ASN gave a presentation of the crisis organisation in the event of a radiological emergency situation to the personnel of the Côtes-d'Armor prefecture and other administrative services (fire brigade, gendarmerie, etc.). The Côtes-d'Armor prefecture then held an emergency exercise on 10th December 2014 in the municipality of Saint-Brieuc (Côtes d'Armor *département*) involving a road traffic accident between a utility vehicle transporting radiopharmaceuticals and a private vehicle.

This local emergency exercise served to test the procedures for alerting the competent authorities (with the exception of the Nantes division of ASN), the implementation of the reflex actions in this type of situation, the triggering of the corresponding contingency plan and the simulated transfer of several medicalised patients to the hospitals of Saint-Brieuc. This exercise involved the deployment of police and emergency service resources on the ground.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE CENTRE, LIMOUSIN AND ILE-DE-FRANCE REGIONS REGULATED BY **THE ORLÉANS DIVISION**

The ASN Orléans division is responsible for regulating nuclear safety and radiation protection in the 9 départements of the Centre and Limousin regions. The Orléans division is also at the disposal of the ASN Paris regional representative, under whose authority it regulates the safety of the BNIs of the Ile-de-France region.

As at 31st December 2014, the workforce of the ASN Orléans division stood at 27 officers: 1 regional head, 4 deputy heads, 18 inspectors and 4 administrative officers, under the authority of the ASN regional representative.

The activities and installations to be regulated in the Centre, Ile-de- France and Limousin regions comprise:

- the Belleville-sur-Loire NPP (2 reactors of 1,300 MWe);
- the Dampierre-en-Burly NPP (4 reactors of 900 MWe);
- the Saint-Laurent-des-Eaux site: the NPP (2 reactors of 900 MWe) in operation, as well as the 2 French gas-cooled reactors (GCR) undergoing decommissioning and the irradiated graphite sleeve storage silos;
- the Chinon site: the NPP in operation (4 reactors of 900 MWe), the 3 French GCRs undergoing decommissioning, the Irradiated Material Facility (AMI) and the Inter-Regional Fuel Warehouse (MIR);
- the 8 BNIs in the CEA Saclay centre, including the Osiris and Orphee experimental reactors;
- the UPRA (artificial radionuclide production plant) operated by CIS bio international in Saclay;
- the 2 BNIs undergoing decommissioning in CEA's Fontenay-aux- Roses centre;
- the Orsay laboratory for the use of electromagnetic radiation, currently in the delicensing phase following decommissioning;
- the medical departments in the Centre and Limousin regions using ionising radiation: 12 radiotherapy centres, 5 brachytherapy departments, 12 nuclear medicine departments, 48 interventional radiology departments, 65 tomography devices, 1,600 medical radiology devices and 2,100 dental radiology devices;
- the industrial and research utilisations of ionising radiation in the Centre and Limousin regions: 20 industrial radiology companies, including 6 gamma radiography contractors, some 400 industrial, veterinary and research devices subject to the licensing system, and some 120 industrial, veterinary and research devices subject to the notification system.

In 2014, ASN carried out 191 nuclear safety and radiation protection inspections: 86 inspections of the nuclear installations on EDF's Belleville-sur-Loire, Chinon, Dampierre-en-Burly and St-Laurent-des-Eaux NPPs (of which 4 concerned transport), 47 inspections on the nuclear sites in the Ile-de-France region (CEA Saclay and Fontenay centres, CIS bio international in Saclay), 58 inspections on small-scale nuclear facilities in the Centre and Limousin regions. ASN also ensured 30 days of labour inspection in the nuclear power plants.

In 2014, 13 significant events rated level 1 on the INES scale were notified by the licensees of EDF nuclear installations in the Centre region, and 4 significant events of level 1 were notified by the licensees of the Ile-de-France nuclear sites. In the small-scale nuclear activities, two events of level 1 on the ASN/SFRO scale were notified in the Centre and Limousin regions.

On the basis of the inspections conducted by the Orléans division, ASN's inspectors drew up 11 violation reports which were submitted to the competent public prosecutors, and served 3 compliance notices.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Belleville-sur-Loire NPP

ASN considers that the performance of the Belleville-sur-Loire NPP is on the whole in line with the general assessment of EDF in the areas of safety, security and radiation protection, but its environmental performance is below average.

With regard to nuclear safety, as in 2013, the management and treatment of deviations can still be improved and remain one of the main lines for improvement identified by ASN for the maintenance and operating activities. Furthermore, ASN considers that particular attention must be paid to the preparation of the operational management and maintenance activities, and more specifically with regard to application of the work documents.

In the area of worker safety and radiation protection, the site's performance matches the average for the EDF reactor fleet. The quantitative indicators are good, but several events that occurred essentially during the outage of reactor 1 indicate organisational weaknesses. ASN therefore considers that the site must be particularly attentive to these signs of weakness.

With regard to the areas of pollution prevention and control of the impact and nuisance for the public and the environment, the site's performance has not yet reached the required level and remains below the general assessment of EDF. Since January 2013, the site has initiated a plan of environmental rigour to lastingly remedy the situation. On 17th December 2013, ASN issued a resolution of which the prescriptions govern the main actions of this plan. In 2014 it carried out a tightened inspection on several themes; progress was observed with regard to the organisation. However, although steps have been initiated to restore compliance with the environmental baseline requirements, knowledge of the regulatory requirements is still insufficient and the mobilisation of all the site's players must be further reinforced.

Chinon site

The nuclear safety and radiation protection performance of the Chinon NPP led ASN to place the site under tightened surveillance at the end of 2010. At the same time, EDF, which agreed with ASN's judgement, engaged a plan of operating rigour to remedy this situation. ASN carried out an in-depth inspection in 2012 to assess the effects of this plan. In 2014, during an inspection spanning three days, ASN verified the measures taken by the licensee further to the in-depth inspection.

ASN considers that in terms of nuclear safety, the Chinon NPP is approaching the level of its general assessment of EDF. The quality of operation and maintenance has improved since the plan for operating rigour was implemented. ASN nevertheless notes that in view of the inspections carried out and the notified events, weaknesses in operating rigour do subsist, particularly during the periodic tests. With regard to maintenance, the site must improve the monitoring of its outside contractors. Improvements are also required in the integration of experience feedback in the area of nuclear safety.

With regard to radiation protection, ASN considers that the performance of the Chinon NPP stands out positively with respect to its assessment of EDF as a whole. In 2014, the site maintained the dynamic trend observed in the preceding years. Radiation protection is duly taken into consideration in the preparation of work involving risks. ASN also notes the strong involvement and responsiveness of the persons concerned and the site's commitment to a radiological cleanliness improvement initiative.

With regard to environmental protection, ASN considers that the performance of the site falls short of its general assessment of EDF performance, but notes that progress has been made in the organisation of the site. In 2014, the management of liquid effluents was not as efficient as in the preceding years because some treatment equipment was out of service for a long time. ASN will moreover check application in 2015 of the programme to restore conformity of the facilities with respect to the applicable regulations, for which the Chinon site has been mobilised.

In 2014, operation of the irradiated material facility (AMI) was marked by application of a remediation plan established by EDF in 2013 at the request of ASN further to its finding of significant organisational malfunctions. The effects of these malfunctions were still being felt at the beginning of 2014. ASN will remain vigilant in 2015 to the improvement in the operating safety of the facility.

EDF has also supplemented, at the request of ASN, the decommissioning authorisation application file submitted in June 2013, in the perspective of final shutdown of the facility in 2016. Provisions for the packaging and storage of the legacy waste still present in the facility have also been made pending its removal to the appropriate management routes. ASN will be attentive to the legacy waste recovery and packaging operations, given the lateness accumulated over the last few years.

EDF plans to transfer part of the appraisal equipment to a new facility on the site, the Integrated expert appraisal laboratory of Ceidre (Lidec). ASN will pay particular attention to the management of this transfer.

ASN considers that the operation by EDF of the inter-regional fuel warehouse (MIR) of Chinon, where new fuel assemblies are stored pending use, must be based on a more robust organisation to improve control of the adaptation of the general operating rules and monitoring of the actions. The safety case must be consolidated as part of the periodic safety review and the stress tests prescribed by ASN resolution of 17th December 2013. These files must be submitted in 2015.

ASN considers that the level of safety of the nuclear facilities of the former Chinon NPP is satisfactory.

The actions and commitments taken further to the in-depth inspection carried out in 2013 have produced results and the management of the waste produced by the facility remains satisfactory. The inspections carried out in 2014 have nevertheless revealed, as in 2013, shortcomings in the integration in the applicable baseline requirements of the modifications relative to work conditions.

The licensee's monitoring of outside contractors is judged satisfactory, particularly on the high-risk work site that the decommissioning of the reactor A3 heat exchangers represents. The licensee's vigilance over subcontracted activities must be maintained in 2015.

ASN will monitor the progress of the repairs to the stormwater networks and the work on the civil engineering of the basements of the Chinon A1 and Chinon A3 installations, which has been carried out to limit the penetration of storm water and improve stormwater management.

Dampierre-en-Burly NPP

ASN considers that the nuclear safety and radiation protection performance of the Dampierre-en-Burly site is on the whole in line with the general assessment of EDF.

The site's organisation with regard to safety is considered satisfactory, particularly for the management of reactor outages and unscheduled maintenance operations. ASN does however note that the inspections it carried out in 2014 reveal, as in the previous year, a lack of rigour in the preparation and performance of maintenance work. On this account, the Dampierre NPP must reinforce its reliability practices when carrying out maintenance work on its facilities. The licensee has started to develop new aids to make the workers more aware of the implications of their activities. ASN will endeavour to evaluate the effectiveness of the actions undertaken to this end during the reactor outage campaign in 2015.

The site's organisation in the areas of worker safety and radiation protection is satisfactory.

Further to the action plan initiated at the end of 2014, ASN notes significant progress in the implementation of means of protection when working in controlled areas. The licensee must thus use the experience acquired during the numerous work interventions associated with the 10-year outages in particular to continue and consolidate its practices as of 2015.

The Dampierre-en-Burly site continues to stand out positively with respect to ASN's general assessment of EDF for the control of the impact of the facilities on the environment, with the environmental issues being taken well into account in the various departments. ASN does however note an increase in certain discharges further to unforeseen technical difficulties in operating processes.

Saint-Laurent-des-Eaux site

ASN considers that the performance of the Saint-Laurent-des-Eaux NPP with respect to safety, radiation protection and environmental protection stands out positively with respect to its assessment of EDF as a whole.

With regard to nuclear safety ASN considers that the site is maintaining a satisfactory level. Nevertheless, the risk analysis procedure and the preparation of maintenance activities, particularly when they come in addition to the initially planned programme, warrant reinforcement. This year, ASN is finding a growing number of ergonomic deficiencies in the operating documentation. Efforts must also continue to be made in the management of the risk of foreign object ingress into the primary system, especially considering that the outage of reactor 2 was seriously disturbed by the presence of migrating objects in the fuel assemblies which led to «cladding defects».

In the area of radiation protection, the site's performance in collective and individual dosimetry is satisfactory on the whole, despite the unfavourable conditions that created the cladding defects of reactor 2. ASN notes the work undertaken to improve control of the limited stay area («orange zone») process[1]. The site must however continue to reinforce the radiation protection culture of the workers.

1. In order to protect the workers against the risks associated with ionising radiation, the regulations provide for nuclear installations to be divided into different areas classified according to the conditions of radiological exposure, with specific access rules imposed for each of these areas. Thus, access to the limited stay areas (called "orange zones" in French) where the equivalent dose rate is likely to be between 2 millisieverts per hour (mSv/h) and 100 mSv/h requires the prior agreement of the radiation protection department and is reserved for personnel employed on unlimited term contracts (CDI).

With regard to the impact of the facilities on the environment, the site maintains good management of the liquid and gaseous discharges and of radioactive and conventional waste, even if cladding defects have led to exceeding of the targets set for radioactive gaseous discharges. Moreover, a few deviations have been observed with respect to the operating baseline requirements relative to the necessary equipment and the gas yard. ASN is however pleased to note the creation of an independent process competent in environmental matters based on the model of the process that exists in the area of safety.

ASN considers that on the whole the level of safety of the nuclear installations of the former Saint-Laurent-des-Eaux NPP is satisfactory.

ASN observes an improvement in the licensee's waste management, particularly in the operating instructions and the upkeep of the storage areas. ASN is now waiting for significant progress to be made in the processing and removal of the legacy waste. ASN notes that EDF has ensured a good standard of on-the-ground monitoring of outside contractors.

Despite the progress of the decommissioning preparation work sites, ASN observes a large number of unforeseen events which lead to lateness in the overall decommissioning schedule for the facility. ASN urges the licensee to find the root causes of these events.

Labour inspection in the nuclear power plants

ASN kept up its monitoring of the work and rest times of EDF employees in 2014. It also continued its checks on compliance with the regulations applicable to the use of temporary workers in the EDF nuclear power plants.

With regard to health and safety, ASN ascertains that EDF puts in place the appropriate measures in response to the observations made regarding the conformity of the equipment used by the employees. Reminders were made during specific inspections to check compliance with the commitments made with regard to labour inspection.

Nuclear research facilities or facilities undergoing decommissioning, nuclear plants and units

CEA's Saclay centre

ASN considers that the BNIs of the CEA Saclay centre are operated under generally satisfactory conditions of safety. CEA must nevertheless be vigilant about maintaining the operating rigour of the BNIs. The CEA's overall organisation for tracking and meeting the commitments taken further to ASN inspections and significant events is of good quality. The situation in this area is still not satisfactory on BNI 72, even if some initial signs of progress have been observed since the periodic reviews were put in place.

ASN considers that the monitoring of outside contractors is well engaged for the centre as a whole but presents disparities between BNIs. Thus, although certain BNIs such as BNI 35 have now started a well-structured process, other BNIs, especially BNI 72, must make further progress, particularly in the setting up of monitoring programmes and field visit traceability.

ASN has also noted the deployment of the planned measures following the detection of several deviations concerning the systems for monitoring radioactive gaseous discharges from the facilities in 2013. CEA must continue its efforts, particularly with regard to the traceability of maintenance on these systems and the monitoring of the contractor in charge of this maintenance. In effect, ASN has noted that failures of the gaseous discharge measuring systems had occurred again in 2014.

CEA must also remain attentive to maintaining the containment of pipes transporting radioactive or hazardous substances. Two events in 2014 led to discharges outside the BNIs but with no impact outside the centre.

Operation of the BNIs

ASN considers that conditions of operation of the Osiris facility were satisfactory. ASN confirmed in 2014 that it was not in favour of Osiris continuing operation beyond 2015 given the current level of safety of this reactor. The Orphée reactor is also operated under satisfactory conditions of safety. ASN will nevertheless be attentive to the quality of the lessons learned from the analysis of the significant events notified for these two reactors with regard to the human and organisational factors and the prevention of equipment failures.

ASN also considers that the level of safety of the irradiated fuel test laboratory (LECI) is satisfactory on the whole. The licensee must however remain extremely vigilant with regard to its operating rigour in order to correct the deviations observed in the controls and periodic tests.

ASN notes the efforts made by BNI 35 to improve the robustness of operation of the Stella unit for treating radioactive liquid effluents.

Operation of the Poséidon irradiator is satisfactory.

Preparation for final shutdown and decommissioning

CEA must submit the final shutdown and decommissioning authorisation application for the Osiris reactor in accordance with the decree of 2nd November 2007.

The decree authorising CEA to proceed with final shutdown and decommissioning of the Ulysse training reactor was published on 18th August 2014. ASN will be attentive to the starting of the operations and the monitoring of subcontracted work.

The level of safety of the decommissioning operations on the former hot laboratories of BNI 49 (LHA - high activity laboratory) is satisfactory. The control of these subcontracted operations, which formed the subject of a new contract in 2014, constitutes a major issue for 2015.

For BNI 35, ASN will keep a close watch over the continuation of removal from storage of the MA 500 tanks so that removal of all the old effluents is completed by the end of 2018.

ASN considers that the safety of BNI 72 is satisfactory but in view of the major work required to prepare for the final shutdown of this solid waste storage and treatment facility, CEA must significantly reinforce its organisation.

The CIS bio international plant in Saclay

ASN considers that the operating safety performance of CIS bio international must be significantly improved.

As a general rule, CIS bio international still displays significant difficulties in managing large-scale undertakings. Thus, many works to improve safety which have been under way for several years are not yet completed and others have not yet been started. ASN considers in particular that the licensee must significantly improve execution of the actions that were specified further to the periodic safety review of the facility. At the time, ASN had prescribed reinforcing the measures to control the fire risk, among other things. As the deadlines for implementing these measures were not met, ASN gave CIS bio international formal notice through ASN Resolutions 2014-DC-0430 of 6th May 2014 and 2014-DC-0454 of 24th July 2014 to install automatic fire extinguishing systems in the various premises containing radioactive materials, following a predetermined schedule. Moreover, pending performance of this work, ASN has prescribed the application of protective measures to reinforce control of the fire risk on the BNI. Following to the observed failure to comply with the deadlines set in the compliance notice of 6th May 2014, ASN has started procedures to impound funds with respect to CIS bio international. ASN has asked CIS bio international to review its organisation in order to finish the work to ensure compliance with standards without delay.

In addition, the deviations observed during the inspections and the predominance of organisational and human factors in the causes of significant events reveal persistent weaknesses in operating rigour and safety culture.

The control of the operating range, the qualification of radiation protection equipment, the management of waste and the maintenance of certain items of equipment must be significantly improved.

CIS bio international has again modified its organisation in 2014. ASN hopes that this reorganisation will improve cross-company action and coordination and contribute significantly and lastingly to operating rigour.

ASN will be particularly attentive to CIS bio international's compliance with the abovementioned resolutions and meeting of its commitments. ASN will thus keep the facility under tightened surveillance and oversight in 2015.

The CEA's centre in Fontenay-aux-Roses

ASN considers that the level of safety of the facilities of the CEA Fontenay-aux-Roses centre can be substantially improved, particularly in the area of fire risk control. It also notes that the decommissioning operations are behind schedule and considers that the CEA's organisation for coordinating these operations must be adapted and reinforced for the major operations of the coming years.

ASN notes positively the efforts made by CEA to meet all its commitments despite being behind schedule in the implementation of a number of them.

ASN also underlines the licensee's clear desire to, insofar as possible, render uniform the good practices of the two BNIS and enhance the reliability of the waste production and removal streams in order to successfully complete the decommissioning of these BNIs. This approach fits into the wider framework of the new organisation put in place for these facilities in October 2013.

The analysis of the notified events and the inspections carried out in 2014 nevertheless bring ASN to the same conclusions as in 2013. Work preparation, whether associated with operating activities including equipment qualification, inspection and periodic tests, maintenance or more specific work, must be very substantially improved. Control of the interfaces between the various players of CEA and its outside contractors to limit the risks associated with organisational and human factors remains an area for improvement. CEA must take care to conserve skills and keep control over the monitoring of subcontracted activities, for which it makes considerable use of external service providers. The three points mentioned above are of vital importance for CEA to control the work of outside contractors.

The fire risk was found to be insufficiently catered for in 2014, as witnessed by the two notified outbreaks of fire. Efforts must be made in the management of waste, of combustible materials and chemical products.

Lastly, ASN notes that since the publication in 2011 of the resolution subjecting certain operations relative to the decommissioning of the Pétrus shielded cells line to ASN authorisation, CEA has made no authorisation applications. The successive postponing of the authorisation application files means there is no visibility on the starting of these operations, yet they represent one of the major risks in the decommissioning of BNI 165. ASN considers this situation to be unsatisfactory. The schedules presented at the end of 2014 must be met.

1.2 Radiation protection in the medical field

Radiotherapy

ASN considers that occupational radiation protection is satisfactorily catered for in the Centre and Limousin regions.

During the inspections carried out in 2014, it was also found that efforts have been made to formalise the practices, resulting from the regulatory provisions relative to treatment quality and safety. ASN's awareness-raising and oversight action during 2014 was moreover oriented towards the quality of the technical verifications of the devices and the conditions of notification and management of adverse events. Lines of progress have been identified for monitoring and evaluating the effectiveness of the proposed improvement actions and compliance with the conditions of performance of the device quality controls.

ASN was notified of 13 significant events in 2014, the same number as in the preceding year. The deviations associated with these events concern the positioning of the irradiation beams, the positioning of the patient and patient identification. Two of these events were rated level 1 on the ASN-SFRO scale, which has eight levels. Level 1 means that benign effects may be observed, but without a notable impact on the treatment.

Consequently, ASN will place particular focus on stepping up its oversight actions on these themes in 2015.

Interventional radiology

In the light of the 13 inspections that ASN carried out in the interventional radiology departments of the Centre and Limousin regions in 2014, ASN considers that occupational radiation protection in the operating theatres is tending to improve (person competent in internal radiation protection, training of workers and dosimetry in particular). Noncompliance with radiation protection measures is nevertheless still persistently observed with the practitioners.

ASN notes that patient radiation protection is not yet sufficiently integrated in the operating theatres. It is better integrated in the dedicated facilities. Three significant events, one concerning the exposure of a patient and the other two concerning exposure of workers, were notified to the Orleans division by interventional radiology departments in 2014. They bear witness to the gradual - but still insufficient - implementation of aids for identifying and analysing adverse events in the operating theatre.

ASN emphasises that the notifications of events and the analysis of the malfunctions that cause them are necessary in order to make progress in treatment safety and quality.

Nuclear medicine

ASN considers that the organisational and material measures implemented on account of occupational radiation protection are satisfactory in the nuclear medicine departments of the Centre and Limousin regions. It will remain attentive to ensure they are maintained and adapted to the emerging risks in nuclear medicine, particularly with regard to treatment with alpha emitters. ASN observes that waste and effluent management is rigorous, but the analysis of the radioactivity measurements taken at the height of the discharge outlets is often lacking or incomplete.

ASN has moreover again found heterogeneity in the organisation dedicated to the detection, recording and analysis of significant events. ASN does however note an increase in the number of notifications in 2014 and will try to see to it that this trend is maintained. The analysis of the notified events reveals that the efforts to ensure the safety of patient care and the management of radiopharmaceuticals must be continued.

Lastly, ASN considers that the medical teams must continue their efforts to improve the protocols for performing scans in nuclear medicine in order to optimise the dosimetry.

Computed tomography, teleradiology

ASN carried out nine inspections in computed tomography departments in 2014 (including one in a centre using teleradiology), while stepping up the verification of measures taken for patient radiation protection. Progress in the optimisation of the doses delivered during examinations is fostered in particular by the modernisation of the equipment, thanks to intensity modulation software among other things. Nevertheless, ASN observes that all the possibilities in this area are not always turned to good account.

ASN is vigilant when teleradiology is used, a practice that is observed at present in 7% of the inter-region facilities. During the examination of the licensing files and the inspections of these centres, it checks on the smooth coordination of radiation protection between the department that performs the examinations and the radiologist, who can intervene from a distance during the examination to guide the radiographer and who interprets the results.

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

Six inspections were carried out in 2014, on work sites and in bunkers, on establishments using gamma ray projectors and X-ray generators. Large disparities persist between the small and the larger structures.

The service providers of the Centre and Limousin regions have not yet embraced the use of the on-line work-site notification application. Several companies will receive a reminder about this.

Research

The Centre and Limousin regions count 29 research departments or units authorised by ASN to use ionising radiation, essentially situated in the towns of Orléans, Tours and Limoges. The university has the largest number of laboratories using ionising radiation, followed by the CNRS, whose research units are all based in Orléans. INRA (French National Institute for Agricultural Research) is in third place with four research units (three in Nouzilly and one in Orléans). The research units of the Centre and Limousin regions have material and human resources for radiation protection that are judged highly satisfactory. Sources and waste management is rigorous and the personnel are on the whole well trained in radiation protection. The four inspections carried out in these units in 2014 reveal the shortcomings in the process for identifying and notifying significant radiation protection events.

1.4 Nuclear safety and radiation protection in the transport of radioactive materials

In 2014 ASN performed 3 inspections in BNIs and 1 inspection in nuclear medicine and brachytherapy departments. The inspections focused chiefly on the measures applied, the organisational structures in place, compliance with package approvals and operational specifications. These inspections show that progress is required in terms of compliance with the requirements of the approvals, including for the performance of package maintenance, robustness and application of operational procedures, securing of containers and quality assurance. More specifically, deliveries of medical radionuclides to hospital centres are most often made outside opening hours when no personnel from the department is present to receive the packages. The inspections revealed that there is no verification of movements on the hospital site, of unloading or measurement of the activity of packages.

The majority of significant events, which mainly concern nonconformity of content, noncompliance with package approval, loss of package integrity, inappropriate handling measures and labelling errors, can be put down to human and organisational causes, but they also result from equipment deficiencies which are currently being corrected. These events are limited in number.

1.5 Radiation protection of the public and the environment

Radiation protection technical controls

Four organisations approved for radiation protection controls (out of 42 in France) have their head office in the Centre and/or Limousin regions. ASN maintained its oversight action in 2014 by auditing two organisations and holding two supervisory checks. The findings of these latter checks concern the conditions of measurement of ionising radiation and the search for anomalies in the radiation attenuation devices.

The main findings of the audits concerned the management rules for the substitution and supervision of the controllers.

When deviations are found, ASN asks for a plan of action to be established and implemented within two months with the general aim of improving the reliability of these controls.

Former uranium mines

In application of the circular of 22nd July 2009, Areva has made an inventory of the mining waste rock storage sites in the Limousin region. Maps have been drawn up and were presented to the region's three site monitoring committees in 2012. The inventorying methodology applied by the former licensee resulted in the identification of areas with the presence of waste rock, and eleven of these displayed an average exposure value of more than 0.6 mSv/year in the three *départements* of the Limousin region.

ASN demands that the legacy licensee undertakes the procedures and work to reduce this exposure to the lowest possible level. To this end, the licensee has drawn up for each site a sheet summarising the data concerning the radiological exposure measurements, the use of the land, the location of the waste rock deposits, particularly when close to housing. Lastly, treatment options are proposed – most often removal of the contaminated materials - with the aim of ensuring that the clean-up is as complete as possible.

These sheets were examined by ASN in 2014 to assist the DREAL; ASN considers that Areva's proposals do not sufficiently integrate the principle of complete clean-up of the site.

At the same time, the booklets present the sites identified when the inventory was established and their assigned classification for each municipality concerned. This information was published in 2014 and made available to the public with the aim of ensuring that there are no sites known to the local residents that have been omitted.

The past operating activities may in certain cases have had a radiological impact on the environment due to the possibilities of radionuclide transfer with the materials or in the drainage system. Even if such exposure generally remains low, ASN considers it important to carry out these assessments to ensure that the transfer of radionuclides between the environment and man is studied. In this context, ASN, assisted by IRSN, examined the study provided by Areva on the modelling of transfers from grass and the ground in the vicinity of the former mining works and asked Areva for further studies.

2. ADDITIONAL INFORMATION

2.1 International action by the Orléans division

In 2014, the Orleans division received a delegation from the Swedish safety authority (SSM - Strål Säkerhets Myndigheten), to discuss the modifications that have been made to the NPPs to draw the lessons from the Fukushima accident. A visit to the Dampierre-en-Burly NPP was organised, including a presentation of the resources of the nuclear rapid intervention force (FARN) hosted on the site.

2.2 Informing the public

Press conferences

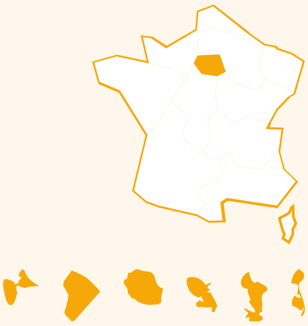
In 2014, ASN held two joint press conferences in Orléans and Paris on the state of nuclear safety and radiation protection.

Work with the CLIs

The division took part in various meetings of the CLIs in the Centre and Ile-de-France regions. During these meetings, the division more specifically presented its assessment of the safety situation of the nuclear facilities concerned and the administrative sanctions taken against the licensees where applicable. Lastly, the division continues to accompany the diversified appraisal initiatives launched by the CLIs of Saint-Laurent-des-Eaux and Fontenay-aux-Roses. The division also invited the CLIs to attend inspections of nuclear power plants in the Centre region as observers.

2.3 The other notable events

The division prepared, under the overall coordination of the Cher *département* prefecture, and took part in the emergency exercise held on 27th May 2014 at the Belleville-sur-Loire NPP. This exercise served to test the organisation that EDF and the public authorities would put in place to cope with a nuclear accident. It aimed in particular at testing the setting up of an interdepartmental response system, which could be deployed on account of the geographic position of the nuclear power plant. The retrospective assessment of the exercise revealed several areas for improvement, particularly regarding the coordination of communication between the various protagonists.



THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE ILE-DE-FRANCE REGION AND OVERSEAS FRANCE DÉPARTEMENTS AND TERRITORIAL COMMUNITIES REGULATED BY THE **PARIS DIVISION**

The Paris division regulates radiation protection and the transport of radioactive substances in the eight *départements* of the Ile-de-France region and the 5 overseas *(Outre-Mer) départements* (Guadeloupe, Martinique, Guyane, La Réunion, Mayotte). It also fulfils duties as expert to the competent authorities of French Polynesia and Nouvelle-Calédonie.

As at 31 December 2014, the workforce of the Paris division stood at 22 officers: 1 regional head, 2 deputies, 17 radiation protection inspectors and 2 administrative officers, under the authority of an ASN regional representative.

The small-scale nuclear facilities to be regulated in the Ile-de-France region and in the overseas *départements* represent 22% of the French total. The two particularities are the diversity and the number of facilities to be regulated. It effectively comprises:

- 34 34 external beam radiotherapy departments (nearly 90 accelerators);
- 18 brachytherapy departments;
- 65 nuclear medicine departments;
- more than 250 interventional radiology departments;
- more than 250 tomography devices;
- about 800 medical diagnostic radiology centres;
- about 8,000 dental diagnostic radiology devices;
- more than 600 users of veterinary diagnostic radiology devices;
- 15 industrial radiology companies using gamma radiography devices;
- more than 500 industrial research devices or sources;
- 14 approved organisations.

In 2014, ASN's Paris division carried out 236 inspections in small-scale nuclear activities and 11 inspections in the transport of radioactive substances. Among these inspections, 215 were carried out in Ile-de-France and 32 in the overseas *départements* and territorial communities (DROM - COM).

The division was notified of 151 significant radiation protection events (ESR), 3 occurring in the area of radioactive substance transport and 148 in small-scale nuclear activities. Among the events notified in the small-scale nuclear activities, 5 were rated level 1 on the INES scale, to which can be added the events concerning radiotherapy patients, of which 37 were rated level 1 on the ASN-SFRO scale.

1. ASSESSMENT BY DOMAIN

1.1 Radiation protection in the medical field

Radiotherapy

ASN carried out 33 inspections of radiotherapy departments in the Île-de-France region and the overseas *départements* in 2014. Six of these inspections concerned the commissioning of new machines, including the first Cyberknife® in the Ile-de-France region. As in 2013, ASN did not systematically inspect all the radiotherapy departments of the Ile-de-France region. Thus 28 departments were inspected in 2014, some of them more than once.

The situation remains highly contrasted as regards to the development of the quality assurance procedures and compliance with the regulatory requirements demanded by ASN in this area. Seven departments had been found to be very far behind expectations in this respect in 2013.

These departments were closely monitored in 2014, in order to verify the progress of their compliance remediation process during the inspections carried out in 2014. As some inspections on the whole showed insufficient progress in the implementation of quality assurance and compliance with regulatory requirements, priority corrective action requests were made and these departments will continue to be subject to tightened monitoring in 2015. A further department was found to be far behind expectations in 2014 and it too will be subject to tightened monitoring in 2015. In all, four centres will be closely monitored in this respect in 2015.

Finally, for five centres, the recurrence of the inspection findings or lateness in the deployment of the quality system led ASN to summon the radiotherapy department and demand it to present its plan of action to bring its activity into compliance. One of these summonses was carried out jointly with the regional health agency (ARS).

The centres notified the Paris division of 59 ESRs, 8 of which were rated level 0 on the ASN-SFRO scale and 37 level 1.

Interventional radiology

ASN carried out 34 inspections in 2014. The inspections during 2014 confirmed the strong radiation protection implications for patients and personnel during interventions carried out using ionising radiation. ASN noted that the way the radiation protection requirements have been integrated in this sector varied greatly according to the departments and specialities. Radiation protection is better integrated in the medical specialities of interventional cardiology and neuroradiology, where the procedures are carried out in dedicated rooms with professionals who are more aware of the radiation protection issues than in the specialities in which the practitioners carry out interventional or fluoroscopy-guided procedures in operating theatres. As in 2013, progress is expected in particular in the optimisation of doses delivered to patients and the development of the radiation protection culture of the operators.

Twelve ESRs were reported to the Paris division, of which 7 concerned patients, 3 concerned workers and 2 concerned women who were unaware of their pregnancy when the procedure was carried out.

ASN organised a second regional seminar for interventional radiology professionals which was held on 7th March 2014 and gathered more than 150 professionals, more than half of whom were persons competent in radiation protection (PCR).

Nuclear medicine

ASN carried out 16 inspections in 2014, including three inspections of the commissioning of new facilities.

ASN observed that further progress is still required in occupational radiation protection, as the risk of external and internal contamination is often insufficiently taken into account, and in the management of radioactive waste and effluents, in order to satisfy all the regulatory requirements.

Nineteen ESRs were notified by the nuclear medicine departments. Nine concerned errors in the preparation or the injection of radionuclides into the patient (wrong radionuclide, wrong patient).

Two events concerned the administration of a capsule of iodine for targeted internal radiotherapy to a female patient who was unaware of her pregnancy.

Computed Tomography

ASN carried out 15 inspections in computed tomography in 2014. They reveal that although the majority of the inspected centres know the regulations in force and have initiated measures to satisfy them, the organisation of patient radiation protection must be improved so that the optimisation principle can be even better applied. Adapting the protocols to the morphology of the patients and regularly optimising the delivered doses are still major avenues for improvement.

Dental radiology

ASN conducted a targeted campaign of 32 inspections in dental radiology in 2014, more specifically in the dental surgeries possessing a device using CBCT (cone beam computed tomography) technology that provides three-dimensional images. They reveal considerable disparities in the knowledge and integration of the radiation protection regulations in the inspected surgeries. More specifically, the obligation to have external quality controls performed was found to be insufficiently known in the inspected establishments.

Regulation of the Public Assistance – Paris Hospitals (AP-HP)

In 2014, ASN carried out its first in-depth inspection in the medical field in the Pitié Salpêtrière Hospital (see below).

TO BE NOTED

In-depth inspection at the Pitié-Salpêtrière Hospital

ASN carried out its first "in-depth" inspection in the medical field from 6th to 10th October 2014. Seven radiation protection inspectors from ASN and three IRSN experts inspected the majority of the departments that use ionising radiation in the Pitié-Salpêtrière Hospital and met with senior management and the cross-cutting departments involved in radiation protection.

The inspectors found a contrast between the substantial material and technological means (facilities, machines, protective equipment, external control services, inspection means, dosimeters, etc.) and the insufficient human resources devoted to radiation protection to meet all the regulatory requirements.

Numerous deviations subsist, mainly in occupational radiation protection (deficiencies in medical monitoring of practitioners, risk assessments and working practice analyses not up to date, dosimeters rarely worn in the operating theatre, highly insufficient training in radiation protection, etc.). A large number of deviations were repeatedly observed in several departments. It is in the operating theatres that the most deviations are found and where the radiation protection culture is the least present.

On completion of its in-depth inspection, ASN considers that the hospital must engage an in-depth reflection on two lines for improvement, namely the human resources devoted to occupational radiation protection and the internal coordination of these means between the different departments involved.

The hospital must moreover continue its efforts and the steps taken in the area of patient radiation protection.

Moreover, further to the repeated findings and requests by ASN concerning the means devoted to occupational radiation protection, ASN summoned the Director General of the AP-HP in June 2014. This summons was followed by a meeting between an ASN commissioner and the senior management of all the hospital groups composing the AP-HP in November 2014. Several commitments were made by the AP-HP following these meetings. ASN will be particularly attentive to the meeting of these commitments in 2015.

In-depth inspection by ASN at the Pitié-Salpêtrière Hospital, October 2014.

1.2 Radiation protection in the industrial and research sectors

Industrial radiology

ASN continued inspecting industrial radiography activities, and users of gamma radiography in particular.

The inspections and the license renewals were specifically monitored with regard to the regularisation of the old pool of exposure bunkers, particularly as concerns their conformity with the applicable standards.

The emphasis was placed on unannounced inspections under work site conditions, with eleven work site inspections. The main deviations found concern the absence of verification of the position of the source when it returns to the safe position and the absence of the warning light system which must be activated during the emission of ionising radiation. Improvements were observed in the marking out of the operation zone and in dose optimisation when possible.

Universities and laboratories or research centres

ASN carried out 20 inspections of research facilities in 2014. The most frequent deviations concern the waste storage facilities and the management of this waste, and the lack of prevention plans when outside companies work in restricted areas.

"Thematic" inspections (waste management, joint radiation protection department) were carried out within large establishments grouping several research facilities. This type of inspection will be renewed.

Eight ESRs were notified in the area in 2014, four of which concerned the discovery of radioactive sources in institutes.

Veterinary

ASN carried out 27 inspections of veterinary radiology facilities in 2014, in line with the inspection campaign started in 2013 with the aim of verifying application of radiation protection rules in the veterinary radiology clinics and surgeries of the Ile-de-France region.

A first stage of document checks resulted in the identification of 300 veterinarians not previously known to ASN, who were informed of the regulatory obligations concerning the administrative situation of their facilities.

After examining the results of this first oversight step, in October 2013 and January 2014 ASN carried out 52 inspections on the theme of the organisation of occupational radiation protection. These inspections allowed an assessment of the way the veterinary radiology clinics and surgeries in the Ile-de-France region take into consideration the regulatory provisions relative to occupational radiation protection. This evidenced the need for progress in the way the radiation protection regulations are taken into consideration in this profession.

ASN presented the results of this campaign and the associated prospects to the regional council of the order of veterinary surgeons in December 2014. ASN will reiterate inspections in veterinary clinics and surgeries in 2015, particularly those that have not satisfactorily regularised their situation.

1.3 Nuclear safety and radiation protection in the transport of radioactive materials

Eleven inspections were carried out on the transport of radioactive substances in small-scale nuclear activities.

The inspections relative to the transport of radiopharmaceutical products reveal that the regulatory obligations concerning the training of the personnel performing the transport operations, the receiving inspections and the shipping of the packages are still insufficiently well known in the nuclear medicine centres.

In 2014, the Paris division of ASN began a partnership with the Department of Public Order and Traffic of the Prefecture of Police of Paris and the Transport Safety Service of the Regional and Interdepartmental Directorate of Infrastructure and Regional Planning in order to carry out unannounced roadside inspections. The first two inspection operations were held in the town of Saclay. Five vehicles were inspected. These inspections revealed significant nonconformities concerning deficiencies in the securing of packages and the failure to specify certain packages on the dispatch note. Other deviations were observed relative to package labelling, the dimensions or positioning of the regulatory placarding on the vehicle and the periodic servicing of fire extinguishers.

1.4 Radiation protection of the public and the environment

Polluted sites and soils

Within the framework of its duties of public information and radiation protection oversight with regard to the management of polluted sites and ground, in 2014 ASN continued its oversight of decontamination work sites such as that of the former Curie laboratories in Arcueil (Val de Marne *département*), the former Marie Curie school in Nogent-sur-Marne (Val de Marne *département*), the CEA site of the Petite Carrière (Small Quarry) of the Orme des Merisiers deposit (Essonne *département*) in Saint-Aubin, the quarters of Clos Rose and Petites Coudraies of Gif-sur-Yvette (Essonne *département*), the 2M Process site in Saint-Maur-des-Fossés (Val de Marne *département*), and the former CEA site of the Fort de Vaujours (Seine et Marne and Seine-Saint-Denis *départements*). More specifically, ASN took part in December 2014 in the second meeting of the Arcueil site (Val de Marne *département*) and in July 2014, in the installation meeting of the Vaujours site (Seine et Marne and Seine-Saint-Denis *départements*) monitoring commission.

The Radium Diagnostic operation has been launched in Ile-de- France since 21st September 2010. The government decided to perform the diagnostics free of charge in order to detect, and where applicable treat, any legacy radium pollution. This operation, which is placed under the responsibility of the Prefect of the Ile-de-France region, the Prefect of Paris, and is coordinated by ASN, concerns 84 sites in Ile-de-France.

Twenty-nine sites had been examined by the end of 2014. Eight of these 29 sites were able to be excluded outright because the buildings are too recent with respect to the period of potential manipulation of radium to be able to have any radioactive contamination. On the remaining 21 sites, more than 420 diagnoses were carried out; in effect, the majority of the sites correspond to one building with many apartments, or to several individual plots. 21 diagnoses revealed traces of radium in premises that are now undergoing rehabilitation. The measured levels of activity are low and the exposure does not present a health risk for the occupants.

For the occupants and owners of the polluted premises, personalised assistance is being provided to apply the necessary protection measures and start the rehabilitation work, paid for by the State. The rehabilitation work has been completed on seven sites, is in progress on ten sites and under preparation for four sites.

2. ADDITIONAL INFORMATION

2.1 Monitoring of organisations approved for radiation protection checks

In 2014, ASN examined the renewal of the approval of one organisation approved for conducting radiation protection checks and approved two new organisations. In this context, audits were carried out to verify the conformity of these organisations with the provisions of Resolution 2010-DC-0191 of 22nd July 2010 setting the conditions and modes of approval of the organisations mentioned in Article R. 1333-95 of the Public Health Code.

ASN also carried out two unannounced supervisory checks during the interventions of these approved organisations and four in-depth inspections of head offices, which on the whole were found to be satisfactory.

2.2 Informing the public

ASN held a press conference in the Paris division on 20th May 2014 to present the results of its regional action.

2.3 ASN's action in the overseas *départements*

ASN carried out two routine inspection campaigns representing 23 inspections in the overseas *départements*, as it does each year.

It also made an additional trip in March to La Réunion Island for the resumption of the activity of the radiotherapy department of the South Reunion university hospital after being suspended from May to October 2013. The inspection carried out on this occasion found the department to be functioning satisfactorily.

ASN considers that the way radiation protection is taken into account in the overseas facilities is, on average, comparable with that in the metropolitan facilities, with specific difficulties inherent to the distance and the absence of certain types of permanent service providers.

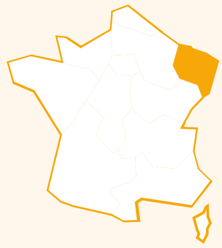
2.4 ASN's action in the overseas communities

During 2014 ASN continued its cooperation work with French Polynesia and New Caledonia in order to develop the regulatory framework governing nuclear activities in these overseas territories.

A mission was sent to French Polynesia in December 2014 to conduct a commissioning visit of the nuclear medicine department of the French Polynesia hospital centre of Papeete. Two other visits of facilities were carried out on this occasion in the same hospital, in the radiotherapy and interventional radiology departments. The mission also provided the opportunity to work on the regulatory texts.

With regard to New Caledonia (Nouvelle Calédonie), a second mission went there in 2014. Six facility visits were carried out with the local authorities, using as a basis the regulatory baseline requirements applicable on French territory. The subjects addressed involved a gamma radiography inspection site, an organisation performing external technical radiation protection checks, a gamma ray densitometer user, veterinary activities and mobile equine veterinary activities in particular, and a follow-up visit to the Nouméa hospital focusing on the computed tomography, interventional and conventional radiology activities. Information meetings were also held with the project leaders of the radiotherapy and nuclear medicine centres. The training measures for the local authorities in charge of licenses and oversight were also continued. Lastly, the work on writing the future regulations also continued on the basis of the latest international baseline requirements. The cooperation with New Caledonia will continue in 2015 with the aim of finalising the draft regulatory texts and initiating conventions with Andra and IRSN.

THE STATE OF NUCLEAR SAFETY AND RADIATION PROTECTION IN THE ALSACE AND LORRAINE REGIONS REGULATED BY THE **STRASBOURG DIVISION**



The Strasbourg division regulates nuclear safety, radiation protection and the transport of radioactive substances in the six *départements* of the Alsace and Lorraine regions.

As at 31st December 2014, the workforce of the Strasbourg division stood at 15 officers: 1 regional head, 2 deputy heads, 9 inspectors and 3 administrative officers, under the authority of the ASN regional representative.

The installations to regulate in the Alsace and Lorraine regions comprise:

- the NPPs at Fessenheim (2 reactors of 900 MWe) and Cattenom (4 reactors of 1,300 MWe);
- 9 external radiotherapy departments;
- 3 brachytherapy departments;
- 14 nuclear medicine departments;
- about 50 interventional radiology departments;
- about 70 CT scanners;
- 4,000 medical and dental diagnostic radiology devices;
- 200 industrial research establishments;
- 3 cyclotrons producing fluorine-18.

In 2014, the Strasbourg division carried out 155 inspections, of which 51 were on the nuclear sites of Fessenheim and Cattenom, and 104 were in small-scale nuclear activities. Among these inspections, 2 focused on the transport of radioactive substances. ASN also ensured 7 days of labour inspection in the nuclear power plants.

During 2014 the division was notified of 132 significant events relating to nuclear safety, the environment, radiation protection and transport operations, of which 88 occurred in BNIs, 2 in the transport of radioactive substances, and 42 in small-scale nuclear activities. Among the events notified for the BNIs, 5 were rated level 1 on the INES scale. Among the events notified in the small-scale nuclear activities, 2 were rated level 1 on the INES scale, to which can be added the events concerning radiotherapy patients, of which 8 were rated level 1 on the ASN-SFRO scale.

In the context of their oversight duties, the ASN inspectors issued one violation report. In application of its sanctioning powers, ASN issued compliance notices to two industrial licensees in small-scale nuclear activities.

1. ASSESSMENT BY DOMAIN

1.1 The nuclear installations

Fessenheim NPP

ASN considers that the nuclear safety, radiation protection and environmental protection performance of the Fessenheim NPP is, on the whole, in line with its general assessment of EDF's performance.

Few inappropriate practices were detected during 2014 and ASN considers that the personnel training is of a good standard. The licensee must nevertheless make further improvements in the preparation of work interventions and documentation management, where a few deviations were noted.

The volume of scheduled maintenance work was relatively low in 2014. ASN considers that these operations went satisfactorily and they were planned sufficiently well in advance. Furthermore, the organisation put in place to prevent and manage emergency situations is of a good standard and the emergency response equipments are in good condition.

The year 2014 was marked by a 7-week unscheduled outage of reactor 1 due to the ingress of water into a non-nuclear part of the installation that damaged electrical cabinets. ASN considers that this incident was well managed by the licensee. The repair operations further to this incident were carried out satisfactorily. ASN nevertheless considers that owing to the possible impact on the safety of the facilities, the licensee must ensure rigorous monitoring of the functionality of the equipment items that do not figure among the equipment important for safety.

ASN notes progress in protection of the environment. The Fessenheim site is well organised and monitoring of the impact of pollution on the environment of the facility is satisfactory. Waste management improved in 2014, even if deviations are still detected.

In the area of occupational radiation protection, the recovery plan implemented in 2012 improved the situation: a positive momentum has been established and the site has satisfactory means of measurement and protection. Progress is still required in the management of work sites and the analysis of experience feedback from work interventions.

Cattenom NPP

ASN considers that the nuclear safety performance of the Cattenom site is on the whole in line with the general assessment of EDF, but its performance in radiation protection and environmental protection is substandard.

ASN considers that the site must restore greater rigour in the operation of the facilities. Several deviations from the operating baseline requirements and deficiencies in the mastery of the installations were noticed. Work preparation was once again sometimes found to be deficient. ASN does however positively note the site's analysis of its experience feedback.

ASN considers that maintenance management is improving, the volume of maintenance activities having been moderate and better planned in 2014. Human resource management is satisfactory. The site must however make further progress in the compliance with the maintenance baseline requirements, the monitoring of deviations and coordination of the activities.

With regard to emergency situation management, the licensee has put in place an effective coordination system and the emergency equipments are well managed. ASN has again noted improvements in control of the fire risk.

Environmental protection was found wanting on several occasions during 2014, with the exceeding of the maximum regulatory value for copper discharges more specifically. ASN nevertheless considers that waste management improved in 2014, after having been below the norm for several years.

With regard to occupational radiation protection, ASN considers that the licensee is making efforts to progress, but the results are not yet sufficient. The improvements resulting from the radiation protection actions plan put in place in 2013 must be continued over the long term. Particular attention must be paid to the radiological cleanliness of the premises, as the year 2014 was marked by many events in this area. This site must also improve its work site management and its handling of deviations during work operations.

Labour inspection in the nuclear power plants

ASN continued its inspections concerning subcontracting, the working times of employees of EDF and of certain subcontractors, and the conditions of health and safety during maintenance work and plant operation.

ASN observed improvements in the management of working time on the Fessenheim site. The site was moreover marked by a serious accident in 2014. The licensee must make progress in the drawing up of prevention plans to prevent the recurrence of such an event.

ASN observed no dangerous situations on the Cattenom site, and no serious accidents happened in 2014. Although progress must still be made in risk prevention, ASN notes better responsiveness in remedying the deviations relative to health and safety.

1.2 Radiation protection in the medical field

Radiotherapy

ASN carried out 4 inspections in the 9 radiotherapy departments in Alsace and Lorraine in 2014.

These inspections focused on the management of treatment safety and quality, the preparation of treatments and the implementation of the professional practices evaluation process. Particular attention was also focused on the centres that put in place innovative treatment technologies.

These inspections confirmed that the departments have continued implementing a quality assurance and risk management system, in accordance with the regulatory requirements defined by the ASN.

In this respect ASN considers that the situation is satisfactory on the whole. However, the integration of innovative treatment technologies in the quality assurance system must be improved and ASN observed difficulties in carrying out and keeping up to date the analysis of the risks run by the patients.

ASN notes positively that all the malfunctions form the subject of experience feedback analysis, and particularly the nine significant events notified to ASN.

Interventional radiology

Following in line with the measures undertaken since 2007, five inspections were carried out in 2014 in interventional imaging activities (in operating theatres or rooms dedicated to these procedures).

The findings further to the inspections confirm the observations made in recent years. Thus, occupational radiation protection is better taken into account in fixed facilities dedicated to radiology than in operating theatres where mobile devices are used. Furthermore, improvements in the identification of the most exposed patients and professionals and optimisation of the procedure protocols are expected. Greater involvement of medical physicists in this sector of activity could bring a real improvement in the situation and help to reduce doses delivered to patients.

Nuclear medicine

ASN inspected three nuclear medicine departments in Alsace and Lorraine in 2014, including one as part of the commissioning of a new positron emission tomography device for detecting molecules marked with fluorine-18. These inspections revealed a situation that is relatively satisfactory. However, the persistence of errors in the administration of radiopharmaceutical drugs is observed. Although these errors generally have no consequences for the patients, the departments must improve the safety of patient treatment and the management of radiopharmaceuticals.

Computed Tomography

ASN continued its inspections of computed tomography departments in 2014. In the light of the six inspections carried out, occupational radiation protection appears to be satisfactory in general. ASN considers that the patient radiation protection measures remain variable, but observes that the departments are becoming more concerned by the subject. The level of involvement of medical physicists varies from one department to another; increasing their involvement could help to optimise practices. The use of Magnetic Resonance Imaging (MRI) techniques when indicated as an alternative remains limited due to the low availability of MRI scanners.

ASN has also undertaken steps with the departments of the Alsace and Lorraine regions aiming at generalising the analysis of dosimetric readings and comparing them with the diagnostic reference levels, as required by the regulations.

ASN also inspects the conditions of practising teleradiology, which consists in examining radiographic images of patients at distance. The inspection conducted by ASN showed that the practice was well mastered on the whole. More specifically, the inspectors observed that substantial work had been carried out before implementing the activity in order to harmonise the examination protocols and that the teleradiology convention put in place was adhered to. Areas for progress were identified with regard to the medical physics organisation plan, which must guarantee the involvement of medical physicists in the performance of the procedures.

Meetings with the professionals

On January 14th 2014, the Strasbourg division held a meeting on its premises for the members of companies intervening as "external" persons competent in radiation protection (PCR) in the dental surgeries or radiology centres of the Alsace and Lorraine regions. This meeting provided the participants with the opportunity to tell ASN about their difficulties in carrying out their duties and to discuss issues concerning the regulations. The "external" PCRs represent key contacts for ASN on account of the large number of establishments in which they work.

ASN inspection of a regional laboratory of the highways authority (East CETE) in Tomblaine (Meurthe-et-Moselle *département*), October 2013.

1.3 Radiation protection in the industrial and research sectors

Industrial radiology

ASN continues regular inspections of industrial radiology activities which have major radiation protection implications.

During the 14 inspections carried out in 2014, the majority of them unannounced, ASN noted that the main establishments inspected on the whole satisfy the regulatory requirements concerning radiation protection. Progress does however remain to be made in the marking out of the work zone and in the performance of inspections at the edges of the marked out work zone.

The recurrence of certain findings notably concerning the provisions for signalling and marking out the work zone around irradiation sources has led ASN to serve a compliance notice on one industrial radiology company that has been subject to tightened monitoring since 2013. At the end of the period specified in the compliance notice, an inspection confirmed that the company was now compliant.

Universities and laboratories or research centres

In 2014, ASN inspected five research laboratories that use unsealed radioactive sources. ASN considers that the research laboratories on the whole comply with the radiation protection requirements concerning training and the dosimetric and medical monitoring of personnel exposed to ionising radiation. Furthermore, the radiation doses received by the workers remain at a very low level.

The centres must however make further progress in the tracking of the source inventories and removing radioactive waste, particularly the waste from legacy activities.

Devices for detecting lead in paint

ASN carried out a vast campaign of inspections of holders of radioactive devices for detecting lead in paint in 2014. Forty-nine inspections were thus carried out, covering 90% of the device holders in the urban agglomerations of Metz and Nancy. Noteworthy among the recorded deviations were irregular administrative situations, the absence of a PCR and failure to comply with the requirements associated with the transport of radioactive sources. The inspectors also found noncompliance with the manufacturer's specified replacement frequency for the radioactive source in order to guarantee measurement reliability, and reported this to the competent departmental population protection services.

In view of the deviations observed and the inaction of the company following ASN's formal notice to comply with the regulations, one of the visits resulted in the transmission of a violation report to the public prosecutor.

Monitoring of approved organisations

In 2014, ASN continued its close monitoring of the organisations responsible for the external radiation protection controls. These organisations, approved by ASN, are subject to unannounced inspections when performing their services, audits of their head offices, and examination of their procedures as part of the approval application.

ASN carried out seven inspections on these approved organisations in 2014 and examined two approval application files.

1.4 Nuclear safety and radiation protection in the transport of radioactive substances

In 2014, ASN conducted two inspections concerning the transport of radioactive substances in the Alsace and Lorraine regions.

The inspection on the Cattenom side revealed no significant deviations from the regulations concerning the safety of transport of radioactive substances. The management of radioactive substance shipments was found to be satisfactory.

In the medical field, the departments must further improve their knowledge of the regulations relative to the safety of transport of radioactive substances.

ASN did not however observe any problem situations in the Alsace and Lorraine regions in 2014.

Lastly, in 2014 ASN assisted the Meuse *département* prefecture in its work to better control the issues relating to the transport of radioactive substances and to update their provisions for emergency situation management in this area.

2. ADDITIONAL INFORMATION

2.1 International action by the Strasbourg division

In the framework of the bilateral exchanges with its German, Luxembourger and Swiss counterparts, the Strasbourg division of ASN took part in several cross-inspections in nuclear power plants and hospitals, either as a guest in foreign countries, or as host to its counterparts.

The division moreover organised the meetings in 2014 and was spokesman for working groups No. 1 and 4 of the Franco-German Nuclear Safety Commission, which are devoted respectively to reactor safety and radiation protection other than in BNIs.

The Strasbourg division also responded to the various requests of its German, Swiss and Luxembourg partners concerning the Cattenom and Fessenheim NPPs. The division more specifically presented ASN's analysis of the results of the Fessenheim NPP stress tests to an assembly of German elected officials from the region of Freiburg im Breisgau.

2.2 Informing the public

Press conferences

In 2014, ASN held two press conferences in Strasbourg and Metz on the situation of nuclear safety and radiation protection.

Work with the CLIs

The Strasbourg division took part in various meetings of the CLIs of Fessenheim and Cattenom.

During these meetings, ASN presented more specifically its assessment of the situation of the safety of the nuclear facilities concerned, and its analysis of the events that occurred in the nuclear power plants during the year. The experience feedback from the Fukushima accident and the actions implemented further to the stress tests were also addressed.

The Strasbourg division also invited the members of the CLI on several occasions to attend the inspections performed in the EDF facilities as observers. The observers from the CLIs were thus able to get a clearer picture of the ASN's activities and the relations between the licensee and the ASN during the inspections on the ground.

Lastly, a meeting was organised between representatives of the Cattenom CLI and an ASN commissioner during which the action of the CLI, the experience feedback from its international opening and questions relating to town planning control and emergency management were raised.

2.3 The other notable events

Management of emergency situations

On 18th March 2014, members of the association Greenpeace entered the Fessenheim nuclear power plant site. The licensee triggered its "safety protection" contingency plan. Although the prevention of malicious acts is outside its area of competence, ASN has set up an emergency organisation, at both local and national level, to check on the appropriateness of the measures taken by the licensee to guarantee the safety of the facilities and to assist the public authorities in the management of this emergency.

09
MEDICAL USES OF IONISING RADIATION

For more than a century now, for both diagnostic and therapeutic purposes, medicine has made use of ionising radiation produced either by electric generators or by radionuclides in sealed or unsealed sources. Even if their benefits and usefulness have long been medically proven, these techniques do however make a significant contribution to the exposure of the general public to ionising radiation. Behind exposure to natural ionising radiation, these techniques represent the second source of exposure for the general public and the leading source of artificial exposure (see chapter 1).

Protection of the staff working in facilities using ionising radiation for medical purposes is regulated by the provisions of the Labour Code. The medical facilities and devices emitting ionising radiation, including sealed and unsealed sources, must satisfy technical rules and procedures defined in the Public Health Code (see chapter 3).

The protection of patients undergoing medical imaging examinations or receiving therapeutic treatment involving ionising radiation is regulated by specific provisions of the Public Health Code (see chapter 3). The principles of justification of procedures and optimisation of the doses delivered are the basis of these regulations. However, contrary to the other applications of ionising radiation, the principle of dose limitation does not apply to patients because of the need to adapt the dose delivered to each individual patient according to the therapeutic objective or to obtain an image of adequate quality to make the diagnosis.

1. MEDICAL AND DENTAL RADIODIAGNOSIS INSTALLATIONS

1.1 Presentation of the equipment and inventory

Medical diagnostic radiology is based on the principle of differential attenuation of X-rays by the organs and tissues of the human body. The information is most often collected on digital media allowing computer processing of the resulting images, and their transfer and filing.

Diagnostic X-ray imaging is one of the oldest medical applications of ionising radiation; it encompasses all the techniques of morphological exploration of the human body using X-rays produced by electric generators. It occupies an important place in the field of medical imaging and comprises various specialities (conventional radiology, interventional radiology, computed tomography, angiography and mammography) and a wide variety of examinations (radiography of the thorax, chest-abdomen-pelvis computed tomography scan, etc.

The request for a radiological examination by the physician must be part of a diagnostic strategy taking account of the patient's known medical history, the question posed, the expected benefit for the patient, the exposure level and the possibilities offered by other non-irradiating investigative techniques (see the French medical imaging good practices guide, updated in March 2013 - see point 5.5).

1.1.1 Medical radiodiagnosis

Conventional radiology

Conventional radiology uses the principle of conventional radiography and represents the large majority of radiological examinations performed if considered by number.

The examinations mainly concern the bones, the thorax and the abdomen. Conventional radiology can be split into two main families:
- diagnostic radiology performed in fixed installations specifically built for that purpose;
- diagnostic radiology carried out on demand using mobile devices, at the patient's bedside for example. This practice must however be restricted to patients who cannot be transported.

Digital subtraction angiography

This technique, which is used to explore blood vessels, is based on the digitisation of images before and after injecting a contrast medium. Computer processing removes the structures around the vessels by subtracting the pre-contrast images from the later ones.

Mammography

Given the composition of the mammary gland and the fine degree of detail sought for the diagnosis, high definition and high contrast are required for the radiological examination, which can only be achieved by special devices operating at low voltage. Some of these generators are also used for breast cancer screening campaigns.

A new three-dimensional imaging technique called "tomosynthesis" is developing in Europe, with reconstruction into a series of slices. The evaluation of this technique, currently in progress in several European countries, should enable its advantages compared with the traditional planar technique to be determined. At present, this technique is not recognised in the context of organised breast cancer screening.

Computed tomography

Computed tomography scanners use a beam of X-rays emitted by a tube that rotates around the patient associated with a computerised image acquisition and processing system. A three-dimensional reconstruction of the organs with image quality higher than that of conventional equipment provides a more detailed picture of the structure of the organs.

This technique can, like magnetic resonance imaging (MRI), be associated with functional imaging provided by nuclear medicine in order to obtain fusion images combining functional information with structural information.

The technological developments made in recent years, allowing dynamic volume acquisitions, have led to an extension of the investigative field and greater ease and speed of performance of these investigations. The negative side is that this technological development can lead to an increased number of image acquisitions and therefore an increase in doses delivered to patients if the principles of justification and optimisation are not correctly applied (see chapter 1).

As at 31st December 2014, the French pool of radiological devices included slightly more than 1000 computed tomography facilities covered by an ASN license.

Teleradiology

Teleradiology makes it possible to guide the performance of radiological examinations carried out in another location and to interpret the results, also from a distance. Data transmissions must be carried out in strict application of the regulations (relating to radiation protection and image production quality in particular) and professional ethics.

UNDERSTAND

Medical imaging: several imaging techniques can be used for a given organ

Medical imaging and biological analyses supplement the diagnostic approach of the physician based on the history of the illness in the patient and the medical examination of the patient.

There are four broad medical imaging techniques. They use X-rays (radiology), gamma rays (nuclear medicine), ultrasounds (ultrasonography) and magnetic fields (Magnetic Resonance Imaging - MRI). These techniques enable the morphology or function of an organ to be studied; in effect, the intrinsic qualities and the medical significance of the resulting images are fundamentally dependent on the physical principle used:

- in radiology, it is the differences in density in a tissue due, for example, to the presence of a tumour, or between different organs, that are revealed. Pulmonary radiology, mammography and X-ray computed tomography are radiological examinations. The computed tomography (CT) scanner provides cross-sectional images of organ structures.
- in nuclear medicine, it is the distribution of a radiopharmaceutical (drug consisting of a vector marked by a radioactive isotope or isolated radionuclide) injected into the human body that is analysed. This functional imaging enables the physiopathological processes to be studied and provides important information on the normal or pathological functioning of a tissue or organ. The choice of radiopharmaceutical is dependent on the target and the studied organ.
- in ultrasonography, ultrasounds are used; it is the sudden changes in acoustic properties of the tissues at the boundaries of the organs and any other interface that are the source of the echoes used to construct images. By combining the Doppler effect with this, it is also possible to measure the flow rate of blood in the vessels.
- in magnetic resonance imaging, it is the elementary magnetic property (the spin) of the nucleus of the hydrogen atom placed in a high and stable magnetic field that enables the density of water in the tissues and the local magnetic interactions to be reconstructed in tomographic slices.

Radiology and nuclear medicine that use ionising radiation are regulated by ASN. Ultrasonography and MRI do not use ionising radiation.

The guide to the good medical imaging examination practices drawn up by the French Society of Radiology (SFR) and the French Society of Nuclear Medicine and Molecular Imaging (SFMN) is the supporting document for choosing the examination method for a symptom or particular pathology. It takes into account the proof of the level of diagnostic performance of the examinations in each of the situations (analysis of international publications), whether the examination delivers radiation or not, and if so, the corresponding doses. No technique is universal; a technique that gives good results for one organ or function of that organ may be less effective for another organ, and vice versa.

Essentially two methods of exchange are used:
- telediagnosis, which enables the doctor on the scene (e.g. an emergency doctor), who is not a radiologist, to send images to a radiologist for interpretation; if necessary the radiologist can guide the radiological operator during the examination and imaging process. In this case, the doctor on the scene is considered to be the doctor performing the procedure and assumes responsibility for it;
- tele-expertise, whereby radiologists can exchange opinions by asking a remote expert radiologist ("teleradiologist") to confirm and refine a diagnosis, to determine a therapeutic orientation or guide a remote examination.

The data transmissions are protected to preserve medical secrecy and image quality.

Teleradiology involves many responsibilities which must be specified in the agreement binding the practitioner performing the procedure to the teleradiologist. The teleradiology procedure is a medical procedure in its own right, like all other imaging procedures, and cannot be reduced to a simple interpretation of images. Teleradiology therefore fits into the general healthcare organisation governed by the Public Health Code and obeys the rules of professional ethics in effect (see the good practices recommendations issued by the professionals).

1.1.2 Interventional radiology

Interventional radiology concerns "all invasive diagnostic and/or therapeutic medical procedures, as well as surgical procedures using ionising radiation for guidance, including monitoring[1] ".

This involves techniques that use fluoroscopy with an image intensifier or flat panel detector and require special equipment, for example in surgical contexts or when performing vascular procedures (particularly in cardiology and neurology).

Interventional techniques using computed tomography are developing, due mainly to the technical progress in the equipment.

These techniques are used during diagnostic interventions (examination of coronary arteries, etc.) or for therapeutic purposes (dilation of coronary arteries, vascular embolisation, etc.) as well as during surgical procedures using ionising radiation to guide or monitor the surgeon's actions. They can require long-duration exposure of the patients who then receive high doses which can sometimes lead to radiation related effects on tissues (cutaneous lesions, etc.). The staff usually work in the immediate vicinity of the patient and are also exposed to higher dose levels than during other radiological practices. Under these conditions, in view of the risks of external exposure it entails, interventional radiology must be optimised to improve the radiation protection of operators and patients.

Interventional radiology facilities are used in rooms dedicated to neurology, cardiology, gastro-enterology, cancerology and, more generally, vascular radiology. Radiology devices are also commonly used for fluoroscopy procedures in operating theatres in several specialised medical fields, such as digestive surgery, orthopaedics and urology.

ASN does not know exactly how many facilities are used for interventional procedures, mainly due to their rapid increase in number over the last few years. The ASN regional divisions initiated actions to compare the information held by the health insurance offices and the Regional Health Agencies (ARS) in order to obtain a more accurate picture of the healthcare activities concerned.

More than 1000 centres (lower bracket) practising interventional radiology and fluoroscopy-guided procedures have thus been inventoried in France.

1.1.3 Dental radiodiagnosis

Intra-oral radiography

Intra-oral type radiography generators are generally mounted on an articulated arm and used to take localised images of the teeth. They operate with relatively low voltage and current and a very short exposure time, of about a few hundredths of a second. This technique is most often associated with digital systems for processing and filing the radiographic images.

Panoramic dental radiography

Primarily used by dental specialists (orthodontists, stomatologists) and radiologists, panoramic radiography gives a single picture showing both jaws, by rotating the radiation generating tube around the patient's head for about ten seconds.

Cone-beam computed tomography

The development of devices using cone-beam Computed Tomography (3D) in the field of dental radiology is continuing. Offering higher performance

1. Definition from the GPMED Advisory Committee for Radiation Protection for the Medical and Forensic Applications of Ionising Radiation (reporting to ASN).

(operating parameters, explored volumes, etc.), the doses delivered by these devices remain significantly higher than in conventional dental radiology.

1.2 Technical rules for fitting out radiology and tomography installations

Radiology installations

A conventional radiological facility comprises a generator (high-voltage unit, X-ray tube), associated with a support – called a stand – for moving the tube, a control unit and an examination table or chair.

The mobile facilities that are commonly used in the same room, such as the X-ray generators used in operating theatres, are to be considered fixed facilities.

As of 2013, radiological facilities must be installed in accordance with the provisions of the new ASN technical resolution 2013-DC-0349 of 4th June 2013 (see chapter 3). This resolution requires that the layout and access to the facilities comply with the radiation protection rules set by French Standard NFC 15-160 in its March 2011 version.

The new standard NFC 15-160 common to all medical radiology facilities, including computed tomography and dental radiology, introduces a method of calculating the required thickness of the protection screens in all facilities that use X-ray generators.

This resolution came into effect on 1st January 2014 and will be applied progressively following the schedule appended to it. It is to be noted that it does not concern radiology devices used at the patient's bedside.

2. NUCLEAR MEDICINE

2.1 Presentation of nuclear medicine activities

Nuclear medicine includes all uses of unsealed radioactive sources for diagnostic or therapeutic purposes. Diagnostic uses can be divided into in vivo techniques, based on administration of radionuclides to a patient, and exclusively in vitro applications (medical biology).

This sector of activity comprises 217 nuclear medicine units with in vivo and associated in vitro facilities, and 41 biology laboratories independent of the nuclear medicine units.

At the end of 2013, 131 positron emission tomography (PET) cameras and 459 single-photon emission tomography (SPECT) devices were inventoried. Forty-seven nuclear medicine units[2] accommodate a total of 168 targeted internal radiotherapy (brachytherapy) rooms.

Nuclear medicine involves about 623 specialist practitioners in this field[3], to which must be added some 1000 physicians from other specialities working with the nuclear medicine units (internal medicine specialists, cardiologists, endocrinologists, etc.).

2.1.1 In vivo diagnosis

This technique consists in examining an organ or a function of the organism with a specific radioactive substance – called a radiopharmaceutical – administered to a patient. The nature of the radiopharmaceutical depends on the studied organ or function. The radionuclide can be used directly or fixed to a carrier (molecule, hormone, antibody, etc.). For example, table 1 presents some of the main radionuclides used in various investigations.

The administered radioactive substance – usually technetium-99m – is located in the organism using a specific detector and scintigraphy techniques. This detector, called a scintillation camera or gamma camera, consists of a crystal of sodium iodide (in the majority of cameras) coupled to a computerised acquisition and analysis system. This equipment produces images of the functioning of the explored tissues or organs. The physiological or physiopathological processes can be quantified.

Today, the majority of gamma cameras are tomographic and can produce cross-sectional images and a three-dimensional reconstruction of the organs (single-photon emission tomography - SPECT).

Fluorine-18, a positron-emitting radionuclide, is today commonly used in the form of a marked sugar, fluorodeoxyglucose (FDG), particularly in oncology. Its utilisation necessitates the use of a special camera. The principle of operation of PET (positron-emission

2. Source: Review of nuclear medicine department inspections (2009-2011).
3. Source: dashboard (SFMN website) 2014.

tomography) cameras is the detection of the coincidence of the photons emitted when the positron is annihilated in the matter near its point of emission.

Nuclear medicine enables functional images to be produced. It is therefore complementary to the purely morphological images obtained using the other imaging techniques, such as conventional radiology, X-ray computed tomography, ultrasonography or magnetic resonance imaging (MRI). In order to make it easier to merge functional and morphological images, hybrid appliances have been developed: positron-emitting tomography (PET) scanners are now systematically coupled with a CT scanner (PET-CT) and gamma-cameras are equipped with a CT scanner (SPECT-CT).

2.1.2 In vitro diagnosis

This is a medical biology technique for assaying certain compounds contained in biological fluid samples taken from the patient, such as hormones, drugs, tumour markers, etc., and it does not involve administering radionuclides to the patients. The technique uses assay methods based on immunological reactions (antigen-antibody reactions labelled with iodine-125), hence the name RIA (radioimmunology assay). The activities contained in the analysis kits designed for a series of assays do not exceed a few thousand becquerels (kBq). Radioimmunology is currently challenged by techniques which make no use of radioactivity, such as immuno-enzymology and chemiluminescence. A few techniques use other radionuclides such as tritium or carbon-14. Here again the activity levels involved are on the order of the kBq.

2.1.3 Targeted internal radiotherapy

Internal radiotherapy aims to administer a radiopharmaceutical emitting ionising radiation, which will deliver a high dose to a target organ for curative or remedial purposes. Two areas of therapeutic application of nuclear medicine can be identified: oncology and non-oncological conditions (treatment of hyperthyroidism, synoviorthesis).

Several types of cancer treatment can be identified:
- systemic treatments (thyroid cancer by iodine-131, non-Hodgkin lymphoma by monoclonal antibodies marked with yttrium-90, prostate cancer with bone metastases by radium-223, etc.);
- selective treatments (treatment of liver cancers with yttrium-90 microspheres).

Some treatments require patients to be hospitalised for several days in specially fitted-out rooms in the nuclear medicine unit to ensure the radiation protection of the personnel, of people visiting the patients and of the environment. The radiological protection of these rooms must be appropriate for the type of radiation emitted by the radionuclides. This is particularly the case with the post-surgical treatment of certain thyroid cancers. The treatments involve administering about 4 GBq of iodine-131.

Other treatments can be on an out-patient basis. Examples include administering iodine-131 to treat hyperthyroidism, strontium-89 or samarium-153 for painful bone metastases, and radium-223 for prostate cancer with bone metastases. Joints can also be treated using colloids labelled with yttrium- 90 or rhenium-186. Finally, radioimmunotherapy can be used to treat certain lymphomas using yttrium-90 labelled antibodies.

2.1.4 Biomedical research in nuclear medicine

Biomedical research in nuclear medicine has been particularly dynamic in the last few years: protocols are regularly developed for new radionuclides and vectors. These innovations mainly concern:
- positron emission tomography (PET) with fluorine-18, gallium-68 and rubidium-82;
- targeted internal radiotherapy with radium-223, microspheres labelled with yttrium-90, vectors labelled with yttrium-90 or lutetium-177.

The use of new radiopharmaceuticals means that the radiation protection requirements associated with their handling must be integrated as early as possible in the process. Indeed, given the activity levels involved,

TABLE 1: Some of the main radionuclides used in the various in vivo nuclear medicine examinations

TYPE OF EXAMINATION	RADIONUCLEIDES USED
Thyroid metabolism	Iodine-123, technetium-99m
Myocardial perfusion	Thallium- 201, Technetium- 99m, Rubidium-82
Lung perfusion	Technetium-99m
Lung ventilation	Krypton-81m, Technetium-99m
Osteo-articular process	Technetium-99m
Oncology - search for metastasis	Fluorine-18, Gallium-68

the characteristics of certain radionuclides and the preparations to produce, appropriate measures must be implemented with regard to operator exposure and environmental impact.

2.2 Layout rules for nuclear medicine facilities

Given the radiation protection constraints involved in the use of unsealed radioactive sources, nuclear medicine units are designed and organised so that they can receive, store, prepare and then administer unsealed radioactive sources to patients or handle them in laboratories (radioimmunology for instance). Provision is also made for the collection, storage and disposal of radioactive wastes and effluents produced in the facility, particularly the radionuclides contained in patients' urine.

From the radiological viewpoint, the personnel are subjected to a risk of external exposure, in particular on the fingers, due in particular to the handling of certain radionuclides (case with fluorine-18, iodine-131 or yttrium-90), and a risk of internal exposure through accidental intake of radioactive substances. Under these conditions, nuclear medicine units must comply with the specific layout rules prescribed by the Order of 30th November 1981 relative to the conditions of use of artificial radionuclides in unsealed sources for medical purposes.

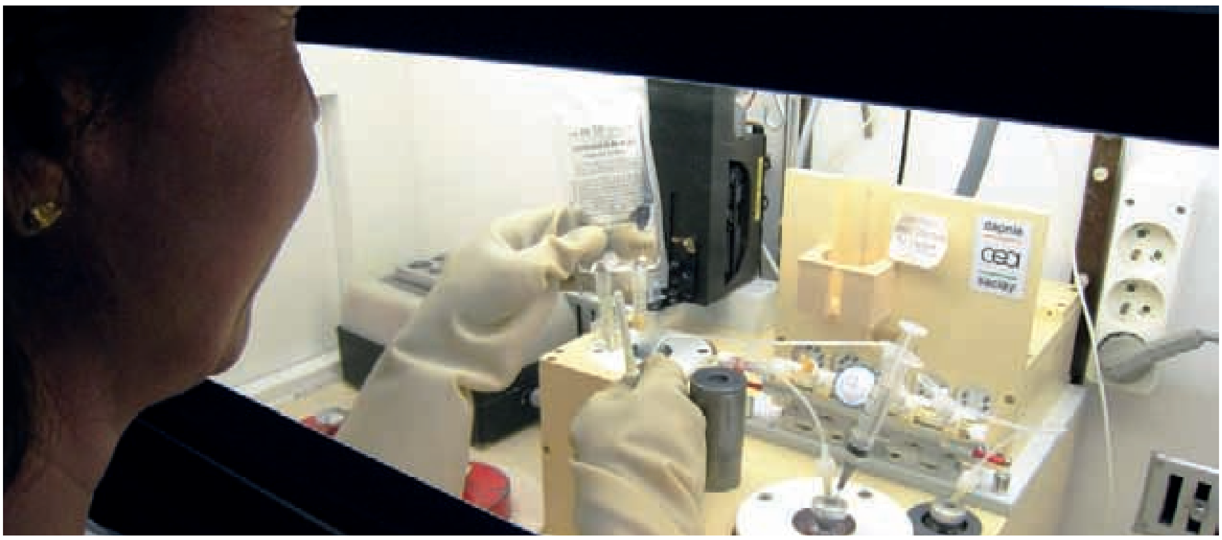
The progress in technologies and the development of new radionuclides have led ASN to revise the Order of 30th November 1981 currently in effect. In 2014, ASN adopted a technical resolution (ASN Resolution 2014-DC-0463 of 23rd October 2014) to update the minimum technical design, operation and maintenance rules to be complied with in vivo nuclear medicine facilities, on the basis of an opinion of the GPMED (January 2012). This resolution, approved by the order of 16th January 2015, introduces new rules applicable to the ventilation of nuclear medicine unit premises and rooms accommodating patients treated for thyroid cancer with iodine-131.

3. EXTERNAL-BEAM RADIOTHERAPY AND BRACHYTHERAPY

3.1 Description of the techniques

Alongside surgery and chemotherapy, radiotherapy is one of the key techniques employed to treat cancerous tumours. Some 175,000 patients are treated each year. Radiotherapy uses ionising radiation to destroy malignant cells (and non-malignant cells in a small number of cases). The ionising radiation necessary for treatment is either produced by an electric generator or emitted by radionuclides in the form of a sealed source. There are thus two ways of delivering the radiation: external-beam radiotherapy, where the source of radiation produced by a particle accelerator or radioactive sources (Gamma knife® for example) is external to the patient, and brachytherapy, where the source is placed in direct contact with the patient, within or as close as possible to the area to treat.

At the end of 2013, external beam radiotherapy installations comprised 452 treatment devices, including 427 conventional linear accelerators. These devices are installed in 175 radiotherapy centres, of which roughly half have public status and the other half private status.



Automated system for filling syringes with radiopharmaceuticals.

TABLE 2: Development of the pool of external radiotherapy treatment devices between 2007 and 2013

YEAR	2007	2008	2009	2010	2011	2012-2013
Conventional accelerators	376	382	412	419	422	427
Tomotherapy	4	6	8	9	12	12
Gamma knife®	3	3	3	4	4	4
Cyberknife®	3	3	3	5	6	7
Proton therapy	2	2	2	2	2	2
TOTAL	**388**	**396**	**428**	**439**	**446**	**452**

Source: ASN.

There are six hundred and fifty three (653) registered radiation oncologists (source: French Radiotherapy Observatory).

TABLE 3: Breakdown of radiotherapy centres according to status in 2012

YEAR	2012
Private (excluding ESPIC))	**92**
Public & ESPIC (non-profit private health care facility)	**83**
- Hospital centre (CH)	40
- University Hospital Centre (CHU)	17
- CLCC	20
- Autre ESPIC	6
TOTAL	**175**

Source: ASN data, inspections in 2012-2013.

3.1.1 External-beam radiotherapy

The irradiation sessions are always preceded by preparation of a treatment plan which defines the dose to be delivered, the target volume(s) to be treated, the irradiation beam setting and the estimated dose distribution (dosimetry) for each patient. Preparation of this plan, which aims to set conditions for achieving a high dose in the target volume while preserving surrounding healthy tissues, requires close cooperation between the radiation oncologist and the medical physicist as well as - when applicable - the dosimetrists.

In the vast majority of treatments, irradiation is ensured using linear particle accelerators with an isocentric arm, emitting beams of photons produced at a voltage varying from 4 to 25 megavolts (MV) or electrons with an energy level of between 4 and 25 megaelectronvolts (MeV) and delivering dose-rates that can vary from 2 to 6 grays per minute (Gy)/min, although some latest-generation linear accelerators can deliver much higher dose-rates of up to 25 Gy/min (in the case of photon beams).

For certain specific therapeutic indications, several centres propose treatments that are made possible thanks in particular to the use of:

- a linear accelerator equipped with specific functions (micro multileaf collimator, additional imaging systems, robotic arm and/or table, etc.);
- a gammatherapy device equipped with more than 200 sources of cobalt-60 focused on a single point;
- a cyclotron producing proton beams.

Stereotactic radiotherapy

Stereotactic radiotherapy is a treatment method which aims to offer millimetre-precise, high-dose irradiation using small beams converging in the centre of the target, for intra-cranial lesions that are surgically inaccessible. In stereotactic radiotherapy treatments, the total dose is delivered either in a single session or in a hypofractionated manner, depending on the pathology being treated. The term radiosurgery is used to designate treatments carried out in a single session.

This technique firstly requires great precision in defining the target volume to irradiate, and secondly that the treatment be as conformal as possible, that is to say that the irradiation beams follow the shape of the tumour as closely as possible.

It was originally developed to treat non-cancerous pathologies in neurosurgery (artery or vein malformations, benign tumours) and uses specific techniques to ensure very precise localisation of the lesion.

It is also more and more frequently used to treat cerebral metastases, but also for extra-cranial tumours.

This therapeutic technique chiefly uses three types of equipment:

- specific systems such as Gamma Knife® which directs the emissions from more than 200 cobalt-60 sources towards a single focal spot (4 units are currently in service in three establishments in France), and CyberKnife® which consists of a miniaturised linear accelerator mounted on a robotic arm;

VERO™ radiotherapy device.

- "conventional" linear accelerators equipped with additional collimation means (mini-collimators, localisers) that can produce mini-beams.

A new system called VERO™ designed for extra-cranial stereotactic treatment has been on the market for a few years. The first in France was installed in 2013. This accelerator has functions enabling patients to be treated in "tracking" mode (irradiation carried out following the movements of the area to treat in real time).

3.1.2 Speci c external-beam radiotherapy techniques

Helical tomotherapy

Tomotherapy involves irradiation that combines the continuous rotation of an electron accelerator with the longitudinal displacement of the patient during irradiation. The technique employed is similar to the principle of helical image acquisitions obtained with computed tomography. A photon beam emitted at a voltage of 6 MV and a dose-rate of 8 Gy/min shaped by a multileaf collimator enabling the intensity of the radiation to be modulated allows the irradiation of large volumes of complex shape as well as extremely localised lesions, which may be in anatomically independent regions. It is also possible to acquire images in treatment conditions and compare them with reference computed tomography images, in order to improve the quality of patient positioning.

At the end of 2014, France totalled 19 sites equipped with facilities of this type.

Intensity modulated arc therapy

Following on from Intensity Modulated Radiation Therapy[4] (IMRT) is the recently introduced Intensity Modulated Arc Therapy, which is now used in France. This technique consists in irradiating a target volume by continuous irradiation rotating around the patient. Several parameters can vary during the irradiation, including the shape of the multileaf collimator aperture, the dose-rate, the rotation speed of the arm or the orientation of the multileaf collimator.

This technique, designated under different terms (VMAT®, RapidArc®) depending on the manufacturer, is achieved using isocentric linear accelerators equipped with this technological option.

Robotic stereotactic radiotherapy

Stereotactic radiotherapy with a robotic arm consists in using a small particle accelerator producing 6 MV photons, placed on an industrial type robotic arm with 6 degrees of freedom, marketed under the name CyberKnife®. Furthermore, the treatment table is also positioned on a robot of the same type. By combining the movement possibilities of the two robots, it is possible to use multiple, non-coplanar beams to irradiate small tumours that are difficult to access using surgery and conventional radiotherapy. This technique enables irradiation to be carried out under stereotactic conditions, and with respiratory tracking.

4. The collimator leaves move during irradiation, which modulates the delivered dose in a complex manner.

Dedicated tomotherapy accelerator.

Given the movement capabilities of the robot and its arm, the usual standards do not apply to the radiation protection of the treatment room and a specific study is therefore required.

At the end of 2014, France totalled 9 sites equipped with facilities of this type.

Intraoperative radiotherapy

Intraoperative radiotherapy combines surgery and radiotherapy, performed concomitantly in the operating theatre environment. The dose of radiation is delivered to the tumour bed during surgical intervention.

In March 2011, the French National Cancer Institute (INCa) launched a call for proposals to support the installation of intraoperative radiotherapy equipment for the treatment of breast cancer patients. One of the objectives of this call for proposals is to carry out a medico-economic evaluation of radiotherapy treatments involving a small number of sessions compared with standard breast cancer treatments. Seven projects deploying an INTRABEAM® accelerator producing X-rays with a voltage of 50 kV were selected and launched between 2011 and 2012.

Hadron therapy

Hadron therapy is a treatment technique based on the use of beams of charged particles - protons and carbon nuclei - whose particular physical properties ensure highly localised dose distribution during treatment. Compared with existing techniques, the delivered exit dose emerging from the irradiated tumour is lower, therefore the volume of healthy tissue irradiated is drastically reduced. Hadron therapy allows the specific treatment of tumours.

Hadron therapy with protons is currently practised in two centres in France - the Curie Institute in Orsay (equipment renewed in 2010) and the Antoine Lacassagne Centre in Nice (equipment currently being renewed).

According to its advocates, hadron therapy with carbon nuclei is appropriate for the treatment of the most radiation-resistant tumours and could bring several hundred additional cured cancer cases per year. This enhanced biological effect is due to the very high ionisation of these particles at the end of their path, combined with a reduced effect on the tissues they pass through before reaching the target volume.

3.1.3 Brachytherapy

Brachytherapy allows specific or complementary treatment of cancerous tumours, specifically in the head and neck, as well as of the skin, the breast, the genitals and bronchial tubes.

This technique consists in implanting radionuclides, exclusively in the form of sealed sources (with the exception of iridium-192 wires, considered to be unsealed sources), either in contact with or inside the solid tumours to be treated.

The main radionuclides used in brachytherapy are caesium-137, iridium-192 and iodine-125.

Brachytherapy techniques involve three types of applications:

a - Low Dose-Rate (LDR) brachytherapy:
- delivering dose-rates of between 0.4 and 2 Gy/h;
- using iridium-192 sources in the form of divisible wires, caesium-137 sources implemented using a specific source applicator. These sources are put into place for a limited duration;
- using iodine-125 sources in the form of seeds implanted permanently.

The iridium-192 sources implanted inside tissues take the form of wires 0.3 or 0.5 mm in diameter, with a maximum length of 14 cm at delivery and with an activity per unit length ranging from 30 megabecquerels/cm (MBq/cm) and 370 MBq/cm. The production and distribution of iridium-192 wires in France have been stopped since May 2014, obliging the user centres to turn to alternative techniques.

The caesium-137 sources take the form of sealed sources 3 mm in diameter and 2 to 8 cm long. The brachytherapy unit must have a "library" of the various sources, corresponding to the types of applications the user wishes to employ. The sources are placed in a storage unit and transferred to the applicator system at the time of treatment.

Low Dose-Rate brachytherapy requires patient hospitalisation for several days in a room with radiological protection appropriate for the maximum activity of the implanted radioactive sources where the patient stays for the duration of his or her treatment (except for brachytherapy of the prostate with seeds of iodine-125).

For the treatment of prostate cancers, iodine-125 sources are used. These sources (seeds), 4.5 mm long and 0.8 mm in diameter, are positioned permanently inside the patient's prostate gland. Their unit activity is between 10 and 30 MBq and treatment requires about a hundred seeds representing a total activity of 1 to 2 gigabecquerels (GBq).

Low Dose-Rate brachytherapy requires that the following premises be available:
- an application room, usually an operating theatre where the source carrier tubes (non-radioactive) are installed in the patient and their correct positioning is checked by X-rays or computed tomography imaging;
- an area for radioactive source storage and preparation.

Low Dose-Rate brachytherapy using sources of iridium-192 and caesium-137 is in the process of being phased out. Conversely, the technique using iodine-125 sources (prostate and ophthalmic brachytherapy) has developed over the last few years.

b - Pulsed Dose-Rate (PDR) brachytherapy:
- delivering dose-rates of between 2 and 12 Gy/h;
- using iridium-192 sources in the form of a source 3.5 mm long, 1 mm in diameter and with maximum activity of 18.5 GBq, implemented with a specific source afterloader.

This technique requires patient hospitalisation for several days in a room with radiological protection appropriate for the maximum activity of the radioactive source used. It is based on the use of a single radioactive source which moves in steps, and stops in predetermined positions for predetermined times.

The doses delivered are identical to those of low dose-rate brachytherapy, but are delivered in sequences of 5 to 20 minutes, or sometimes even 50 minutes, every hour for the duration of the planned treatment, hence the name pulsed dose-rate brachytherapy.

Pulsed dose-rate brachytherapy offers a number of radiation protection advantages:
- no handling of sources;
- no continuous irradiation, which enables the patient to receive medical care without irradiating the staff or having to interrupt the treatment.

However, it is necessary to make provisions for accident situations related to the operation of the source afterloader and to the high dose-rate delivered by the sources used.

c - High Dose-Rate (HDR) brachytherapy:
- delivering dose-rates in excess of 12 Gy/h;
- using iridium-192 sources in the form of a source 3.5 mm long, 1 mm in diameter and with maximum activity of 370 GBq, implemented with a specific source afterloader. Some recently installed source afterloaders use a high-activity (91 GBq) cobalt-60 source.

This technique does not require patient hospitalisation in a room with radiological protection and is performed on an outpatient basis, in a room with a configuration comparable to that of an external- beam radiotherapy room. The treatment is performed with an afterloader containing the source and involves one or more sessions of a few minutes, spread over several days.

High dose-rate brachytherapy is used mainly for gynaecological cancers. This technique is being developed for treatment of prostate cancers, usually in association with an external beam radiotherapy treatment.

d - Brachytherapy in France

In 2013, 64 radiotherapy centres held an ASN license to perform brachytherapy treatments. These 64 centres are spread over the French territory as a whole (metropolitan France and its overseas *départements*) covering two sectors: 60% of the centres belong to the public or non-profit private health care (ESPIC) sector and 40% to the private sector.

The number of centres using these different techniques at the end of 2013 is indicated in table 4.

DISTRIBUTION of brachytherapy centres according to status (%)

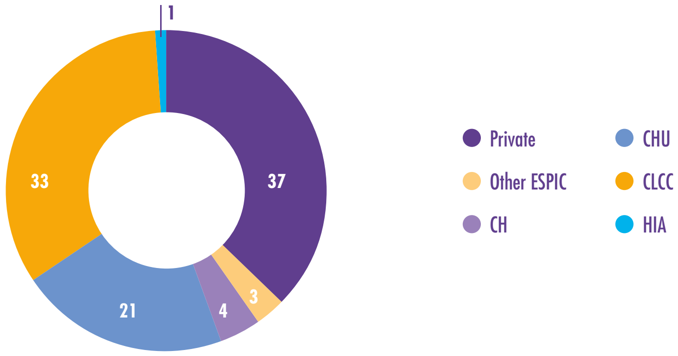


TABLE 4: Number of centres using the different brachytherapy techniques

TECHNIQUE USED		NUMBER OF CENTRES
Low dose rate	Iridium wire	26
	Iodine seed	38
	Cs137 afterloader	10
PDR		23
HDR		39

Source: inspection ASN année 2013.

3.2 Technical rules applicable to installations

3.2.1 Technical rules applicable to external-beam radiotherapy installations

The devices must be installed in rooms specially designed to guarantee radiation protection of the staff, turning them into veritable bunkers (wall thickness can vary from 1 m to 2.5 m of ordinary concrete). A radiotherapy installation comprises a treatment room including a technical area containing the treatment device, a control station outside the room and, for some accelerators, auxiliary technical premises.

The protection of the premises, in particular the treatment room, must be determined in order to respect the annual exposure limits for the workers and/or the public around the premises. A specific study must be carried out for each installation by the machine supplier, together with the medical physicist and the Person Competent in Radiation protection (PCR).

This study defines the thicknesses and nature of the various protections required, which are determined according to the conditions of use of the device, the characteristics of the radiation beam and the use of the adjacent rooms, including those vertically above and below the treatment room. This study should be included in the file presented to support the application for a license to use a radiotherapy installation, examined by ASN.

In addition, safety systems must indicate the machine status (operating or not) and must switch off the beam in an emergency or if the door to the irradiation room is opened.

3.2.2 Technical rules applicable to brachytherapy installations

The rules for radioactive source management in brachytherapy are comparable to those defined for all sealed sources, regardless of their use.

Low Dose-Rate brachytherapy

This technique requires the following premises:
- an application room, usually an operating theatre where the source carrier tubes (non-radioactive) are installed in the patient and their correct positioning is checked by X-rays or tomography imaging;
- hospitalisation rooms specially reinforced for radiation protection reasons, in which the radioactive sources are positioned and where the patient stays for the duration of the treatment;
- an area for radioactive source storage and preparation.

For certain applications (use of caesium-137 in gynaecology), a source afterloader can be used to optimise staff protection.

In cases where permanent implant techniques are used (seeds of iodine-125 in particular for treating prostate cancer), the applications are carried out in the operating theatre with ultrasonography monitoring, and do not require hospitalisation in a room with radiation protection.

Pulsed Dose-Rate brachytherapy

This technique uses source afterloaders (generally 18.5 GBq of iridium-192). The treatment takes place in hospitalisation rooms with radiological protection appropriate for the maximum activity of the radioactive source used.

High Dose-Rate brachytherapy

As the maximum activity used is high (370 GBq of iridium-192 or 91 GBq of cobalt-60), irradiation can only be carried out in a room with a configuration comparable to that of an external beam radiotherapy room.

4. BLOOD PRODUCT IRRADIATORS

4.1 Description

The irradiation of blood products is used to prevent post-transfusion reactions in blood-transfusion patients. The blood bag is irradiated with an average dose of about 20 to 25 grays. Irradiation is ensured by a self-shielded device (radiological protection by lead), therefore it can be installed in a room which does not require additional radiation protection. Depending on the models, the irradiators are equipped either with radioactive sources (1, 2 or 3 sources of caesium-137 with a unit activity of about 60 terabecquerels - TBq) or with electrical X-ray generators.

The policy initiated in 2009 to gradually replace the source-equipped irradiators by X-ray generators has reversed the composition of the equipment pool which now comprises more X-ray generators than irradiators with sources.

4.2 Technical rules applicable to facilities

A blood product irradiator must be installed in a dedicated room designed to provide physical protection (fire, flooding, break-in, etc.). Access to the device, which must have a lockable control console, must be limited to authorised persons only.

5. THE STATE OF RADIATION PROTECTION IN THE MEDICAL SECTOR

Radiation protection in the medical field concerns patients receiving treatment or undergoing diagnostic examination, health professionals (physicians, medical physicists, medical radiation technologists, nurses, etc.) using or participating in the use of ionising radiation, and also the population, such as members of the public moving around a health facility, or population groups that could be exposed to waste or effluents from nuclear medicine units.

Since 2008, ASN has periodically produced documents presenting a national synthesis of the main lessons learned from inspections, based on indicators that determine compliance with the regulatory radiation protection requirements. These syntheses enable the state of radiation protection in the different areas (radiotherapy, nuclear medicine, interventional radiology, etc.) to be assessed for publication in the annual report. The syntheses are based on the findings established during the year preceding their publication. ASN also publishes annual or several-year national appraisals of inspection results; they are available at www.asn.fr. 2014 saw the publishing of an assessment of computed tomography (2013 inspections) and an assessment of external-beam radiotherapy (2012 and 2013 inspections).

5.1 Exposure situations in the medical field

5.1.1 Exposure of health professionals

The risks for health professionals arising from the use of ionising radiation are firstly the risks of external exposure generated by the medical devices (devices containing radioactive sources, X-ray generators or particle accelerators) or by sealed and unsealed sources (particularly after administering radiopharmaceuticals). When using unsealed sources, the risk of contamination must be taken into consideration in the risk assessment (particularly in nuclear medicine).

The prevention of risks of exposure of health professionals to ionising radiation is required by provisions of the Labour Code concerning occupational radiation protection.

5.1.2 Exposure of patients

The exposure of patients to ionising radiation must be distinguished from the exposure of workers and the public insofar as it is not subject to a dose limit. The only principles applicable remain those of justification and optimisation (see introduction to this chapter).

The patient's exposure situation differs depending on whether diagnostic or therapeutic medical applications are being considered. In the first case, it is necessary to optimise the exposure to ionising radiation in order to deliver the minimum dose required to obtain the appropriate diagnostic information or to perform the planned intervention procedure; in the second case, it is necessary to deliver the highest possible dose needed to destroy the tumour cells while at the same time preserving the healthy neighbouring tissues as much as possible.

Whatever the case however, control of the doses delivered during imaging examinations and treatments is a vital requirement that depends not only on the skills of the patient radiation protection professionals but also on the procedures for optimising and maintaining equipment performance.

The steps undertaken by ASN since 2011 in collaboration with the health authorities and medical imaging professionals (see chapter 1) are designed to progressively ensure fully effective control over the doses delivered to patients. Many measures have been taken in this respect, including the updating and reinforcement of training in patient radiation protection for interventional practitioners in particular, the development of a quality assurance baseline in the radiology departments and centres provided for in Cancer Plan 3, the development of access to MRI and the defining of reference levels for the most highly irradiating interventional procedures.

5.1.3 Exposure of the general public and environmental impact

With the exception of incident situations, the potential impact of medical applications of ionising radiation is likely to concern:
- members of the public who are close to facilities that emit ionising radiation but do not have the required protection;
- persons close to patients having received a treatment or a nuclear medicine examination, particularly those using radionuclides such as iodine-131, or a brachytherapy with iodine-125;
- the specific professional categories (e.g. sewage workers) liable to be exposed to effluents or waste produced by nuclear medicine units.

The available information concerning radiological monitoring of the environment carried out by IRSN (Institute of Radiation Protection and Nuclear Safety), in particular the measurement of ambient gamma radiation, on the whole reveals no significant exposure level above the variations in the background radiation. On the other hand, radioactivity measurements in major rivers or wastewater treatment plants in the larger towns occasionally reveal the presence above the measurement thresholds of artificial radionuclides used in nuclear medicine (e.g. iodine-131). The available data on the impact of these discharges indicate doses of a few tens of microsieverts per year for the most exposed individuals, in particular people working in the sewerage networks and wastewater treatment plants (source: IRSN studies, 2005 and 2014). Furthermore, no trace of these radionuclides has ever been measured in water intended for human consumption (see chapter 1).

The person close to patients having been treated with radiopharmaceuticals (e.g. treatment of thyroid cancer or hyperthyroidism with iodine-131) can be exposed to ionising radiation for a few days due to the residual activity in the patient. ASN published recommendations in this subject in 2007, and in February 2012, the association of Heads of European Radiological Protection Competent Authorities (HERCA) proposed a model of a European card to be given to each patient leaving hospital after treatment with iodine-131. This card provides information to those who may be concerned, such as health professionals having to treat the patient, or border authorities, that the person has been administered radionuclides.

5.2 Some general indicators

5.2.1 Licenses and declarations

In 2014, ASN issued:
- 4,810 acknowledgements of receipt of declarations of medical and dental diagnostic radiology devices, of which nearly 64% concerned dental radiology devices;
- 681 licenses (for entry into service, renewal or cancellation), of which 363 were in computed tomography, 163 in nuclear medicine, 110 in external-beam radiotherapy, 36 in brachytherapy and 9 for blood product irradiators.

5.2.2 Dosimetry of health professionals

According to the data collected in 2013 by IRSN, 222,975 people working in sectors using ionising radiation for medical and veterinary purposes were subject to dosimetric monitoring of their exposure. Medical radiology alone accounts for nearly 52% of the medical staff exposed.

In all, more than 98% of the health professionals monitored in 2013 received an annual effective dose below 1 millisievert (mSv).

Six exceedances of the annual effective dose limit of 20 mSv were recorded and no exceeding of the annual dose limit at the extremities (500 mSv) was reported.

5.2.3 Report on signi cant radiation protection events

The recording and analysis of malfunctions and the notification of significant radioprotection events (ESR) to ASN has been constantly increasing since 2007.

These notifications provide the professionals with increasingly valuable experience feedback, helping to improve radiation protection in the medical field for workers and patients alike.

A total of 557 ESRs concerning the medical field were notified to ASN in 2014, a figure similar to that for 2013. A dip in the number of ESRs notified in radiotherapy was however observed in 2014, with a drop of about 23% in external-beam radiotherapy.

ASN receives two notifications of ESRs in the medical field per working day on average. The incident notices are published on *www.asn.fr*.

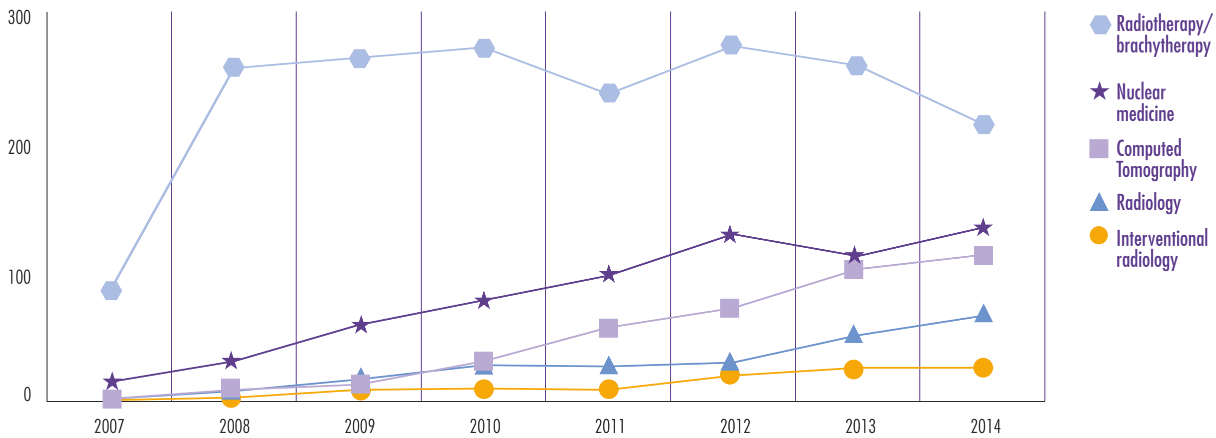
Significant events concerning workers (40 ESRs)

The ESRs notified in 2013 concern all the fields of activity. The most significant include:
- the exposure of a surgeon working in neuro-traumatology who in one month received more than a quarter of the regulatory annual whole-body dose, revealing a lack of radiation protection culture (event rated level 2 on the INES scale);
- exposure beyond the annual regulatory limits of a surgeon practising in the liberal sector in a clinic which highlights the human and organisational failings in radiation protection within that establishment (event rated level 2 on the INES scale);
- exposure of a technician from an external company in a radiotherapy bunker when adjusting the accelerator settings, highlighting the inadequacy of the safety barriers put in place (rated level 1 on the INES scale);
- the internal contamination with radioactive iodine of technicians labelling molecules with radioactive iodine following chromatography work performed without using any confinement and extraction system.

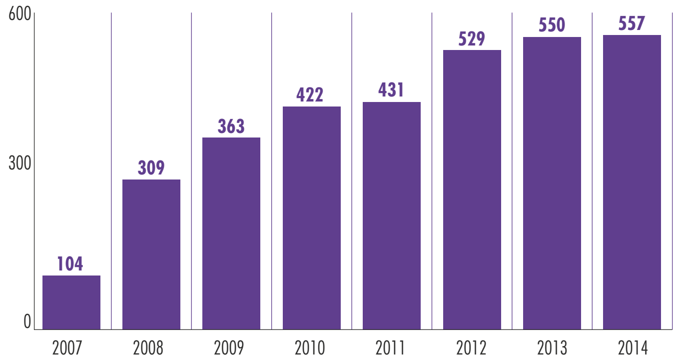

Retour d'expérience

First experience feedback sheet.

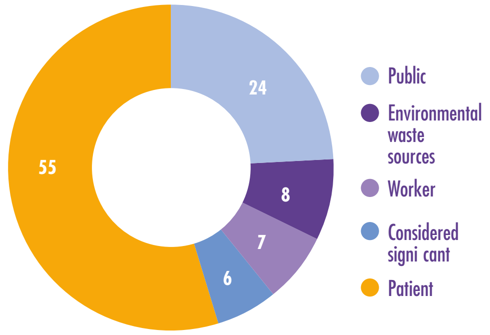
ESR NOTIFICATIONS by area of activity



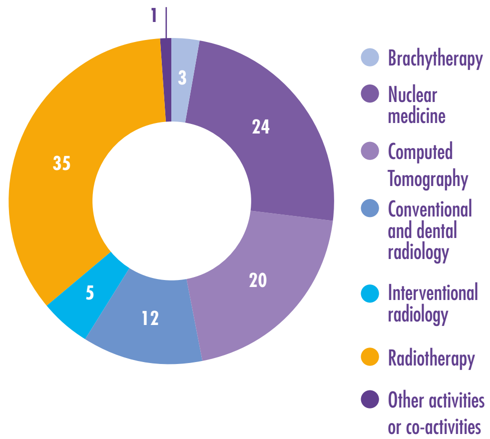
MEDICAL ESRs



NOTIFICATION CRITERIA FOR ESRs in the medical field notified to ASN in 2014 (%)



ESRs IN THE MEDICAL FIELD notified to ASN in 2014 (%)



Significant radiation protection events concerning patients (302 ESRs)

In radiotherapy

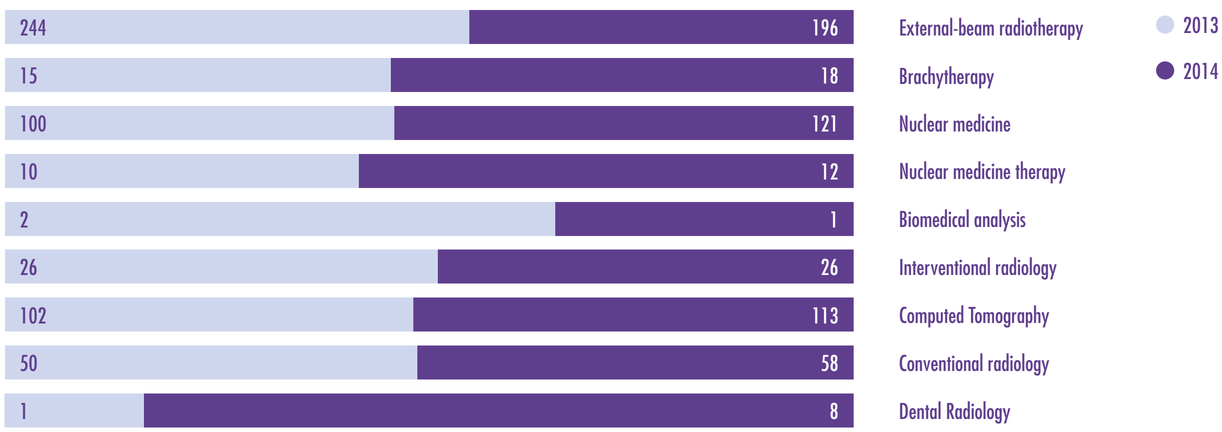
The majority of notified events (55%) concerning patients come from radiotherapy departments; these events did not have serious health consequences for the patients.

With regard to the ESRs notified in radiotherapy:

- 192 events concerning radiotherapy patients were declared in 2014. Compared with 2013, this number is stable for the ESRs rated level 1 on the ASN-SFRO scale and down for ESRs rated level 0.
- the majority of the events resulted from an anomaly in patient positioning without serious health consequences for the patient.
- 117 events were rated level 1 on the ASN-SFRO scale, which comprises 8 levels from 0 to 7. Quarterly reports of these level-1 events are produced and published on *www.asn.fr*.

One event notified in 2013 and three events notified in 2014 in external-beam radiotherapy were rated level 2 on the ASN-SFRO scale.

NUMBER OF NOTIFICATIONS per medical activity - comparison of 2013 and 2014



In nuclear medicine

More than one hundred ESRs have been notified each year in nuclear medicine since 2011 with 134 ESRs for the year 2014:

- the most frequent ESRs concern errors in the administration of radiopharmaceuticals, patient identity errors and errors concerning the dose to administer.
- several events notified in 2014 concerned pregnant women, 2 of them involving radioactive iodine therapy. The analyses of the events will be issued to the professionals in 2015.

The analysis of these events reveals a lack of quality and risk management culture in the nuclear medicine departments concerned.

In radiology

Although the number of notifications remains low, those concerning patients are increasing constantly in radiology departments (computed tomography and interventional radiology).

It is in the area of interventional radiology that the most serious consequences are observed with the onset of deterministic effects for the patient.

Significant radiation protection events concerning sources and radioactive waste and effluents (47 ESRs)

These ESRs are associated with the loss of radioactive sources or the dispersion of radionuclides (leaks of radioactive effluents from pipes or tanks, uncontrolled discharge of effluents into the collective sewerage network, removal of waste to an inappropriate disposal route).

The number events associated with leaks of radioactive effluents from nuclear medicine units increased in 2014. They reveal deficiencies in the maintenance and monitoring of facilities that are becoming obsolete. Despite the feedback from ASN to all the nuclear medicine units in 2009 and 2012, ESRs of this type are still being notified. It can only be concluded that the management of radioactive effluents is inefficient, as witnessed by the absence of steps to prevent uncontrolled discharges.

In 2014, ASN rated an event level 2 on the INES scale for insufficient monitoring of the radioactive effluent management system.

Medical exposure of women unaware of their pregnancy (133 ESRs)

The notifications made to ASN concern exposure of the foetus in women who were unaware of their pregnancy when they underwent a medical imaging examination. For the events notified in 2014, the doses received were without expected consequences for the foetus or the child after birth (ICRP, 2007). The analysis of these notifications rarely reveals deficiencies in the information given to the women prior to the examination when making their appointment, immediately before the examination and via posters in the changing booths.

These notifications represent 99% of the notifications made under the "public" criterion.

TO BE NOTED

Radiotherapy course partially delivered to a non-target volume of the patient

ASN rated the event level 2 on the ASN-SFRO scale (Jean Godinot Anti-Cancer Institute of Reims).

When defining the volumes to be treated by radiotherapy, the target ganglionic volume was identified on the opposite side to that prescribed. This error, called a wrong-side error, was repeated in 10 sessions of a treatment course that initially comprised 25 sessions. The checks made before the start of treatment did not detect this error. ASN has asked the Jean Godinot Institute to conduct broader and deeper reflections to define more clearly the verification steps throughout treatment preparation and delivery (identification of the verification steps, of check points, of the persons responsible for verification and the associated traceability).

Exceeding of the regulatory annual exposure limit value by a practitioner

ASN rated the event level 2 on the INES scale (Bordeaux CHU, Pellegrin Hospital, Bordeaux).

One 14th October 2014, ASN was informed by the Bordeaux CHU (University Hospital Centre) of the exceeding of the regulatory annual whole-body limit of 20 mSv by an orthopaedic surgeon when using an interventional radiology device (image intensifier) in the operating theatre (the dose received between June 2013 and June 2014 was 25 mSv).

The investigations carried out by the hospital were unable to identify the causes of this exposure and more specifically whether the practitioner used the personal protection equipment regularly. Furthermore, the surgeon's failure to wear an active dosimeter meant that the measurement results could not be compared with the passive dosimetry results.

ASN conducted an inspection on 1st December 2014 in the department in which the event occurred. This was followed up by a corrective action letter concerning in particular the effective wearing of dosimeter by all the professionals involved and the deployment of collective protection equipment.

Given that a worker had already exceeded the regulatory limits under similar conditions of practise in 2009 and 2010 in the same centre, ASN rated this incident level 2 on the INES scale.

Synthesis of the significant radiation protection events notified in 2014

The events notified to ASN in 2014 show that the most significant consequences from the radiation protection aspect concern:
- for workers, interventional radiology (external exposure of operators, and of extremities in particular) and nuclear medicine (contamination of workers other than health professionals);
- for patients, interventional radiology with deterministic effects observed in patients having undergone particularly long and complex procedures, as well as in nuclear medicine with radiopharmaceutical administration errors;
- for the public and the environment, leaks of radioactive effluent containment systems in nuclear medicine.

The analyses of the ESRs notified to ASN once again underline the need to increase the involvement of persons competent in radiation protection (PCR) and medical physicists in the management of radiation protection, to develop training of the professionals who are not specialists in ionising radiation, to implement procedures for quality management and safety and for the evaluation of professional practices.

ASN has undertaken several actions to disseminate the lessons learned from the events:
- the distribution of circular letters to interventional radiology professionals and to the nuclear medicine professionals, in the latter case concerning the radiation protection of patients administered radiopharmaceuticals prepared using automated systems (nuclear medicine);
- the distribution of periodic radiotherapy information bulletins based on the capitalisation of the notified ESRs (more than 1900 incidents in radiotherapy since 2007), produced by the radiotherapy professionals and ASN (bulletin No. 6 on patient safety in radiotherapy published in 2014 concerns wrong-side errors);
- the publication of articles in the scientific reviews *Radioprotection* (Volume 49 / Number 01 / 2014, pp 61-6 and Radiation Protection Dosimetry (October 1st, 2014) and participation in national and international professional congresses (IRPA, International Radiation Protection Association, 2014).

Furthermore, a new experience feedback aid for the professionals was also produced in 2014. The Experience feedback information sheet highlights a significant event notified to ASN. Its aim is to rapidly inform the professionals of significant events and incite them to reflect upon means of preventing the recurrence of such events. The Experience feedback sheet is a complementary aid to the Patient Safety- Paving the way for Progress bulletin.

The first two Experience Feedback sheets were published in 2014. They addressed the subjects of repositioning error during kV imaging and source jamming in high dose-rate brachytherapy.

5.3 Radiation protection situation in radiotherapy

The safety of radiotherapy treatments has been a priority area of ASN oversight since 2007. In view of the results of the inspections and the progress made in terms of treatment safety, as of 2012 radiotherapy centres will be checked every two years. An annual inspection frequency is nevertheless maintained for the centres with vulnerabilities in terms of human resources or organisation, and those who are behind schedule in ensuring compliance with ASN resolution 2008-DC-0103 of 1st July 2008. Moreover, particular attention is paid to departments having undergone major modifications (organisational or material), and centres implementing new techniques.

In 2013, ASN asked the GPMED (Advisory Committee of Experts for Radiation Protection for the Medical and Forensic Applications of Ionising Radiation) to issue recommendations on the conditions of implementing high-precision irradiation techniques in radiotherapy and the associated practices, based on the best practices existing in France and abroad. The conclusions of the working group mandated by the GPMED were presented to the GPMED on 9th December 2014, which is expected to give its opinion in early 2015.

5.3.1 Radiation protection of radiotherapy professionals

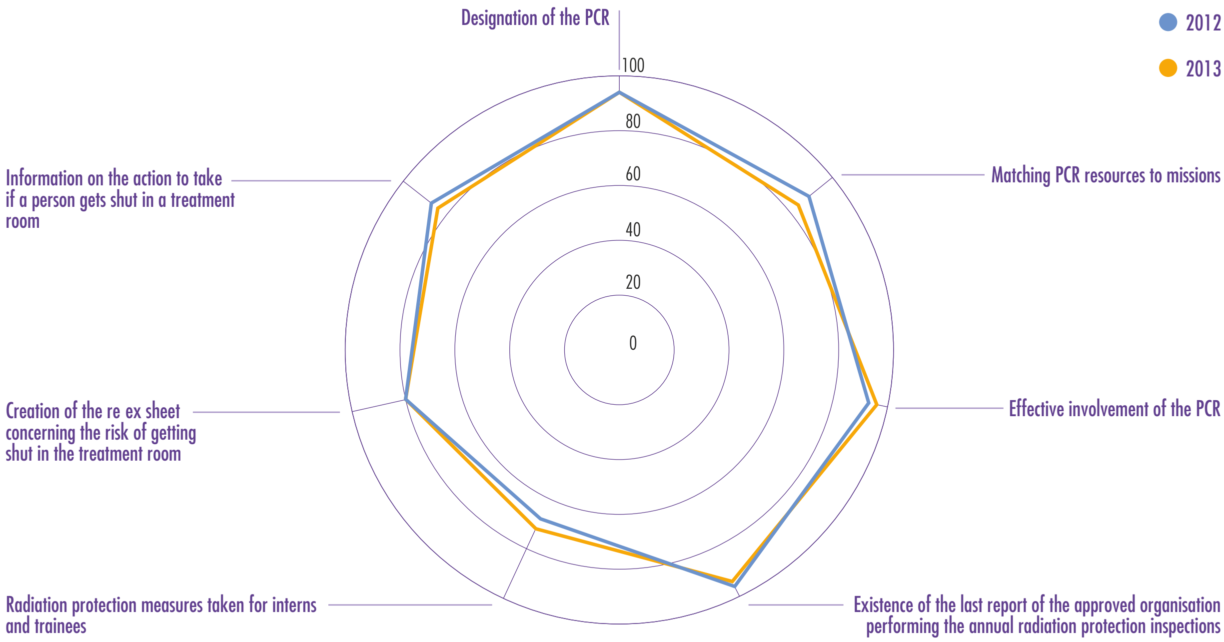
When the facilities are correctly designed, the radiation protection implications for the professionals in radiotherapy are limited due to the protection provided by the walls of the irradiation room.

The inspectors nevertheless pay particular attention to the risk of a person getting shut in the bunker, particularly personnel with little experience of such facilities (newly hired staff, trainees). They also examine the annual radiation protection verification reports produced by an ASN-approved entity and verify the implementation of the requirements concerning PCRs, such as their appointment, their duties and the means available to them.

During the year 2013, 80% of the inspected centres drew up instructions on the action to take in the event of a person getting shut in a bunker, and 72% of the inspected centres made provisions for trainees and interns.

ASN moreover verifies the radiation protection requirements for the personnel when it delivers the licenses to possess and use the devices, particularly during the facility conformity inspection.

RESULTS OF INDICATORS concerning worker radiation protection in 2012 and 2013 (%)



Source: inspections ASN.

5.3.2 Radiation protection of radiotherapy patients

The ASN inspections carried out in 2013 confirm the positive trend begun in 2008 with regard to the increased human resources deployed in the medical radiation physics field.

At the end of 2013, all the centres had more than one full-time equivalent (FTE) medical physicist. ASN counts 22 centres with less than two FTE medical physicists.

Implementation of a quality management system

Although all the centres have implemented a patient treatment safety and quality management system (ASN technical resolution 2008-DC-103 of 1st July 2008), the progress of the system varies greatly from one centre to another. Depending on the regulatory requirement considered, failures to comply with the regulatory deadlines set by ASN resolution 2008-DC-0103 are noted. Thus, in 2013, 11% of the centres inspected had not appointed an operational quality manager (compared with 29% in 2011). When a manager has been appointed, the means available to fulfil the duties of the function are not always defined.

The documentary system is assessed during the inspections by verifying the presence of a quality document management procedure and the good control of documents, records in effect, along with the existence of particular procedures associated with the treatment processes. Although 84% of the inspected centres have a quality document management procedure, control of the documentary system and of the document records requires substantial investment by the centres in order to achieve efficient document management. Documentary system management must therefore be further improved.

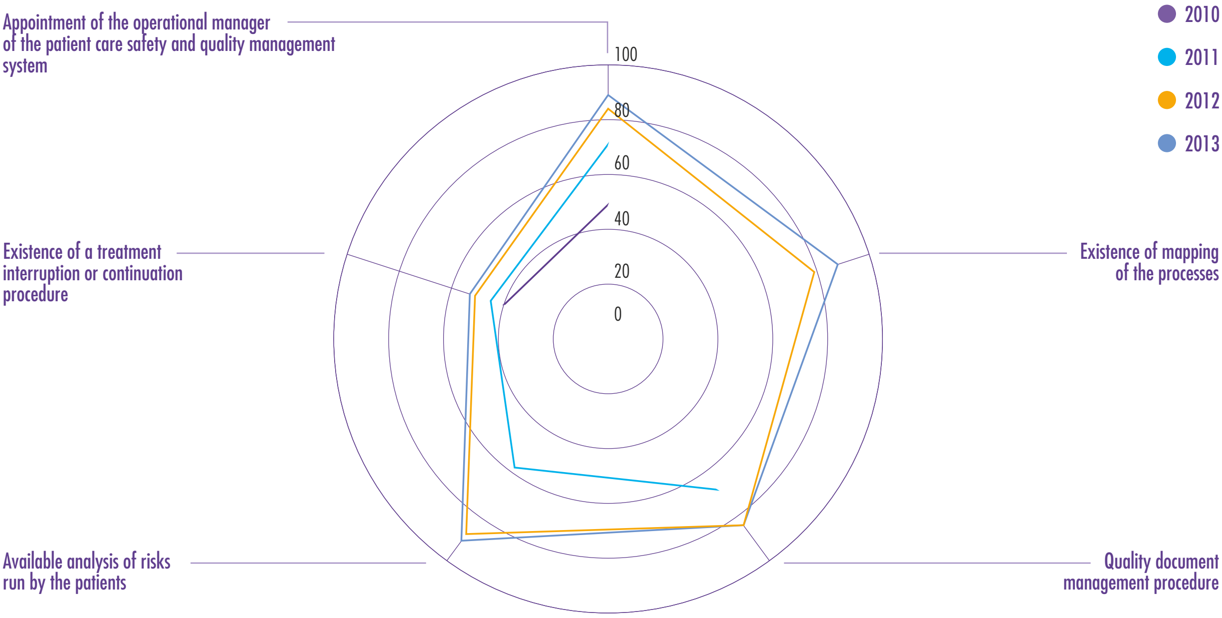
The risks run by the patients are analysed in 91% of the centres inspected in 2013, but the analysis is updated in only 55% of the centres, especially when new techniques are introduced, yet this is the very moment when such analyses are essential. Noting reluctance on the part of the radiotherapy departments to embrace these risk analyses, ASN has produced - in collaboration with the radiotherapy professionals - an assessment of the difficulties encountered with a view to issuing recommendations to facilitate application of this procedure. An IRSN appraisal requested by ASN was carried out in 2014 and recommendations will be proposed in 2015.

The figure below illustrates the progress in the approach to the management of treatment safety and quality since 2010.

Control of the treatment procedures

The inspections in 2012-2013 targeted one step of the treatment in order to verify the existence of written procedures formalising the practices and their effective implementation. The step examined in this context was the patient setup during the first treatment session ("planning session").

DEVELOPMENT OF CRITERIA since 2010 concerning the deployment of section 1 of ASN Resolution 2008-DC-0103 (%)



Source : inspections ASN.

It was observed in 2013 that:
- 98% of the inspected centres have the dosimetric treatment plan approved by the medical physicist and the radiation oncologist before delivering the treatment;
- in 100% of the inspected centres, verification images are taken for all the treatment beams; however they are only approved by the radiation oncologist before the first treatment session in 86% of the inspected centres (in a number of centres the images are not approved until after second or third session, or even in some cases at the weekly follow-up appointment);
- 83% of the inspected centres have a written procedure for the patient set-up on the treatment device and 13% are in the process of writing such a procedure.

Management of risks and addressing malfunctions

The widespread implementation of an internal system for recording malfunctions was confirmed in 2013, with 92% of the inspected centres having and using such a system.

ASN observed in 2013 that 88% of the inspected centres have an organisational set-up enabling them to regularly bring together multidisciplinary skills to analyse significant radiation protection events. The involvement of the management of medical establishments in this area is essential and must be maintained over the long term.

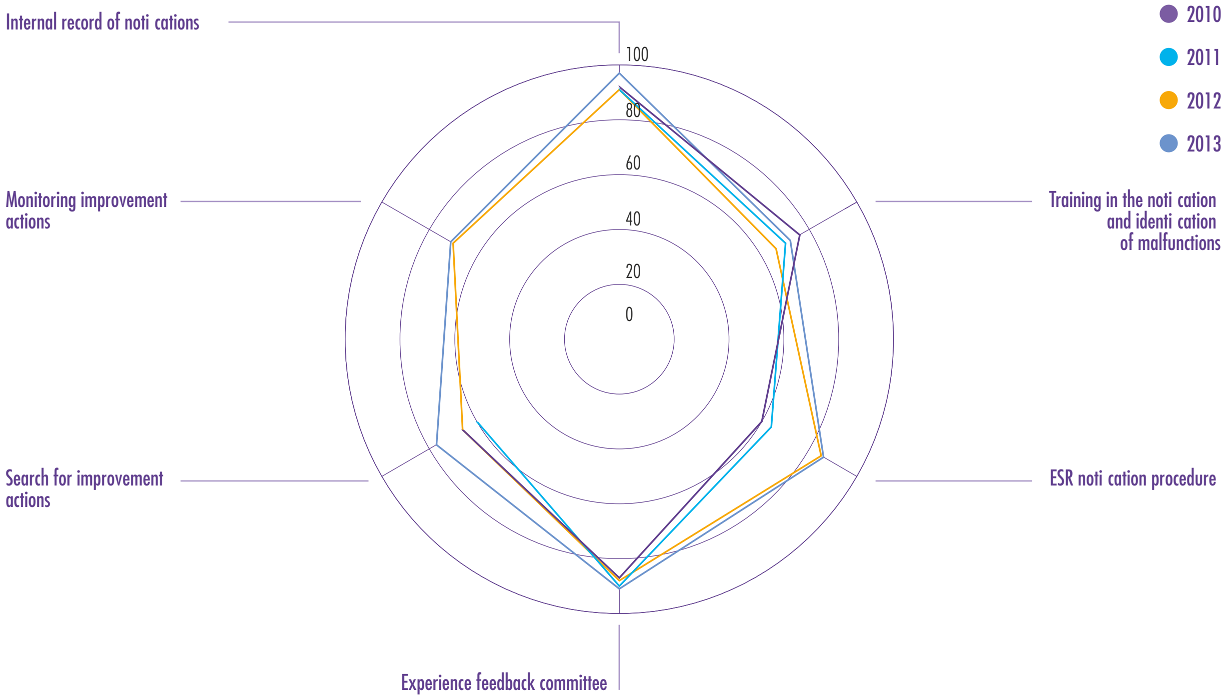
In 2013, 66% of the centres identified improvement measures after analysing the events and 66% monitor the implementation of these improvement measures.

5.3.3 Summary

To conclude, ASN has observed continuous improvement in the implementation of the quality and safety management requirements in radiotherapy departments since 2008 and considers that the findings established at the end of 2013 are encouraging, while at the same time underlining the variability between centres, particularly with regard to the control of the documentary system and records.

Concerning risk management, further efforts must be made to identify the improvement actions and monitor them over time.

RESULTS OF THE INDICATOR concerning the management of risks and events (%)



Source: inspections ASN.

5.4 The state of radiation protection in brachytherapy

Thirty-one inspections covering slightly less than 50% of the brachytherapy departments were carried out in 2013.

5.4.1 The treatment quality and safety management system

The majority of the centres have put in place appropriate measures for:
- appointing the manager of the treatment quality and safety management system (89% of the centres);
- producing the document management procedure (89% of the centres);
- internal communication (95% of the centres).

Two indicators concerning the implementation of the treatment quality and safety management system are qualified as "insufficient". The first is the formalising of process mapping which is only carried out in 64% of the inspected centres, while the second is the conducting of the analysis of risks run by the patient in brachytherapy, which has been done and is available in just 39% of the centres and in the process of being carried out in 44% of the centres.

There are margins for improvement in the management of quality documents and quality records.

5.4.2 Management of sources

The majority of the centres have put in place appropriate measures for:
- recording the movements of sources (95% of the centres);
- transmitting the inventory of sources to IRSN each year (100% of the centres);
- the management of waste/sources after implanting iodine seeds, with systematic verification of the remaining sources (number) with respect to the implanted and ordered sources (85% of the centres).

Management of the brachytherapy sources is satisfactory; nevertheless, of the 31 centres inspected, 15 have expired sealed sources and only 33% of these centres have taken steps to have them removed.

5.4.3 Worker radiation protection

The majority of the centres have put in place appropriate measures for:
- having a PCR designated by the employer (100% of the centres);
- defining the PCR's duties (100% of the centres) and resources (89% of the centres);
- passive dosimetry monitoring of workers that could be exposed (100% of the centres);
- active dosimetry monitoring of personnel working in controlled areas (95% of the centres).

The indicators concerning training in worker radiation protection and advanced training in worker radiation protection for high-activity sources (44% of the centres have accomplished the latter) are qualified as "insufficient". The same goes for the performance of internal technical controls, performed in only 63% of the inspected centres, and development of the technical control programme, also carried out in 63% of the inspected centres.

Progress remains to be made in the risk analyses (68% of the inspected centres) and the analyses of working practices and conditions (84% of the centres).

5.4.4 Radiation protection of patients

Most of the centres have put in place appropriate measures to develop the medical physics organisation plan (89% of the centres) and keep an up-to-date inventory of the medical devices using ionising radiation and a register for recording operations (maintenance and quality control).

In the procedure reports, information on the identification of the device used is only provided in 39% of the centres and information for estimating the dose is only provided in 68% of the centres.

Training in patient radiation protection is only provided in 78% of the centres.

5.4.5 Emergency situations and the management of malfunctions

The majority of the centres have put in place appropriate measures for:
- internal recording of events foreshadowing malfunctions or undesirable situations;
- an organisation allowing the multidisciplinary analysis of the causes of internal events and all ESRs;
- the implementation of an events management procedure;
- seeking improvement actions for the analysed events.

Only 61% of the centres monitor the improvement action following an event or a malfunction.

5.4.6 Summary

ASN considers that the findings of the inspections carried out in 2013 are encouraging. With regard to the deployment of a quality management system, the brachytherapy units benefit from the organisation set up in external-beam radiotherapy for both worker and patient radiation protection.

Lateness in the deployment of aids specific to brachytherapy is nevertheless observed. Efforts must thus be made regarding the regulatory requirements relative to process mapping, training in patient radiation protection and advanced training in worker radiation protection when high-activity sources are held, the removal of expired sources, the scheduling and performance of internal technical controls of radiation protection, the completeness of the procedure report, the conducting of the study of risks run by patients and the monitoring of improvement actions following a significant radiation protection event.

Lastly, a recent event involving source jamming of an HDR afterloader led to the exposure of workers and a female patient. This event brought home the importance of defining emergency measures, particularly within the framework of the on-site emergency plan, and of reinforcing worker training in these emergency measures. This point will be an inspection priority for the year 2015.

5.5 The radiation protection situation in nuclear medicine

The assessment of the 67 inspections carried out in 2013 representing about 31% of the facilities resulted in the following findings.

5.5.1 Radiation protection of nuclear medicine professionals

Implementation of the regulatory obligations by the departments was considered satisfactory on the whole, particularly with regard to the designating and defining of the PCR's duties, the setting up of appropriate dosimetry and the performance of the external verification of radiation protection.

Progress is nevertheless required in providing the PCR with sufficient resources, making the delimiting of controlled areas consistent with the assessment of the risks, analysing all the working practices and conditions, and taking internal exposure into account.

Ring dosimeters are now worn systematically by the operators concerned. However, the operators are often not given any recommendations concerning the way the ring should be worn to optimise the relevance of the measurement (e.g.: recommendations per the ORAMED programme – Optimisation of Radiation Protection for Medical staff – if the department has not carried out a specific study on its operators).

Lastly, particular efforts must still be made to meet the following regulatory requirements.
- the assessment of risks, which is only exhaustive in 63% of the units;
- personnel training in radiation protection, which only covers all the persons concerned in 52% of the units;
- the performance of internal radiation protection verifications, which are carried out in full in just 63% of the nuclear medicine units; moreover, only 49% of the units comply with the regulatory verification frequency.

5.5.2 Radiation protection of patients in nuclear medicine

Most of the regulatory requirements concerning radiation protection of patients are known and adhered to by the nuclear medicine units: setting up of an organisation aiming at involving a medical physicist, development of medical radiation physics organisation plans (POPM) and the setting up of an inventory of medical devices.

Although the majority of nuclear medicine units have got used to sending their dosimetric records to IRSN each year, 20% of the units do not compare the results with the diagnostic reference levels, therefore the desired optimisation objective is not achieved. Furthermore, although the maintenance and quality control operations are recorded, the organisation for checking that they have been effectively carried out is still not in place.

Training in patient radiation protection, which does not cover all the professionals concerned in 40% of the units, remains a weak spot. Despite the accreditation delivered to several organisations by the ANSM (French National Agency for Medicines and Health Products Safety) in 2013, only 31% of the inspected units had the external quality control of their single-photon emission computed tomography (SPECT) facility performed.

5.5.3 Protection of the general public and the environment

Today, almost all the inspected units have a contaminated waste and effluent management plan. These documents are nevertheless incomplete with respect to the requirements of the Order of 23rd July 2008 in 25% of the units. Furthermore, 24% of the establishments with nuclear medicine units are not yet equipped with a fixed-station detection system for screening the waste intended for the non-radioactive waste disposal route. Moreover, relatively few units (26%) have a discharge license issued by the sewage network manager (Article L. 1331-10 of the Public Health Code).

5.5.4 Summary

ASN continued the inspections of nuclear medicine units in 2014, and initiated or continued work on the regulations to improve radiation protection in this field of activity (updating of the unit layout and organisation rules: see point 2.2).

A working group including all the stakeholders (heads of health care facilities, nuclear medicine professionals, wastewater treatment plant and sewerage system operators, administrations and regulating Authorities concerned, technical experts) was set up in early 2013 to issue recommendations on the conditions of discharge of radionuclide-contaminated effluents into the public sewerage system. These recommendations are expected to be issued in 2015.

5.6 Radiation protection situation in conventional radiology and computed tomography

ASN has maintained the field of computed tomography as an inspection priority in 2014 (in 2012, CT procedures accounted for 71% of the average effective dose received by the population, whereas they represent just 10% by number (see chapter 1)).

The action plan engaged by ASN since 2011 has, among other things, allowed the updating of the Guide to good medical imaging practices[5] which is available via the Internet (early 2013) and on smartphone and tablet (November 2014), and should enable professionals referring patients for radiological examinations (general practitioners, specialists and emergency doctors) to better apply the principle of justification. This guide enables the referring physician to choose the least irradiating examination method that is appropriate for the pathology and the intended purpose.

Inspection results

In 2013, 96 computed tomography facilities were inspected, representing around 10% of the pool. The final result of the inspections, confirmed by an analysis of the indicators over 2011, 2012 and 2013 concerning

5. Guide available on the website of the French Society of Radiology (SFR) (http://gbu.radiologie.fr/).

269 computed tomography facilities, i.e. more than 26% of the pool, reveals better embracing of the radiation protection of workers than of patients, and confirms the shortcomings already detected in 2012. The main findings:
- with regard to patient radiation protection, the principle of justification seems to be better applied than the principle of optimisation;
- with regard to worker radiation protection, the required improvements must focus on the carrying out of the analyses of working practices and conditions, the refreshing of training in the radiation protection of workers who could be exposed, and monitoring by active dosimetry;
- with regard to patient radiation protection, improvements are required in the following: providing justification information in the medical prescription, training personnel in patient radiation protection, optimising the examination protocols, analysing the dosimetric readings of the diagnostic reference levels (DRL) (76% of the structures meet the obligation to transmit data to IRSN, with a major shortfall in paediatrics[6]) and the removal of quality control nonconformities.

In 2013, ASN asked the GPMED to produce recommendations on measures to improve the participation of imaging centres in the collection and analysis of dosimetric data associated with the DRLs and on any changes to be considered in the regulatory provisions for radiology and nuclear medicine. The conclusions are expected in early 2015.

At the European level, ASN participates in the initiatives of HERCA targeting:
- CT scanner manufacturers to improve the optimisation tools available on their equipment;
- European medical societies such as the European Society of Radiology, and international organisations such as the World Health Organisation (WHO) for questions relating to the justification of imaging examinations that use ionising radiation.

In July 2014, HERCA published a document entitled Justification of Individual Medical Exposures for Diagnosis: HERCA Position Paper, which aims at presenting the regulator's viewpoint on roles and responsibilities in the medical exposure justification process. This document takes into account the requirements of the new European Directive 2013/59/Euratom (see chapter 3).

On 26th September 2014, HERCA organised a multipartite meeting of the stakeholders in Brussels with the aim of discussing the problems concerning application of the principle of justification in medical imaging procedures. HERCA noted the keenness to collaborate expressed by all the participants, and notably the international bodies such as International Atomic Energy Agency (IAEA), the World Health Organisation (WHO) and the European Commission, the European professional radiological associations (European Society of Radiology, European Association of Nuclear Medicine, European Federation of Radiographer Societies, International Society of Radiographers and Radiological Technologists, European Federation of Organisations in Medical Physics), the manufacturers of medical equipment represented by the European Coordination Committee of the Radiological, Electromedical and Healthcare IT Industry and World Family Doctors, Caring for People representing the general practitioners. The interests of the patients were expressed via the WHO network Patients for Patient Safety.

5.7 Radiation protection situation in interventional radiology

During the last few years, significant radiation protection events have been notified to ASN following the appearance of lesions (radiodermatitis, necrosis) in patients having undergone particularly long and complex interventional procedures. In addition to these notifications which emphasise the major implications of radiation protection for patients, one must consider the notifications concerning workers whose exposure has resulted in exceedances of the regulatory limits.

Since 2009, the monitoring and regulation of radiation protection in interventional radiology has been a national priority for ASN.

The ASN Commission's deliberation of 14th June 2011 on improving radiation protection in interventional radiology, based on the GPMED's recommendations, underlines the strong implications of radiation protection in this field and recommends several actions that are necessary to improve it.

The appraisal of radiation protection in radiology is based on indicators allowing an assessment of the implementation of the regulations relative to the radiation protection of the medical staff and the patients and the regulations concerning the medical devices (maintenance, quality inspection, dose measuring systems). In 2015 ASN will publish a national report on the inspections carried out from 2010 to 2012 covering more than 400 departments performing interventional radiology procedures.

5.7.1 Radiation protection of interventional radiology professionals

The findings established on completion of the inspections in 2013 confirm the observations made over the last few years. Thus, radiation protection of

6. Analysis of data concerning updating of the diagnostic reference levels for radiology and nuclear medicine. 2011-2012 results PRP-HOM/2014-9. Bilan 2011-2012 PRP-HOM/2014-9.

medical professionals is applied to a greater extent in the fixed and dedicated radiology facilities than in the operating theatres in which mobile devices are used.

The inspections overall reveal inadequacies in the performance of the working practices and conditions, particularly with respect to doses to the extremities and the eyes and in dosimetric monitoring (active and at extremities).

The lack of training of medical staff, especially private practitioners, working in operating theatres is a fact and a poor radiation protection culture can be observed in this sector. In addition, the personal or collective radiation protection equipment is used infrequently or not at all, even when available in sufficient quantities. Furthermore, the personnel in question show little concern for their own radiation protection and are not aware of the doses they can and/or do receive, due to the failure to wear the appropriate and regulatory dosimetry means.

Moreover, the still incomplete use of dosimetry and the lack of appropriate dosimetric monitoring, in particular of the extremities for certain fluoroscopy-guided procedures, and the absence of medical monitoring of the practitioners, make it difficult to assess the status of worker radiation protection in this sector. ASN does nevertheless observe improvements in the inspected departments and greater awareness of the professionals as a result of the information feedback from notified events.

For the PCRs, there are still methodological and organisational difficulties and they do not always have the means enabling them to perform their duties in full.

Moreover, in the private sector, the analyses of private practitioners' working practices and conditions, their dosimetric monitoring, their medical monitoring and, where applicable, that of their employees, represent a recurrent difficulty.

5.7.2 Radiation protection of patients in interventional radiology

The findings established on completion of the inspections in 2013 with regard to patient radiation protection also confirm the observations made over the last few years. This holds true for the shortcomings observed in the application of the principle of dose optimisation, be it in the setting of the machines and

Interventional radiology examination (interventional cerebral angiography).

the protocols used or in the practices. They result from insufficient operator training in patient radiation protection and sub-optimal use of the radiology devices, as the dose optimisation functions of the devices are insufficiently well known.

The low level of use of medical physicists in departments practicing interventional radiology hinders implementation of the principle of optimisation: greater involvement of medical physicists would more specifically allow better use of the equipment and the application of protocols adapted to the procedures performed. When medical centres call upon outside medical physics service providers, it is observed that the centres rarely adopt the procedures and documentation used by these service providers. The analysis of the notified events has already highlighted considerable reductions in delivered doses, ranging from 40 to 70%, as a result of the optimisation measures implemented by the medical physicist.

These findings confirm insufficient application of the optimisation principle and can lead to potential risk situations.

5.7.3 Summary

As in 2013, ASN considers that the urgent measures it has been recommending for several years to improve the radiation protection of patients and professionals in the exercise of interventional practices have still not been taken. These measures concern increasing medical physicist staff numbers and user training and quality assurance, organising professional practice audits, increasing the means allocated to PCRs, training medical professionals in patient radiation protection and the publication of good practices guides by the learned societies.

In the field of medical physics in particular, the efforts made since 2007 to boost the numbers of medical physicists must be continued in order to meet the medical imaging needs.

ASN also asked the HAS (French National Authority for Health) to draw up national recommendations for monitoring patients having undergone interventional radiology procedures that could lead to effects on tissues. These recommendations were published in 2014 by the HAS[7].

Finally, ASN considers that regulatory measures should be taken to make it compulsory to install systems for estimating the delivered radiation dose during radiological procedures on existing radiology devices that do not have such systems. Transposition of the new European directive on basic standards for radiation protection (see chapter 3) into the French regulations should enable the pool of equipment used in this area to be renewed more quickly, at least as concerns the equipment used for the examinations delivering the highest radiation levels.

In 2014 the review of the actions recommended by ASN in medical imaging provided the opportunity to assess the situation concerning specific subjects in the interventional areas, such as the issuance of good practice guides for the various specialities, the training of medical professionals in patient radiation protection, the definition of DRLs, or the increase in means assigned to the PCRs.

Due to the implications - as much for the radiation protection of professionals, where limit exceedances are still observed, as for that of patients, where significant radiation protection events are notified - and because of the shortcomings in the radiation protection culture of medical workers, particularly in operating theatres, ASN is maintaining the inspection of interventional radiology as a national priority in its 2015 inspection programme.

6. OUTLOOK

The gradual improvement in the safety of radiotherapy treatment procedures observed by ASN through its inspections each year since 2007 must be continued in order to achieve good control of procedures and thus guarantee the radiation protection of patients.

Still observing shortcomings in the embracing of a priori risk analyses, ASN – in collaboration with professionals – is preparing recommendations to facilitate the implementation of this approach.

On the basis of the work carried out in 2014 by the GPMED concerning the new practices and techniques in radiotherapy, ASN will be very attentive to the opinion given on this subject and will undertake, with the Minister responsible for Health and the INCa, the necessary actions to reinforce patient safety and protection during their implementation.

In the area of diagnostic X-ray imaging and during interventional procedures, on the basis of the results of the actions undertaken since 2011 to achieve better control over doses delivered to patients, ASN will approach the health authorities to ask that strategic coordination of the recommended actions be set up, particularly and in priority with regard to quality assurance, the time devoted to medical physics for operational application of the principle of optimisation of patient radiation protection, the upgrading of the MRI

7. *"Improving patient monitoring in interventional radiology and fluoroscopy-guided procedures – reducing the risk of deterministic effects".*

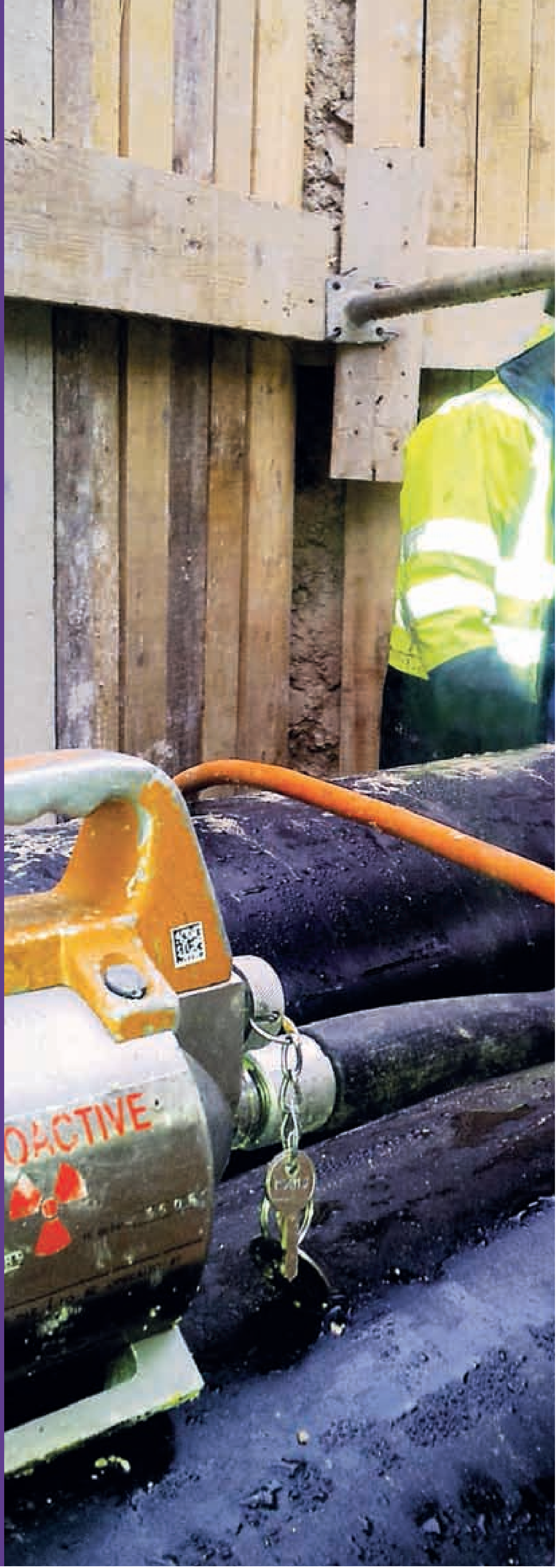
equipment pool to permit true application of the principle of justification and the implementation of training initiatives by the learned societies alongside the publishing of good practice guides. In addition to these priority actions, ASN considers it necessary to identify population groups for whom particular vigilance is required.

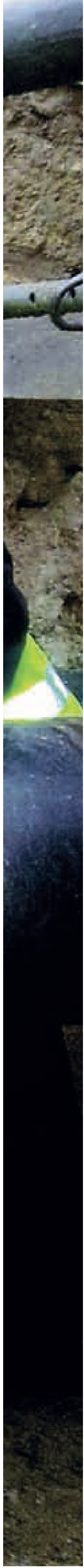
With regard more specifically to medical radiation physics, ASN will closely monitor the work initiated in 2014 by the Ministry of Health to give medical physicists and dosimetrists a status that ensures greater recognition of their role in treatment safety and patient radiation protection.

Lastly, ASN remains attentive to the work coordinated by the HAS (National Authority for Health) concerning the evaluation of clinical practices that expose individuals to ionising radiation for medical purposes. After the publication in late 2012 of the methodological guide "Patient radiation protection and analysis of continuous professional development practices and certification of healthcare establishments", and extensive communication in 2013 at professional congresses in particular, ASN will continue to monitor the deployment of the clinical practices assessment programmes, particularly during its inspections. A review of the inspection findings will be published in 2015.

10

INDUSTRIAL, RESEARCH AND VETERINARY USES AND SOURCE SECURITY





The industrial and research sectors have been using sources of ionising radiation in a wide range of applications and locations for many years now. The purpose of the radiation protection regulations currently in force is to check that the safety of workers, the public and the environment is ensured. This protection includes source management, monitoring of the conditions in which sources are held, used and disposed of, from fabrication through to end-of-life. It also involves monitoring the main stakeholders, that is to say the source manufacturers and suppliers, and enhancing their accountability.

The regulatory framework governing nuclear activities in France falls within the scope of the Public Health Code and the Labour Code, and guides the regulation activities for which ASN is responsible. It results from the transposition of the Euratom directives (see chapter 3).

The radiation sources used are either radionuclides - essentially artificial - in sealed or unsealed sources, or electrical devices generating ionising radiation. The applications presented in this chapter concern the manufacture and distribution of all sources, the industrial, research and veterinary uses (the medical activities are presented in chapter 9) and activities not covered by the basic nuclear installations system (these are presented in chapters 12, 13 and 14).

1. INDUSTRIAL, RESEARCH AND VETERINARY USES OF RADIOACTIVE SOURCES

1.1 Sealed radioactive sources

Sealed radioactive sources are defined as sources whose structure or packaging, in normal use, prevents any dispersion of radioactive substances into the ambient environment. Their main uses are presented below.

ASN inspector examining a variable-depth mobile gamma ray densitometer.

1.1.1 Industrial irradiation

Industrial irradiation is used for sterilising medical equipment, pharmaceutical or cosmetic products and for the conservation of foodstuffs. It is also a means of voluntarily modifying the properties of materials, for example, to harden polymers.

These consumer product irradiation techniques can be authorised because, after being treated, these products display no residual artificial radioactivity (the products are sterilised by passing through radiation without themselves being "activated" by the treatment). Industrial irradiators often use cobalt-60 sources, whose activity can be very high and exceed 250,000 terabecquerels (TBq). Some of these installations are classified as BNIs (see chapter 14).

1.1.2 Non-destructive testing

Gamma radiography is a non-destructive testing technique using radioactive sources, which is able to assess homogeneity defects in materials. It is frequently used to check weld beads. This technique primarily uses sources of iridium-192, cobalt-60, and selenium-75, whose activity can reach about twenty terabecquerels at the most. A gamma radiography device is usually a mobile device which can be moved from one worksite to another. It consists primarily of:
- a source applicator, used as a storage container when the source is not in use;

- a guide tube, end-piece and remote-control for moving the source between the applicator and the object to be inspected, while protecting the operator who can thus remain at a distance from the source;
- a radioactive source inserted into a source holder.

Gamma radiography devices mainly use high-level sources and can present significant risks for the operators in the event of incorrect operation, failure to comply with radiation protection rules, or operating incidents. As such, it is an activity with high radiation protection implications that figures among ASN's inspection priorities.

UNDERSTAND

Selenium-75 gamma radiography

The use of selenium in gamma radiography has been authorised in France since 2006. Implemented in the same devices as those functioning with iridium-192, ASN considers that industrial radiographers make too little use of selenium-75. In effect, only about 3% of the devices are equipped with it. However, it can be used in place of iridium-192 in numerous industrial fields, especially in petrochemistry. With a radioactive half-life longer than that of iridium-192 (120 days as opposed to 74), the use of selenium-75 in gamma radiography offers significant radiation protection advantages. The equivalent dose rates are about 55 millisieverts (mSv) per hour and per TBq at one metre from the source, as opposed to 130 for iridium-192. This allows a significant reduction in the safety perimeters required and facilitates intervention in the event of an incident.

SU 100 gamma ray projector.

1.1.3 Veri cation of physical parameters

The operating principle of these physical parameter verification devices is the attenuation of the signal emitted: the difference between the emitted signal and the received signal can be used to assess the information looked for.

The radionuclides most frequently used are carbon-14, krypton-85, caesium-137, americium-241, cobalt-60 and promethium-147. The source activity levels are between a few kilobecquerels (kBq) and a few gigabecquerels (GBq).

These sources are used for the following purposes:
- atmospheric dust measurement; the air is permanently filtered through a tape running at a controlled speed, placed between source and detector. The intensity of radiation received by the detector depends on the amount of dust on the filter, which enables this amount to be determined. The most commonly used sources are carbon-14 (activity level: 3.5 MBq) or promethium-147 (activity level: 9 MBq). These measurements are particularly used for air quality monitoring by verifying the dust content of discharges from plants;
- basis weight measurement: a beta radiation beam passes through the paper and is then received by a detector. The signal attenuation on this detector gives the paper density and thus the basis weight. The sources used are generally krypton-85, promethium-147 and americium-241 with activity levels not exceeding 3 GBq;
- measurement of a liquid level: a gamma radiation beam passes through the container of liquid. It is received by a detector positioned opposite. The signal attenuation on this detector indicates the filling level of the container and automatically triggers certain operations (stop/continue filling, alarm, etc.). The radionuclides used depend on the characteristics of the container and the content. As applicable, americium-241 (activity level: 1.7 GBq), caesium-137 - barium-137m (activity level: 37 MBq) are generally used;
- density measurement and weighing: the principle is the same as for the above two measurements. The sources used are generally americium 241 (activity level: 2 GBq), caesium-137 - barium-137m (activity level: 100 MBq) or cobalt-60 (30 GBq);
- soil density and humidity measurement (gammadensimetry) in particular in agriculture and public works. These devices operate with a pair of americium-beryllium sources and a caesium-137 source;
- logging, which enables the geological properties of the subsoil to be examined by inserting a measurement probe comprising a source of cobalt-60, caesium-137, americium-241 or californium-252.

1.1.4 Neutron activation

Neutron activation consists in irradiating a sample with a flux of neutrons to activate the atoms in the sample. The number and the energy of the gamma photons emitted by the sample in response to the neutrons received are analysed. The information collected enables the concentration of atoms in the analysed material to be determined.

This technology is used in archaeology to characterise ancient objects, in geochemistry for mining prospecting and in industry (study of the composition of semiconductors, analysis of raw mixes in cement works).

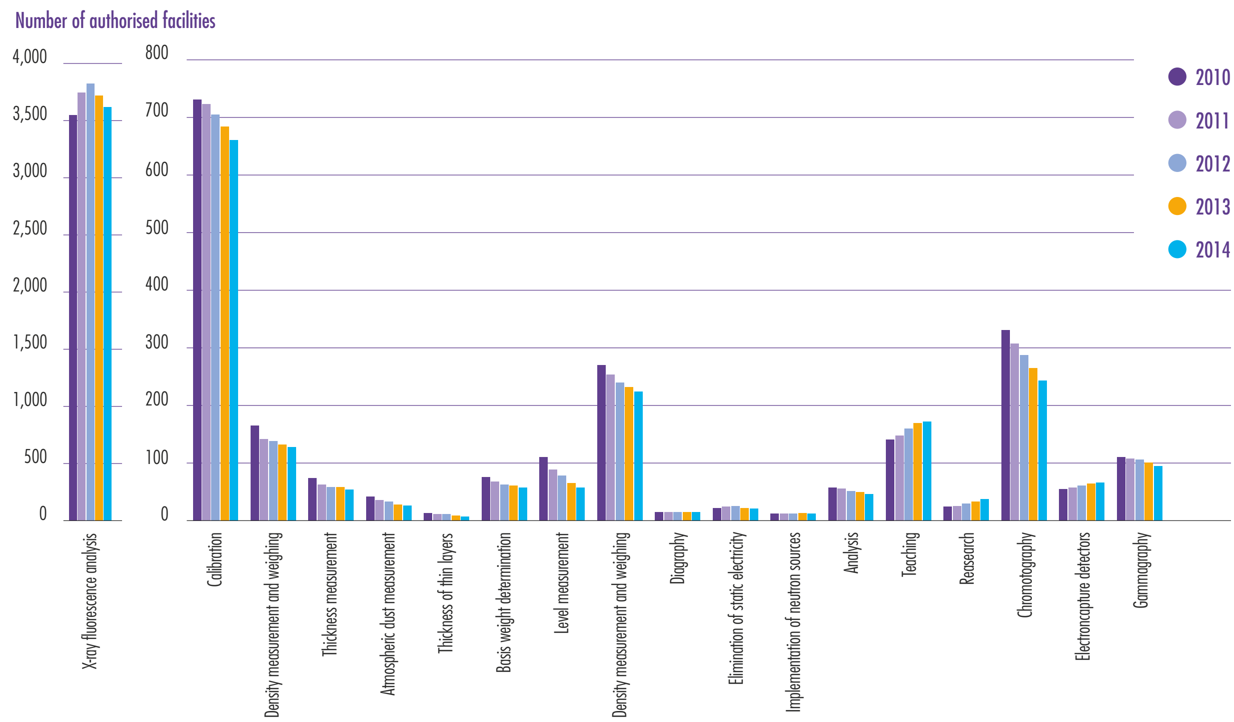
Given the activation of the material analysed, this requires particular vigilance with regard to the nature of the objects analysed. Article R. 1333.3-of the Public Health Code in fact prohibits the use of materials and waste originating from a nuclear activity for the manufacture of consumer goods and construction products, if they are or could be contaminated by radionuclides, including by activation (see point 4.3).

1.1.5 Other common applications

Sealed sources can also be used for:
• eliminating static electricity;
• calibrating radioactivity measurement devices (radiation metrology);
• practical teaching work concerning radioactivity phenomena;
• detection by electron capture. This technique uses sources of nickel-63 in gaseous phase chromatographs and can be used to detect and dose various chemical elements;
• ion mobility spectrometry used in devices that are often portable and used to detect explosives, drugs or toxic products;
• detection using X-ray fluorescence. This technique is particularly useful in detecting lead in paint. The portable devices used today contain sources of cadmium-109 (half-life 464 days) or cobalt-57 (half-life of 270 days). The activity of these sources can range from 400 MBq to 1,500 MBq. This technique, which uses a large number of radioactive sources nationwide (nearly 4,000 sources), is the result of a legislative system designed to prevent lead poisoning in children, requiring a check on the lead concentration in paints used in residential buildings constructed before 1st January 1949, on the occasion of any sale, any new rental contract or in the case of work significantly affecting the coatings in the common parts of the building.

Graph 1 specifies the number of facilities authorised to use sealed radioactive sources for the applications identified. It illustrates the diversity of these applications and their development over the last five years (from 2010 to 2014).

GRAPH 1: Use of sealed radioactive sources



It should be noted that a given facility may carry out several activities, and if it does, it appears in graph 1 and the following diagrams for each activity.

1.2 Unsealed radioactive sources

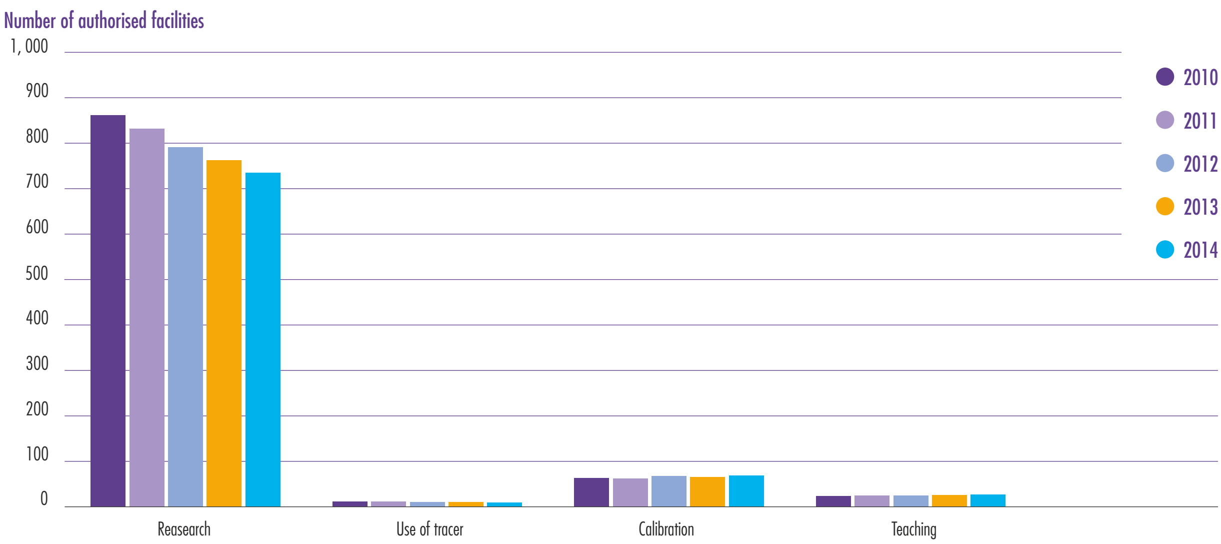
The main radionuclides used in the form of unsealed sources in non-medical applications are phosphorus-32 or -33, carbon-14, sulphur-35, chromium-51, iodine-125 and tritium. They are in particular used in the research sector and in pharmaceutical establishments. They are a powerful investigative tool in cellular and molecular biology. Using radioactive tracers incorporated into molecules is common practice in biological research. There are also several industrial uses, for example as tracers or for calibration or teaching purposes. Unsealed sources are used as tracers for measuring wear, searching for leaks or friction spots, for building hydrodynamic models and in hydrology.

As at 31st December 2014, the number of facilities authorised to use unsealed sources stood at 840.

Graph 2 specifies the number of facilities authorised to use unsealed radioactive sources in the applications identified in the last five years (from 2010 to 2014).

Preparation of a radioactive tracer in the Pasteur Institute laboratory in Lille.

GRAPH 2: Use of unsealed radioactive sources



2. INDUSTRIAL, RESEARCH AND VETERINARY USES OF ELECTRICAL DEVICES EMITTING IONISING RADIATION

Electrical devices emitting ionising radiation are mainly used in industrial radiography, where they are replacing devices containing radioactive sources, as well as in veterinary applications. Graphs 3, 4 and 6 specify the number of facilities authorised to use electrical devices generating ionising radiation in the listed applications. They illustrate the diversity of these applications which have evolved over the last five years (from 2010 to 2014). This evolution is closely related to the regulatory changes introduced in 2002 and later in 2007, which created a new licensing or notification regime for use of these devices. At present, the situation of the professionals concerned is being brought into compliance in many activity sectors.

2.1 Industrial applications

The electrical devices emitting ionising radiation are chiefly X-ray generators. Like the devices containing radioactive sources, they are used in industry, non-destructive structural analyses (analysis techniques such as tomography, diffractometry, also called X-ray crystallography, etc.), checking the quality of weld beads or inspecting materials for fatigue (in aeronautics in particular).

The applications of these devices, which work using the principle of X-ray attenuation, include use as industrial gauges (measurement of drum filling, thickness measurement, etc.), inspection of goods containers or luggage and also the detection of foreign bodies in foodstuffs.

The increasing number of types of device available on the market can be explained more particularly by the fact that when possible, they replace devices containing radioactive sources. The advantages of this technology with regard to radiation protection are linked in particular to the total absence of ionising radiation when the equipment is not in use. Their utilisation does however lead to worker exposure levels that are comparable with those resulting from the use of devices containing radioactive sources.

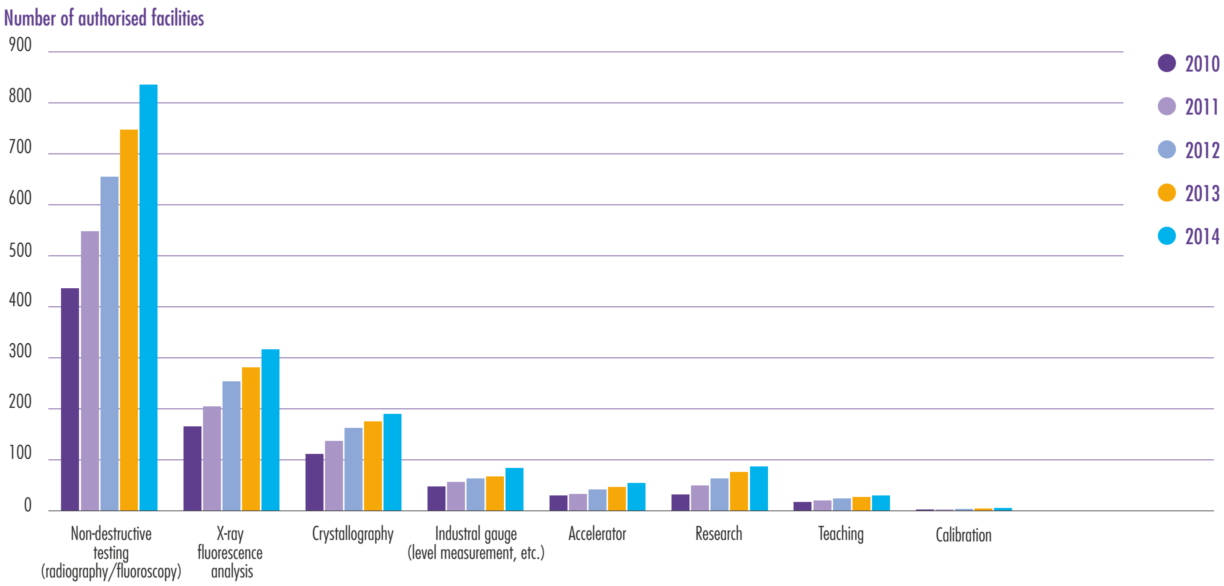
Radiography for checking the quality of weld beads or for the fatigue inspection of materials

These are fixed or worksite devices that use directional or panoramic beams. These devices can also be put to more specific uses, such as radiography for restoration of musical instruments or paintings, archaeological study of mummies or analysis of fossils.

Baggage inspection

Ionising radiation is used constantly in security screening checks, whether for the systematic verification of baggage or to determine the content of suspect packages. The smallest and most widely used devices are installed at the inspection and filtering checkpoints in airports, in museums, at the entrance to certain buildings, etc.

GRAPH 3: Use of electrical devices generating ionising radiation (outside the veterinary sector - see point 2.2)



The devices with the largest inspection tunnel areas are used in airports for screening air freight, large baggage items and hold baggage in airports. This range of devices is supplemented by tomographs, which give a series of cross-sectional images of the object being examined.

The irradiation zone inside these appliances is sometime delimited by doors, but most often simply by one or more lead curtains.

Baggage inspection by the French customs authorities.

X-ray body scanners

This particular application is given for information only, since the use of X-ray scanners on people during security checks is prohibited in France (in application of Article L. 1333-11 of the Public Health Code). The experiments carried out in France are based on non-ionising imaging technologies (millimetre wave scanners).

Inspection of consumer goods

The use of devices for detecting foreign bodies in certain consumer products has developed over the last few years, such as for detecting unwanted items in food products or cosmetics.

X-ray diffraction analysis

X-ray diffraction appliances, which are self-shielded, are being increasingly used by research laboratories. Experimental devices used for X-ray diffraction analysis can however be built by experimenters themselves with parts obtained from various suppliers (goniometer, sample holder, tube, detector, high-voltage generator, control console, etc.).

X-ray fluorescence analysis

Portable X-ray fluorescence devices are intended for the analysis of metals and alloys.

Measuring parameters

These appliances, which operate on the principle of X-ray attenuation, are used as industrial gauges for measuring fluid levels in cylinders or drums, for detecting leaks, for measuring thicknesses or density, etc.

Irradiation treatment

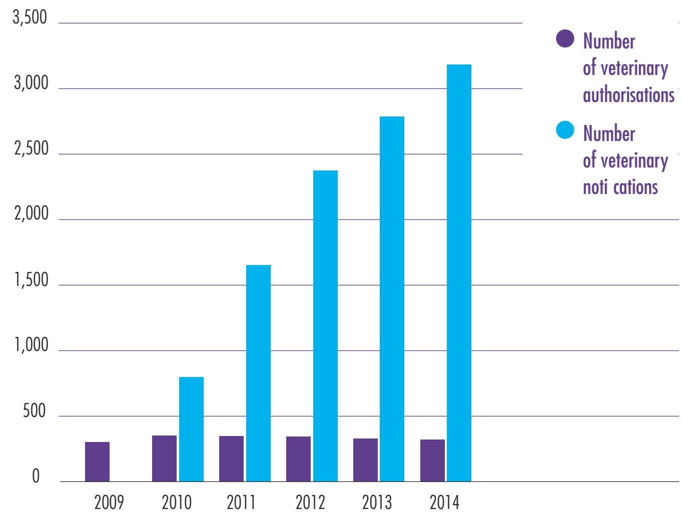
More generally used for performing irradiations, the self-shielded appliances exist in several models that sometimes differ only in the size of the self-shielded chamber, while the characteristics of the X-ray generator remain the same.

2.2 Veterinary diagnostic radiology

The profession counts approximately 16,000 veterinary surgeons and 14,000 non-veterinary employees. Veterinary surgeons use diagnostic radiology devices in a context similar to that of the devices used in human medicine. Veterinary diagnostic radiology activities essentially concern pets:
- 90% of the 5,793 veterinary structures in France have at least one diagnostic radiology device;
- about fifteen computed tomography scanners are used in veterinary applications to date;
- other practices drawn from the medical sector have been implemented more recently: scintigraphy, brachytherapy and external radiotherapy.

The treatment of large animals (mainly horses) requires the use of more powerful devices installed in specially equipped premises (radiography of the pelvis, for example) and of portable X-ray generators, used either indoors - dedicated or other premises - or outside in the open air. This activity, which has significant radiation protection implications for the veterinary surgeons and the grooms, is one of ASN's inspection priorities.

GRAPH 4: Use of electrical devices generating ionising radiation for veterinary activities



The devices used in the veterinary sector are sometimes derived from the medical sector. However, the profession is increasingly adopting new devices specially developed to meet its own specific needs.

2.3 Particle accelerators

The Public Health Code defines an accelerator as a device or installation in which electrically charged particles undergo acceleration, emitting ionising radiation at an energy level in excess of 1 megaelectronvolt (MeV).

Use of this type of device is subject to the notification or licensing regime specified in Articles L. 1333-4 and R. 1333-17 of the Public Health Code. When they meet the characteristics specified in Article 3 of Decree 2007-830 of 11th May 2007 concerning the list of BNIs, these facilities are listed as BNIs.

Certain applications require the use of particle accelerators which produce photon or electron beams, as applicable. The inventory of particle accelerators in France, whether linear (linacs) or circular (cyclotrons - see point 3 - and synchrotrons), comprises about 50 identified installations (except for BNIs) which can be used in a wide variety of fields:
- research, which sometimes requires the coupling of several machines (accelerator, implanter, etc.);
- radiography (fixed or mobile accelerator);
- radioscopy of lorries and containers during customs checks (fixed-site or mobile accelerators);
- modification of material properties;
- sterilisation;
- conservation of foodstuffs;
- etc.

In the field of research, two synchrotron radiation production installations can be mentioned in France: the ESRF (European Synchrotron Radiation Facility) in Grenoble (Isère *département*), and the SOLEIL synchrotron (Optimised Source of Intermediary Energy Light of the LURE laboratory) at Gif-sur-Yvette (Essonne *département*).

Recently, particle accelerator imaging systems have been used in France to combat fraud and large-scale international trafficking. This technology, which is felt by the operators to be effective, must however be used under certain conditions in order to comply with the radiation protection rules applicable to workers and the public, in particular:
- a ban on activation of construction products, consumer goods and foodstuffs as specified by Article R. 333-4 of the Public Health Code, by ensuring that the maximum energy of the particles emitted by the accelerators used rules out any risk of activation of the materials being verified;
- a ban on the use of ionising radiation on the human body for purposes other than medical. Thus, the use of ionising technologies to seek out illegal immigrants in transport vehicles is prohibited in France;
- the setting up of procedures to ensure that the checks conducted on the goods or transport vehicles do not lead to accidental exposure of workers or other individuals. During customs inspections of trucks using tomographic techniques, for example, the drivers must be kept away from the vehicle and other checks must be performed prior to irradiation to detect the presence of any illegal immigrants, in order to avoid unjustified exposure of persons during the inspection.

2.4 Other electrical devices emitting ionising radiation

This category covers all the electrical devices emitting ionising radiation other than those mentioned above and not excluded by the license and notification exemption criteria set out in Article R. 1333-18 of the Public Health Code.

This category notably includes devices generating ionising radiation but not used for this property, such as ion implanters, electron-beam welding equipment, klystrons, certain lasers, certain electrical devices such as high-voltage fuse tests.

UNDERSTAND

Synchrotrons

The synchrotron is a member of the same circular particle accelerator family as the cyclotron (see point 3), but is far larger, enabling energies of several gigaelectronvolts (GeV) to be achieved by means of successive accelerators. Owing to the low mass of the particles (generally electrons), the acceleration created by the curvature of their trajectory in a storage ring produces an electromagnetic wave when the speeds achieved become relativistic: this is synchrotron radiation. This radiation is collected at various locations called beam lines and is used to conduct scientific experiments.

3. MANUFACTURERS AND DISTRIBUTORS OF RADIOACTIVE SOURCES

ASN oversight of the suppliers of radionuclide sources or devices containing them is crucial to ensuring the radiation protection of the future users. It is based on the one hand on the technical examination of the appliances and sources with respect to operating safety and radiation protection conditions during future utilisation and maintenance. It also ensures the security of source movements, their traceability and the recovery and disposal of used or end-of- life sources (see point 4.2.1). Source suppliers must also play a teaching role with respect to users.

At present, only the suppliers of sealed radioactive sources or devices containing them, and of unsealed radioactive sources are regulated in France (see point 4.4). There are about 150 suppliers listed, and among them, 32 low and medium-energy cyclotrons are currently licensed under the Public Health Code in France. As at 1st March 2015, 30 cyclotrons are in operation. Among these, 18 are used exclusively for the daily production of radiopharmaceuticals, 6 are used for research purposes and 6 are used exclusively for joint production and research purposes.

UNDERSTAND

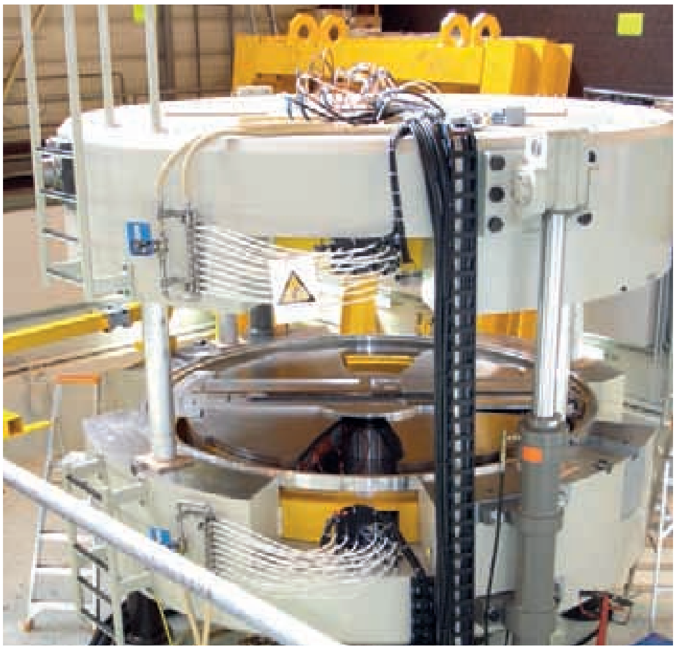
Cyclotrons

A cyclotron is a device 1.5 to 4 metres in diameter, belonging to the circular particle accelerator family. The accelerated particles are mainly protons, with energy levels of up to 70 MeV. A cyclotron consists of two circular electromagnets producing a magnetic field and between which there is an electric field, allowing the rotation of the particles and their acceleration at each revolution. The accelerated particles strike a target which is activated and produces radionuclides.

Low and medium energy cyclotrons are primarily used in research and in the pharmaceutical industry to produce positron emitting isotopes, such as fluorine-18 or carbon-11. The radionuclides are then combined with molecules of varying complexity to form radiopharmaceuticals used in medical imaging. The best known of them is ^{18}F-FDG (fluorodeoxyglucose marked by fluorine-18), which is an industrially manufactured injectable drug, commonly used for early diagnosis of certain cancers.

Other radiopharmaceuticals manufactured from ^{18}F have also been developed in recent years, such as ^{18}F-Choline, ^{18}F-Na, ^{18}F-DOPA, as well as radiopharmaceuticals for exploring the brain. To a lesser extent, the other positron emitters that can be manufactured with a cyclotron of an equivalent energy range to that necessary for the production of ^{18}F and ^{11}C are oxygen-15 (^{15}O) and nitrogen-13 (^{13}N). Their utilisation is however still limited due to their very short half-life.

The levels of activities involved for the ^{18}F usually found in pharmaceutical facilities vary from 30 to 500 GBq per production bombardment. The positron emitting radionuclides produced for research purposes involve activities that are usually limited to a few tens of GBq.



Arronax Cyclotron.

4. REGULATION OF INDUSTRIAL, RESEARCH AND VETERINARY ACTIVITIES

The provisions of the Public Health Code relating specifically to the industrial and research applications provided for in the Public Health Code are specified in this section. The general rules are detailed in chapter 3 of this report.

4.1 The Authorities regulating the sources of ionising radiation

In application of the Public Health Code, ASN is the authority that grants the licenses and receives the notifications, in accordance with the system applicable to the nuclear activity concerned.

The Public Health Code does nevertheless provide for a series of waivers to alleviate the licensees' administrative constraints. The notification or licensing obligation does not apply to installations licensed under another system, and more specifically:

- for the unsealed radioactive sources held, manufactured and/or used in installations licensed under the mining system (Article 83 of the Mining Code) or in Installations Classified on Environmental Protection Grounds (ICPE) which come under Articles L. 511-1 to L. 517-2 of the Environment Code, and have a licensing system, the Prefect is the authority responsible for ensuring that these licenses contain instructions relative to the radiation protection of the nuclear activities carried out on the site;
- for installations and activities relating to national defence, ASND (Defence Nuclear Safety Authority) is responsible for regulating radiation protection aspects;
- for installations authorised under the BNI system, ASN regulates the radioactive sources and electrical devices emitting ionising radiation necessary for the operation of these installations as defined by this system. Holding and using other sources within the perimeter of the BNI remain subject to licensing pursuant to Article R. 1333-17 of the Public Health Code.

In no way do these waivers exempt the beneficiary from the need to comply with the requirements of the Public Health Code, in particular those concerning the acquisition and transfer of sources.

The distribution, import and export of radioactive sources, however, are not concerned by these waivers, and are subject to ASN authorisation.

Nuclear materials, for their part, are subject to specific regulations provided for in Article L. 1333-2 of the Defence Code. Application of these regulations is overseen by the Minister of Defence with regard to nuclear materials intended for defence needs, and by the Minister in charge of Energy with regard to nuclear materials intended for any other use.

Since the publication in the Official Journal of Decree 2014-996 of 2nd September 2014 (and correction in the Official Journal of 13th September 2014) amending the nomenclature of the ICPEs, some facilities previously licensed by Prefectural order under the Environment Code for the possession and use of radioactive substances are now regulated by ASN under the Public Health Code.

The following are now subject to the Public Health Code system:

- establishments holding or using sealed radioactive sources subject to notification or licensing on account of section 1715 of the ICPE nomenclature;
- establishments holding unsealed radionuclides in quantities of less than 10 m^3 previously subject to notification or licensing under section 1715 of the ICPE nomenclature;

Only the establishments holding unsealed radioactive substances in quantities exceeding 10 m^3 are subject to the system for classified installations (excluding the medical sector and particle accelerators). Any sealed radioactive sources also possessed or used by these establishments are regulated by ASN under the Public Health Code.

The prescriptions applicable to these installations are now those of the Public Health Code and the Labour Code.

However, Article 4 of the abovementioned decree provides that the license or notification delivered under section 1715 shall continue to be valid as a license or notification under the Public Health Code until a new license is obtained under the Public Health Code or, failing this, for a maximum period of five years, that is to say until 4th September 2019 at the latest. Any change relating to the license shall either be notified to ASN or form the subject of a new license application, depending on the case.

4.2 Licensing and notification of ionising radiation sources used for non-medical purposes

4.2.1 Integration of the principles of radiation protection in the regulation of non-medical activities

ASN verifies application of the three major principles governing radiation protection and which are written into the Public Health Code (Article L. 1333-1), namely justification, optimisation of exposure and dose limitation (see chapter 2).

Assessment of the expected benefit of a nuclear activity and the corresponding health drawbacks may lead to prohibition of an activity for which the benefit does not seem to outweigh the risk. Either a generic prohibition is declared, or the license required on account of radiation protection is not issued or is not extended. For existing activities, justification is reassessed when license renewal applications are made if the current state of knowledge and technology warrants it.

Optimisation is a notion that must be considered in the technical and economic context, and it requires a high level of involvement on the part of the professionals. ASN considers in particular that the suppliers of devices are at the core of the optimisation approach (see point 3). They are responsible for putting the devices on the market and must therefore design them such that the exposure of the future users is minimised. ASN also checks application of the principle of optimisation when examining the license application files, when conducting its inspections, and when analysing the various significant events notified to it.

4.2.2 Applicable licensing and noti cation systems

Applications relating to the holding and use of ionising radiation sources are reviewed by the regional divisions of ASN. Examination of license applications for the manufacture and distribution of sources is carried out at a central, national level.

The licensing system

As part of a simplification process with a graded approach based on the radiological risks and implications, ASN has produced and deployed licensing application forms adapted to each activity which are available on *www.asn.fr*.

To better integrate the true situation of responsibilities in the non-medical sectors, where the radioactive sources and devices are often managed more by an entity than by an individual, these new forms allow representatives of artificial persons to apply for a license, pursuant to Article R. 1333-24 of the Public Health Code. They also list the documents that must be enclosed with the application. All the other documents listed in the appendix to ASN resolution 2010-DC-0192 of 22nd July 2010 must of course be held by the applicant and kept at the disposal of the inspectors in the event of verification. It is moreover possible that ASN will request further information during its examination of the license application.

Small-scale nuclear activities stand out by their considerable diversity and the large number of licensees involved. ASN must therefore adapt its efforts to their radiation protection implications to ensure effective oversight of these activities. In this perspective, it is continuing to implement its graded approach which consists in adapting the regulatory constraints and the level of oversight to the risks that the nuclear activity presents. As part of the transposition of Directive 2013/59/Euratom of 5th December 2013, ASN has started an overall revision of the regulatory provisions (see chapter 3).

The notification system

To achieve a balance in the sectors of activity subject to notification or licensing, and therefore better adapt the regulatory requirements to the radiation protection implications, ASN introduced a notification system for the industrial, research and veterinary sectors in 2009. This led to the publication of several approved resolutions (see chapter 3) defining on the one hand the scope of application of this new system and on the other, its implementation procedures.

The following are concerned:
- veterinary diagnostic radiology devices (fixed only) meeting one of the following conditions:
  - the emission beam is directional and vertical, except for all tomography devices;
  - the device is used for intra-oral radiography (ASN resolution 2009-DC-0146 of 16th July 2009, amended by resolution 2009-DC-0162 of 20th October 2009, Official Journal of 26th February 2010).
- electrical devices emitting ionising radiation, for which the equivalent dose rate at 10 cm from all accessible surfaces in normal conditions of use and as a result of their design, is less than 10 microsieverts per hour (µSv/h).

The notification form drawn up by ASN to facilitate application of resolution 2009-DC-0148 of 16th July 2009 defining the detailed content of the information to be appended to the notifications has been designed so as to simplify its utilisation and processing. No document has to be added to the notification form if the devices declared meet the requirements specified in ASN's resolutions and are eligible for this system. At the same time, ASN is running a tele-notification project to simplify the process even further.

In a completely different field, the notification system was extended in 2012 to include companies installing, maintaining or removing ionisation chamber smoke detectors (see point 4.3). Following the publication on 15th March 2012 of ASN resolution 2011-DC-0252 of 21st December 2011, a notification form was produced and placed on-line on *www.asn.fr*.

4.2.3 Statistics for 2014

Suppliers

In the light of the fundamental role played in the radiation protection of future users by the suppliers of sources or devices containing them (see points 3 and 4.2.1), ASN exercises particularly strict control in this field. During the course of 2014, 60 license or license renewal applications were examined by ASN, and 58 inspections were carried out.

Users

Case of radioactive sources

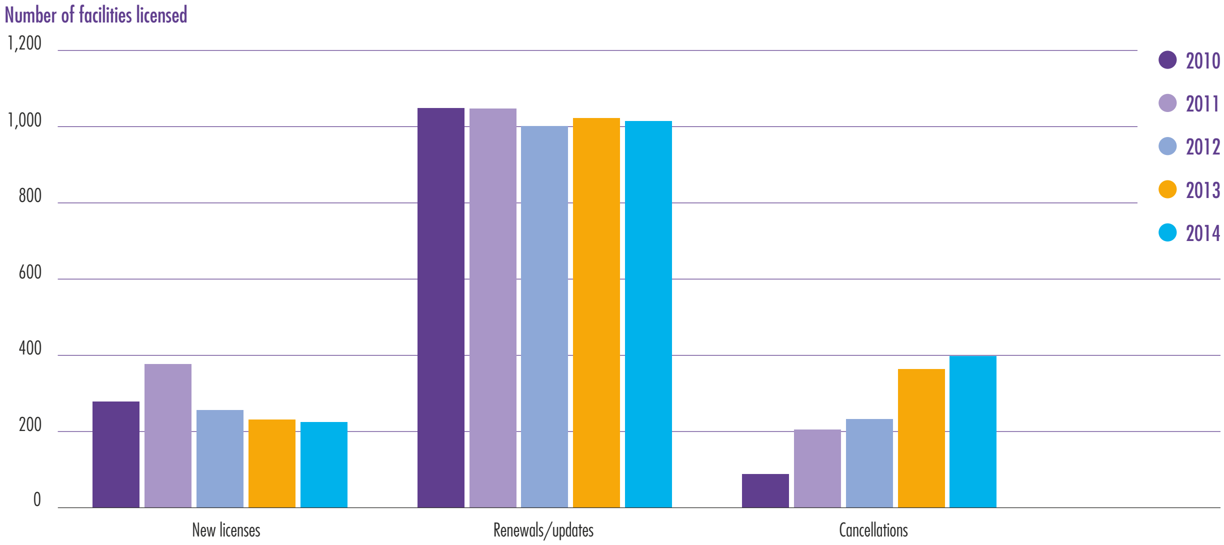
In 2014, ASN reviewed and notified 225 new licenses, 1,015 license renewals or updates and 398 license cancellations. Graph 5 presents the licenses issued or cancelled in 2014 and trends in this area for the last five years.

Once the license is obtained, the licensee can procure sources. To do this, it collects supply request forms from the Institute of Radiation Protection and Nuclear Safety (IRSN), enabling the institute to verify - as part of its duty to keep the inventory of ionising radiation sources up to date - that the orders are in conformity with the licenses of both the user and the supplier. If the order is correct, the movement is then recorded by IRSN, which notifies the interested parties that delivery can take place. In the event of any difficulty, the movement is not validated and ASN is contacted by IRSN.

Case of generators of ionising radiation

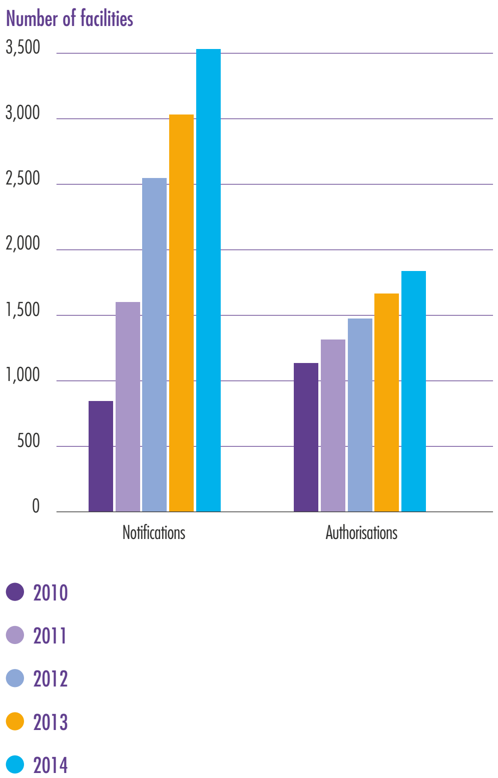
ASN has been responsible for regulating these devices since 2002, and is gradually building up its capacity in this area where numerous administrative situations need to be regularised. It granted 206 licenses and 229 license renewals for the use of electrical X-ray generators in 2014. Given the new regulatory provisions allowing the implementation of a notification system in place of the licensing system since 2010, ASN also delivered 500 notification certificates in 2014.

GRAPH 5: Radioactive source "user" licenses delivered each year



A total of 1,837 licenses and 3,530 notification certificates have been delivered for electrical devices emitting ionising radiation since decree 2002-460 was issued. Graph 6 illustrates this trend over the past five years.

GRAPH 6: Total number of "user" license and notifications for devices generating ionising radiation



4.3 Unjustified or prohibited activities

4.3.1 Application of the ban on the intentional addition of radionuclides in consumer goods and construction products

The Public Health Code indicates *"that the intentional addition of radionuclides to consumer goods and construction products is prohibited"* (Articles R. 1333-2 and 3).

The trading of radioactive stones or decorative objects, accessories containing sources of tritium such as watches, key-rings, hunting equipment (sighting devices), navigation equipment (bearing compasses) or equipment for river fishing (strike detectors) is specifically prohibited.

Article R. 1333-4 of this same code states that waivers to these prohibitions can, if the advantages they bring outweigh the health risks they can represent, be granted by order of the Minister responsible for Health and, depending on the case, by the Minister responsible for Consumption or the Minister responsible for Construction, after consulting ASN and HCSP (French High Public Health Council). No waiver is possible for foodstuffs, toys, jewellery and cosmetic products.

ASN considers that this system of waivers to the regulations must remain very limited. It was implemented for the first time in 2011 for a waiver request concerning the use of a neutron analysis device in several cement works (order of 18th November 2011 from the Ministers responsible for Health and Construction – Official Journal of 3rd December 2011, ASN Opinion 2011-AV-0105 of 11th January 2011 and ASN Opinion 2011-AV-0124 of 7th July 2011).

The list of consumer goods and construction products concerned by an ongoing waiver request or for which a waiver has been granted is published on the website of the French High Committee for Transparency and Information on Nuclear Security (HCTISN). This body has decided to set up the working group to develop proposals concerning the public consultation and information procedures in the case of requests for waivers to the ban on the intentional addition of radionuclides in consumer goods or construction products. This working group has held two meetings.

Two ministerial decisions formed the subject of an order in 2014:
- the waiver to the ban on adding radionuclides for use in light bulbs by order of 12th December 2014 of the Ministers responsible for Health and Construction (Official Journal of 27th December 2014).
- refusal of the waiver on adding radionuclides in watches by order of 12th December 2014 (Official Journal of 27th December 2014).

Light bulbs containing very small quantities of radioactive substances

Certain light bulbs, chiefly very high intensity discharge lamps used in public places or professional environments, and in certain vehicles, contain very small quantities of radioactive substances (krypton-85, thorium-232 or tritium). These substances serve to increase the light intensity or facilitate illumination of the lamps. Addition of these radioactive substances has been common practice for several decades.

On the basis of technical assessments demonstrating their very low impact in terms of radiation protection, several European countries have exempted these objects from the licensing or notification system provided for by the European regulations relative to radiation protection.

ASN has taken up this issue since 2009, reminding the manufacturers concerned by the production and distribution of light bulbs that the intentional introduction of radionuclides into consumer goods is prohibited in France by the Public Health Code. To put their situation in order, the manufacturers have lodged a file with the DGPR (General Directorate for Risk Prevention), applying for a waiver to this prohibition. In April 2012, on the basis of the initial results of this examination, ASN indicated that it had identified no health risk that would warrant it requesting, as a preventive measure, the cessation of the sale of these lamps and the removal of the lamps already installed.

ASN's Opinion 2014-AV-0211 of 18th September 2014 indicates that the health risk resulting from the radioactive properties of the substances added to discharge lamps is very low for the public and for workers for each step in the lamp life cycle, apart from the manufacturing phase, which should remain subject to the licensing system of the Public Health Code.

ASN nevertheless pointed out that application of the principle of justification for activities involving a risk of exposure of persons to ionising radiation should encourage, insofar as possible, the manufacturers to seek alternative methods and new technologies that enable the use of ionising radiation to be reduced.

The addition of tritium in watches

In 2012, a foreign manufacturer applied for a waiver to the prohibition on the addition of radionuclides stipulated in Article R. 1333-2 of the Public Health Code for the addition of tritium in watches. The permanent illumination of these watches through the addition of tritium would, according to the manufacturer, be a necessity for particular professions such as the armed forces, the police force and emergency response services. Considering that alternative techniques to radioactive sources exist for the illumination of watches, confirmed by the departments concerned, ASN issued a favourable opinion on the draft order refusing the waiver (ASN Opinion 2014-AV-0210 of 18th September 2014).

4.3.2 Application of the justi cation principle for existing activities

The justification of existing activities must be re-assessed periodically in the light of current knowledge and technological changes in accordance with the principle described in point 3.2.1. If the activities are no longer justified by the benefits they bring, or with respect to other non-ionising technologies that bring comparable benefits, they must be withdrawn from the market. A transitional period for definitive withdrawal from the market may be necessary, depending on the technical and economic context, particularly when a technological substitution is necessary.

Smoke detectors containing radioactive sources

Devices containing radioactive sources have been used for several decades to detect smoke in buildings, as part of firefighting policy.

These devices, called ionisation chamber smoke detectors (ICSD) comprise two ionisation chambers, of which only one allows the entry of combustion gases. By comparing the strength of the current crossing the two chambers, a change in the atmosphere can be detected when the smoke enters the unsealed chamber. This triggers the fire alarm. Several types of radionuclides have been used (americium- 241, plutonium-238, nickel-63, krypton-85). The activity of the most recent sources used does not exceed 37 kBq, and the structure of the detector, in normal use, prevents any propagation of radioactive substances into the environment.

New non-ionising technologies have gradually come to compete with these devices. Optical devices now provide comparable detection quality, and can therefore satisfy the regulatory and normative fire detection requirements. ASN therefore considers that smoke detection devices using radioactive sources are no longer justified and that the seven million ionic smoke detectors installed on 300,000 sites must be progressively replaced.

The regulatory framework governing their removal was put in place more than two years ago with the publishing of the order of 18th November 2011 and two ASN resolutions of 21st December 2011.

This regulatory framework aims at:
- planning the removal operations over ten years;
- supervising the maintenance or removal operations that necessitate certain precautions with regard to worker radiation protection;
- preventing any uncontrolled removals and organising the collection operations in order to avoid detectors being directed to an inappropriate disposal route, or even simply being abandoned;
- monitoring the pool of detectors and making it an obligation for each facility with one or more fire-detection lines featuring ICSDs to draw up an inventory sheet. This inventory sheet must be communicated to the duly declared or ASN-authorised professionals (maintenance, installation or removal professionals) working on the facility, for updating. If no work has been carried out before 31st December 2014, the user must nevertheless

communicate the sheet to such a professional; they are obliged to transmit annual activity reports to IRSN. These sheets and their updates will enable the reduction in the total numbers of ionic detectors installed throughout France to be monitored during the course of the phase-out. IRSN, which is in charge of processing the sheets, considers that an initial summary of the results could be produced in 2015.

Two years after the implementation of the new regulatory system for ionic smoke detector removal and maintenance activities, ASN has delivered, as at 1st March 2015, 203 notification certificates and 8 national licenses (delivered to industrial groups with a total of 101 agencies) for ICSD removal and fire safety system maintenance activities.

ASN maintains close relations with QUALDION, an association created in 2011 which labels the companies that comply with the regulations relative to radiation protection and fire safety. The list of QUALDION-labelled companies is available on the association's website page: *www.lne.fr/fr/-certification/certification-label-qualdion.asp*. ASN participates with the association in communication campaigns targeting the holders of ionic detectors and professionals (Expoprotection trade fair, Mayors' trade fair, etc.).

Surge suppressors

Surge suppressors (sometimes called lightning arresters) and not to be confused with lightning conductors, are small objects with a very low level of radioactivity used to protect telephone lines against voltage surges in the event of lightning strike. These are sealed devices, often made of glass or ceramic, enclosing a small volume of air containing radionuclides to pre-ionise the air and facilitate sparkover. The use of surge suppressors has been gradually abandoned since the end of the 1970s, but the number remaining to be removed, collected and disposed of is still very high (approximately 1971 million units). When installed, these devices represent no risk of exposure for individuals. However, there can be a risk of exposure and/or contamination if these objects are handled without precautions or if they are damaged. These risks must be taken into account in the removal, storage and disposal operations in order to protect the public and the workers.

ASN issued a reminder of this to France Télécom, which has begun an experimental process of inventorying, removing, sorting and disposing of surge suppressors in the Auvergne region and has proposed a national removal and disposal plan for all the surge suppressors present in France which will be applied progressively over the coming years.

Lightning conductors

ASN wants to see the progressive and organised recovery of these radioactive lightning conductors, and for several years now has been informing professionals to ensure that their removal complies with radiation protection requirements for workers and the public. ASN has stepped up its action in this respect by reminding the professionals concerned of their obligations, particularly that of having an ASN license for the activity of removing and storing the lightning conductors pursuant to Articles L. 1333-1, L. 1333-4, and R.1333-17 of the Public Health Code. At the same time, ASN has been carrying out field checks on the companies involved in the recovery of these objects.

In 2012, ASN launched a campaign of measurements with IRSN and in collaboration with companies, to assess the protective measures necessary when removing radioactive lightning conductors. The results of this campaign will lead to the production of a guide intended for the professionals. This guide, currently being finalised by ASN, the French National Agency for Radioactive Waste Management (Andra) and IRSN, should be published in 2015.

Locating the radioactive lightning conductors around the country is an essential step in eventually being able to remove all of the installed items. This is one of the goals of the INAPARAD association and its website: *www.paratonnerres-radioactifs.fr*.

ASN underlines the benefits of this survey and of informing the owners of these lightning conductors. It does however point out that removing these lightning conductors is not currently mandatory and that it must be done by authorised companies. Local priorities can be defined according to the physical condition of the lightning conductors and/or rehabilitation projects for the buildings concerned.

Additional information on radioactive lightning conductors is available on the following web sites: *www.andra.fr* and *www.paratonnerres-radioactifs.com*.

UNDERSTAND

Radioactive lightning conductors

In 1914, Léo Szilard, a Hungarian scientist, developed the first lightning conductor with a radioactive head. In 1932 the French company Hélita put the first radioactive lightning conductor onto the market. Companies subsequently developed other products, including the brands Duval Messien, Franklin France and Indelec. Having radioactive sources on the head of the lightning conductor was supposed to increase the protection range compared with a "conventional" lightning conductor, by making the air around the sealed sources conductive. The rods were equipped, according to their type, with sealed sources of radium-226, and subsequently americium-241.

Radioactive lightning conductors were manufactured and installed in France between 1932 and 1986. The ban on the sale of radioactive lightning conductors was declared in 1987. This order did not make the removal of installed radioactive lightning conductors compulsory. Consequently, there is no obligation to remove the radioactive lightning conductors installed in France at present, apart from in certain ICPEs (Order of 15th January 2008 setting the removal deadline at 1st January 2012) and certain installations under Ministry of Defence responsibility (Order of 1st October 2007 setting the removal deadline at 1st January 2014).

Andra estimates that there are still 40,000 radioactive lightning conductors installed in France. ASN considers that these radioactive objects - even if they generally present no risk unless handled - contain sources with significant levels of activity and therefore present exposure risks for the people coming into contact with them, during their removal for example.

Furthermore, experience has shown that the containment of radioactive sources can deteriorate over time, thereby increasing the radiological risks when the lightning conductor is removed. The removal operations must therefore be carried out by specialist companies and be directed towards the disposal routes established by Andra.

4.4 Reinforcement of the regulation of electrical devices generating ionising radiation

ASN wishes to supplement the provisions introduced into the Public Health Code in 2007, and thus complete the development of the regulatory framework allowing the distribution of electrical devices for generating ionising radiation to be subject to licensing in the same way as the suppliers of radioactive sources. Experience shows that in this respect, the joint technical examination of files by ASN and the device suppliers/manufacturers brings substantial gains in radiation protection optimisation (see points 3 and 4.2.1).

For electrical devices used for non-medical purposes, there is no equivalent of the mandatory CE marking for medical devices, such as to confirm conformity with several European standards covering various fields, including radiation protection. Furthermore, experience feedback shows that a large number of devices do not have a certificate of conformity to the standards applicable in France. These standards have been mandatory for many years now, but some of their requirements have become partly obsolete or inapplicable due to the lack of recent revisions.

Back in 2006, ASN contacted the Ministry of Labour, the LCIE (Central Laboratory of the Electrical Industries), CEA and IRSN, and urged Union Technique de l'Electricité (UTE) to start updating these standards.

With regard to the design of the devices, and in the absence of any pertinent national or international baseline technical requirements, ASN is looking into the development of the applicable technical requirements for licensing the devices. After presenting the first orientations to the Advisory Committee for Radiation Protection, for Industrial Applications and Research into Ionising Radiation and the Environment (GPRADE) in June 2010, ASN continued its work with the support of IRSN and the assistance of other reference players such as CEA and the LCIE, with a view to developing a baseline technical standard for this type of device.

In the same way as for ASN resolution 2008-DC-0109 of 19th August 2008 relative to the distribution of radioactive sources, ASN is currently preparing the regulatory changes necessary, based on the work done. This work, carried out jointly with IRSN in 2013 and 2014, will allow the defining of the minimum requirements applicable to devices generating X-rays.

With regard to the design of facilities, UTE ran a process to revise the NF-C 15-160 standards and the associated specific standards (installation standards). On the basis of this work, ASN initiated an update of the design and layout rules for facilities inside which X-rays are produced and used, and published ASN Resolution 2013-DC-0349 of 4th June 2013 setting the minimum technical rules for the design of facilities in which X-rays are present, which was approved on 22nd August 2013. This resolution concerns industrial and scientific (research) facilities such as industrial radiography using X-rays in a bunker, veterinary radiology and medical facilities such as conventional radiology, dental radiology and scanners (see chapters 3 and 9). The resolution entered into force on 1st January 2014.

4.5 Detection of abnormal radioactivity in materials and goods in France

ASN considers that the increase in the number of cases of detection of abnormal radioactivity in metals and consumer goods across the world is worrying. It registers five events per year on average relating to the presence of radioactivity in shipments transported to or from France.

The products mainly involved are the following:
- contaminated finished products including consumer, equipment and production goods (kitchen utensils, handbags, sports equipment, valves, axles, machine tools, radiator grilles, steel bars, etc.);
- contaminated semi-finished products (ingots, scrap, etc.);
- sealed sources themselves.

In 62% of cases, the radionuclide detected is artificial in origin. This concerns radionuclides initially manufactured and packaged in the form of sealed radioactive sources intended for use in industry or the medical sector. Owing to a lack of controls in the country of origin, these radioactive sources finish by entering scrap recycling routes.

If not detected in time, they are melted down in metal ingot production plants, thus contaminating the raw material and all the semi-finished and finished products made with these raw materials worldwide.

In the other cases, the radionuclides are natural in origin. This phenomenon is new, widespread and expanding rapidly. It is due to the use of thorium-based ceramics (tourmaline) notably in the textile industry. In 2011, following a number of notifications, ASN contacted IRSN for an analysis of several marketed products. The conclusions of this study show that exposure of an individual to radiation from these textiles remains very slight, but can in certain cases be higher than the annual regulation limit for the public (1 mSv). ASN remains vigilant with regard to these products, informs the industrial firms concerned when they have been identified, and has additional analyses conducted if necessary.

At present, France does not have systematic means of detection at strategic points, particularly transport hubs: ports and airports. Some companies are equipped with detection systems installed either to comply with the regulations in force pursuant to the Environment Code (landfills, hospitals, waste disposal facilities, etc.), or for commercial reasons dictated by their partners (international trade with the United States).

Between 2001 and 2009, pushed by the United States, 27 countries including Greece, the Netherlands, the United Kingdom, Belgium, Spain and Portugal acquired at least one detection facility. There is currently no European or international protocol for the detection of radioactivity in goods at borders.

At present the only information at the disposal of France is that received from its neighbouring countries. Belgium thus informs ASN whenever its portals are triggered by shipments coming from or intended for France. In such cases, additional investigations are carried out to identify the companies concerned (traders, manufacturers and importers) and/or the exporting country, and to determine the fate of the goods.

In certain cases it is necessary to sort the package(s) to identify and segregate the incriminated products and have them disposed of in authorised facilities. If they are returned to the consignor, the transport of the goods must comply with the regulations applicable to the carriage of dangerous goods. These operations (transport, sorting, packaging, disposal, etc.) involve significant cost which is generally borne by the French manufacturer.

ASN considers that France must rapidly adopt a national strategy for radioactivity detection on its territory, and make the corresponding investments in equipment and training.

Given the possible economic side-effects of these incidents, ASN recommends that all firms involved in commercial trading of metal-based products with countries outside the European Union, conduct checks on the radioactivity level of the imported products.

4.6 Implementation of monitoring of radioactive source protection against malicious acts

Even if the safety and radiation protection measures as a result of the regulations do guarantee a certain level of protection against the risk of malicious acts, they cannot be considered sufficient. Reinforced oversight of protection against malicious acts using hazardous sealed radioactive sources was thus strongly encouraged by International Atomic Energy Agency (IAEA) which published a code of conduct for the safety and security of radioactive sources (approved by the Board of Governors on 8th September 2003) and guidelines for the import and export of radioactive sources (published in 2005). The G8 supported this approach, notably at the Evian summit in June 2003, and France sent IAEA confirmation that it was working towards application of the guidelines laid out in the code of conduct (undertakings by the Governor for

France of 7th January 2004 and 19th December 2012). The general aim of the Code is to obtain a high level of safety and security for those radioactive sources which can constitute a significant risk for individuals, society and the environment.

Monitoring sources for radiation protection and safety purposes and monitoring them to combat malicious acts have many aspects in common and mutually consistent objectives. This is why ASN's counterparts abroad are usually responsible for monitoring both domains. ASN has the necessary hands-on knowledge of the sources concerned - which are regularly inspected by its regional divisions - to accomplish both missions.

The Government decided to entrust ASN with the task of monitoring the tracking and protection measures falling to the body responsible for the nuclear activity. It could in particular consist of limiting source access to duly authorised persons only, of placing one or more physical protective barriers between the source and unauthorised persons, of making intruder detection systems mandatory, or of ensuring source tracking. The legislative process initiated in 2008 by the Government with the assistance of ASN led to a bill being tabled before the Senate in 2012.

Furthermore, parliamentary work on the green growth energy transition bill has taken this issue into consideration

As it had announced, ASN continued its work to prepare the implementing texts necessary for actual deployment of the controls and reinforced measures to inventory the existing facilities. This identification process, which focused on establishments holding high-activity sealed sources, led to 180 visits by ASN in 2013 and 2014.

Furthermore, in order to obtain a harmonised view of the country as a whole, reinforce the training of ASN's radiation protection inspectors in this new field of competence and make advance provision for rapid and effective deployment of this new mission, appropriate tools have been produced, distributed and presented to the inspectors in each ASN division. These training modules will be developed as the work progresses and will be incorporated into the initial training of the inspectors.

These check-out visits will more specifically make it possible to assess the impact of the technical prescriptions envisaged and currently being defined by a working group piloted by the defence and security highofficial at the Ministry for the Environment, in which ASN plays an active role, more specifically by contributing its knowledge of the facilities.

5. THE MAIN INCIDENTS IN 2014

The inspections conducted on radiation sources and a complete round-up of radiation protection events in the non-BNI field notified to ASN are presented in chapter 4 of this report.

Industrial radiography

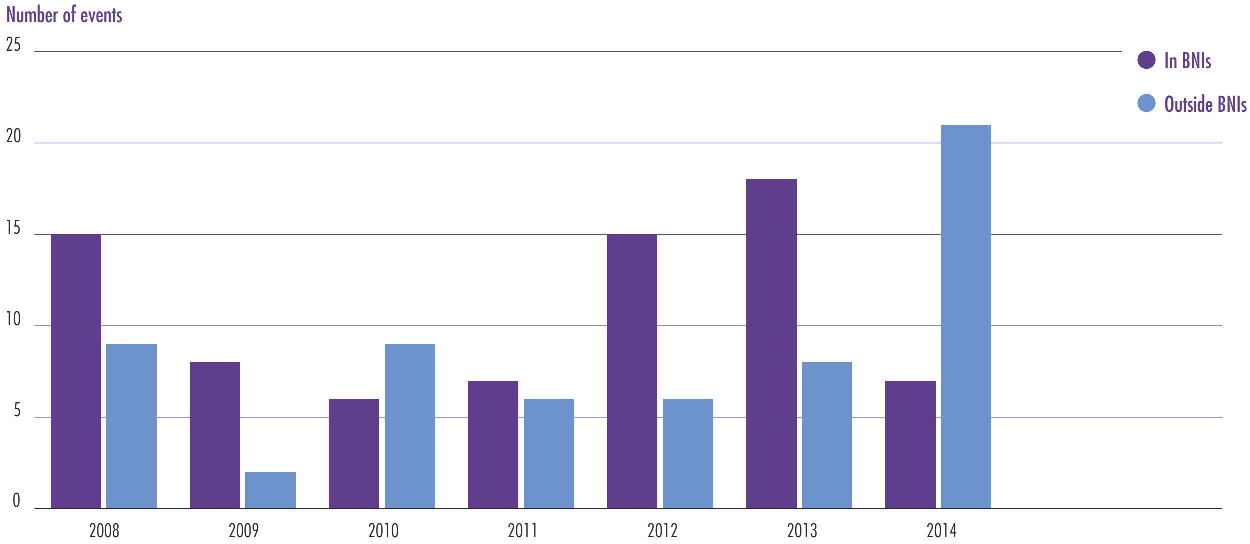
In the area of gamma radiography, further to notable incidents that occurred at the beginning of the 2010's involving the jamming of industrial gamma radiography sources (Blayais NPP (Gironde *département*), the Esso refinery at Fos-sur-Mer (Bouches du Rhône *département*), the STIC company in Rambervillers (Vosges *département*), the Feursmétal company in Feurs (Loire *département*) and Hachette et Driout in Saint-Dizier (Haute-Marne *département*), ASN initiated an in-depth reflection with the stakeholders and IRSN on the lessons to learn from the recent incidents. On 28th November 2012, 25th September 2013 and 7th April 2014 it convened all the stakeholders in order to identify generic technical solutions to facilitate the recovery of gamma radiography sources for which control has been lost.

Several other incidents also occurred in 2014, two of which were rated level 2 on the INES scale (see boxes). Graph 7 illustrates this trend over the last few years. Graph 8 indicates the main causes of these incidents.

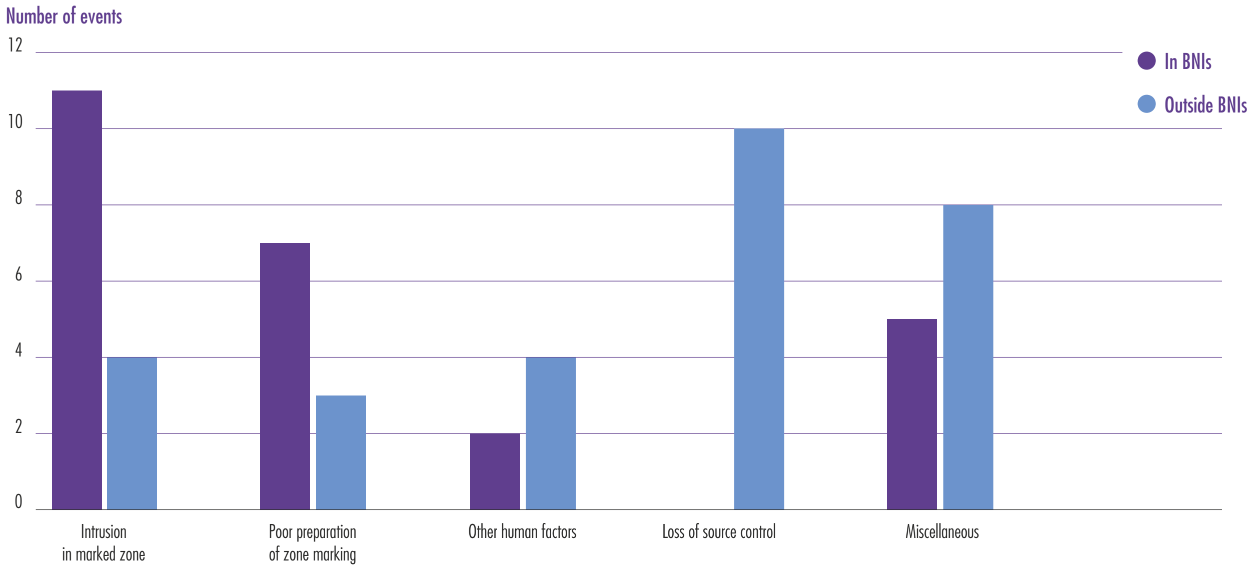
In the last few months several incidents relating to rupture of the plug (see illustration P. 355) on GAM 80/120 devices have been recorded:
- on 16th October 2013, in Lacq (Pyrénées Atlantiques *département*) on a work site of the PRORAD company;
- on 3rd February 2014, in Harfleur(Seine-Maritime *département*) on a work site of the SGS company;
- on 19th February 2014, in Yvetot (Seine-Maritime *département*) on a work site of the Institut de soudure company;
- on 25th April 2014, in Corbas (Rhône *département*) on a work site of the Institut de soudure company;
- on 8th July 2014, in Equeurdreville-Hainneville (Manche *département*) on a work site of the company CTE Nordtest;
- on 22nd September 2014, in Loon-Plage (Nord *département*) on a work site of the CEP Industrie company;
- on 31st October 2014, in Vielle-Saint-Girons (Landes *département*) on a work site of the PRORAD company.

The analysis of these particular incidents enabled the origin of the rupture of this part to be identified and led ASN to ask the supplier to put in place preventive actions as part of the annual maintenance of the devices.

GRAPH 7: Trend in the number of industrial radiography events notified to ASN



GRAPH 8: Main causes of industrial radiography events notified to ASN in 2013-2014



The operation for rendering safe and recovering the radioactive source on a device with a ruptured plug can be satisfactorily carried out by the manufacturer if the incident has been suitably detected and no untimely action such as disconnection of the accessories or locking of the device has been attempted. It does nevertheless present a degree of technical complexity, requires appropriate equipment and can lead to a significant radiological risk in the event of a secondary incident.

The majority of the source jamming incidents, whether caused by material or organisational deficiencies, such as foreign objects in the guide tube or non-connection of the remote control cables, were correctly managed by the operators and managers of the companies concerned, and were rapidly resolved. On the other hand, the poor practices observed prompted ASN to send the professionals concerned further reminders about the correct practices which result from the regulatory radiation protection provisions applicable to gamma radiography. They concern in particular the verification of the position of the gamma ray projector source by means of a radiation detector when it returns to the safe position and the securing of the work site by the radiographer(s), which must be limited to the immediate reassessment of the zoning and the corresponding zone marking. The complementary operations concerning putting in place biological protections and recovering the source require prior

TO BE NOTED

Irradiation of a worker during an operation on a defective gamma ray projector

On 16th July 2014, the Director of the regional agency of Institut de soudure of Latresne (Gironde *département*) informed ASN of the accidental exposure of a worker to ionising radiation on 11th June 2014.

During a weld inspection operation by gamma radiography carried out by two employees of Institut de soudure on a worksite in Pau (Pyrénées-Atlantiques *département*), the radioactive source of the gamma ray projector got jammed inside its guide tube.

Using a metal rod found on site, one of the operators managed to free the jammed source and return it to the safe position in the body of the device. During this operation, the operator was directly exposed to the radiation emitted by the radioactive source.

Development of the operator's dosimeter revealed that he had received a dose of 22.94 mSv in June, essentially during that one operation of 11th June.

For workers liable to be exposed to ionising radiation during their professional activities, the annual regulation dose limits are, for twelve consecutive months, 20 mSv for the whole body and 500 mSv for a skin surface area of 1 cm2.

The regional department of Institut de soudure was informed of this event on 8th July. It notified ASN of the event on 16th July. The Bordeaux regional division of ASN conducted a reactive inspection at the head office of Institut de soudure in Latresne (Gironde *département*) to clarify the circumstances of the incident. The follow-up letter to this inspection is published on ASN's website.

ASN notes that the initiative taken by the operators to manipulate the device in order to unblock the radioactive source is not in conformity with the license issued to Institut de soudure authorising the use of gamma ray projectors, and underlines the abnormally long time taken to notify ASN of the incident.

Insofar as this incident resulted in a worker being exposed in a single event to a radiation dose exceeding the regulatory annual limit, ASN has provisionally rated the event level 2 on the INES scale.

analysis with persons competent in radiation protection and coordination of the managers of the companies concerned, and can only be implemented in a second phase.

Even though the French regulations are on the whole adhered to and are more stringent than the international standards, ASN considers that improvements are required in work site preparation and incident management.

Cyclotrons

With regard to cyclotron oversight, ASN notes one incident relating to pressure regulation faults in the shielded enclosures (PETNET Solutions, Lisses (Essonne *département*) on 1st April 2014). During an inspection carried out on 1st April 2014 at PETNET Solutions, the ASN inspectors discovered a fault in the pressure regulation of the shielded enclosures for the production of 18F-FDG, causing pressure fluctuations inside the enclosures. This failure makes it impossible to perform automatic leak tests before starting production operations and can call into question the containment of radioactive material inside the shielded enclosures. Further to the inspectors' findings, the licensee immediately organised compensatory measures to maintain the containment of the shielded enclosures and updated the safety instructions for the operators. This event caused no radiation exposure beyond the regulatory limits for the workers. The public was not concerned by this event. During the weeks following this incident, the necessary corrective measures were implemented by the licensee and formed the subject of a communication and a presentation to ASN by the company managers (*www.asn.fr/Controler/Actualites-du-controle/Avis-d-incidents-dans-le-domaine-medical/Defaut-de-regulation-des-pressions-des-enceintes-blindees*).

TO BE NOTED

Incident during radiographic inspections on the site of DCNS - Nantes Centre in Indret (Loire-Atlantique *département*)

On 18th April 2014, the Nantes centre of the DCNS Group informed ASN of an incident that occurred during the night of 17th to 18th April 2014 when carrying out radiographic inspections on the Indret site.

A team comprising one operator from the OTECMI company and one operator from the SGS Qualitest Industrie company was performing radiographic exposures in one of the workshops of the DCNS site using a gamma ray projector containing a sealed radioactive source of iridium-192 with an activity of 1.95 TBq.

During a radiographic inspection, the source is remotely ejected from the device using a manual remote-control, before being returned to its protective housing. A safety zone is set up around the device. At the end of exposure, once the source is in the safe position, the operator can enter this zone to remove or install the films near the parts to undergo radiography.

Thinking that the exposure was finished, the worker from SGS Qualitest Industrie entered the safety zone to remove the film when the radioactive source was not in the protection position.

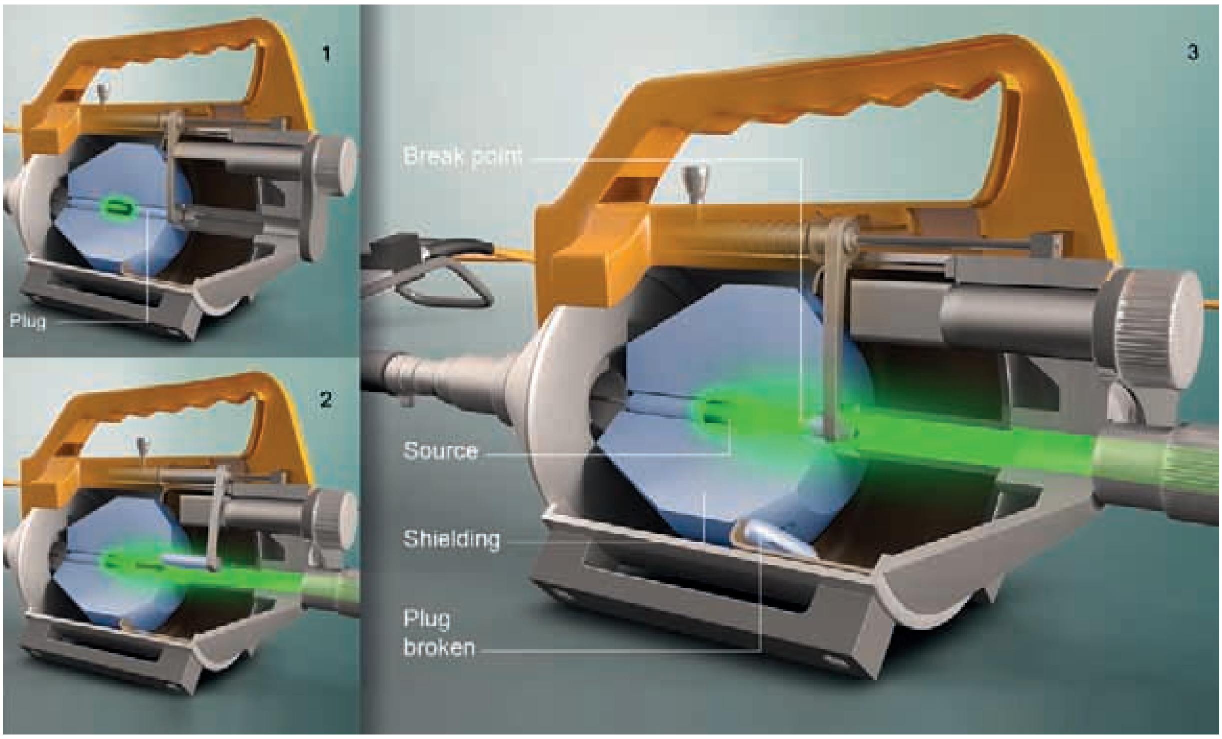
Alerted by the OTECMI radiographer, the SGS Qualitest Industrie radiographer immediately left that zone. The operators then informed the persons competent in radiation protection of their respective companies and the DCNS.

Owing to the very short duration of the operation (about one minute), the operator exposure, estimated at 2.85 mSv, is below the regulatory annual occupational exposure limit of 20 mSv for a worker.

The Nantes division of ASN carried out an inspection on 15th May 2014. The inspection and the analysis of the event revealed several failures to comply with essential radiation protection procedures, in particular with regard to zone entry instructions. The radiographer from SGS Qualitest Industrie approached the source in the irradiation position despite triggering of the audio alarm of his active dosimeter, despite the indication specifying that the source was in the irradiation position, and without a radiation meter.

On account of noncompliance with all the rules relative to zone entry having led to significant exposure of a worker, ASN rated this incident level 2 on the INES scale.

CROSS-SECTIONAL VIEW of a GAM 80/120 gamma ray projector showing the plug



1 - Safe position ; 2 - Open position ; 3 - Plug broken

UNDERSTAND

Source jamming in gamma radiography

Gamma radiography is a non-destructive testing technique consisting in positioning a radioactive source close to the element to be inspected, in order to obtain a radiographic image which can subsequently be used to check the quality of the part.

The loss of control of the sources is one of the main causes of incidents in this field. It can lead to significant exposure of the workers nearby, or even of the public if used in an urban area. This loss of control is primarily encountered in two situations:

- the radioactive source remains jammed in its guide tube. The cause of jamming is often the presence of foreign bodies in the tube, or deterioration of the tube itself;
- the source-holder containing the radionuclide is no longer connected to the remote control. The cable joining the source and the remote control is not correctly connected and the source can no longer be operated.

France has an inventory of gamma radiography devices compliant with technical specifications that are stricter than the international standards. However, equipment failures can never be ruled out, especially in the event of poor upkeep of the equipment. Operator errors are also observed as being the cause of incidents.

ASN also notes that the procedures and steps to be taken by the radiologists when faced with these situations are insufficiently understood and adhered to.

6. ASSESSMENT OF RADIATION PROTECTION IN THE INDUSTRIAL, RESEARCH AND VETERINARY FIELDS, AND OUTLOOK

In the field of regulating applications of ionising radiation in the industrial, research and veterinary sector, ASN is working to ensure that the operators take full account of the risks involved in the use of ionising radiation.

Industrial radiography

After sending out a circular letter to all the operators on 27th September 2012 reminding them of the regulations and asking them to improve worksite preparation and incident management, ASN initiated an approach with the General Directorate for Labour (DGT) designed to overhaul the existing regulatory texts on the subject, tightening the requirements with regard to justification given the existence of known alternative methods.

The design of the devices and of the facilities, the use of devices, notably on the worksites, and the training of the operators were examined during this regulatory overhaul process and within the working group comprising all the stakeholders.

Alongside this, ASN organised restricted technical meetings with the stakeholders to define standard typical scenarios for loss of source control, develop technical recovery solutions and define best practices in the event of an incident involving loss of control of sources. The conclusions of this working group should be published in early 2015. The draft provisions will shortly be subject to consultation by professionals.

Industrial radiology activities have serious radiation protection implications for the workers and are an inspection priority for ASN, with more than 110 inspections carried out per year in this field, including unannounced night-time inspections on the work sites. In 2014, ASN finalised the setting up of a system for remotely declaring construction site schedules for industrial radiography contractors. A lack of reliability of the information provided by certain licensees has been observed, leading to difficulties in performing the inspections. ASN will focus particular attention on this point in 2015 with respect to industrial radiography contractors.

According to the survey carried out by ASN in the sector, 70% of the industrial radiography agencies have a specialised fixed facility (bunker) and 70% of the agencies also operate in "worksite" configuration. 50% of the industrial radiography tests performed are in worksite configuration. In this configuration, iridium-192 gamma ray projectors are the most commonly used, representing two-thirds of the worksites. X-ray generators are mainly used on the other worksites. Very few tests are conducted outside the bunker with particle accelerators, or gamma ray projectors using cobalt-60 or selenium-75. On the whole, one test in three uses iridium-192 in the worksite configuration. These worksites are primarily located in industrial units and processes and in BNIs.

The significant percentage of tests in "worksite" configuration within industrial units suggests insufficient application of the justification principle because in many cases parts could probably have been transported to a secure bunker for inspection.

Moreover, through its inspections, ASN observes that the way risks are taken into account varies between companies. The regulations relating to worker training and the periodic external inspection of sources and devices and worker dosimetry are on the whole satisfied. However, despite the progress made, preparation of the interventions still requires close attention from the various parties involved, more specifically on the worksite to mark out the work zones, for the forecast dose evaluations and for coordination between the ordering customers and the contractors in order to reinforce the preparation of the work and allow effective preventive measures to be taken. ASN is worried by the zoning defects observed because this constitutes the main safety barrier in the worksite configuration, in particular to prevent inadvertent exposure.

The work conditions on the site (poor accessibility, night work, etc.), equipment maintenance (projectors, guide tubes, etc.) are major factors affecting personnel safety. The incidents often result from sources getting jammed outside the safe shielded position. ASN notes that the exposure rates and condition of the equipment are not unrelated to the probability of an incident. It moreover underlines that if any equipment operating anomalies are observed when using a gamma ray projector, such as abnormal source projection or retraction forces, operations should be immediately stopped and the equipment inspected. Furthermore, if a source becomes jammed, no attempt should be made to free it, and the on-site emergency plans required by the regulations – though rarely drawn up – must be implemented.

With regard to justification and optimisation, the review by the non-destructive inspection professionals led to the drafting of guidelines. These include:

- a guide to help industrial firms find an alternative to gamma radiography inspection using iridium-192 on pipe manufacturing welds (ALTER'X project run by Institut de soudure;
- a guide coordinated by the French Confederation for Non-Destructive Testing (COFREND) aiming to promote the use of alternative methods, which comprise functional tools such as a flowchart to identify gamma radiography replacement conditions or charts describing the inspection and its objectives.

The professionals have also undertaken work, in particular with regard to the updating of the construction and maintenance codes for industrial equipment, in order to promote the use of non-ionising inspection methods.

ASN considers that implementation of these guidelines and recommendations and work progress are insufficient, and that the ordering customers have an essential role to play in ensuring progress in radiation protection in the field of industrial radiography.

As mentioned in point 4, ASN has initiated an approach aiming to overhaul the existing regulatory texts in this area, reinforcing the requirements with regard to justification, given the existence of recognised alternative methods.

The design of the devices and facilities, the use of devices, especially on worksites, and operator training were examined as part of this regulatory overhaul process. This tightening of the regulations will also involve the ordering customers with regard to justification and the human and material resources available in the event of incidents.

Regional initiatives to establish charters of best practices in industrial radiography have been in progress for several years at the instigation of ASN and the labour inspectorate, particularly in the Provence-Alpes-Côte d'Azur, Haute-Normandie, Rhône-Alpes, Nord-Pas-de-Calais and Bretagne/Pays de la Loire regions and enabled regular exchanges between the various participants to continue in 2014. The ASN divisions and other regional administrations concerned also organise regional awareness-raising and discussion symposia which are attracting growing interest from the stakeholders of this branch.

UNDERSTAND

Gamma radiography
Serious accidents abroad

Gamma radiography accidents in France have remained limited in number and consequences since March 1979, when a worker had to have a leg amputated after having picked up a 518 GBq source of iridium-192 and put it in his pocket. This incident had led to a tightening of the regulations in effect at the time.
ASN continues to keep itself informed of significant accidents around the world which have had major deterministic effects.

Recent examples brought to ASN's attention include:

- in 2014 in Peru, an employee was exposed to 500 mSv whole body and 25 gray (Gy) on the left hip when he moved a guide tube and a collimator without realising that the source was disconnected from the remote control cable and had remained in the collimator (^{192}Ir, 1.2 TBq, 30 minutes of exposure);
- in 2013, in Germany, an employee of a non-destructive testing company was exposed to more than 75 mSv whole body and 10 to 30 Gy at the extremities (hands) while attempting to release a source from a guide tube.
- in 2012, a Peruvian employee was admitted to Percy hospital in Clamart following exposure of 1 to 2 Gy (whole body) and of 35 Gy to the hand (70 Gy at the fingertips) after handling a guide tube with his bare hands, without first checking the position of the source. The industrial radiographer required partial amputation of the fingers of the left hand.
- in 2011, 5 Bulgarian workers were admitted to Percy hospital in Clamart for major treatment following irradiation of 2 to 3 Gy owing to an error in the handling of a gamma ray projector, from which they believed the source had been removed.
- in 2011, in the United States, an apprentice radiographer disconnected the guide tube, noticed that the source was protruding from the source applicator and tried to push the source into the device with his finger. The estimated dose received at the extremity was 38 Gy.

Research establishments

ASN's monitoring of establishments and laboratories using radioactive sources for research purposes shows a distinct improvement in radiation protection in this sector. Generally speaking, the steps taken in recent years have produced significant results in the incorporation of radiation protection into research activities and an overall rise in awareness of radiation protection issues.

The most notable improvements concern the involvement of the Person Competent in Radiation protection (PCR), the training of exposed workers, radiation protection technical controls and waste and effluent storage conditions.

The notification criteria and the regulatory requirements with regard to notification are still to a large extent poorly-known in public research facilities and ASN notes that there is little supervision of radiation protection event tracking and notification in the inspected entities. More than 58% of the entities do not have significant events management procedures.

ASN registered the notification of 46 significant events relating to research activities for the 2011-2013 period. Even though this number remains low, it does nevertheless represent a change in practice with respect to the past since only 28 events were registered for the 2008-2010 period.

The notified significant events are of two main types:
- the discovery or loss of radioactive sources (65%);
- the detection of contamination (28%).

For the 2011 to 2013 period, 4 incidents were rated level 1 on the INES scale, while the others were rated level 0.

The situation regarding the removal of effluents and radioactive waste, including old sealed sources, can be improved. On this point, technical, economic and regulatory difficulties have been identified by the licensees and ASN, with ASN contributing to the working group specially created for this question under the National Plan for Radioactive Materials and Waste Management (PNGMDR).

ASN has reminded the licensees of particular provisions regarding the disposal of liquid scintillation vials at end-of-life.

In 2014 ASN signed a collaboration agreement with the General Inspectorate of the French Education and Research Administration. The signing of this agreement formalises the exchanges that have already begun on inspection practices and the putting in place of reciprocal information procedures for improving the effectiveness and complementarity of the inspections. This agreement will facilitate the organisation of joint inspections.

UNDERSTAND

Research activities

The use of ionising radiation in research activities concerns various fields such as medical research, molecular biology, the agri-food industry, materials characterisation, etc.
It primarily involves the use of unsealed sources (^{125}I, ^{32}P, ^{33}P, ^{35}S, ^{3}H, ^{14}C...). Sealed sources (^{133}Ba, ^{63}Ni, ^{137}Cs, ^{60}Co...) are also used in gas chromatographs or scintillation counters or, with high-level sources, in irradiators. Electric generators emitting X-rays are used for X-ray fluorescence or X-ray diffraction spectrum analyses. One should also note the existence of scanners for small animals (cancer research) in research laboratories and medical schools.
Particle accelerators are for their part used in research into matter or for the manufacture of radionuclides.

The number of licenses issued by ASN in the research sector is stable at around 800. Each year, ASN carries out an average of 60 inspections in this sector.

Veterinary surgeons

With regard to veterinary structures, the administrative situation has been continuously improving for a number of years now (as at end 2014, nearly 3,506 structures had been notified or authorised) but this is still unsatisfactory given the number of establishments utilising ionising radiation in the country (about 5,000).

Of the veterinary activities, those performed on large animals (primarily horses) and outside specialised veterinary facilities (in so-called "worksite" conditions), are considered to be those with the highest potential radiation protection implications, more specifically for persons from outside the veterinary facility taking part in these interventions.

The inspections carried out by ASN on more than 30% of these veterinary structures as part of a national priority in the inspection programme revealed areas for improvement in which ASN remains vigilant when examining licensing applications and performing inspections:
- shortcomings in the application of worker monitoring by active dosimetry and in the internal radiation protection controls;
- deficient and sometimes inexistent implementation of radiological zoning;
- the necessity to reinforce the radiation protection of persons external to the veterinary practice who participate in the diagnostic radiology procedures;
- an unsatisfactory administrative situation.

The result of the efforts made by the veterinary bodies in the last few years to ensure conformity with the regulations have been confirmed by the inspectors who have noted good field practices in the inspected structures, and more specifically:
- the presence of in-house PCRs in the majority of structures;
- the use of personal protective equipment (PPE) almost systematically;
- an approach to optimise the conditions of diagnosis in nearly all the structures.

The extensive nationwide commitment of the profession to harmonising practices, raising awareness, training student veterinary surgeons and drafting framework documents and guides is seen in a very positive light by ASN, which every year takes part in meetings with the profession's national bodies (more particularly the veterinary radiation protection commission) jointly with the General Directorate for Labour.

ASN presented the conclusions of the inspections to the national authorities of the veterinary profession so that they can take the necessary steps to continue to improve the radiation protection measures applied in equine veterinary structures.

ASN encourages veterinary professionals to continue the ongoing reflection on the optimisation of conditions of diagnostic radiology in "worksite" conditions and, more generally, to focus their efforts on improving the radiation protection of persons from outside the veterinary profession.

The profession must also start harmonising practices and having a broad reflection on the justification for performing diagnoses in "worksite" conditions when specially designed facilities are available.

Removal of lightning conductors

The removal of old lightning conductors containing radioactive sources has significant radiation protection implications (see point 4.3.2).

A guide for professionals produced by ASN, Andra and IRSN will be published in early 2015. At the same time, ASN will take steps to inform lightning conductors possessors in order to speed up the planning of removals.

Suppliers of ionising radiation sources

As stated in point 3.4, ASN considers that the regulatory oversight of suppliers of electrical ionising radiation generators is still insufficient, given that the technical characteristics of the devices put on the market are of prime importance for optimising the exposure protection of their users. The work conducted by ASN in this area led to the publication of ASN resolution 2013-DC-0349 of 4th June 2013 and will be continued in

X-ray examination of a horse.

2015 to propose a draft resolution setting the technical requirements for the devices distributed in France.

Cyclotrons

In the field of radiopharmaceuticals production, there are 32 low- and medium-energy cyclotrons in France, 30 of which are in service: 18 are used for the daily production of drugs intended for medical imaging, 6 are used only for research purposes, while 6 are operated for joint production and research purposes (also see point 3).

In this field, for which ASN has had oversight responsibility since early 2010, each new facility or major modification of an existing facility is the subject of a complete examination by ASN. The main radiation protection issues on these facilities must be considered as of the design stage. Application of the standards, in particular standard NF M 62-105 "Industrial accelerators: installations", ISO 10648-2 "Containment enclosures" and ISO 17873 "Nuclear facilities - Criteria for the design and operation of ventilation systems for nuclear installations other than nuclear reactors", guarantees safe use of the equipment and a significant reduction in risks.

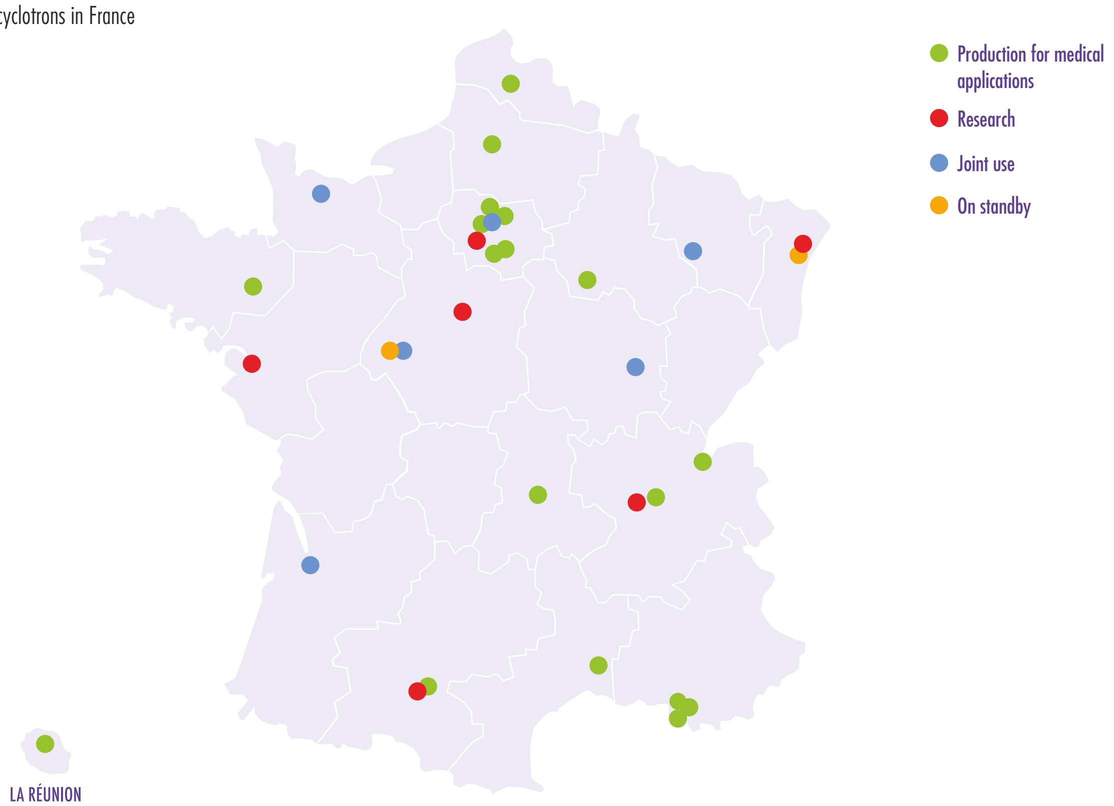
The establishments that hold a cyclotron and use it to produce radionuclides and products containing radionuclides are subject to gaseous effluent discharge limits specified in their license. The discharge levels depend on the frequency and types of production involved.

In order to minimise the activity discharged at the stack outlet, systems for filtering and trapping the gaseous effluents are installed in the production enclosures and in the facilities' extraction systems. Consequently, the discharged activities are very low and the short half-life of the radionuclides discharged in gaseous form means there is no impact on the public and the environment.

Some licensees have also installed, beside the shielded enclosures, systems for recovering the gases to allow their decay before their discharge, allowing a substantial reduction in the activities discharged into the environment.

ASN performs about a dozen inspections on these facilities every year. Aspects related to radiation protection, user safety and the correct operation of cyclotrons and production platforms receive particular attention during the inspections. The scope of the inspections performed includes - apart from the aspects relating to radiation protection - the monitoring and maintenance of the production equipment, the inspection of the surveillance and control systems and the gaseous discharge results. The radiation protection organisation of these facilities is satisfactory and they are fully familiar with the regulations. National action plans have been put in place by the licensees and

MAP of cyclotrons in France



are monitored by ASN in order to ensure continuous improvement of radiation protection and safety in these facilities.

There are disparities in the technical and organisational means implemented by the licensees according to the age of the facilities and the type of activities performed (research or industrial production). Experience feedback in this area has led ASN to ask IRSN to establish recommendations and requirements necessary for the control of the radiological risks applicable to establishments using a cyclotron and producing radionuclides and products containing radionuclides. A draft resolution on the minimum technical design, operating and maintenance rules for this type of facility is currently being prepared by ASN and should be subject to consultations in 2015

The cyclotron contains no permanent radioactive source. In normal operation, the very short lifetime of the radio-isotopes manufactured (less than 2 hours) makes for very rapid decay. The production units employ systems to trap radioactive gases emitted during the synthesis process. Environmental discharges are monitored by the manufacturer and limits are set in the licenses issued by ASN. Liquid and solid waste containing radioisotopes emitting positrons are stored for several days before being dealt with as non-radioactive waste.

Since 1st November 2013, the nuclear activity licenses issued under the Public Health Code and involving the use of a cyclotron are concerned by the public consultation system. The licensing files are put on line on the ASN website (source distributors) for public consultation. Ten files have already undergone public consultation since the system was put in place.

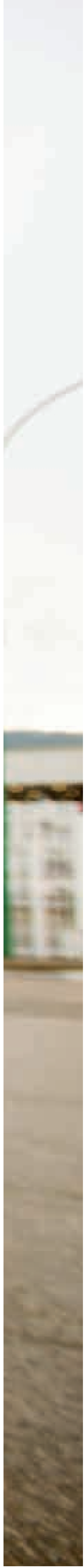
Monitoring the protection of radioactive sources against malicious acts

Although the subject of monitoring the protection of radioactive sources against malicious acts was the subject of interministerial discussions back in 2008, France has not so far defined the prevention obligations to protect the sources against malicious acts or designated an authority with a legal capacity to perform controls. A bill aiming to task ASN with this mission was submitted to the Senate in 2012 but has not yet been examined. In 2014 ASN brought the subject before the members of parliament within the framework of the examination of the energy transition bill.

At the same time, in 2014 ASN continued, along with its institutional partners, the preparation of the implementing texts necessary for the effective implementation of monitoring and the steps initiated in 2013 to produce an inventory of the existing facilities and anticipate staff training and the development of appropriate tools for rapid and effective implementation of this new duty.

11

TRANSPORT OF RADIOACTIVE SUBSTANCES



The transport of radioactive substances is a specific sector of dangerous goods transport characterised by the risks associated with radioactivity.

The scope of regulation of the safety of radioactive substance transport covers various fields of activity in the industrial, medical and research sectors. It is based on stringent and restrictive international regulations.

1. MOVEMENTS AND RISKS IN THE TRANSPORT SECTOR

1.1 The diversity of radioactive substance transport movements

The regulations place these packages in different risk "classes". Class 1, for example, represents explosive materials and objects, class 3 flammable liquids, and class 6 toxic and infectious materials. Class 7 covers hazardous radioactive material. About 770,000 shipments of radioactive substances are transported each year in France. That represents about 980,000 packages of radioactive substances, or just a few per cent of the total number of dangerous goods packages transported each year in France.

The nuclear industry accounts for about 12% of the packages transported: this involves the transport of new and spent fuel, uranium hexafluoride (UF_6), waste, contaminated tools, etc. The majority of the packages transported (55%) are for the non-nuclear industry (checking lead in paint, gamma radiography weld inspections, use of sealed sources for irradiators, etc.). This is followed by the medical sector, with 31% of the packages (pharmaceutical products, radiotherapy sources, etc.). Finally, the remaining 2% correspond to non-nuclear research (for example, the transport of radioactive tracers).

The fuel cycle necessitates an estimated annual total of 19,000 shipments involving 114,000 packages. These include approximately:
- 2,000 shipments from or to foreign countries or transiting via France, representing about 58,000 packages shipped;
- 389 shipments of new uranium-based fuel and some 50 shipments of new uranium and plutonium-based "MOX" fuel;
- 220 shipments transporting spent fuel from the nuclear power plants operated by EDF to the La Hague reprocessing plant operated by Areva;
- about 100 shipments of plutonium in oxide form transported from the La Hague reprocessing plant to the MELOX fuel production plant in the Gard *département*;
- 250 shipments of uranium (UF_6) hexafluoride necessary for the fuel manufacturing cycle.

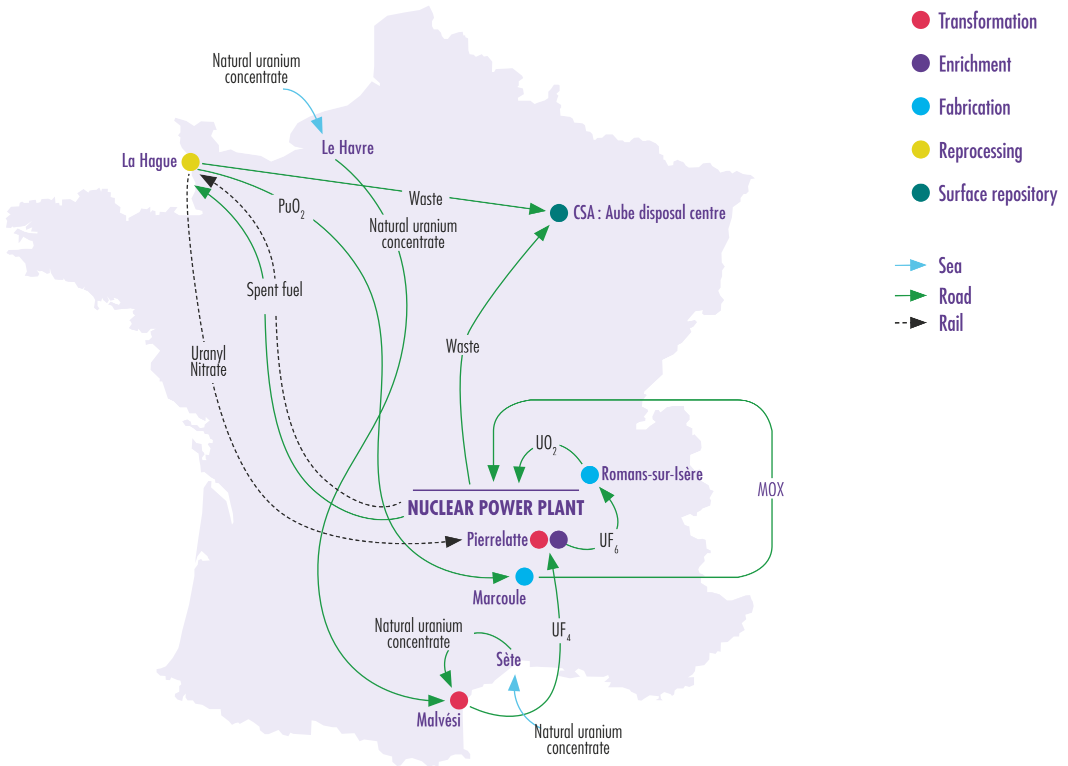
1.2 Risks associated with the transport of radioactive substances

The content of the packages is highly diverse: their radioactivity varies over more than fifteen orders of magnitude, that is to say from a few thousand becquerels for low-level pharmaceutical packages, to quadrillions (billions of billions) of becquerels for spent fuel. Their weight also varies from a few kilogrammes to about a hundred tonnes.

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

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

TRANSPORT operations relating to the fuel cycle in France



BREAKDOWN per mode of transport

APPROXIMATE NUMBER OF PACKAGES AND SHIPMENTS		ROAD	ROAD AND AIR	ROAD AND RAIL	ROAD AND SEA	ROAD, SEA AND RAIL	ROAD, SEA AND AIR
Packages approved by ASN	Number of packages	17,875	1,315	455	1,916	0	0
	Number of shipments	12,356	1,249	382	385	0	0
Packages not requiring approval by ASN	Number of packages	866,052	46,942	2,894	6,803	34,364	5,316
	Number of shipments	735,492	21,008	533	905	81	5,316

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

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

The statistical data presented in this chapter come from a study conducted by ASN in 2012. It is based on information collected in 2011 from all the consignors of radioactive substances (BNIs, laboratories, hospitals, source suppliers and users, etc.), as well as on reports from the transport safety advisers. A summary is available on the ASN website[1].

1. *www.asn.fr/Informer/Actualites/Enquete-de-l-ASN-sur-les-flux-de-transport-de-substances-radioactives (ASN survey on radioactive substances traffic)*

2. ROLES AND RESPONSIBILITIES

2.1 Regulation of nuclear safety and radiation protection

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

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

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

2.2 Protection against malicious acts

The prevention of malicious acts consists in preventing sabotage, losses, disappearances, theft and misappropriation of nuclear materials that could be used to manufacture weapons. In the regulatory framework, the Defence and Security High Officials (HFDS), under the Ministers responsible for Energy and Defence, represent the Authority responsible for preventing malicious acts targeting nuclear materials.

In practice, it is the HFDS of the Ministry of Ecology who is delegated this role by the two abovementioned HFDS.

2.3 Regulation of the other classes of dangerous goods

Regulation of the transport of dangerous goods is monitored by the MTMD (Hazardous Materials Transport Mission) of the Ministry of Ecology. This entity is tasked with ensuring the measures relative to the safe transport of dangerous goods other than class 7 (radioactive) by road, rail and inland waterways. It has a consultative body (CITMD - Interministerial Hazardous Materials Transport Committee) that is consulted for its opinion on any draft regulations relative to the transport of dangerous goods by rail, road or inland waterway.

Inspections on the ground are carried out by land transport inspectors attached to the DREALs (Regional Directorates for the Environment, Planning and Housing).

For regulation to be as consistent as possible, ASN collaborates regularly with the administrations responsible for applying the regulations in their particular sector of activity. For example, in 2012 ASN took part in the training of DGAC (General Directorate for Civil Aviation) inspectors responsible for monitoring the air transport of hazardous goods in order to present to them the specificities of class 7 and the experience feedback from ASN's inspections on these subjects.

The breakdown of the various regulatory oversight missions is summarised in the table below.

ADMINISTRATIONS responsible for regulating the mode of transport and the package

MODE OF TRANSPORT	REGULATION OF MODE OF TRANSPORT	PACKAGE REGULATION
Sea	General Directorate for Infrastructure, Transport and the Sea (DGITM) of the Ministry for Ecology, Sustainable Development and Energy (MEDDE). ASN provides its support for monitoring compliance with the prescriptions of the International Code of safety rules for the transport of spent nuclear fuels, plutonium and highly radioactive waste in packages on-board ships ("Irradiated Nuclear Fuel" code). General directorate for energy and climate (DGEC) of the Ministry of Ecology, Sustainable Development and Energy ("Irradiated Nuclear Fuel" code).	The DGITM is competent to regulate packages of dangerous goods in general and in close coordination with ASN for packages of radioactive substances.
Road, rail, inland waterways	General Directorate for Energy and Climate (DGEC) of the Ministry of Ecology, Sustainable Development and Energy.	The General Directorate for Risk Prevention (DGPR) is responsible for regulating packages of dangerous goods in general and in close coordination with ASN for radioactive substances.
Air	General Directorate for Civil Aviation (DGAC) of the Ministry of Ecology, Sustainable Development and Housing (MEDDE).	DGAC is competent to regulate packages of dangerous goods in general and in close coordination with ASN for packages of radioactive substances.

3. DRAFTING OF INTERNATIONAL AND EUROPEAN REGULATIONS

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

3.1 The different types of package

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

3.1.1 Excepted packages

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

3.1.2 Non- ssile industrial or type A packages

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

Type A packages can, for example, be used to transport radioisotopes for medical purposes commonly used in nuclear medicine departments, such as technetium generators.

3.1.3 Fissile and type B packages

Type B packages allow the transport of some of the most radioactive substances such as spent fuels, vitrified high level, long-lived nuclear waste and fresh fuels. Given the level of risk associated with these packages, they are subject to approval delivered by ASN based on the examination of a safety file. These packages are essentially for the nuclear industry and for industrial technical inspections, including industrial radiology.

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

3.1.4 Type C packages

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

BREAKDOWN of transported packages by type

	TYPE OF PACKAGE	APPROXIMATE SHARE OF PACKAGES TRANSPORTED ANNUALLY
Packages approved by ASN	Type B packages	2%
	Other packages approved by ASN	1%
Packages not requiring approval by ASN	Type A packages not containing fissile radioactive substances	31%
	Industrial packages not containing fissile radioactive substances	8%
	Excepted packages	58%

3.2 Requirements applicable to each type of package

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

The regulations thus require that type A packages that contain no fissile materials (such as enriched uranium), be designed to withstand incidents that can occur during handling or storage operations. They must therefore be subjected to the following tests:
- exposure to a severe storm (rainfall reaching 5 cm/hour for at least 1 hour);
- drop test onto an unyielding surface from a height varying according to the mass of the package (maximum 1.20 m);
- compression equivalent to 5 times the weight of the package;
- penetration by dropping a standard bar onto the package from a height of 1 m.

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

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

Type B packages, which are used to transport the most dangerous materials, must be designed such that safety is guaranteed, including in the event of a transport accident. These accidents are represented by the following tests:

- three consecutive tests:
  - a 9 m drop test onto an unyielding surface;
  - a 1 m drop onto a spike;
  - encircling fire of at least 800°C for 30 minutes;
- immersion in 15 m deep water (200 m water depth for spent fuel) for 8 h.

These tests, which are similar to the automotive industry's crash-tests, were recommended by IAEA. They have been designed, firstly to cover 95% of the most severe accidents, and secondly with the aim of being readily reproducible from one country to another. These tests are thus recognised and applied very widely by the IAEA member countries. Their performance is obligatory within the European Union.

3.3 Defining the responsibilities of the transport stakeholders

The main participants in transport arrangements are the consignor and the carrier.

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

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

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

The transport of some radioactive substances (including packages containing fissile material) is subject to prior notification to ASN and the Ministry of the Interior by the consignor. The notification indicates the materials transported, the packages used, the transport conditions and the contact details of the persons involved. 1,197 notifications were addressed to ASN in 2014.

3.4 Regulatory oversight of radiation protection

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

The general regulations relative to radiation protection provided for by the Public Health Code and by the Labour Code also apply to the transport of radioactive substances as a nuclear activity in its own right: the public and non-specialised workers must not be exposed to a dose exceeding 1 milliSievert (mSv) per year. However, this limit is not intended to be an authorisation to expose the public to up to 1mSv. Moreover, the justification and optimisation principles applicable to all nuclear activities also apply to the transport of radioactive substances (see Chapter 2).

Radiation protection forms the subject of specific requirements in the regulations applicable to the transport of radioactive substances. Thus, for transport by road, the regulations stipulate that the radiation at the surface of the package must not exceed 2 mSv/h (this limit can be increased to 10 mSv/h in the case of exclusive use, where actions near the package are limited). The radiation on the outer surface of the vehicle must not exceed 2 mSv/h, and must be less than 0.1 mSv/h at a distance of 2 metres from the vehicle.

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

These limits are supplemented by requirements relative to the organisation of radiation protection within companies. The transport stakeholders must establish a radiological protection programme that integrates the measures taken to optimise human exposure. It may be necessary to implement dose monitoring of the exposed person according to the foreseeable dose evaluation required by the Labour Code for certain operations (loading, stowing, unloading, etc.).

Training is also a key factor in the radiological protection programmes. It is required by the regulations. All the stakeholders in the transport chain must thus be trained and made aware of the nature of the risks associated with radiation so that they can protect themselves and others against these risks.

In 2013, ASN looked more specifically to obtain a summary of the dosimetry of drivers working for radiopharmaceutical package transport companies for the past five years. To this end, it asked the French Institute for Radiation Protection and Nuclear Safety (IRSN) to conduct a study of data in the Siseri (ionising radiation exposure surveillance information system) database of the doses of individuals exposed during transport operations. This study, submitted to ASN in late 2013, shows exposure of these individuals that is higher than the average of exposed workers in France, with considerable variations between companies. It suggests that radiation protection optimisation efforts must be made by certain transport companies. In 2014, ASN contacted the carriers of radiopharmaceutical products to initiate an action plan in this field.

3.5 Regulation of the safety of transport operations within the perimeter of nuclear facilities

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

Since 1st July 2013, these transport operations are subject to the requirements of the "BNI Order", published on 7th February 2012 (see Chapter 3). This order requires that on-site transport operations be incorporated into the safety baseline requirements for BNIs. The on-site transport of dangerous goods presents the same risks and inconveniences as the transport of dangerous goods on the public highway. The safety of transport must be overseen with the same rigour as for any other risk or inconvenience present within the perimeter of the BNI.

In 2014, ASN received notification from most BNIs that they were modifying their general operating rules in order to incorporate on-site transport operations into their baseline safety requirements. These notifications were examined by ASN. Not all the BNIs have yet modified their general operating rules and additions to the baseline safety requirements are still being awaited.

Furthermore, certain on-site transports of radioactive substances carried out by BNI 116 at Areva La Hague were jointly reviewed by the Advisory Committees for Transport (GPT) and for Laboratories and Plants (GPU) on 14th January 2014. Following this review, ASN asked Areva to modify the transport systems for the Hermès/Mercure and Navette package models, designed respectively for the transport of hulls and end-pieces resulting from the cutting up of spent fuel and for intermediate or high-level standard waste containers (CSD), within a time-frame of five years.

ASN also produced a draft guide designed to provide the licensees with recommendations for implementing the regulations concerning on-site transport operations.

3.6 Public information

Order 2012-6 of 5th January 2012 extends the public information obligations to persons responsible for nuclear activities. It is Article L. 125-10 of the Environment Code that sets the threshold beyond which the person responsible for transport must communicate the information requested by a citizen, by reclassification of the provisions of Decree 2011-1844 of 9th December 2011. The thresholds are defined as being those *"above which, in application of the international conventions and regulations governing the transport of dangerous goods, of the Code of Transport and of the texts taken for their application, the transport of radioactive substances is subject to the delivery – by ASN or by a foreign Authority competent in the field of radioactive substance transport - of an approval of the transport package design or a shipment approval, including under special arrangement"*. Any citizen can therefore now ask the persons in charge of transport for information on the risks presented by the transport operations referred to in the decree.

A person to whom a nuclear licensee or transport supervisor has refused to communicate information, can refer the matter to the CADA (Administrative Documents Access Commission), for its opinion. The matter must be referred to the CADA prior to any legal action. Disputes relative to communication refusals can then be brought before the administrative jurisdictions, even if they are between two private individuals.

In 2014, ASN also drew up an information sheet on the transport of radioactive substances, intended for the general public and available on *www.asn.fr.* This sheet answers questions frequently asked by the public, notably concerning the risks inherent in these transport operations, the organisation of the response by the public authorities to an emergency or the routes followed for these transport operations.

4. ASN ACTIONS

4.1 Delivery of approval certificates and shipment approvals

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

In some cases, IRSN's appraisal is supplemented by a meeting of the Advisory Committee for Transport (GPT). The opinions of the Advisory Committees are always published on *www.asn.fr.* The GPT, for example, met in 2012 to examine a new package concept, DE 25, developed by CEA for the transport of waste.

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

These approvals are generally issued for a package design independently of the actual transport operation, for which no prior notification of ASN is generally required, but which may involve security checks (physical protection of materials under the control of the Defence and Security High Official (HFDS) at the Ministry of Ecology, Sustainable Development and Energy).

TO BE NOTED

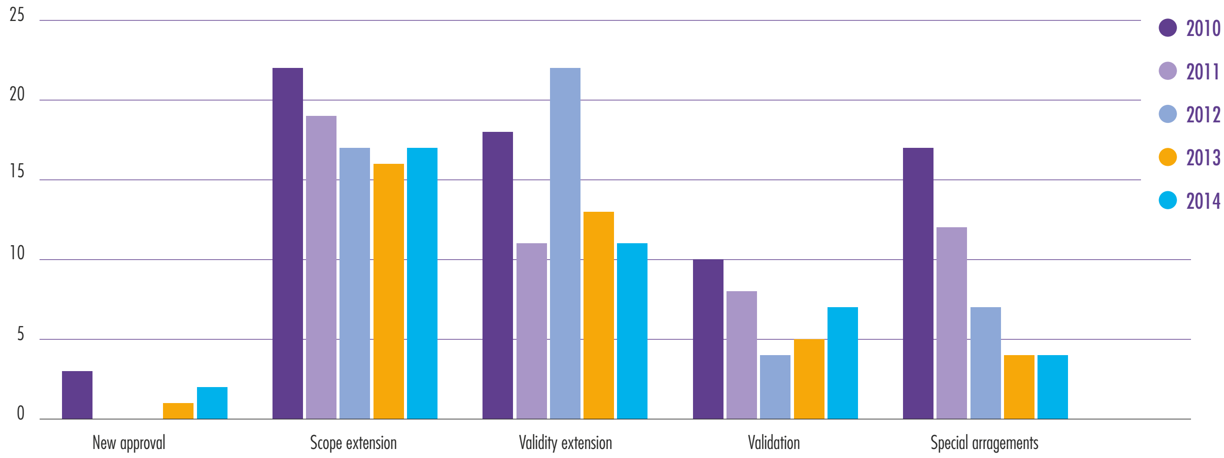
TN G3 - New packaging model for the transport of spent fuels - drop tests

The TN 12/2 and TN 13/2 transport packaging types are today used to take spent fuels from EDF's NPPs to the Areva reprocessing plant at La Hague. The TN G3 packaging is a new concept developed by TN International designed to replace the TN 12/2 and TN 13/2 packaging by about 2020. This packaging development is linked to ASN's aim of no longer issuing any approvals as of that date that are based on the 1985 edition of the IAEA radioactive materials transport regulations. The packaging of the TN12 family will then be about 40 years old. The TN G3 is thus designed to comply with the changes to the regulatory framework and to the materials to be transported (increased burnup fraction, initial enrichment, etc.).

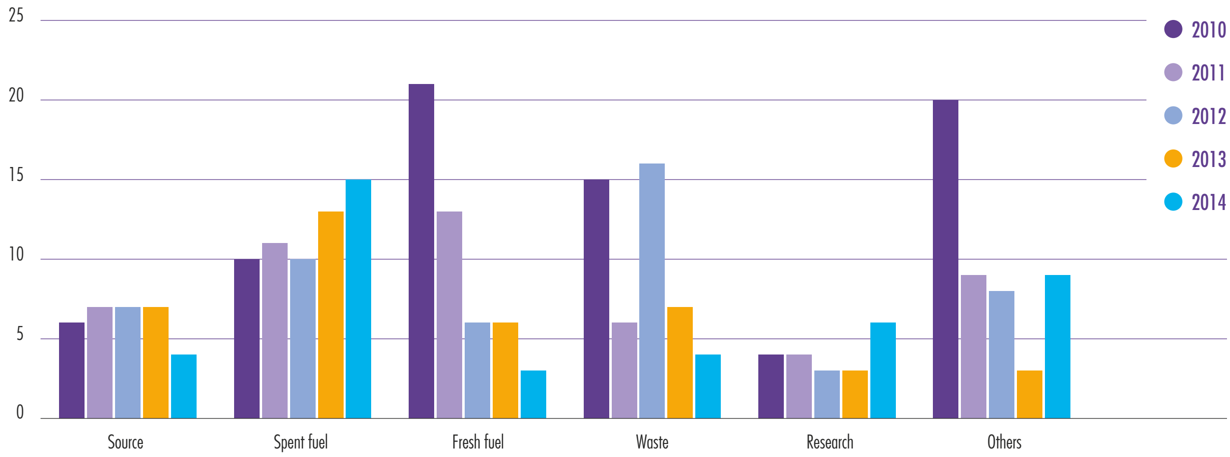
In order to evaluate the performance of the package following the mechanical tests stipulated by the regulations, the TN International company drew up a drop tests programme to be performed on a 1/3 scale mock-up of the TN G3 package model. The drop tests were performed in early 2014 and underwent two ASN inspections.

The results of the test campaign will be included in the safety file supporting the approval application expected for 2015. This package model will be examined by the members of the Advisory Committee for Transport in 2016.

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



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



One metre drop onto spike.

Nine-metre drop.

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

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

ASN delivered 41 approval certificates in 2014, for which the breakdown by type is shown in graph 1. The breakdown and nature of the transport operations concerned by these certificates in are shown in graph 2.

Finally, in May 2009, ASN published an applicant's guide for approval of shipments and package models or radioactive materials for civil purposes transported on the public highway. The guide presents ASN's recommendations to the applicants, to facilitate examination of the package approval applications and of the shipment approvals for the transport of radioactive substances. It also specifies how the safety files are to be transmitted to ASN and to IRSN, their structure, the contents of the draft approval certificate, the operating experience feedback from previous reviews and the requirements to be met if a package design or material is modified. This guide was translated into English in 2010 for distribution to some of the European Union authorities with competence for transport issues. A revision of this guide was started in 2014. All the stakeholders (ASN, IRSN, applicants and foreign nuclear Authorities) responded to this consultation and helped produce this draft guide. This new version to be published in 2015 takes up points of doctrine that were previously disseminated as circular letters, in order to improve clarity and group the information in a single document.

4.2 Monitoring all the stages in the life of a package and its shipment co nditions

ASN performs inspections at all stages in the life of a package, from manufacture and maintenance through to package preparation, carriage and reception.

In 2014, ASN carried out 113 radioactive substance transport inspections (all sectors considered).

4.2.1 Package manufacturing inspections

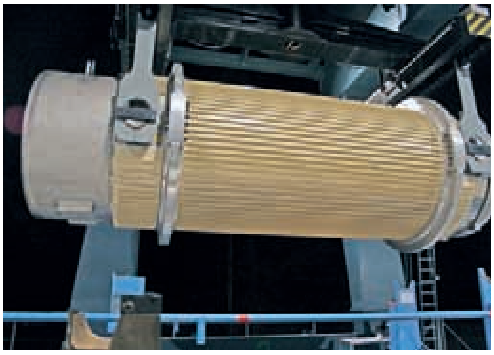
The manufacture of transport packaging is subject to the regulations applicable to the transport of radioactive substances. In accordance with the regulatory requirements, each manufacturer of an approved package model must be able to provide ASN with all information needed to demonstrate the conformity of the manufacture of the packaging with the package model specifications approved by ASN. These specifications are defined in the safety file specific to each packaging and represent the safety case for the package model. The safety file sets packaging design goals. It contains everything relating to the prescriptions concerning the packaging and its content and to the tests required for the package model's safety case.

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

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


ASN manufacturing inspection on the new CN2700 packaging.

In 2014, ASN inspected the manufacture of a TN 81 package shell (model approved for the transport of vitrified, compacted waste) and a TN 17MAX package shell (new packaging model intended for the transport of spent fuel elements) as well as the non-destructive inspection methodology adopted to verify the absence of manufacturing defects. ASN also inspected the manufacture of the CN2700 package model designed for the transport of research fuel and carried out a joint inspection with the Swiss Federal Nuclear Safety Inspectorate (ENSI) on the manufacture of the TN 24 BH packaging used in



TN 81 packaging.

Switzerland for the transport and storage of spent fuel (see box opposite).

The follow-up letters to these inspections are available on *www.asn.fr.*

During these inspections, ASN checks the quality assurance procedures implemented for the production of a package on the basis of the design data, and ensures that the inspections and any manufacturing deviations are traceable.

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

When subcontractors are used, ASN checks the monitoring of manufacturing by the manufacturer in charge and intervenes directly on the manufacturing sites, which are sometimes located in other countries. Thus, for inspection of the manufacture of the 30B cylinders, ASN inspected a production factory in China in June 2012.

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

4.2.2 Maintenance inspections of type B packages

The consignor or user of a package filled with radioactive substances must be ready to prove to ASN that this package is periodically inspected and, if necessary, repaired and maintained in good condition such that it continues to satisfy all the relevant requirements and specifications of its safety file and approval certificate, even after repeated use.

TO BE NOTED

Joint inspection of the manufacture of packagings intended for the transport and storage of nuclear fuel

ASN carried out a joint inspection with the Swiss Federal Nuclear Safety Inspectorate (ENSI) on the manufacture of the TN 24 BH packaging intended for the transport and storage of spent fuel in Switzerland.

After it has been used, the spent fuel from the Swiss nuclear power plants is transported once to a storage site in Switzerland.
Several package models can be used for fuel transport and storage. One of them is a French design: the TN 24 BH.

This packaging is designed by TN International and approved in France by ASN. The regulations applicable to the transport of dangerous goods on the public highway requires that a package model approval be issued by the competent authority in the country of origin of the package model.

Welding and final assembly of the various component parts of the packaging are also carried out by a French company, in Alsace.

Two ASN inspectors visited the packaging manufacturer in Alsace on 21st and 22nd July 2014, accompanied by two ENSI inspectors, an expert from IRSN, ASN's technical support organisation, and an inspector from the Swiss Technical Inspection Association (ASIT), ENSI's technical support organisation, in order to check the manufacture of the TN 24 BH packagings.

They were present at various manufacturing operations (machining, welding, etc.) and inspected the storage conditions for the materials used in the manufacture of the packaging (welding filler materials, components necessary for the production of the packaging resin, etc.). They verified the conformity of the operations with the manufacturing procedures and with the specifications of the package model safety file. They also looked at the quality assurance in place, the manufacturer surveillance by TN International and the relations between the various parties concerned.

The inspectors found no significant manufacturing deviations. They did however note that the assessment of manufacturing defects by the ordering customer could be reinforced and asked for a more detailed analysis of the impact of certain repairs.

The inspection follow-up letter can be consulted on *www.asn.fr.*

TN 24 BH packaging shell.

For type B packages, the ASN inspections concern the following maintenance activities, for example:
- the periodic inspections of the components of the containment envelope (screws, bolts, welds, seals, etc.);
- the periodic inspections of the securing and handling components;
- the frequency of replacement of the package components which must take account of any reduction in performance due to wear, corrosion, aging, etc.

In 2014, ASN carried out several maintenance inspections including two at TN International, to check the maintenance of the TN 112 packaging designed to transport MOX fuel and the LR 144 packaging designed to transport radioactive liquid effluents, and one at TransNuBel.

4.2.3 Inspections of packages not requiring approval

For the packages that do not require ASN approval, the consignor must be able, at the request of ASN, to provide the documents proving that the package design complies with the applicable prescriptions. More specifically, for each package, a certificate delivered by the manufacturer attesting full compliance with the design specifications must be held at the disposal of ASN.

The various inspections carried out in 2013 and 2014 confirm the improvement in the documents presented to ASN and the first steps taken to integrate the recommendations ASN gives in its guide for packages which are not subject to approval.

In 2014, ASN continued to work on updating this guide. The licensees were asked to submit their comments on this update and these were then incorporated into a version to be issued in early 2015. The guide proposes a structure and a minimum content for the safety files demonstrating that packages which are not subject to approval do comply with all the applicable prescriptions, along with the minimum content of a declaration or a certificate of conformity of a package design with the regulations.

ASN thus noted improvements in the content of the certificate of conformity and the safety file drawn up by the participants concerned, more specifically for the industrial package models. However, the designers of type A package models must continue to make efforts, notably on the representative nature of the tests performed and the associated safety case.

Furthermore, ASN still finds that some of the entities concerned (designers, manufacturers, distributors, owners, consignors, companies performing the regulatory drop tests, package maintenance, etc.) display shortcomings in the demonstration of package conformity with the regulations. The areas for improvement remain in particular the following:
- the description of the authorised contents per type of package;
- demonstration that there has been no loss or dispersion of the radioactive content under normal transport conditions;
- compliance with the regulatory radiation protection requirements;
- the representativeness of the tests performed.

4.2.4 Inspections of the shipment of packages of radioactive substances

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

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

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

ASN's inspections reveal deficiencies in the knowledge of the regulations and responsibilities on the part of the transport stakeholders in small-scale nuclear activities.

Knowledge of the regulations applicable to the transport of radioactive substances seems to be substandard in the medical sector in particular, where the measures taken by some hospitals or nuclear medicine units when returning radionuclide packages after use and shipping sources for maintenance need to be tightened.

ASN has moreover observed that an increasing number of BNIs are using outside contractors to prepare and ship packages of radioactive substances. ASN is particularly attentive to the monitoring of these contractors.

ASN also carried out three inspections in 2014 in the railway sector, more specifically in collaboration with the inspectors of the French Rail Safety Institution (Établissement français de sécurité ferroviaire). In 2014, it was clear that SNCF attached greater importance to training and radiation protection than in the past. ASN however remains vigilant with

In the port of Fos-sur-Mer, ASN inspection of ship-to-train transhipment of a package containing uranium oxide, November 2014.

respect to this mode of transport in the light of three derailments notified in 2013.

4.2.5 Safety management

At the end of 2012, ASN conducted three technical visits to the major players in radioactive substance transport for the fuel cycle, namely Areva, EDF and CEA, in order to assess the management of safety in this area. Analysis of these visits led to the follow-up letters published on *www.asn.fr* in 2013. Among the main recommendations, ASN asks that the general transport organisation take account of subcontracting, that the individual and collective expertise of the participants in the transport of radioactive substances be put to best use and that operations that are important for safety be clearly identified. Finally, ASN considers that in certain cases, consideration should be given to a method for recording and analysing experience feedback from all transport activities, involving the packaging users.

4.2.6 Analysis of incidents

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

ASN must be notified of any deviation from the regulations or the safety files applicable to the transport of radioactive materials; this notification should conform to the events notification guide, as required by Article 7 of the order of 29th May 2009 concerning the transport of dangerous goods by road (TMD order). This events notification guide was communicated by letter to the various stakeholders in the transport of radioactive substances on 24th October 2005 and can be consulted on *www.asn.fr.* It defines the various conditions of notification and rating of transport events on the INES scale. In addition to the notification, a detailed incident report must be sent to ASN within two months.

Events declared in 2014

In 2014, ASN was notified of 63 events rated level 0, and 3 events rated level 1 on the INES scale. Graph 3 shows the trend for the number of events notified since 2000.

Areas of activity concerned by these events

More than half of the events are notified by the industrial stakeholders in the nuclear cycle (EDF and Areva in particular). Nearly one quarter of the significant events concern radioactive pharmaceutical products. The other events concern transports for research and industrial activities (gamma radiography for example).

TO BE NOTED

Incident affecting a 48Y* cylinder: Separation of lifting lug

On 18th December 2013, ASN was informed by Areva NC on the Tricastin site that a lifting lug on a 48Y cylinder in the Pierrelatte storage area, under the oversight of the ASND, was found to have separated. Following this discovery and the initial inspections carried out on the 48Y cylinders, ASN asked that all those in possession of such cylinders in France refrain from:
- shipments on the public highway of 48Y cylinders filled with uranium hexafluoride;
- on-site handling or transport of 48Y cylinders filled with liquid uranium hexafluoride;
- if these operations were to require the use of the 48Y cylinder lifting lugs and if the satisfactory strength of these lifting lugs had not been verified according to criteria approved by ASN.
- following this request, Areva NC proposed a method for inspecting the 48Y cylinder lifting lugs, based on:

48Y cylinder.

Lifting lugs used for package handling and tie-down

- a visual and magnetic particle inspection of the lifting lug welds;
- an overload test at 1.5 times the maximum operating load on the two pairs of diametrically opposed lifting lugs;
- a second visual and magnetic particle inspection of the lifting lug welds.

If no defect is detected, the cylinder's lifting lugs are considered to be suitable for handling or tie-down both on and off the site. The cylinders for which one of the inspections revealed a defect are withdrawn from service pending the finalisation of repair procedures.

To ensure that on-site handling does not subject the lifting lugs to higher stresses than the load test, Areva NC performed acceleration measurements with the systems used on the Tricastin site.

Based on this information, the lifting lugs inspection criteria were approved by ASN and shipments of full 48Y cylinders on the public highway were able to resume. The origin of the incident is currently being investigated.

** The 48Y cylinders are used to transport non-enriched uranium hexafluoride (UF^6).*

Very few transport-related event notifications are made by the conventional industrial and research sectors when compared with the actual traffic volumes. Analysis of the data nevertheless shows that this low notification level is probably due to small-scale nuclear activity professionals failing to notify events, usually due to unfamiliarity with the events notification process.

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

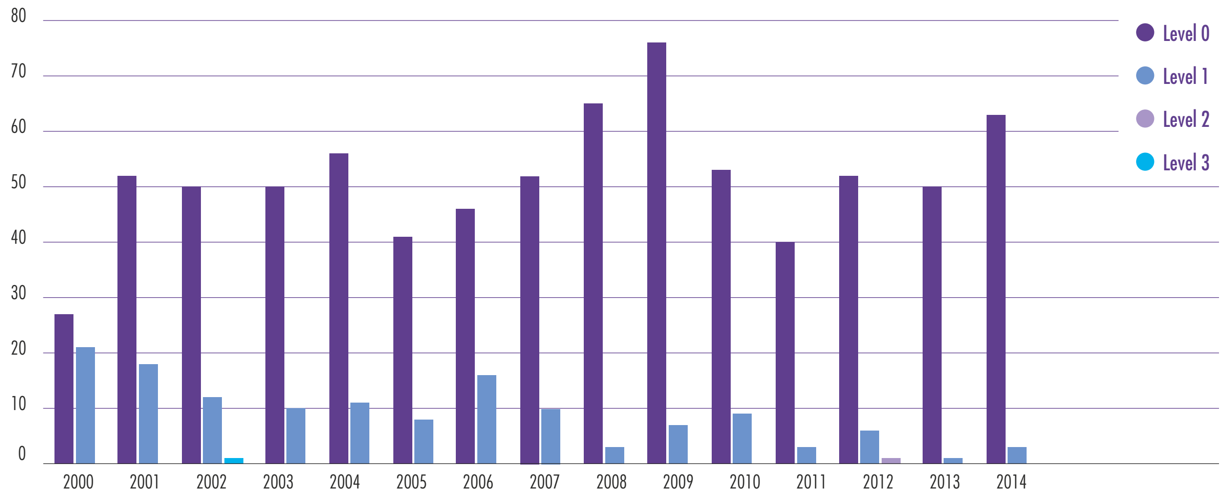
Causes of events

Errors in documentation, package labelling and vehicle placarding are the most frequent causes of the significant events notified. These are followed by notifications that the regulation contamination or dose rate limits have been exceeded.

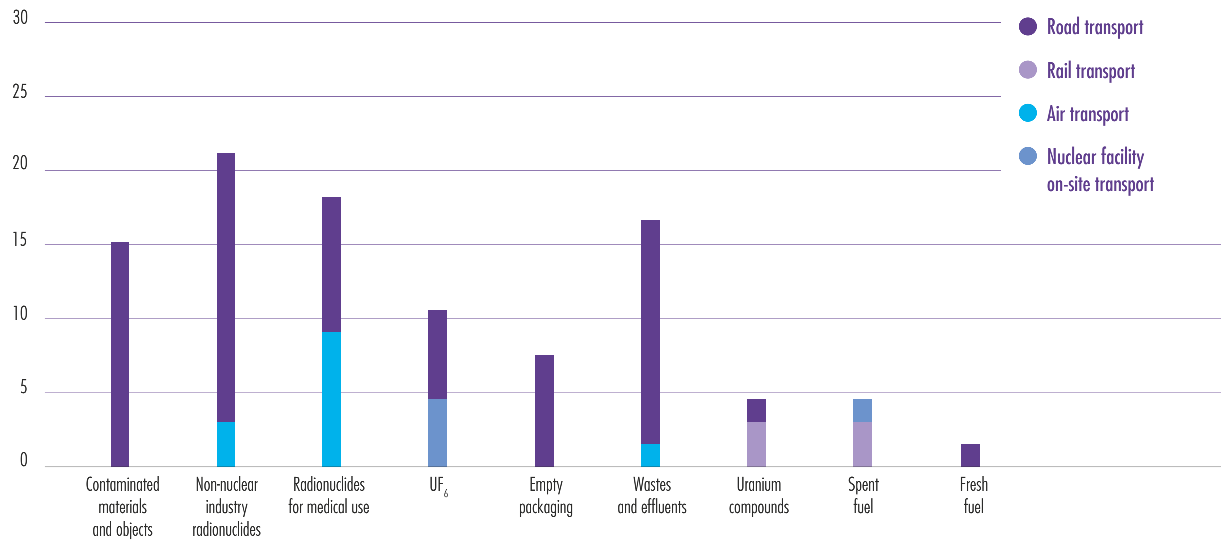
The other causes of significant events recorded include:
- shortcomings in the maintenance of packaging and package preparation (for example: inadequate chocking at loading, screw loosening during transport owing to vibration);
- package damage, usually owing to inadequate stowage or to handling accidents;
- theft or loss of packages of radiopharmaceuticals.

ASN also took part in two emergency exercises involving a shipment of radioactive substances:
- an exercise on 26th June 2014, in the Vaucluse *département*, for which the scenario included an accident involving a shipment of a package containing depleted uranium;
- a joint exercise with Belgium, on 2nd April 2014, for which the scenario included an accident involving a shipment of uranium hexafluoride on the Franco-Belgian border.

GRAPH 3: Trend in the number of radioactive substance transport incidents or accidents notified between 2000 and 2014



GRAPH 4: Breakdown of notified transport events by content and mode of transport in 2014



4.3 Participation in international relations in the transport sector

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

4.3.1 Participation in the work of IAEA

ASN represents France on the Transport Safety Standards Committee (TRANSSC) which, under the supervision of IAEA, comprises experts from all countries in order to draft the document which underpins the regulations applicable to the transport of radioactive substances. 2011 saw the conclusion of the revision cycle for these regulations, which began in 2008. The new 2012 edition integrates modifications with the objective of harmonising practices with the UN recommendations for the transport of dangerous goods. The most important changes concern criticality safety, with the modification of the configurations of substances classified as excepted fissile substances, materials for which no demonstration of criticality safety is required at present, subject to compliance with the weight limits per package and per consignment. These modifications could more particularly have an impact on the transport of waste containing fissile radionuclides, which will become subject to safety case constraints.

4.3.2 Participation in the work of the European Association of Competent Authorities on transport

The European Association of Competent Authorities on the Transport of Radioactive Material (EACA) was created in December 2008. Its purpose is to promote the harmonisation of practices in the regulation of the safety of transport of radioactive substances, and to encourage exchanges and experience feedback between the various Authorities. The plenary meeting of May 2014, for example, provided the opportunity to work on finalising the content of a European inspection guide, which will be usable by the inspectors of all the European Authorities and to discuss experience feedback from certain incidents.

4.3.3 Bilateral relations with ASN's foreign counterparts

ASN devotes considerable efforts to maintaining close ties with the competent authorities of the countries concerned by the numerous shipments to and from France. Prominent among these are Belgium, the United Kingdom, Germany, the United States of America and Switzerland.

Belgium

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

Since 2005, an annual exchange meeting is held by ASN and AFCN in order to make a closer examination of the safety files for the French package designs validated in Belgium and to discuss inspection practices in each country. In 2014, an AFCN inspector observed an emergency exercise organised by ASN, together with the office of the Prefect of the Vaucluse *département*, involving a shipment of radioactive substances.

United Kingdom

Over the last few years ASN and the United Kingdom's Office for Nuclear Regulation (ONR) have developed close ties. Both countries underwent a review coordinated by IAEA, demonstrating the high level of competence of the two authorities with regard to radioactive substance transport, thus enhancing their mutual trust and confidence.

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

Having successfully cooperated on the Memorandum of Understanding signed in February 2006, ASN and the ONR extended their cooperation on the following subjects, through an agreement concluded on 27th February 2008:
- licensing procedures;
- inspections;
- emergency procedures;
- guides for domestic and international transport of radioactive substances;
- radioactive substance transport standards;
- quality assurance systems.

Discussion meetings are regularly held by ASN and ONR to examine safety files for the package models used in the United Kingdom and France.

Germany

The French and German authorities meet regularly to discuss a number of technical subjects: numerous shipments cross the Franco-German border. ASN participates in the Franco-German technical committees concerning the schedule for returning the waste resulting from the reprocessing of German spent nuclear fuel. A new package is currently being designed in Germany for the transport of compacted waste. In this context, ASN is involved in the definition of the packaging specifications, equivalent to the safety option file in France, and it will participate in the technical meetings concerning the drop tests when the time comes.

United States

The United States Authorities (Nuclear Regulatory Commission - NRC and Department of Transportation - DOT) contacted ASN with a view to setting up collaboration on subjects of joint interest. Without waiting for this approach to be formalised, close collaboration between the French and American Authorities was initiated in 2011 to learn the lessons from the transport events observed on a package of American design intended for the transportation of uranium hexafluoride.

Switzerland

ASN began bilateral exchanges with the Swiss Federal Nuclear Safety Inspectorate (ENSI) in 2012. ENSI conducted an inspection on 4th June 2012 in the

Mühleberg NPP in Switzerland, concerning the shipment of packaging loaded with spent fuel, for which ASN had issued an approval certificate.

ASN and ENSI have decided to meet regularly to discuss the package design safety files and the checks on the instructions associated with the correct utilisation of these transport packages. In 2014, the technical discussions mainly concerned the mechanical strength of the borated baskets of certain packagings of the TN24 family, following ageing of the materials. A joint ASN/ENSI inspection was carried out to check the manufacture of a French packaging used in Switzerland to transport spent fuel (see page 229).

TO BE NOTED

Monitoring the preparedness of emergency respondents

In 2013 and 2014, ASN carried out inspections at the main carriers of radioactive substances, in order to check the steps taken with regard to preparedness for emergency situations involving a transport of radioactive substances. They in particular looked at the organisation in place, the material and human resources available, the personnel training and the emergency exercises held.

The results of these inspections contributed to the draft guide being produced by ASN concerning the "content of the management plans for radioactive substances transport incidents and accidents".
ASN considers that the transport stakeholders must implement a plan to manage transport incidents and accidents involving radioactive substances (or an "emergency plan") describing the planned response in the case of an event, incident or accident involving a shipment of radioactive substances.
The purpose of the guide is to determine the elements which should be described in an "emergency plan", for example: the procedure for transmitting the alert, the description of the organisation set up by the stakeholder, the tools and equipment at its disposal, examples of standard messages, etc.

The draft guide produced by ASN was opened to public consultation from 15th August to 22nd September 2014. It was published in December 2014.

5. SUMMARY AND OUTLOOK

At the end of 2012, ASN presented an assessment of the safety of transport of radioactive substances in France based on event notifications communicated to ASN and on the inspections covering the period from 2007 to 2011, to the members of the Advisory Committee for Transport and the Transport Safety Commission (Advisory Committee for Transport called on by the ASND, the Authority responsible for nuclear transport associated with national defence). It gave rise to a report made available on *www.asn.fr* in July 2013. Areas for improvement concerning the preparation, organisation and shipping of packages to BNIs have been identified, as well as for the carriage of packages, the manufacture and maintenance of packagings, the review of approval applications and the management of emergency situations.

Production of the report was also based on comparisons with the inspection practices of foreign nuclear regulators and on some general observations made during the inspections or when reviewing the approval applications. ASN drafted an action plan for the transport field on the basis of this report. Its provisions include:
- the publication and updating of best practice guides for specialised audiences (for example, a guide recalling the requirements applicable to the transport of radioactive substances in the medical field),
- the creation of working groups comprising persons belonging to all the entities involved in the transport of radioactive substances (ASN, IRSN, designers, owners and users of packagings) in order to work on specific subjects, such as improving the usability of the documents needed for package transport or stowage,
- written requests to the licensees (for example concerning greater consideration being given to organisational and human factors at all steps in a transport operation),
- tighter inspection on specific topics such as verification of compliance with the obligations linked to training of those involved in transport operations, examination of package conformity at the moment of shipment, examination of the radiological protection programme of the carriers and the steps taken to optimise the radiation protection of the drivers.

ASN has also set up a national working group involving packaging designers, carriers and IRSN experts, to advance the definition of the acceleration values to be adopted for the design of the package tie-down devices according to the mode of transport (road, rail, or air).

Increase in safety requirements relating to on-site transport operations performed within the perimeter of BNIs

The requirements concerning on-site transport operations performed within the perimeter of BNIs were reinforced on 1st July 2013, with the entry into force of the main provisions of the BNI Order. The vast majority of the nuclear sites concerned did not make sufficient efforts to ensure that the necessary changes were made to the existing safety baseline requirements in order to guarantee conformity with the regulations in 2013.

Compliance with the regulatory requirements will be closely monitored by ASN in 2015, notably with regard to on-site transport operations involving dangerous goods other than class 7. It will be particularly attentive to the correct updating of the general operating rules and the safety file for the on-site transport operations concerned. In addition, the correct working of the internal authorisations system regulated in 2013 (for CEA's BNIs) and 2014 (for the Melox BNI and for the BNIs on the Tricastin, Romans and Malvési sites) will be checked on the one hand with respect to the procedures adopted by the licensees and, on the other, to the resolutions issued by ASN.

Preparation of a system of registration of carriers of radioactive substances

With regard to regulatory matters, 2012 saw the European Commission adopt a draft regulation aiming at instituting a system for registering radioactive substance carriers. This unique registration system would replace the national notification and licensing procedures stemming from application of Euratom directives and transcribed in France by Article R.1333-44 of the Public Health Code. In 2013, ASN contributed to the European debate on this topic, in order to improve the draft regulation. In the meantime, ASN has started to prepare a draft resolution proposing a system of carrier registration via a remote-registration procedure, which was the subject of stakeholder consultation in 2014. This registration system will make it possible to obtain an exhaustive list of carriers of radioactive substances in order to make it easier to monitor them through ASN inspections and make them more familiar with and aware of safety and radiation protection rules.

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

ASN notes improvements concerning compliance with the regulatory requirements concerning the transport of packages not subject to approval (see point 4). Back in 2007, ASN asked for them to be brought into compliance with the regulations before the end of 2010. The inspections carried out by ASN have shown that the demands made during the inspections covering the 2008-2010 period, particularly regarding the content of the package model design conformity justification file, have been taken into account; there are however still cases where this document does not exist or is incomplete.

When the safety case for a package model cannot be provided (notably for the ISO containers used in type-A packages), the entities concerned downgrade their package to a design that is less demanding in terms of safety. In 2014, ASN once again devoted efforts to checking that such downgrading was appropriate for the radioactive substances transported and did not compromise the safety of transport. ASN also drew the attention of the organisations that assist the packaging suppliers to the regulatory requirements for preparing the package conformity files and certificates.

Therefore, although the situation has generally improved in terms of regulatory compliance with regard to industrial type packages, ASN considers that this situation is not yet satisfactory for type A packages. Inspections more particularly targeting the verification of the safety files (definition of content, stowage, etc.) and the certificates associated with type A packages will therefore be carried out again in 2015.

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

The design of transport packages requiring ASN approval is inspected in depth during the examination of the approval request. Once it has been ascertained that the package design complies with the regulatory requirements, its manufacture and subsequent routine maintenance in accordance with the requirements of its safety file must be verified. ASN has planned to maintain a large number of inspections in this area in 2015, particularly with regard to the maintenance of the oldest packagings.

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

ASN has led an initiative to draw up a guide to the drafting of emergency plans intended for the entities responsible for transport. A consolidated draft guide on which the stakeholders expressed their opinions was completed in 2012. A public consultation was held in 2014. The aim of the final version of this guide, which will be published in 2015, is to harmonise and improve the practices of those responsible for transport in this area.

For the transport field, ASN also intends to learn all possible lessons from the Fukushima Daiichi accident, by examining the safety of the transport of radioactive substances with regard to accidents that are low-probability, but the consequences of which would lead to significant harm to the public or the environment:

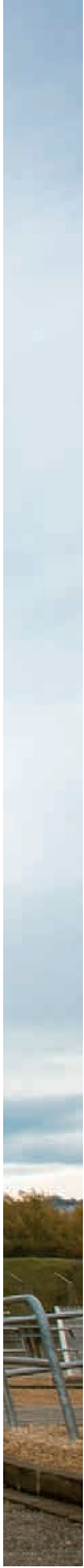
- in 2013, ASN asked the packaging designers on the one hand to review the existing studies concerning the performance of their packagings in the event of hazards (fire, drop, submersion or immersion) for which the duration or intensity would exceed those of the regulation tests and, on the other, to propose methods for supplementing the available knowledge in this field.
- in 2014, this process was extended to the consignors, carriage commission agents and carriers, asking them to define the material provisions (means of inspection, rescue vehicles, means of handling, means of repackaging, means of recovering a package in the event of a mired vehicle or shipwreck, etc.) and organisational measures to be adopted in the event of a major emergency.
- in 2015, the Advisory Committee for Transport will be required to issue an opinion on some of the recommendations resulting from the examination of the elements forwarded.

Transparency in the area of transport

Growing public and media interest in the transport of radioactive substances was observed for several international shipments organised in 2011. Consequently, ASN has made it a priority to develop the information made available to the public concerning the regulation of the safety of transport of radioactive substances. After devoting an issue of *Contrôle* magazine to this topic in 2012, ASN completed the educational file on its website with an analysis of radioactive substances traffic volumes and published an information brochure intended for the public in 2014.

ASN moreover ensures that the requirements under Article L. 125-10 of the Environment Code, stipulating that the person responsible for transport must communicate the information requested by a citizen, are also correctly applied in the radioactive substance transport sector.

12
EDF NUCLEAR POWER PLANTS (NPPS)



Regulation of NPPs is a traditional duty of ASN. The nuclear power reactors are at the heart of the nuclear industry in France. Many other nuclear installations described in the other chapters of this report produce the fuel intended for these plants or reprocess it, are used for disposal of the waste produced by them or are used to study the physical phenomena related to reactor operation and safety. The French reactors are technically similar to each other and form a standardised fleet owing to the process of standardisation and are operated by Électricité de France (EDF). This licensee's industrial policy choices have led it to entrust a significant part of reactor maintenance work to outside contractors.

ASN requires the highest level of safety standards for regulating NPPs and adapts the standards continuously in the light of new knowledge. Monitoring the safety of the reactors in service, under construction and planned for the future, is the daily task of around 200 members of ASN staff working in the Nuclear Power Plant Department (DCN) and the Nuclear Pressure Equipment Department (DEP), and of the staff of the regional divisions. It also requires the support of some 200 experts from Institute for Radiation Protection and Nuclear Safety (IRSN).

ASN is developing an integrated approach to regulation that covers not only the design of new facilities, their construction, modifications, integration of feedback on events or maintenance problems but also, via the expertise its inspectors have built up, the fields of human and organisational factors, radiation protection, the environment, worker safety and the application of labour legislation. This integrated approach allows ASN to develop a finer appreciation and decide on its position each year with regard to the current status of nuclear safety, radiation protection and the environment in NPPs.

1. OVERVIEW OF NUCLEAR POWER PLANTS

1.1 Description of an NPP

1.1.1 General presentation of a pressurised water reactor

In routing heat from a hot source to a heat sink, all thermal electric power plants produce mechanical energy, which they then transform into electricity. Conventional power plants use the heat given off by the combustion of fossil fuels (fuel oil, coal, gas). Nuclear plants use the heat resulting from the fission of uranium or plutonium atoms. The heat produced is used to vaporise water. The steam is then expanded in a turbine which drives a generator producing a 3-phase electric current with a voltage of 400,000 V. After expansion, the steam passes through a condenser where it is cooled on contact with tubes circulating cold water from the sea, a water course (river) or an atmospheric cooling circuit.

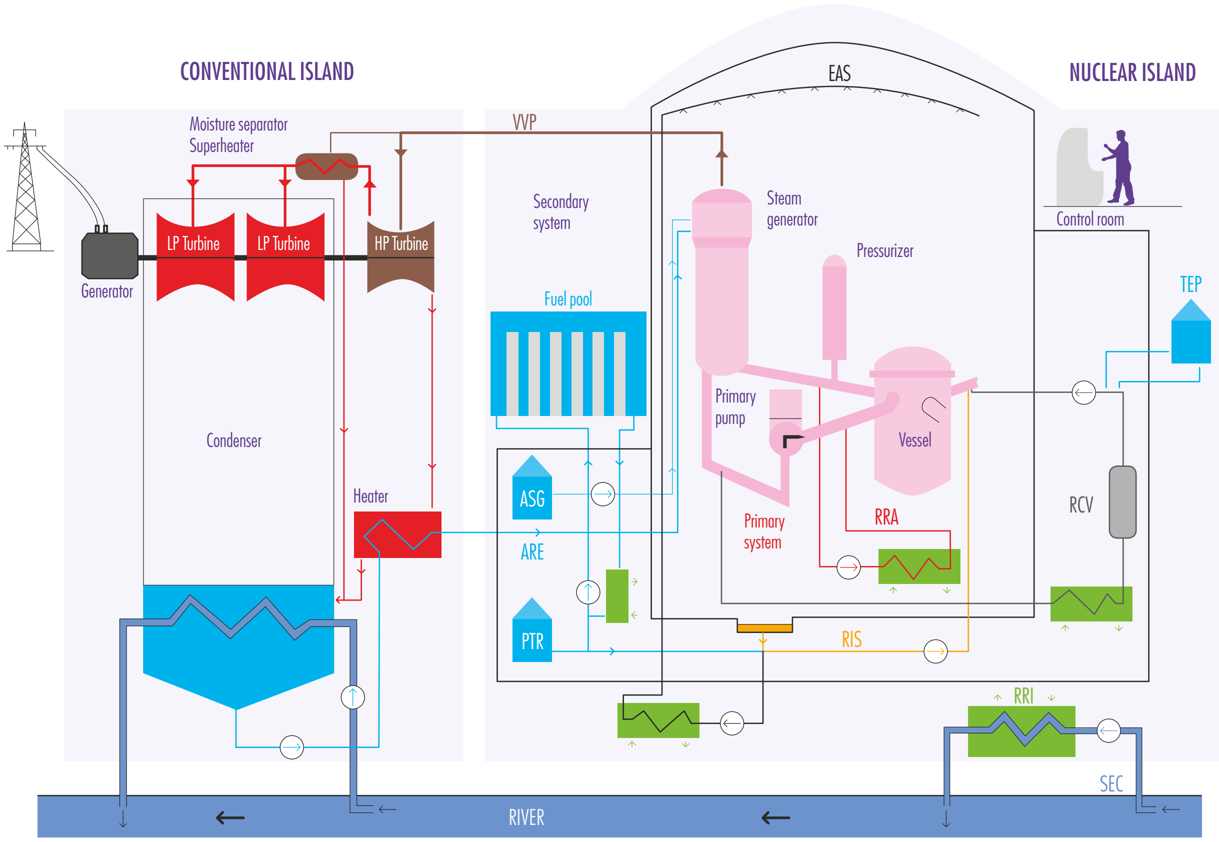
Each reactor comprises a nuclear island, a conventional island, water intake and discharge infrastructures and possibly a cooling tower.

The nuclear island mainly consists of the reactor vessel, the reactor coolant system, the steam generators and the circuits and systems ensuring reactor operation and safety: the chemical and volume control, residual heat removal, safety injection, containment spray, steam generator feedwater, electrical, I&C and reactor protection systems. Various support function systems are also associated with these elements: primary effluent treatment, boron recovery, feedwater, ventilation and air-conditioning, and backup electrical power (diesel generating sets).

The nuclear island also comprises the systems removing steam to the conventional island as well as the building housing the fuel storage pool (BK). This building, which adjoins the reactor building, is used to store new and spent fuel assemblies (one third or one quarter of the fuel is replaced every 12 to 18 months depending on the reactor operating modes). The fuel is kept submerged in cells in the pool. The pool water, to which boric acid is added, on the one hand absorbs the neutrons emitted by the nuclei of the fissile elements to avoid sustaining a nuclear reaction and, on the other, acts as a radiological barrier.

The conventional island equipment includes the turbine, the AC generator and the condenser. Some components of this equipment contribute to reactor safety. The secondary systems belong partly to the nuclear island and partly to the conventional island.

THE PRINCIPLE of a pressurised water reactor



The safety of pressurised water reactors, built around the concept of defence in depth, involves a series of independent barriers, for which the safety analysis must demonstrate the effectiveness in normal operating situations and accident situations. There are generally three of these barriers, consisting of the fuel cladding (see point 1.1.2) for the first barrier, the main primary and secondary systems (see point 1.1.3) for the second barrier and the reactor building containment (see point 1.1.5) for the third barrier.

1.1.2 Core, fuel and fuel management

The reactor's core consists of fuel assemblies in the form of "rods" comprising pellets of uranium oxide or a mixture of uranium and plutonium oxides (known as MOX fuel) contained in closed metal tubes, referred to as the "cladding". As a result of fission, the uranium or plutonium nuclei emit neutrons which, in turn, produce further fissions: this is known as the chain reaction. These nuclear fissions release a large amount of energy in the form of heat. The primary system water enters the core from below at a temperature of about 285°C, heats up as it flows up along the fuel rods and exits through the top at a temperature close to 320°C.

At the beginning of the operating cycle, the core has a considerable energy reserve. This gradually falls during the cycle, as the fissile nuclei disappear. The chain reaction, and hence reactor power, is controlled by:
- inserting control rod cluster assemblies, containing elements that absorb neutrons, to varying depths in the core. These enable the reactor to be started and stopped and its power level to be adjusted to the electrical power to be produced. Dropping the control rod assemblies under the effects of gravity enables the reactor to be shut down in an emergency;
- adjusting the concentration of boron (which absorbs neutrons) in the primary system water during the cycle as the fissile material in the fuel gradually becomes depleted.

At the end of the cycle, the reactor core is unloaded for renewal of part of the fuel.

EDF uses two types of fuels in its pressurised water reactors:

- uranium oxide based fuels (UO_2) with uranium-235 enrichment to a maximum of 4.5%. These fuels are fabricated in several plants in France and abroad, which belong to the fuel manufacturers Areva and Westinghouse;
- fuels consisting of a mixture of depleted uranium oxides and plutonium (MOX). The MOX fuel is produced by the Areva Melox plant. The initial plutonium content is limited to 8.65% (average per fuel assembly) and provides an energy performance equivalent to UO_2 fuel initially enriched to 3.7% with uranium-235. This fuel can be used in the twenty-eight 900 MWe reactors for which the creation authorisation decrees (DAC) provide for the use of MOX fuel.

The way in which the fuel is used in the reactors, known as "fuel management" is specific to each reactor plant series. It is characterised in particular by:

- the nature of the fuel used and its initial fissile content;
- the maximum degree of fuel depletion at removal from the reactor, characterising the quantity of energy extracted per ton of material;
- the duration of a reactor operating cycle;
- the number of new fuel assemblies loaded at each reactor refuelling outage (generally 1/3 or 1/4 of the total number of assemblies);
- the reactor operating mode (at constant power or by varying the power to match demand), which determines the loads to which the fuel is subjected.

1.1.3 Primary system and secondary systems

The primary system and the secondary systems transport the energy given off by the core in the form of heat to a turbogenerator set which produces electricity.

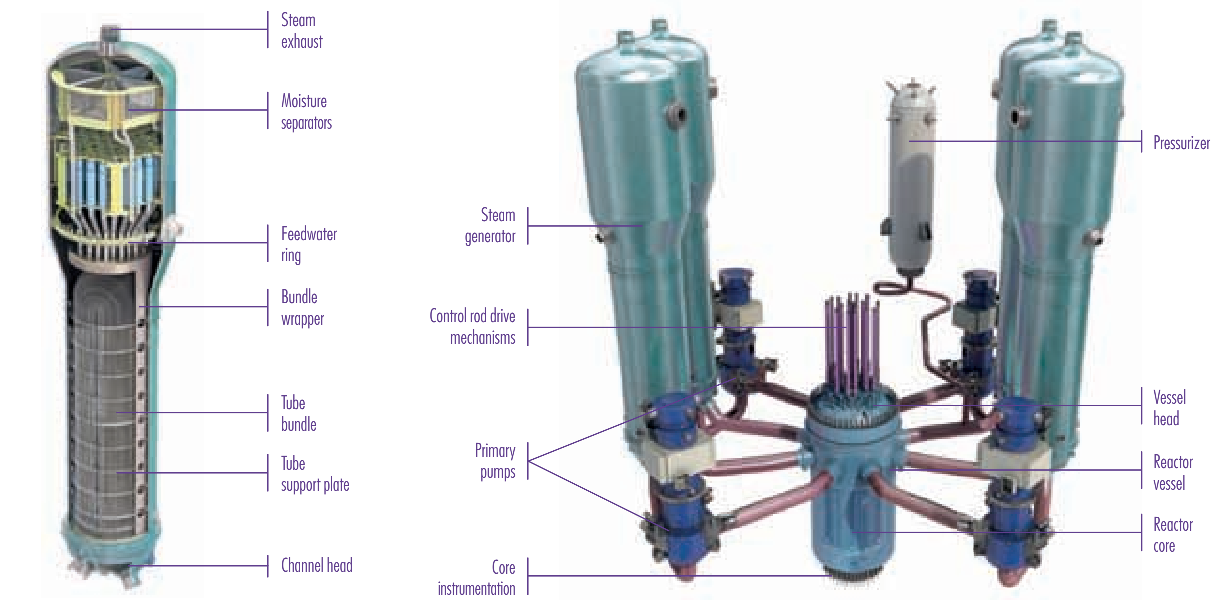
The primary system consists of cooling loops (three loops for a 900 MWe reactor and four for a 1300 MWe, 1450 MWe or 1650 MWe type EPR reactor). The role of the primary system is to extract the heat given off in the core by circulation of pressurised water, referred to as the primary or reactor coolant water. Each loop, connected to the reactor vessel containing the core, comprises a circulating pump (known as the primary or reactor coolant pump) and a Steam Generator (SG). The primary water, heated to more than 300°C, is kept at a pressure of 155 bar by the pressuriser, to prevent it from boiling. The entire primary system is located inside the containment.

The primary system water transfers the heat to the secondary system water via the steam generators. The steam generators are exchangers which contain 3,500 to 5,600 tubes, depending on the model, through which the primary reactor coolant water circulates. These tubes are immersed in the water of the secondary system and boil it, without ever coming into contact with the primary water.

Each secondary system principally consists of a closed loop through which water runs in liquid form in one part and as steam in the other part. The steam produced

A cooling tower in Chinon, July 2013.

A STEAM GENERATOR and a main primary system of a 1300 MWe reactor



in the steam generators is partly expanded in a high-pressure turbine and then passes through moisture separators before final expansion in the low-pressure turbines, from which it is then routed to the condenser. The condensed water is then heated by reheaters and sent back to the steam generators by the condensate extraction pumps and the feedwater pumps.

1.1.4 Cooling systems

The purpose of the cooling systems is to condense the steam coming from the secondary system turbine. They consist of a condenser, a heat exchanger with thousands of tubes through which cold water circulates after being taken from the external source (sea or river) or from an atmospheric cooling system. When the steam comes into contact with the tubes it condenses and can be returned in liquid form to the steam generators (see point 1.1.3). The cooling system water heated in the condenser is then discharged to the natural environment (open circuit) or, when the river flow is too low or heating too great in relation to the sensitivity of the environment, cooled in a cooling tower (closed or semi-closed circuit).

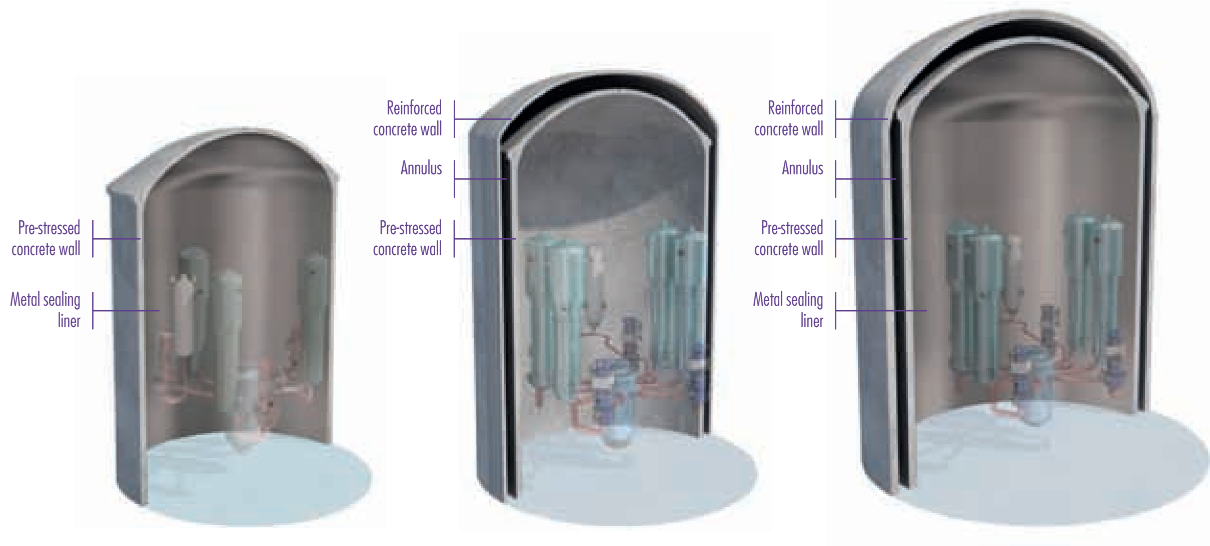
The cooling systems are environments favourable to the development of pathogenic micro-organisms. The use of titanium or stainless steel as the construction material for riverside reactor condensers, in place of brass, requires the utilisation of disinfection systems, primarily by means of biocidal treatment. Cooling towers contribute to the atmospheric dispersal of legionella bacteria, whose proliferation can be prevented by appropriate treatment of the structures (descaling, implementation of biocidal treatment, etc.).

1.1.5 Reactor containment building

The PWR containment building has two functions:
- confine radioactive products likely to be dispersed in the event of an accident. The containments are therefore designed to withstand the pressures and temperatures that could result from the most severe reactor loss of coolant accident and offer sufficient leaktightness in such conditions.
- protect the reactor against external hazards.

Two different containment models have been designed:
- the 900 MWe reactor containments, consisting of a single wall of pre-stressed concrete (concrete containing steel cables tensioned to ensure compression of the structure). This wall offers mechanical resistance to pressure, as well as structural integrity with regard to an external hazard. Leaktightness is provided by a metal liner covering the entire inner face of the concrete wall;
- the 1300 MWe and 1450 MWe reactor containments consist of two walls: an inner wall made of pre-stressed concrete and an outer wall made of reinforced concrete. Leaktightness is provided by the inner wall and the annulus ventilation system (EDE) which collects and filters residual leaks from the inner wall before discharge. Resistance to external hazards is mainly ensured by the outer wall.

REACTOR containments



Reactor containments 900 MWe

Reactor containments 1,300 MWe/ 1,450 MWe

Reactor containments 1,650 MWe

1.1.6 The main auxiliary and safeguard systems

During normal operation as well as during reactor shutdowns or restarts, the auxiliary systems contribute to carrying out safety functions: control of nuclear reactions, removal of heat from the primary system and of residual heat from the fuel, plus containment of radioactive substances. This chiefly involves the Chemical and Volume Control System (RCV) and the Residual Heat Removal System (RRA).

The purpose of the safeguard systems is to control incidents and accidents and mitigate their consequences. This primarily concerns the Safety Injection System (RIS), the reactor building Containment Spray System (EAS) and the Steam Generator Auxiliary Feedwater System (ASG).

1.1.7 Other systems important for safety

The other main systems or circuits important for safety and required for reactor operation are:
- the Component Cooling System (RRI), which cools a number of nuclear equipment items; this system operates in a closed loop between the auxiliary and safeguard systems on the one hand, and the systems carrying water from the river or the sea (heat sink) on the other;
- the Essential Service Water System (SEC), which uses the heat sink to cool the Component Cooling System;
- the Reactor Cavity and Spent Fuel Pool Cooling and Treatment System (PTR), used notably to remove residual heat from fuel elements stored in the fuel building pool;
- the ventilation systems, which confine radioactive materials by depressurising the premises and filtering all discharges;
- the fire-fighting water systems;
- the instrumentation and control system;
- the electrical systems.

2. NUCLEAR SAFETY

2.1 Social, organisational and human factors

ASN's oversight of the organisational and human aspects is in particular based on inspections which concern the measures taken by the licensee to take account of social, organisational and human factors (SOHF) in all phases of the lifecycle of an NPP. The inspections carried out by ASN concern the work done by the operators, but also the working conditions and the means made available to the operators in order to perform the work. In addition, the quality and implementation of the EDF jobs, skills, training and qualifications management system are checked. The same applies to the resources, skills and methodology used for implementation of the SOHF approach by EDF. ASN also monitors the EDF safety management system, which must provide a framework and support for the decisions and actions which either directly or indirectly concern safety issues. Finally, ASN monitors EDF's organisation for analysing events, the depth of the analyses carried out to ensure that the root causes are looked for, as well as the preparation and implementation of the follow-up to these analyses.

In addition to the inspections, ASN oversight is based on the evaluations it requests from IRSN and the Advisory Committee for Nuclear Reactors (GPR). For example, the opinion of the GPR was requested in 2013 concerning the management of safety and radiation protection during reactor outages in 2015 and the satisfactory control of EDF's subcontracting of the maintenance work carried out in the NPPs.

2.2 Management of subcontracted activities

The maintenance of French reactors is to a large extent subcontracted by EDF to outside contractors, with the total workforce representing about 20,000 employees. EDF justifies the use of subcontracting by the need to call on specific or rare expertise, the highly seasonal nature of reactor outages and thus the need to absorb workload peaks.

A system of prior contractor qualification was put into place by EDF. It is based on an assessment of the technical know-how and the organisation of the subcontracting companies. The principles are described in the "Progress and sustainable development charter" signed by EDF and its main contractors. In 2013, the French nuclear sector finalised "social specifications" applicable to the provision of services and work performed at a nuclear facility. EDF has transposed these social specifications into its subcontracting contracts since July 2013.

The nuclear licensee's decision to resort to subcontracting must not compromise the technical skills it must retain in-house, in order to carry out its responsibility for safety and be able to effectively monitor the quality of the work performed by the subcontractors. ASN considers that poorly managed subcontracting is liable to lead to poor quality of work and have a negative impact on the safety of the facility and the radiation protection of those involved (the subcontractors are in fact exposed to a large share of the dose linked to the work done on all the reactors: see point 4.1.4). These consequences can be the result of the use of insufficiently competent personnel, insufficient monitoring of the contractors by the licensee or degraded working conditions.

The Order of 7th February 2012 setting the general rules for BNIs requires that the licensee monitor the activities performed by outside contractors, in order to ensure that the operations they perform comply with the defined requirements and, more generally, that they apply the nuclear safety, radiation protection and environmental protection policy defined by the licensee. The licensee must also ensure the availability of a sufficient number of contractors with the expertise needed to perform the maintenance operations required to ensure the safety of the reactors.

Inspectors from ASN's Lyon division in the Bugey NPP, November 2014.

ASN carries out inspections on the conditions in which subcontracting takes place at EDF. ASN in particular checks EDF's implementation of and compliance with a process to ensure the quality of the activities subcontracted: the choice of contractors, monitoring, integration of experience feedback and adequacy of the resources for the volume of work to be done. ASN also pays close attention to worker protection, notably compliance with health and safety rules and working and rest times, and checks the legality of the service contracts, in particular assessing the independence of the subcontractors carrying out the service from the ordering customer.

2.3 Reactor operation and control

Fuel assembly.

2.3.1 Operation under normal conditions: ensuring compliance with baseline requirements and examining changes to documents and hardware

The general operating rules (RGE) cover the operation of nuclear power reactors. These are drafted by the licensee, constitute the operational implementation of the hypotheses and conclusions of the safety assessments resulting from the safety report and set the limits and conditions for the operation of the facility.

Changing Technical Operating Specifications

Within the RGE , the technical operating specifications (STE) define the normal and degraded mode operating ranges of the reactor, taking account of the acceptable variations in the parameters controlled (pressures, temperatures, neutron flux, chemical and radiochemical parameters, etc.) and the time for which the equipment necessary in the event of an incident and accident is unavailable.

The STE change in order to incorporate operating experience feedback from their application and take into account changes made to the facilities and improve their performance. The licensee can also modify them in order to carry out an operation in conditions that are different from those initially considered.

ASN must be notified of any changes to the STE before they are implemented. Among these, certain temporary changes to the STE with minimal impact on safety are exempted from this notification requirement, provided that they can be dealt with by the internal authorisation system implemented by EDF and regulated by an ASN resolution.

During NPP inspections, ASN verifies that the licensee complies with the STE and, as necessary, the compensatory measures associated with any temporary modifications. It also checks the consistency between the normal operating documents, such as instructions and alarm sheets, the STE and the training of the persons responsible for implementing them.

Examination of modifications made to the equipment

To improve the industrial performance of its production facility, process any deviations detected, implement design changes following periodic safety reviews or operating experience feedback, EDF regularly makes changes to its facilities. ASN is notified of those changes liable to affect nuclear safety or environmental protection before their implementation and they are examined before ASN issues its corresponding position statement.

ASN checks the ways in which the changes it has approved are implemented, more specifically during reactor refuelling and maintenance outages.

2.3.2 Incident or accident operations

Chapter VI of the RGE comprises all the reactor operating rules for an incident or accident situation and prescribes how the reactor is to be controlled in these situations. ASN must be notified of any changes to Chapter VI of the RGE, liable to affect nuclear safety, before they are implemented.

Chapter VI of the RGE changes in order to take account of experience feedback from incidents and accidents and to take account of modifications made to the facilities, in particular those resulting from the periodic safety reviews.

ASN also regularly checks the incident or accident operating rules and how they are implemented. To do this, ASN runs simulations with the facility's shift crews. It thus checks that the operating instructions applied are consistent with the rules of Chapter VI of the RGE, the implementation methods for these documents and the management rules for specific equipment used in accident operating situations.

2.3.3 Operation in a severe accident situation

If the reactor cannot be brought to a stable condition after an incident or accident and if a series of failures leads to core degradation, the reactor is said to be entering a severe accident situation. To deal with this type of unlikely situation, various steps must be taken to enable the operators to safeguard the containment in order to minimise the consequences of the accident (see point 1.3.1 of Chapter 5). The operators then rely on the skills of the emergency response teams set up at both local and national level. These teams use the on-site emergency plan (PUI) plus the severe accident operation guide and the emergency teams action guides in particular.

ASN periodically examines the strategies presented by EDF in these documents, in particular for the reactor periodic safety reviews.

2.4 Fuel

2.4.1 Developments in fuel design and management

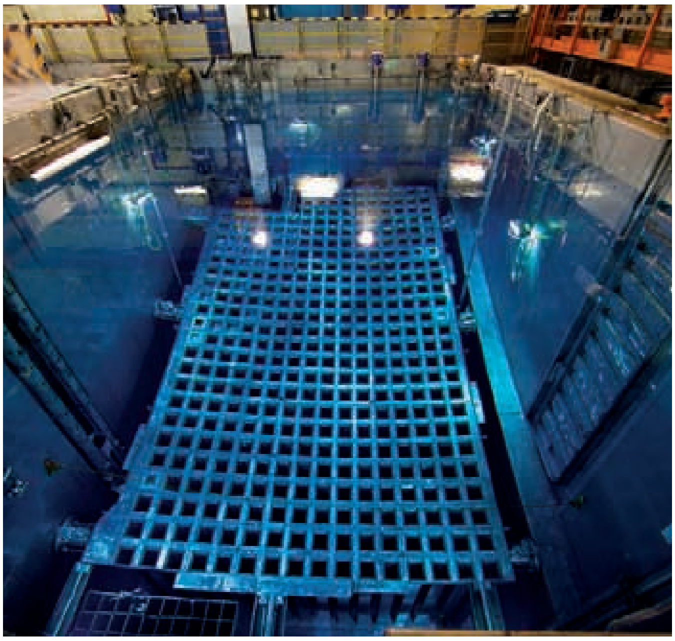
In order to enhance the availability and performance of the reactors in operation, EDF, together with the nuclear fuel manufacturers, researches and develops improvements to fuels and their use in the reactor. The latter is known as "fuel management" and is described in point 1.1.2.

ASN ensures that each change in fuel management is the subject of a specific safety case for the reactors concerned, based on the specific characteristics of the new fuel management. When a change in the fuel or its management model leads to EDF revising an accident study method, this requires prior review and cannot be implemented without ASN approval. When significant changes are made to fuel management, its implementation is dependent on a resolution being issued by the ASN Commission.

2.4.2 Monitoring the condition of fuel in the reactor

Fuel behaviour is an essential element in core safety in normal operation or accident conditions and its reliability is of prime importance. The leaktightness of the fuel rods, of which there are several tens of thousands in each core and which constitute the first containment barrier, are therefore the subject of particular attention. During normal operation, leaktightness is monitored by EDF by means of continuous measurement of the activity of radioelements in the primary system. Any rise in this activity level beyond predetermined thresholds is the sign of a loss in fuel assembly leaktightness. During shutdown, EDF must look for and identify the assemblies containing leaky rods, which must not then be reloaded. If the activity in the primary system becomes too high, the RGE require reactor shutdown before the end of its normal cycle.

ASN ensures that EDF looks for and analyses the causes of the loss of leaktightness observed, in particular by examining the defective rods in order to determine the origin of the failures and prevent them from reoccurring. Preventive and remedial actions may therefore affect the design of rods or assemblies, their manufacture, or the reactor operating conditions. Furthermore, assembly handling conditions, the loading and unloading of the core and measures for the exclusion of foreign material from the systems and pools are also the subject of operating requirements, some of which contribute to the safety case and with which EDF's compliance is verified by ASN. ASN also conducts inspections to ensure that EDF carries out adequate monitoring of its fuel assembly suppliers in order to guarantee



Saint-Laurent-des-Eaux NPP, fuel building, spent fuel pool, December 2013.

that their design and manufacture comply with the rules established. Finally, ASN periodically calls on the Advisory Committee for Nuclear Reactors (GPR) concerning the lessons learned from fuel operating experience feedback.

2.5 Pressure equipment

Owing to the energy that it could release in the event of failure, irrespective of the possibly hazardous nature of the fluid that would then be released, pressure equipment entails risks that must be kept under control. Such equipment (tanks, heat exchangers, pipes, etc.) is not specific to the nuclear industry alone. It is found in many sectors of activity such as the chemical, petrochemical, paper-making and the refrigeration industries. It is therefore subject to regulations set by the Ministry in charge of the prevention of technological risks, which imposes the requirements with a view to guaranteeing the safe manufacture and operation of this equipment.

Nuclear Pressure Equipment (NPE) is pressure equipment specifically designed for installation in nuclear facilities. This for example includes the reactor vessel, steam generators, or primary system piping. This equipment can also play an important role in the safety of nuclear facilities, because it entails a three-fold risk in the event of failure: the risk linked to the energy released, owing to the pressure or temperature of the fluid or gas it contains, the risk of radioactive releases and the risk that its failure could generate an incident or prevent it from being brought under control.

The regulations applying to NPE in particular are included in the order of 12th December 2005 relating to nuclear pressure equipment. This order sets requirements for NPE, in combination with those directly arising from the regulations applicable to conventional pressure equipment (decree 99-1046 of 13th December 1999) and those relating to nuclear safety. These new requirements entered into force on 22nd January 2011. They concern the design, the manufacture and the in-service monitoring of this equipment. Application of these regulations implies the intervention by organisations approved by ASN, to carry out the checks required by the regulations on this equipment, in addition to monitoring of the licensees. These operations include oversight of the placement of this equipment into service, an assessment of the conformity of repaired equipment and its periodic re-qualification.

2.5.1 Monitoring the manufacture of nuclear pressure equipment

ASN assesses the conformity with the regulatory requirements of the NPE items most important for safety, known as "level N1". This conformity assessment concerns the equipment intended for the new nuclear facilities (EPR) and the equipment spares intended for nuclear facilities already in operation (replacement steam generators in particular). For the performance of these duties, ASN can rely on the organisations that it approves. These latter can be tasked by ASN with performing some of the inspections on the level N1 equipment and are responsible for assessing conformity with the regulatory requirements applicable to nuclear pressure equipment that is less important for safety, referred to as "level N2 or N3".

Oversight by ASN and its approved organisations comes into play at different stages of design and manufacture of nuclear pressure equipment. It takes the form of examination of the technical documentation for each item of equipment and of inspections in the manufacturers' facilities as well as those of their suppliers and subcontractors. Five organisations or inspection bodies are currently approved by ASN to assess NPE conformity: Apave SA, Asap, Bureau Veritas, AIB Vinçotte International and the EDF OIU.

In 2014, ASN and the approved organisations carried out:
- 3,490 inspections to check the manufacture of nuclear pressure equipment intended for the Flamanville 3 EPR reactor, representing 5,654 man-days in the manufacturers' plants, as well as those of their suppliers and subcontractors,
- 1,262 inspections to check the manufacture of the spare steam generators intended for the NPP reactors in operation, which represented 3,633 man-days in the manufacturer's plants, as well as those of their suppliers and subcontractors.

Most of these inspections were performed by the approved organisations, under the supervision of ASN.

2.5.2 Monitoring the main primary and secondary systems

The reactor primary and secondary systems (MPS and MSS) operate at high temperature and high pressure and contribute to the containment of the radioactive substances, to cooling and to controlling reactivity.

The monitoring of the operation of these systems is regulated by the order of 10th November 1999 relative to the monitoring of operation of the main primary system and the main secondary systems of nuclear pressurised water reactors mentioned in point 3.6

of Chapter 3. These systems are thus monitored and periodically maintained by EDF. This monitoring is itself checked by ASN.

These systems are subject to periodic re-qualification every ten years, which comprises a complete inspection of the systems involving non-destructive examinations, pressurised hydrotesting and verification of the good condition and good operation of the over-pressure protection accessories.

2.5.3 Monitoring of nickel-based alloy areas

Several parts of pressurised water reactors are made with nickel-based alloy. The use of this type of alloy is justified by its resistance to generalised or pitting corrosion. However, in reactor operating conditions, one of the alloys adopted, Inconel 600, proved to be susceptible to stress corrosion. This particular phenomenon occurs when there are high levels of mechanical stress. It can lead to the appearance of cracks, as observed on the SG tubes in the early 1980s or, more recently in 2011, on a vessel bottom head penetration in the Gravelines reactor 1. These cracks require that the licensee repair the areas concerned or isolate them from the rest of the system to prevent any risk.

At the request of ASN, EDF adopted an overall monitoring and maintenance approach for the areas concerned. Several parts of the main primary system made of Inconel 600 alloy are thus subject to special monitoring. For each one, the in-service monitoring programme, defined and updated annually by the licensee, is submitted to ASN, which checks that it meets the requirements concerning inspection objectives and frequencies.

2.5.4 Monitoring the resistance of reactor vessels

The reactor vessel is one of the essential components of a PWR. For a 900 MWe reactor, it is 14 m high, 4 m in diameter and 20 cm thick. It weighs 300 tonnes. It contains the reactor core and its instrumentation. In normal operation, the vessel is entirely filled with water and withstands a pressure of 155 bar at a temperature of 300°C.

Regular and accurate monitoring of the state of the reactor vessel is essential for the following two reasons:
- vessel replacement is not envisaged, for reasons of technical feasibility and economics;
- rupture of this item is not considered in the safety assessments. This is one of the reasons for which all steps must be taken as of the design stage, in order to guarantee its resistance for the duration of reactor operations, including in the event of an accident.

In normal operation, the vessel's metal slowly becomes brittle, under the effect of the neutrons from the fission reaction in the core. This embrittlement makes the vessel particularly sensitive to pressurised thermal shocks or to sudden pressure surges when cold. This susceptibility is also aggravated when defects are present, which is the case of some of the reactor vessels that have manufacturing defects under their stainless steel liner.

ASN regularly examines the files related to the vessels transmitted by EDF in order to ensure that the in-service behaviour demonstration for the vessels is sufficiently conservative and complies with the regulations.

In 2013, EDF transmitted the file justifying behaviour of the 1300 MWe reactor vessels beyond their third ten-yearly outage inspections. In 2015, ASN will issue an opinion on the continued service of the 1300 MWe reactors for the ten years following their third ten-yearly inspection, after consulting the Advisory Committee for nuclear pressure equipment.

2.5.5 Monitoring steam generator maintenance and replacement

The integrity of the steam generator tube bundle is an important nuclear safety issue. This is because any damage to the tube bundle (corrosion, wear, cracking, etc.) can lead to a primary system leak to the secondary system. Furthermore, a steam generator tube rupture (SGTR) would lead to bypassing of the reactor containment, which is the third containment barrier. The steam generators are the subject of a special in-service monitoring programme, established by EDF, reviewed periodically and examined by ASN. After inspection, tubes that are too badly damaged are plugged to remove them from service.

Mechanical and chemical cleaning of steam generators

Over time, the SGs tend to become clogged with corrosion products from the secondary system exchangers. This takes the form of a build-up of soft or hard sludge on the tubesheet, fouling of the walls of the SG tubes and clogging of the foliate channels of the tube support plates. The corrosion products form a layer of magnetite on the surface of the internals. On the tubes, the layer of deposits (fouling) reduces the heat exchange capacity. In the foliate channels (clogging), the deposits prevent the free circulation of the water-steam mixture, which creates a risk of damage to the SG tubes and internals and can degrade its operation as a whole.

To prevent or mitigate such effects, various solutions are used to minimise metal deposits: chemical or mechanical cleaning (remedial or preventive), material replacement (brass by stainless steel or titanium alloy, which are more corrosion-resistant) in certain secondary exchanger tube bundles and an increase in the pH of the secondary system.

Replacement of steam generators

Since the 1990s, EDF has been conducting a programme to replace those steam generators (SGR programme) with the most heavily degraded tube bundles, with priority being given to those made of Inconel 600 without heat treatment (600 MA). The SGR campaign for the 600 MA tube bundles (26 reactors) of the 900 MWe plant series is coming to an end with the SGR on Le Blayais reactor 3. It continues with the SGR for the heat treated Inconel (600 TT) tube bundles on Cruas 4 for the 900 MWe plant series carried out in 2014 and Paluel 2 scheduled for 2015 on the 1300 MWe plant series. This will be carried out before the third ten-yearly outage for the most heavily cracked SGs and no later than the fourth ten-yearly outage for the others.

On the occasion of these SGR operations, certain elbows of the primary system piping can also be replaced. These operations are needed in order to anticipate the effects of thermal ageing which affect the mechanical properties of this equipment. The Paluel SGR in 2015 will include the replacement of fifteen elbows on the main primary system.

Incorporation of international operating experience

In 2012, a leak from the primary system to the secondary system occurred on an SG in the San Onofre NPP (United States). Premature wear linked to direct contact between tubes led to this leak. ASN ensured that EDF had analysed the phenomena underlying this deterioration and had provided data to prove that the SGs in the French NPPs were not significantly concerned by this mode of deterioration. Particular monitoring has nonetheless been implemented on the tubes potentially concerned.

2.5.6 Monitoring the other reactor pressure equipment

ASN is also responsible for monitoring EDF's implementation of the regulations applicable to non-nuclear pressure equipment utilised in the NPPs. In this respect, ASN in particular carries out audits and surveillance visits on the site inspection departments. These departments, under the responsibility of the licensee, are responsible for carrying out inspections to ensure the safety of pressure equipment.

2.6 Verification of containment conformity

The containments undergo inspections and tests to check their conformity with the safety requirements. Their mechanical performance in particular must guarantee a good degree of reactor building tightness, in the event of its internal pressure exceeding atmospheric pressure, which can happen in certain types of accidents. This is why these tests, at the end of construction and then during the ten-yearly outages, include a pressure build-up in the inner containment, with measurement of the leak rate.

2.7 Protection against natural events, fire and explosions

2.7.1 Prevention of seismic risks

Although the probability of a strong earthquake is low in France, EDF's consideration of this risk is nonetheless closely monitored by ASN. Seismic protection measures are taken into account in the design of the facilities. They are periodically reviewed in line with changing knowledge and changes to the regulations, on the occasion of the periodic safety reviews.

Design rules

Basic safety rule (RFS) 2001-01 of 31st May 2001 defines the methodology for determining the seismic risk to surface BNIs (except for radioactive waste long-term repositories).

This RFS is supplemented by a 2006 ASN guide which defines acceptable calculation methods for a study of the seismic behaviour of buildings and particular structures such as embankments, tunnels and underground pipes, supports or tanks.

Buildings and equipment important for the safety of NPPs are designed to withstand earthquakes of an intensity greater than the most severe earthquakes that have ever occurred in the region of the site.

Seismic design reviews

As part of the periodic safety reviews, the seismic reassessment consists in verifying the adequacy of the seismic design of the facility, taking account of changing knowledge about seismic activity in the region of the site or about the methods for assessing the seismic behaviour of elements of the facility. The lessons learned from international experience feedback concerning earthquakes are also analysed and integrated into this framework.

The studies carried out for the safety review associated with the third ten-yearly outage inspections of the 900 MWe reactors (VD3-900) led to the definition of equipment or structural reinforcements. For the two sites of the first series of 900 MWe nuclear reactors (CP0 – Bugey and Fessenheim), the main modifications concern the structure of the electrical buildings (reinforcement of the wind bracing) and of the nuclear auxiliary buildings (consolidation of posts, etc.). By comparison with the reactors of the CP0 series, the modifications to the reactors of the VPY series (second series of 900 MWe nuclear reactors) are less significant. The main modifications concern the reinforcement of structures and tank anchoring. The integration of the risk of the turbine hall constituting a potential hazard for the electrical building also required a few minor modifications. These modifications are implemented on the occasion of the ten-yearly outages.

Changes in the available knowledge have led EDF to reassess the seismic hazard for the periodic safety review associated with the third ten-yearly outages for the 1300 MWe reactors (VD3-1 300). ASN considers that the seismic hazards determined by EDF are acceptable, with the exception of that of Saint-Alban, which is too low given the current state of knowledge. ASN therefore asked EDF:
- to reassess the seismic spectrum for the Saint-Alban site to take account of uncertainties;
- to define a working programme to verify the strength of the equipment and civil engineering structures and make any necessary seismic reinforcements for the VD3-1 300 periodic safety review.

Extreme earthquakes

Following the Fukushima accident, ASN asked EDF to define and install a “hardened safety core” of material and organisational measures to control the fundamental safety functions in extreme situations which, in the French context, are comparable to those which occurred in Japan on 11th March 2011. This hardened safety core shall notably be designed to withstand an earthquake of an exceptional level, exceeding those adopted in the design or periodic safety review of the installations: see point 3.1.

Flooding of the Fort Calhoun NPP (United States) in June 2011.

2.7.2 Drafting of ooding protection rules

The partial flooding of the Le Blayais NPP in December 1999 led the licensees, under the supervision of ASN, to reassess the safety of the existing BNIs with respect to this risk in more severe conditions than previously and to make a number of safety improvements, with a schedule proportionate to the potential consequences. This work was completed in 2014, in accordance with ASN's prescriptions.

On 11th April 2013, ASN published guide N°13 on BNI protection against external flooding, based on new knowledge to ensure that the external flooding risk is taken into account more exhaustively and more robustly. It is based on the lessons learned from the incident on the Le Blayais NPP, to which it adds the definition of certain hazards and means of protection. For the existing facilities, the guide recommends that the periodic safety review be the particular framework for assessing the protection of these facilities in the light of the new recommendations. As each BNI is to carry out a periodic safety review every ten years, ASN asked EDF in 2014 to take account of the recommendations of the guide for all of its reactors over the coming ten years.

Following the stress tests performed in the wake of the Fukushima Daiichi accident, ASN considered that with regard to protection against flooding, the requirements arising from the complete reassessment performed after the flooding of the Le Blayais NPP in 1999 provided the nuclear power plants with a high level of protection against the risk of external flooding. However, in June 2012, ASN issued several resolutions to ask the licensees:
- to reinforce NPP protection against certain hazards, such as intense rainfall and earthquake-induced flooding;
- to define and implement a "hardened safety core" of material and organisational measures to control the fundamental safety functions in extreme situations and in particular in the case of flooding beyond the design-basis safety requirements (see point 3.1).

2.7.3 Prevention of heat wave and drought risks

During the heat wave in the summer of 2003, some watercourses necessary for NPP cooling saw a reduction in their flow rate as well as significant warming.

Significant temperature rises were also observed in certain NPP premises housing heat-sensitive equipment.

EDF took account of this experience feedback and initiated reassessments of the operation of its facilities in air and water temperature conditions more extreme than those initially included in the design. In parallel with development of these "extreme heat" baseline safety requirements, EDF initiated the deployment of a number of priority modifications (such as the increase in the capacity of certain heat exchangers) and adopted operating practices optimising the cooling capacity of the equipment and improving the resistance of equipment susceptible to high temperatures.

ASN approved the application of these baseline requirements to the 900 MWe reactors in 2012 as well as the performance of the resulting modifications. ASN also asked EDF to take account of the comments it made during this examination process with a view to drafting and implementing baseline requirements applicable to the other plant series.

EDF has also initiated a monitoring programme in order to anticipate climate changes which could compromise the hypotheses adopted in the "extreme heat" baseline safety standards.

2.7.4 Consideration of re risks

In the same way as the other BNIs, nuclear power plants are now subject to a new statutory resolution from ASN on the control of fire risks (see point 3.2.2 of chapter 3).

Controlling the fire risk in nuclear power plants is built around the principle of defence in depth, based on three levels: facility design, prevention and fire-fighting.

The design rules should prevent the spread of any fire and limit its consequences. This is primarily built around:
- "fire zoning", that is the principle of dividing the facility into sectors designed to contain the fire within a given perimeter, each sector being bounded by sectoring elements (fire doors, fire-walls, fire dampers, etc.), offering a specified fire resistance rating;
- protection of redundant equipment performing a fundamental safety function.

Prevention primarily consists in:
- ensuring that the nature and quantity of combustible material present in the premises remains below that of the scenarios used for zoning;
- identifying and analysing the fire risks in order to take steps such as to avoid them. In particular, for all work liable to cause a fire, a "fire permit" must be issued and protective measures must be taken.

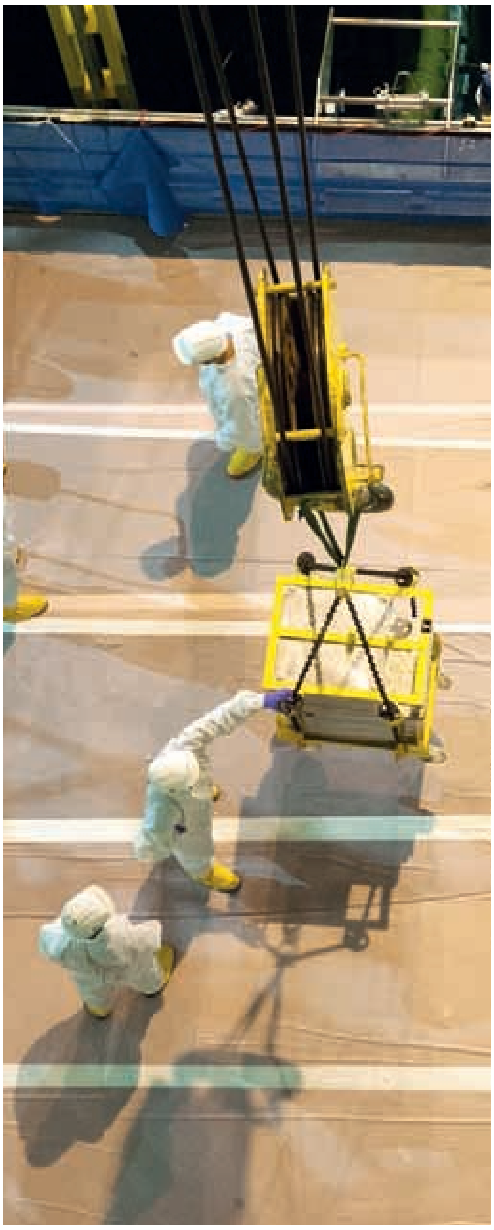
Finally, fire-fighting should enable a fire to be tackled, brought under control and extinguished within a time compatible with the fire resistance rating of the sectoring elements.

ASN checks that the fire risk is taken into account in the NPPs, notably through an analysis of the licensee's baseline safety requirements, monitoring of significant events notified by the licensee and inspections performed on the sites.

2.7.5 Consideration of explosion risks

An explosion can damage elements that are essential for maintaining safety or may lead to failure of the containment with the release of radioactive materials into the facility, or even into the environment. Steps must therefore be taken by the licensees to protect the sensitive parts of the facility against explosions.

ASN checks these prevention and monitoring measures, paying particular attention to ensuring that the explosion risk is included in EDF's baseline safety requirements and organisation. ASN also ensures compliance with the "Explosive ATmospheres" (ATEX) regulations with respect to worker protection.



Civaux NPP, the reactor building during the unit outage, August 2014.

2.8 ASN oversight of reactor outages

Reactors need to be shut down periodically in order to renew the fuel, which becomes gradually depleted during the operating cycle. At each outage, one third or one quarter of the fuel is renewed.

These outages mean that it is possible to access parts of the installation which would not normally be accessible during operation. The outages are therefore an opportunity to verify the condition of the NPP by running checks and performing maintenance work, as well as to implement the modifications scheduled for the NPP.

These refuelling outages can be of several types:
- simple refuelling outage (ASR) and partial inspection (VP) outage: these outages last a few weeks and are devoted to renewing part of the fuel and conducting a programme of verification and maintenance that is more extensive during a partial inspection than during a simple refuelling outage;
- ten-yearly outage (VD): this outage entails a wide-ranging verification and maintenance programme. This type of outage, which lasts several months and occurs every 10 years, is also an opportunity for the licensee to carry out major operations such as a complete inspection and hydrotest on the primary system, a reactor building containment test or incorporation of design changes decided as part of the periodic safety reviews (see point 2.11.4).

These outages are scheduled and prepared for by the licensee several months in advance. ASN checks the steps taken to guarantee safety and radiation protection during the outage, and the safety of operation during the coming cycle(s).

The checks carried out by ASN mainly concern the following aspects:
- during the outage preparation phase, the conformity of the reactor outage programme with the applicable baseline requirements. As necessary, ASN asks for additions to this programme;
- during the outage – through regular briefings and inspections – the implementation of the programme and the handling of any unforeseen circumstances;
- at the end of outage, when the licensee presents its reactor outage report, the condition of the reactor and its readiness for restart. After this inspection, ASN will either approve reactor restart or not;
- after the reactor restarts, the results of all tests carried out during the outage and during the restart phase.

2.9 Maintenance and testing

2.9.1 Regulation of maintenance practices

ASN considers that preventive maintenance is an essential line of defence in maintaining the conformity of a facility with its baseline safety requirements.

In order to improve the reliability of the equipment contributing to safety but also its industrial performance, EDF regularly seeks to optimise its maintenance activities in the light of best practices used in the industry and by NPP licensees in other countries.

In 2010, EDF thus informed ASN of its intention to deploy a new maintenance methodology developed by the American licensees, called AP-913. This maintenance method is primarily based on:
- classification of the equipment according to its importance for safety or the availability of the installation;
- in-service monitoring of the equipment;
- the production of equipment and system health reports;
- adjustment of the content and frequency of the maintenance tasks on the basis of these health reports and operating experience.

The maintenance programmes resulting from the application of this new methodology lead to a significant rise in the number of maintenance tasks and in workload, as well as greater use of in-service equipment monitoring.

The various steps in the AP-913 process and the organisational conditions of its deployment in the NPPs are examined and monitored by ASN with the technical support of IRSN.

2.9.2 Examining the periodic test programmes and monitoring their implementation

The elements important for protection, identified by the licensee, undergo qualification in order to guarantee their ability to perform the functions assigned to them, in terms of loadings and the ambient conditions associated with the situations in which they are required. The periodic tests help maintain this qualification and the associated rules constitute Chapter IX of the general operating rules (RGE). These rules set the nature of the technical inspections, their frequency and the corresponding criteria which allow periodic verification of compliance with the qualification requirements.

ASN ensures that the periodic technical checks on the elements important for protection are relevant and are continuously improved. It also checks that they are performed in accordance with the general operating rules.

2.9.3 The use of ef cient control methods

Article 8 of the order of 10th November 1999 concerning monitoring of the operation of the main primary system and the main secondary systems of pressurised water reactors specifies that the non-destructive testing processes used for in-service monitoring of the pressure equipment of the main primary and secondary systems of nuclear reactors must, before they are used for the first time, be qualified by an entity comprising experts from inside and outside EDF, whose competence and independence are verified by the French accreditation committee (COFRAC).

Qualification is a means of guaranteeing that the examination method actually achieves the level of performance specified in a precise set of specifications.

To date, 90 applications have been qualified by the in-service inspection programmes. Further applications are currently being developed and qualified in order to address new requirements, in particular concerning the Flamanville 3 EPR reactor, for which 39 processes will be implemented during the pre-service inspection.

Owing to the radiological risks linked to gamma radiography, ultrasound applications are preferred to radiography applications, provided that they can offer equivalent inspection performance.

2.10 Maintaining and continuously improving nuclear safety

2.10.1 Correction of deviations

The checks carried out at the initiative of EDF and the additional verifications requested by ASN can lead to the detection of deviations from the defined requirements, which must then be processed. These deviations can have a variety of origins: design problems, construction defects, insufficient control of maintenance work, degradation as a result of ageing, etc.

The measures for detecting and correcting deviations, as prescribed by the order of 7th February 2012 setting out the general rules for BNIs, play an important role in maintaining the level of safety of the facilities.

"Real time" verification

The performance of periodic tests and preventive maintenance programmes on the equipment and systems helps identify deviations. Routine field inspections are also an effective means of discovering faults.

Ten-yearly verifications: conformity checks

EDF carries out periodic safety reviews on the nuclear reactors every ten years (see point 2.11.4). EDF thus compares the actual condition of the NPPs with their applicable safety requirements and identifies any deviations. These verifications can be supplemented by a programme of additional investigations designed to check the parts of the facility which are not covered by a preventive maintenance programme.

Informing ASN and the public

When a deviation is detected, and in the same way as any BNI licensee, EDF is required to assess the impacts on nuclear safety, radiation protection or protection of the environment. If necessary, EDF sends ASN a significant event notification. As of level 1 on the INES scale, the public is informed of the events thus notified by the licensees on *www.asn.fr*.

On 15th July 2014 ASN issued a resolution which supplements ASN's requirements for information after an NPP reactor outage period: the licensee must therefore enclose a summary of the deviations and of the progress made in handling them, in support of its application for authorisation to restart the reactor.

ASN's remediation requirements

ASN requires that deviations with an impact on safety be corrected as soon as possible and within a time-frame proportionate to the potential implications. This is why, for the most significant deviations, ASN reviews the remediation procedures and deadlines proposed by EDF. To carry out this review, ASN takes into consideration the actual and potential safety consequences of the deviations. ASN cannot authorise restart of the reactor or decide to shut down the NPP until the repair has been completed.

This is the case if the risk involved in continuing operation while the deviation is present is considered to be unacceptable and if there is no appropriate remedial measure. Conversely, the time to correct a less serious deviation can be increased when the particular constraints so warrant and if the safety impact is acceptable. These constraints may be the result of the time needed to prepare for remediation in conditions of complete safety.

2.10.2 Examination of events and operating experience feedback

Operating experience is a source of continuous improvement in terms of nuclear safety, radiation protection and protection of the environment. ASN requires that EDF notify it of the significant events occurring in its NPPs, in accordance with predetermined notification criteria (see point 3.4.2 of Chapter 4). Each significant event is therefore rated by ASN on the International Nuclear Events Scale (INES), which comprises eight levels from 0 to 7.

ASN checks how EDF organises and analyses operating experience feedback from significant events and events that have occurred in other countries. At the local and national levels, it examines all significant events notified (a summary of their analysis for 2014 is given in 4.1.6). The significant events considered to be noteworthy owing to their recurrent or generic nature undergo detailed analysis with the support of IRSN. During inspections in the NPPs, ASN also reviews the organisation of the sites and the steps taken to deal with significant events and take account of operating experience. Finally, at the request of ASN, the Advisory Committee for reactors periodically reviews feedback from PWR operation (see box page 408).

2.11 NPP operating life extension

Although the regulations governing the operation of the NPPs in France set no time limit for their operating authorisation, Article L.593-18 of the Environment Code states that the licensee must review the safety of each reactor every ten years.

2.11.1 The age of NPPs

The NPPs currently in operation in France were built over a relatively short period of time: forty-five reactors, representing 50,000 MWe, or three quarters of the power output by the French fleet, were commissioned between 1980 and 1990 and seven reactors, representing a further 10,000 MWe, between 1991 and 2000. In December 2014, the average age of the reactors, calculated from the date of initial reactor criticality, was as follows:
- 33 years for the thirty-four 900 MWe reactors;
- 27 years for the twenty 1300 MWe reactors;
- 17 years for the four 1450 MWe reactors.

AGE PYRAMID of the French nuclear power generating reactors (NPP fleet in France as at end of 2014; by date of 1st criticality; power per reactor)

Date of 1st criticality									Global power
1977	Fessenheim 1	Fessenheim 2							1,800 MWe
1978	Bugey 2	Bugey 3							1,800 MWe
1979	Bugey 4	Bugey 5							1,800 MWe
1980	Tricastin 1	Gravelines 1	Tricastin 2	Tricastin 3	Gravelines 2	Dampierre 1	Gravelines 3	St-Laurent B1	7,200 MWe
1981	Dampierre 2	St-Laurent B2	Blayais 1	Dampierre 3	Tricastin 4	Gravelines 4	Dampierre 4		6,300 MWe
1982	Blayais 2	Chinon B1							1,800 MWe
1983	Cruas 1	Blayais 4	Blayais 3	Chinon B2					3,600 MWe
1984	Cruas 3	Paluel 1	Cruas 2	Paluel 2	Gravelines 5	Cruas 4			6,200 MWe
1985	St-Alban 1	Paluel 3	Gravelines 6	Flamanville 1					4,800 MWe
1986	Paluel 4	St-Alban 2	Flamanville 2	Chinon B3	Cattenom 1				6,100 MWe
1987	Cattenom 2	Nogent 1	Belleville 1	Chinon B4					4,800 MWe
1988	Belleville 2	Nogent 2							2,600 MWe
1990	Cattenom 3	Penly 1	Golfech 1						3,900 MWe
1991	Cattenom 4								1,300 MWe
1992	Penly 2								1,300 MWe
1993	Glofech 2								1,300 MWe
1996	Chooz B1								1,450 MWe
1997	Chooz B2	Civaux 1							2,900 MWe
1999	Civaux 2								1,450 MWe

● 900 MWe ● 1,300 MWe ● 1,450 MWe

Source: ASN-3rd December 2013

2.11.2 Main factors in ageing

Like all industrial installations, NPPs are subject to ageing. ASN ensures that, in line with its general operating and maintenance strategy, EDF takes account of ageing-related phenomena in order to maintain a satisfactory level of safety throughout the operating life of the facilities.

To fully understand the ageing of an NPP, other factors must be looked at rather than simply the time that has elapsed since it was commissioned.

Deterioration of replaceable items

Equipment ageing is the result of phenomena such as the wearing of mechanical parts, the hardening of polymers, the corrosion of metals, and so on. This type of deterioration must be taken into account as of the design and construction stage, as well as through a programme of monitoring and preventive maintenance, with repair or replacement as necessary.

Equipment or component obsolescence

Before it is installed in the NPPs, some equipment undergoes a "qualification" process designed to ensure that it is able to perform its functions in the stress and atmosphere conditions corresponding to the accident situations in which it would be required. The availability of spares for this equipment is heavily dependent on the development of the industrial network of suppliers and the cessation of manufacture of certain components or the closure of the manufacturing company which can lead to supply difficulties. Before installing spares that are different from the original parts, EDF must check that these new parts do not compromise the required "qualification" of the equipment on which they are to be installed. Given the duration of this procedure, the licensee must anticipate replacement well in advance.

The lifetime of non-replaceable items

Non-replaceable items such as the reactor vessel (see point 2.5.4) and the containment (see point 2.6) are the subject of close monitoring to ensure that their ageing is as anticipated.

2.11.3 How EDF manages equipment ageing

The approach adopted by EDF to control the ageing of its facilities is based on three key points:

- anticipation of ageing in the design: during the design and manufacture of components, the choice of materials and the installation arrangements are tailored to the intended operating conditions and take account of the kinetics of known or presumed deterioration processes.
- monitor the actual condition of the facility: during operation, degradation phenomena other than those considered in the design can be discovered. The periodic monitoring and preventive maintenance programmes, the additional investigation programmes as well as examination of operating experience (see points 2.9.1, 2.10.1 and 2.10.2) are all designed to detect these phenomena.
- repair, modify or replace equipment: given the operating constraints liable to be generated by such operations, especially when they can only be performed during reactor outages, the licensee must seek to anticipate them, in particular to take account of the time needed to procure new components, the time required to prepare for and carry out the work, the risk of obsolescence of certain components and the loss of technical skills on the part of the workforce.

As of their third ten-yearly inspection, a detailed analysis of the condition of the reactors and the effective control of their ageing is thus carried out by EDF.

Given EDF's envisaged goal of continued reactor operations beyond forty years, the satisfactory control of ageing and the management of equipment obsolescence constitute key safety issues (see point 2.11.4).

2.11.4 The periodic safety review

In accordance with the provisions of Article L. 593-18 of the Environment Code, EDF must carry out a periodic safety review of its reactors every ten years, comprising the following two parts:

- a check on the condition and conformity of the facility: this step is based on a large number of inspections and tests in addition to those performed in real-time. These verifications can concern checks on the initial design studies as well as field inspections of equipment not addressed by maintenance programmes, or tests conducted every ten years such as the containment pressure tests. Any deviations detected during these investigations are then restored to conformity within a time-frame commensurate with their potential consequences;
- the safety reassessment: this step aims to assess the safety of the facility in the light of the experience acquired during operation, changing knowledge, the requirements applicable to the more recent facilities and international best practices. Following these reassessments, EDF identifies the modifications it intends to make to its facilities in order to reinforce their safety.

The review process for the EDF reactors

In order to benefit from the standardisation of its reactors, these two parts of the review are first of all the subject of a generic design programme for a given plant series (900 MWe, 1300 MWe and 1450 MWe reactors). The results of this programme are then implemented on each of the reactors of the plant series on the occasion of its ten-yearly outage inspection.

Following the ten-yearly outage inspection, the licensee sends ASN a report containing the conclusions of the periodic safety review. In this report, the licensee states its position on the regulatory conformity of

Effect of ageing: piping oxidisation.

its facility as well as on the modifications made to remedy deviations observed or to improve the safety of the facility. The review report contains information provided for in Article 24 of Decree 2007-1557 of 2nd November 2007.

ASN analysis

The orientation of the generic conformity verification programmes and the safety reassessment is the subject of a position statement by ASN following consultation of the Advisory Committee for reactors (GPR). On this basis, EDF carries out safety reassessments and defines modifications on which ASN gives its position after consulting the GPR.

ASN then informs the Minister responsible for Nuclear Safety of its analysis of the review conclusions report for each reactor, mentioned in Article L. 593-19 of the Environment Code and can issue new prescriptions regarding its continued operation.

2.12 The Flamanville 3 EPR reactor

The EPR reactor is a pressurised water reactor based on a design "evolution" in relation to the reactors currently in service in France, enabling it to comply with reinforced safety objectives.

After a period of about ten years during which no nuclear reactors were built in France, EDF submitted an application in May 2006 to the Ministers responsible for nuclear safety and radiation protection for the creation of a 1650 MWe EPR type reactor, called Flamanville 3, on the Flamanville site, which already houses two 1300 MWe reactors.

The Government authorised its creation by Decree 2007-534 of 10th April 2007, following ASN's favourable opinion, subsequent to the inquiry conducted with the assistance of its technical support organisations.

After issue of this Creation Authorisation Decree and the building permit, construction of the Flamanville 3 reactor began in September 2007. The first pouring of concrete for the buildings in the nuclear island began in December 2007. Since then, the civil engineering (structural) work has continued and is now almost completed. In 2014, EDF completed the construction work on the inner containment and began pre-stressing it. Installation of components (tanks, piping, pumps, cables and electrical and I&C cubicles, etc.) is continuing. In 2014, the first large components (vessel, steam generators, etc.) making up the main primary system were installed.

In parallel with the construction work on the Flamanville site, manufacture of the systems, components and pressure equipment, in particular that of the primary system (vessel, pressuriser, pumps, valves, pipes, etc.) and secondary system (valves, pipes, etc.) is now almost complete. ASN is still waiting for the manufacturers to provide it with important justifications concerning the quality of manufacture of the pressure equipment, more specifically with regard to the vessel head.

According to EDF, commissioning of Flamanville 3 is scheduled for 2017.

Installation of the first steam generator on the Flamanville EPR site, September 2014.

2.12.1 The stages up to commissioning of the Flamanville 3 reactor

Pursuant to Decree 2007-1557 of 2nd November 2007 (see point 3.1.3 of Chapter 3), ASN authorisation is required to bring nuclear fuel inside the perimeter of the NPP and to start up the NPP. In compliance with Article 20 of this same decree, the licensee must send ASN a file comprising the safety analysis report, the general operating rules, a study on facility waste management, the on-site emergency plan, the decommissioning plan and an update of the facility's impact assessment, one year prior to the planned date of commissioning and six months before fuel is brought onto the site. EDF intends to submit the Flamanville 3 commissioning authorisation application in the spring of 2015.

Without waiting for transmission of the complete commissioning authorisation application file, ASN and IRSN are jointly examining the elements transmitted by EDF concerning:
- the technical references necessary for the safety case and for finalising the detailed reactor design;
- the detailed design of some systems that are important for safety presented in the safety report;
- certain essential elements of the commissioning application file.

In parallel with this technical examination, ASN also checks the construction of the facility and assesses the conformity of the nuclear pressure equipment that is most important for safety with the requirements set by the regulations.

2.12.2 Construction oversight

For ASN there are numerous construction oversight issues relating to the Flamanville 3 reactor. They concern:
- checking the quality of installation construction in a manner commensurate with the safety, radiation protection and environmental protection issues, in order to be able to rule on the ability of the installation to meet the defined requirements;
- building on the experience acquired by each party concerned during the construction of this new reactor.

To do this, ASN issued prescriptions for the design, construction and commissioning tests of Flamanville 3 and for the operation of the two Flamanville 1 and 2 reactors located close to the construction site. The principles and procedures for oversight of the EPR reactor construction cover the following steps:
- the detailed design, which defines the data necessary for construction;
- the construction activities, which include site preparation after issue of the authorisation decree, manufacture, construction, qualification, erection and testing of structures, systems and components, either on the site or on the manufacturers' premises.

This oversight includes EDF's preparation for reactor operations following commissioning, management of the risks to neighbouring BNIs (Flamanville reactors 1 and 2) created by the construction activities, radiation protection and protection of the environment. As the subject is a nuclear power reactor, ASN is also responsible for labour inspectorate duties on the construction site. In addition, ASN oversees the manufacture of pressure equipment that will form part of the primary and secondary systems and of the nuclear steam supply system. ASN's main actions in this field in 2014 are described in point 3.3.

2.12.3 Cooperation with foreign nuclear regulators

To be able to share its experience with other nuclear regulators, ASN multiplies technical exchanges with its foreign counterparts on the topic of regulating the design, construction and operation of new reactors.

Bilateral relations

ASN enjoys close relations with foreign nuclear regulators in order to share previous and current experience of authorisation procedures and regulation of the construction of new reactors. These relations started in 2004 with the Finnish nuclear safety regulator (STUK) with a view to the construction of EPR type reactors on the sites at Olkiluoto (Finland) and Flamanville (France). Since then, STUK and ASN have worked closely together. In 2014, a technical progress meeting concerning the two projects was held in Finland and a visit to the Olkiluoto 3 construction site was organised.

In 2014 ASN and the Chinese nuclear safety regulator (NNSA) shared their operating experience about the vessels and control rod drive mechanisms in the EPR reactors of Flamanville and Taishan. These components are all manufactured in France.

Multinational cooperation

Some international bodies such as NEA and WENRA also provide opportunities for exchanges on practices and lessons learned from overseeing reactor construction.

ASN is a member of the Multinational Design Evaluation Programme (MDEP) which evaluates the design of new reactors (see point 3.3 of Chapter 7). In this context, ASN took part in 2014 in the activities of the working group devoted to the detailed design of the EPR. With the support of IRSN, ASN more specifically took part in the work dealing with severe accidents, I&C, probabilistic safety assessments and the modelling of accidents and transients. The group also held two plenary sessions.

ASN also takes part in the Working group on regulation of new reactors, which is a technical group of the Nuclear Energy Agency's (NEA) Committee on Nuclear Regulatory Activities (CNRA), see point 3.2 of Chapter 7. The corresponding work in particular led to the creation of a database of anomalies and deviations observed in recent construction projects., ASN contributes to this database based on the deviations observed on Flamanville 3.

For ASN, these international exchanges are one of the driving forces behind the harmonisation of safety requirements and regulatory practices.

2.13 Labour Law in the nuclear power plants

ASN carries out labour inspectorate duties in the nineteen nuclear power plants in operation, the eight reactors undergoing decommissioning and the EPR under construction at Flamanville. The number of people working in an NPP varies between 800 and 2,000 EDF and permanent service provider employees, supplemented by a large number of contractors and subcontractors involved in maintenance during reactor outage periods.

These workers are exposed on the one hand to risks resulting from ionising radiation (see point 3.2) and on the other to the conventional risks involved in any industrial facility, such as those relating to electrical installations, to pressure equipment, to chemical products, to hydrogen (explosion risk) and nitrogen (asphyxia risk) systems, to work at height, or to the handling of heavy loads.

The health, safety, working conditions and quality of employment of the employees of EDF, its contractors or subcontractors, along with the safety of the facilities, now benefit from regulation by ASN.

Since 2009, the links between the labour inspection steps taken and the other NPP regulation activities have been consolidated in order to achieve the integrated view of regulation sought by ASN. This is in particular the case for radiation protection, subcontracting, or for Social, Organisational and Human Factors (SOHF).

As at 31st December 2014, the ASN resources for its labour inspectorate duties are:
- twelve labour inspectors, including two working on a full-time basis, assigned to the regional divisions, working directly with the sites;
- a central labour director, responsible for managing and coordinating the network of labour inspectors and acting as the interface with the Ministry responsible for labour. The agreement with the General Directorate for Labour of the Ministry responsible for labour, renewed on 15th January 2015, is implemented in the regions by agreements between the ASN divisions and the Regional Directorates for Enterprises, Competition, Consumption, Labour and Employment (DIRECCTE).

2.14 Personnel radiation protection

Exposure to ionising radiation in a nuclear power reactor comes from activation of corrosion products and from fuel fission products. All types of radiation are present (neutrons, α, ß and γ) and the risk of exposure is both external and internal. In practice, more than 90% of the doses come from external exposure to ß and γ radiation. Exposure is primarily linked to maintenance operations during reactor outages.

ASN checks compliance with the regulations relative to protection of workers liable to be exposed to ionising radiation. In this respect, ASN concerns itself with all workers active on the sites, whether EDF or contractor personnel.

This oversight is carried out on the one hand during inspections (specifically on the topic of radiation protection, one to two times per year and per site, during reactor outages, following incidents, as well as in the EDF head office departments and engineering centres), and on the other on the occasion of the review of files concerning occupational radiation protection (significant events, design, maintenance or modification files, EDF documents implementing the regulations, etc.) with the possible support of IRSN's technical expertise.

Finally, meetings are held periodically between ASN, IRSN and EDF in order to monitor the progress of the technical or organisational projects being studied or actually deployed, to compare ASN's analysis with that of the licensee, more specifically through annual reviews, and to identify possible areas for improvement.

2.15 The environmental and health impacts of NPPs

2.15.1 Revision of the prescriptions concerning water intake and discharges

The Environment Code empowers ASN to define prescriptions concerning BNI water intake and discharges (see point 3.3.1 of Chapter 4).

On the occasion of the renewals or modifications of these prescriptions, ASN sets the limit values for emissions, water intake and discharge of effluents on the basis of the best available technologies in technically and economically acceptable conditions, taking into consideration the characteristics of the installation, its location and the local environmental conditions.

TO BE NOTED

Radiological impact of discharges

The calculated radiological impact of the maximum discharges given in the EDF files on the most heavily exposed population group, still remains well below the allowable public dosimetric limit (1 mSv/year).

The annual effective dose delivered to the population reference group (group subject to maximum radiological impact) is thus estimated to be a few microsieverts to several tens of microsieverts per year, depending on the particular site. This exposure represents less than 0.1% of the total average dose to which the French population is exposed (see Chapter 1).

ASN also sets the rules applicable to the management and monitoring of effluent discharges, water intake, environmental monitoring and information of the public and the authorities (see point 3.3 of Chapter 4).

In order to set these rules, ASN bases its work on operating experience from all the reactors, while taking account of operational changes (change in conditioning of systems, anti-scaling treatment, biocidal treatments, etc.) and the higher-level regulations.

2.15.2 Oversight of waste management

Management of the radioactive waste produced by NPPs is covered by the general framework for management of waste from all BNIs, presented in Chapter 16. For all waste, whether or not radioactive, ASN examines the licensee's waste study as required by the regulations and as described in Chapter 3 (see point 3.5.1), in particular comprising a summary of the waste produced, the quantities involved and the management methods, the "waste zoning" and the status of the existing disposal solutions.

Each site sends ASN annual details of the waste it generates, indicating the disposal routes, a comparison with previous years, a report on any discrepancies observed and on the organisation of the site, as well as any notable occurrences and future prospects. In compliance with the regulations, EDF carries out waste sorting at source, in particular differentiating between waste from nuclear zones and other waste. The licensee and ASN hold regular meetings to discuss waste-related matters and waste management, notably through annual reports.

These elements, as well as the inspections during which the inspectors review the site's waste management organisation, constitute the basis of ASN's monitoring of the management of waste produced by EDF's NPPs and compliance with the regulations.

Handling of concrete hulls in the effluent treatment building in the Saint-Alban/Saint-Maurice NPP, November 2013.

2.15.3 Increased protection against other risks and nuisances

Some cooling systems in NPPs are environments that are favourable to the development of legionella and other amoebas (see point 1.1.4). ASN therefore sets maximum legionella concentration levels for cooling systems equipped with cooling towers and for *Naegleria fowleri* amoeba concentration levels downstream of the environmental discharge, along with facility monitoring requirements.

Through file reviews and its field checks, ASN closely monitors the progress of the preventive or remedial measures taken by EDF to reduce the risk of the proliferation of these micro-organisms and the results of these actions, in particular the chemical discharges resulting from biocidal treatment.

A draft resolution concerning the prevention of microbiological risks linked to the cooling installations of nuclear power reactor secondary systems is currently under preparation, in order to make changes to these regulations that are consistent with those of installations classified on environmental protection grounds (ICPE).

Finally, the steps taken by EDF to enable chillers to operate with coolants with a lower overall heating potential are well advanced. Chiller management does not however make it possible to eliminate the unwanted discharge of these fluids into the atmosphere.

3. NUCLEAR SAFETY AND RADIATION PROTECTION NEWS

3.1 Experience feedback from the Fukushima Daiichi accident

After the Fukushima Daiichi accident, ASN issued a set of resolutions dated 5th May 2011 asking the operators of major nuclear facilities to perform stress tests in the light of this accident.

These were carried out on the basis of specifications which were consistent with the ENSREG (European Nuclear Safety Regulators Group) (see point 2.3 of Chapter 7) specifications developed for the European stress tests.

The results of these stress tests were presented to the Advisory Committees for Reactors and for Laboratories and Plants which met on 8th, 9th and 10th November 2011, and ASN issued a position statement on them on 3rd January 2012. This position was itself examined within the framework of the European stress tests, which were completed in April 2012.

On the basis of the options of the Advisory Committee and the conclusions of the European stress tests, ASN issued a series of resolutions dated 26th June 2012 requiring EDF to implement:
- a hardened safety core of material and organisational provisions aiming at:
  - preventing an accident with fuel melt, or limit its progression,
  - limiting large-scale radioactive releases,
  - enabling the licensee to carry out its emergency management duties;
- a local emergency centre allowing emergency management of the nuclear site as a whole in the event of an extreme external hazard;
- a nuclear rapid intervention force (FARN) which, using mobile means external to the site, can intervene on a nuclear site in a pre-accident or accident situation,
- a range of corrective measures or improvements, notably the acquisition of additional communication and radiological protection means, the implementation of additional instrumentation, extensive consideration of internal and external hazard risks, improvement of the way in which emergency situations are taken into account.

EDF has met all the regulatory deadlines and its commitments.

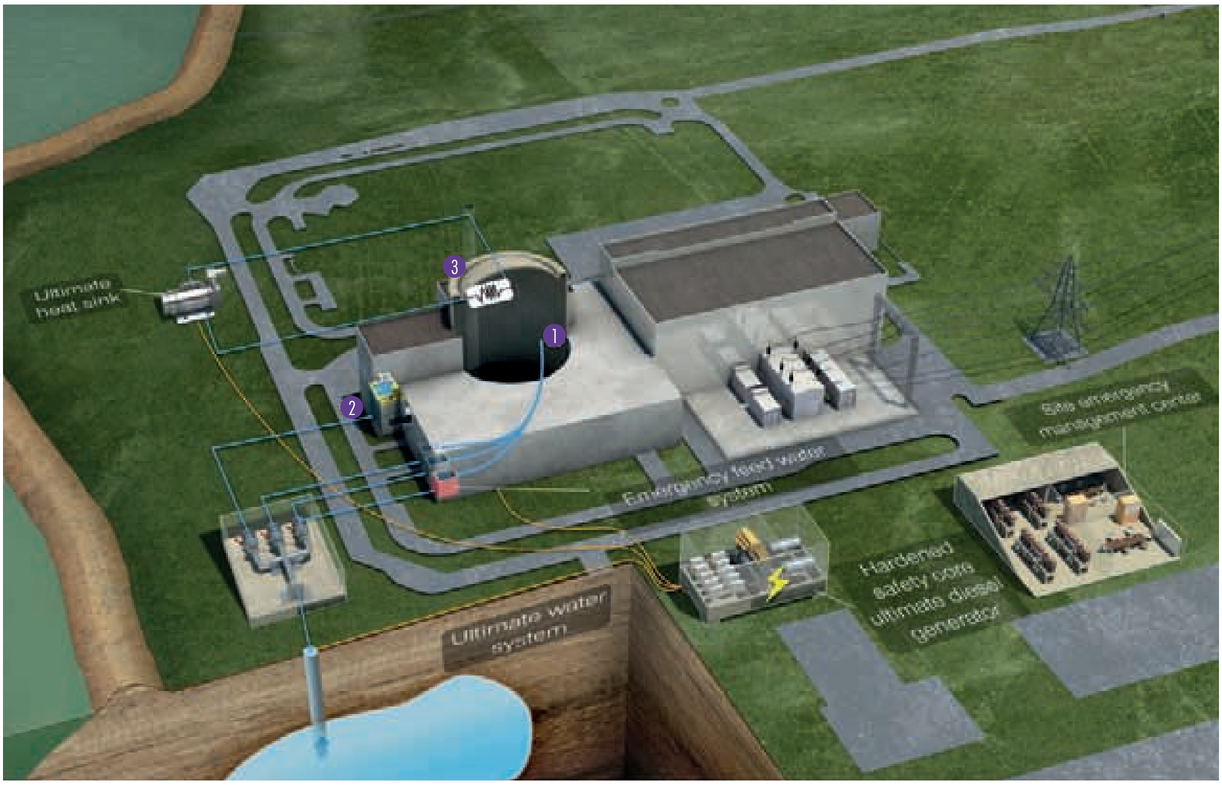
Nevertheless, ASN has supplemented its demands with a set of resolutions dated 21st January 2014 aiming to clarify certain design provisions of the hardened safety core.

ASN's demands are part of a continuous process to improve safety with regard to the targets set for the third-generation reactors and aim to be able to cope with situations far beyond those normally considered for this type of facility.

These demands are issued in application of the defence-in-depth approach and as such concern measures to prevent and mitigate the consequences of an accident, based on both additional fixed means and external mobile means planned for all the facilities on a site, beyond their initial design basis.

Given the nature of the required work, the licensee must carry out studies for the design, construction and installation of new equipment, which first of all require time and then require a schedule to optimise their implementation on each NPP. Insofar as this major work is carried out on nuclear sites which are in service, it is also necessary to ensure that the safety of the power plants is not degraded during the work phases.

THE PRINCIPLE of the hardened safety core



❶ reactor cooling
❷ pool cooling
❸ reactor building cooling

3.2 NPP operating life extension

The licensee of a nuclear facility must conduct a periodic safety review of its facility every ten years (see point 2.11.4).

The reactors of the 900 MWe plant series

The periodic safety review associated with the third ten-yearly outage inspections

In July 2009, ASN issued a position statement on the generic aspects of an operating lifetime extension for the 900 MWe reactors beyond 30 years. ASN has not identified any generic element that would compromise EDF's ability to manage the safety of the 900 MWe reactors until the next periodic safety review. ASN considers that the new baseline safety requirements presented and the modifications envisaged by EDF are such as to maintain and improve the overall level of safety of these reactors.

As this generic assessment does not take account of any individual specific features, ASN gives an opinion on the ability of each reactor to continue to function, more specifically based on the results of inspections performed during the reactor conformity check during the third ten-yearly outage and on the assessment of the reactor safety review report submitted by EDF.

In 2014, a further 5 reactors incorporated the improvements resulting from the periodic safety reviews on the occasion of their third ten-yearly outages, thus raising to 24 the number of the 900 MWe plant series reactors (out of 34) which had carried out their third ten-yearly outage inspection.

In 2014, ASN also sent the Minister responsible for Nuclear Safety its analysis of the conclusions of the reports for Dampierre-en-Burly reactor 1 and Bugey reactor 5. On the basis of this analysis, ASN identified nothing that would compromise EDF's ability to satisfactorily control the safety of these two 900 MWe reactors until their next periodic safety review. Pursuant to Article L.593-19 of the Environment Code, ASN took this opportunity to issue additional prescriptions designed to reinforce the safety of these reactors.

The periodic safety review associated with the fourth ten-yearly outage inspections

After familiarising itself with ASN's requests of June 2013 concerning the orientations of the generic studies programme carried out by EDF in order to extend the operating life of the reactors beyond 40 years, EDF drafted and in October 2013 submitted its orientation file for the periodic safety review associated with the fourth ten-yearly outage inspections for the 900 MWe reactors (DOR VD4-900). Further to ASN's requests for additional data in March 2014, EDF updated its file.

ASN is conducting a detailed review of the DOR VD4-900 with the assistance of IRSN. ASN intends to issue a position statement on this file during the course of 2015, after consulting the Advisory Committee for nuclear reactors (GPR) and the Advisory Committee for nuclear pressure equipment.

UNDERSTAND

Implications of reactor operating life extension beyond forty years

The reactor operating life extension beyond forty years can only be envisaged if associated with a proactive, ambitious conformity verification and safety improvement programme.

With regard to the assessment of the situation of the reactors, the operating life extension beyond the fourth periodic safety review is a particular milestone. This is because, as of this review, certain reactor systems, structures or components will be required to function beyond their initial design hypotheses. This is the case of components, such as the vessel or the containment, that are particularly critical because they are not replaceable.

The implementation of an appropriate approach for the satisfactory control of ageing and obsolescence which in particular enables the risks linked to the degradation phenomena which could occur after forty years to be anticipated is a significant challenge.

Furthermore, a wide-ranging check on the conformity of each reactor and its operation, covering all the requirements defined for the elements important for protection, is necessary in order to assess the real condition of the reactors with a view to their continued operation. It is important that at the end of this check, EDF be in a position to restore the conformity of its facilities within an appropriate time-frame.

With regard to the safety review, if operation of the existing reactors were to be extended beyond 40 years, they would be operating alongside other reactors around the world of more recent design and compliant with significantly reinforced safety requirements. Over and above the question of the satisfactory control of ageing, extending the operating life of the reactors is also dependent on an ambitious reassessment of safety aiming to achieve a level as close as possible to that of a new reactor. In particular, the safety reassessment studies should be carried out in the light of the safety objectives applicable to new reactors, such as the EPR, in accordance with the position adopted by the WENRA association of European nuclear safety regulators.

The reactors of the 1300 MWe plant series

The periodic safety review concerning the second ten-yearly outage inspections

In 2006, ASN gave a favourable opinion to the generic aspects of continued operation of the 1300 MWe reactors up to their third ten-yearly outage inspections, provided that the modifications decided on during this review were effectively implemented.

In 2014, the Golfech 2 and Penly 2 reactors in turn incorporated the improvements resulting from the periodic safety review linked to their second ten-yearly outage inspection. All of the twenty 1300 MWe reactors have thus undergone their second ten-yearly outage inspection.

In 2014, ASN also sent the Minister responsible for Nuclear Safety its analysis of the reports on the conclusions of the safety review for the Cattenom 2 and 3, Nogent-sur-Seine 1 and 2, Penly 1 and Saint-Alban 1 and 2 reactors.

On the basis of this review, ASN has not identified any element that would compromise EDF's ability to satisfactorily control the safety of the 1300 MWe reactors until the next periodic safety review.

Pursuant to Article L.593-19 of the Environment Code, ASN took this opportunity to issue additional prescriptions designed to reinforce the safety of these reactors.

The periodic safety review associated with the third ten-yearly outage inspections

In 2011, ASN issued its opinion on the orientations of the safety review associated with the third ten-yearly outage inspections for the 1300 MWe reactors.

After several years of examination, with the assistance of IRSN, ASN requested the opinion of the GPR in October 2014 concerning the conclusions of the generic studies performed by EDF on the various topics selected during the orientation phase, as well as on the modifications being envisaged to improve safety. In early 2015, ASN will rule on the generic aspects of the operating life extension of the 1300 MWe reactors beyond thirty years.

Paluel reactor 2 will be the first 1300 MWe reactor to undergo a third ten-yearly outage inspection in 2015.

The reactors of the 1450 MWe plant series

The periodic safety review associated with the first ten-yearly outage inspections

In 2008, ASN gave its opinion on the orientations of the periodic safety review concerning the first ten-yearly outage inspections for the 1450 MWe reactors

These first ten-yearly outage inspections of the 1450 MWe reactors took place between 2009 and 2012.

In 2014, ASN completed its analysis of the safety review conclusions reports transmitted by EDF and is preparing the prescriptions it intends to issue.

The periodic safety review associated with the second ten-yearly outage inspections

In 2011, EDF transmitted its orientation proposals for the generic studies programme for the periodic safety review associated with the second ten-yearly outage inspections of the 1450 MWe reactors.

In early 2012, ASN asked the GPR for its opinion concerning these orientations.

Following the GPR meeting, EDF completed its generic studies programme at the end of 2012 with a certain number of measures and clarified a certain number of its proposals.

In February 2015, ASN finally ruled on the orientations of the periodic safety review associated with the second ten-yearly outage inspections of the 1450 MWe reactors.

The second ten-yearly outage inspections for the 1450 MWe plant series reactors are scheduled to start in 2018 with the Chooz B2 reactor and will run until 2022.

3.3 Monitoring the construction of the Flamanville 3 EPR reactor

Detailed design review for Flamanville 3

The detailed design review is carried out by ASN with the technical support of IRSN on the basis of a documentary review and specific assessments. This review is part of the preparation for the future examination of the commissioning authorisation application for Flamanville 3 that EDF intends to submit in the spring of 2015, as required by Article 20 of decree 2007-1557 (see point 2.12.1). In 2014, this review continued on subjects such as back-up electrical systems, the methods used for carrying out accident studies, or the content of the future general operating rules.

In 2014, two GPR meetings were also devoted to Flamanville 3. The first concerned the level 1 probabilistic safety assessments (core meltdown risk) performed by EDF, the second the approach proposed by EDF for classifying elements important for protection according to their role in the nuclear safety case and the definition of the related requirements.

In 2014, ASN also conducted four inspections in the EDF engineering departments responsible for the detailed design studies and oversight of manufacturing at the suppliers. ASN thus verified the implementation of the order of 7th February 2012 in their activities, more specifically with respect to the handling of deviations, change management or the preparation of the documentation necessary for performing start-up tests.

Oversight of construction activities on the Flamanville 3 NPP

On the Flamanville 3 construction site, in 2014 ASN carried out 21 inspections with the assistance of IRSN, on construction, performance of the first start-up tests and the preparation of the future licensee. These in particular concerned the following technical topics:
- civil engineering, including the activities involved in the construction and pre-stressing of the reactor building inner containment;
- mechanical assembly activities, more specifically concerning the reactor coolant system, the valves, the mechanical penetrations of the reactor building inner containment, the equipment necessary for operation of the emergency generating sets and the liquid and gaseous effluents treatment equipment;
- the electrical systems assembly activities, including cable laying operations in the buildings, the installation of the electrical penetrations of the reactor building inner containment and the assembly completion checks on the electrical switchboards;
- the assembly and modification activities on the I&C systems, in particular the installation of cabinets, the connection of the associated cables and the modification of the wiring inside the cabinets;
- the first start-up tests and the associated organisation, in particular for the equipment situated in the reactor pumping station;
- non-destructive inspection of welds and worker radiation protection;
- the site's organisation for dealing with deviations and managing hardware modifications;
- the organisation of the shift crew for the future Flamanville 3 reactor, so that the operating documentation can be drawn up;
- the organisation of the monitoring of outside contractors;
- the environmental impact of the construction site.

In its construction site oversight activities, ASN devoted particular attention to the following subjects in 2014:
- maintaining a strategy to conserve the equipment and structures present on the construction site until the commissioning of Flamanville 3. Owing to the reactor commissioning postponements announced by EDF, ASN ensures that EDF pays particular attention to defining and complying with requirements for conserving the equipment already installed and the structures already built. ASN regularly examines this point during its inspections, in particular ensuring

that the risks associated with work being carried out in the buildings simultaneously by several trades are taken into account;
- the actual integration by EDF of the experience feedback from deviations which occurred during the first concrete pre-stressing operation. Pre-stressing determines compliance with the inner containment's ability to withstand an accident situation, a point on which ASN is particularly vigilant. During the first pre-stressing activities, non-compliance with the working procedures led to deviations in the composition of the cement injected and the pre-tensioning of the cables. ASN was attentive to the implementation of the action plan defined by EDF to prevent these deviations from happening again;
- the beginning of the main primary system installation activities. This system contains the reactor core and is thus of primary importance for safety. With regard to EDF's activities, ASN examined the monitoring carried out by EDF on the outside contractors participating in installation of the primary system, in particular its manufacturer Areva NP. In this respect, ASN pays particular attention to compliance with the cleanness requirements and the adequate management by EDF of joint-contractor work in the vicinity of the equipment;
- the preparation for and performance of the first start-up tests on the pumping station equipment. The start-up tests must help demonstrate that the reactor's structures, systems and components meet the requirements assigned to them. In 2014, ASN carried out further checks during the tests on the pumping station systems;
- the preparation for operation of the Flamanville 3 reactor by the EDF entity which will be responsible for operation after construction. This entity currently comprises 400 staff. With a view to reactor commissioning, EDF is continuing with a process of gradual transfer of responsibility for the operation of the structures, systems and components from the entity in charge of construction and reactor start-up operations to the entity in charge of its future operation. The steps in this process enable the future operating personnel to upgrade their skills, familiarise themselves with the reactor equipment, draw up operating documentation and develop the appropriate tools. Through its oversight, ASN verifies whether the future shift crews take advantage of operating experience and best practices employed in EDF's NPPs and whether they correctly assimilate the working of the equipment during reactor construction and systems start-up tests.

Labour inspectorate duties on the Flamanville 3 reactor construction site

The actions carried out by the ASN labour inspectors in 2014 consisted in:
- carrying out safety checks on the construction site;
- taking part in meetings of the Committees for Health, Safety and Working Conditions (CHSCT) of the contractors;

ASN inspection on the Flamanville EPR construction site: preparation of electrical cables prior to laying, February 2014.

- answering direct queries from the employees;
- carrying out inquiries following occupational accidents.

In 2014, the ASN labour inspectors also carried out checks concerning illegal employment and continued their work on cases currently being investigated.

Monitoring the manufacture of nuclear pressure equipment for the Flamanville 3 reactor

Over the course of 2014, ASN continued to assess the conformity of the nuclear pressure equipment (NPE) for the reactor primary and secondary systems. In 2014, ASN therefore carried out nine inspections of Areva NP or its subcontractors in the plants manufacturing this NPE. In addition, several thousand inspections were carried out by the approved organisations. Manufacturing has been completed for most of the major equipment items and is in progress for valves.

In 2010 and 2011, several nonconformities were detected by Areva NP during the manufacture of the Flamanville 3 EPR reactor vessel head. More specifically, there were numerous defects in the vessel head adapter welds. These deviations required Areva NP to carry out large-scale repairs, which started in 2013. This repair work continued in 2014 and was closely monitored by ASN. Following ASN requests, Areva NP developed a more effective ultrasound method in 2013 to inspect the vessel head adapter welds. This was implemented at the end of 2014. The vessel head repairs should be completed in 2015. Areva is also experiencing difficulties in providing the justifications required by ASN concerning control of the risk of heterogeneity in the properties of the vessel head material.

On the Flamanville site, the construction of the EPR's nuclear steam supply system is progressing in successive assembly phases, for which ASN, together with the organisations approved for assessment of the conformity of nuclear pressure equipment, ensures compliance with the necessary pre-requisites. These pre-requisites in particular concern adequate consideration of the risks inherent in assembly, the checks to be performed on the site and the organisation put in place by EDF and Areva NP to limit the risks associated with the activities carried out in the vicinity by other contractors and to ensure the cleanness of the working areas and the assembled equipment.

ASN and the approved organisation review the technical documentation concerning assembly operations and the monitoring of the assembly or manufacture of nuclear pressure equipment carried out on the site. They require that Areva analyse the feedback from one assembly sequence before initiating the next one. This was in particular the case following the discovery in late 2014 of defects in a primary system weld. Areva regularly experiences difficulties in providing the technical documentation necessary for initiating on-site assembly operations. In 2014, ASN carried out three inspections of Areva NP on the assembly of the NSSS and three inspections of the inspection organisations or bodies approved by ASN to monitor these activities. These inspection organisations and bodies themselves carried out several hundred inspections in 2014.

The NSSS assembly operations will be gradually expanded, after ASN checks that the experience acquired during the first activities has been taken into account.

3.4 The reactors of the future: initiating discussions on Generation IV safety

Since 2000 CEA, in partnership with EDF and Areva, has been looking at the development of fourth generation[1] nuclear reactors, notably within the framework of the Generation IV International Forum (GIF). This forum was created in 2000 at the initiative of the U.S. Department of Energy and comprises thirteen member countries represented by their research organisations and industrial firms. The aim of the forum is to pool R&D work and to keep open the choice of possibilities for industrial development from amongst the following six selected technologies:
- SFR: Sodium-cooled Fast Reactor;
- GFR: Gas-cooled Fast Reactor;
- HTR/VHTR: Gas-cooled High Temperature (850°C) and Very High Temperature (1,000°C) fast reactors;
- LFR: Lead-cooled Fast Reactor;
- MSR: Molten Salt Reactor;
- SCWR: Super Critical Water Reactor.

For those promoting the fourth generation reactors, the main issue is to ensure sustainable development of nuclear energy while improving the use of natural resources, reducing the production of radioactive waste and offering an improved ability to deal with security, proliferation or terrorism risks. There is a wide consensus on these objectives amongst GIF's members. For those promoting them, the industrial deployment of fourth generation reactors is envisaged in France no earlier than the middle of the 21st century. It will require prior creation of a prototype, for which the planned commissioning date is set at 2020 by the Act of 28th June 2006 on the sustainable management of radioactive materials and waste.

1. "4th Generation" reactors are identified by comparison with those reactors immediately available to replace those currently in service, known as the third generation (this term itself refers to the fact that the reactors currently in service are the second generation, for example the PWR reactors which in France replaced the gas-cooled reactors, which constituted the first generation).

With this simultaneously medium and long-term view, at a stage much earlier than that required by the regulatory procedure, ASN wishes to monitor the development of fourth generation reactors by French industry, as well as the associated safety concerns – as was the case with development of the EPR so as to be in a position, at the appropriate time, to establish the safety objectives for these future reactors. For ASN, fourth generation reactors will have to meet stricter nuclear safety, radiation protection and environmental protection objectives.

ASN underlines the importance it attaches to the safety justification of the plant technology chosen over those adopted by the GIF. In this context, and on the basis of the documents transmitted at its request by CEA, Areva and EDF in 2009 and 2010, ASN asked the Advisory Committees for Nuclear Reactors (GPR), for Plants (GPU) and for Waste (GPD) for their opinion on the range of various reactor technologies envisaged for the fourth generation, with regard to the more stringent nuclear safety, radiation protection and environmental protection objectives, as well as with respect to the possibility of separation and transmutation of long-lived radioactive elements mentioned by the Programme Act of 28th June 2006 on the sustainable management of radioactive materials and waste. The Advisory Committee met in April 2014 and, on the basis of an IRSN report, familiarised itself with the advantages and drawbacks of each of the above-mentioned technologies, given their current state of development. The R&D needs designed to underpin the safety case were also presented, as were certain aspects to be considered regarding the safety of the fuel cycle associated with these technologies. ASN will issue a position statement in 2015 on the objectives and orientations of the fourth generation reactors.

At the same time, CEA undertook studies for a prototype Sodium-cooled Fast reactor (SFR): the Astrid project (Advanced Sodium Technological Reactor for Industrial Demonstration). In mid-2012, CEA sent ASN the Safety Orientations Report (DOrS)[2] for the Astrid prototype. The safety orientations report was reviewed by the Advisory Committees during the first half of 2013 and ASN issued a position statement in April 2014 (see Chapter 14).

2. The DOrS precedes the safety options file (DOS) that CEA intends to draft ahead of submitting the creation authorisation request for the BNI. As of the beginning of the project, the main purpose of the safety orientations and options reports is to check that correct account is taken of the safety issues.

3.5 The other notable findings of 2014

3.5.1 Notable findings relating to oversight of pressure equipment

Application of the regulations concerning nuclear pressure equipment

On 9th July 2014, the ASN Chairman met the main industrial stakeholders involved in the application of the regulations concerning nuclear pressure equipment (NPE). During these discussions, ASN asked EDF to ensure that the NPE manufacturers were able to exercise their responsibilities in full, more specifically to perform the risk assessment required by the regulations, before beginning to design their equipment. ASN also asked the main NPE manufacturers for a rapid and significant change in their current practices in order to bring them fully into line with the regulatory requirements, in particular with regard to the transmission of satisfactory technical documentation prior to beginning the manufacturing work.

The request for justifications prior to the installation of the replacement steam generators intended for the Le Blayais NPP reactor 3

After reviewing the design and the manufacture of the new steam generators intended for reactor 3 of the Le Blayais NPP, ASN found that not all the required safety justifications for their assembly and start-up had been provided. On 24th November 2014, ASN therefore asked Areva and EDF to provide additional safety justifications. These were pre-requisites for assembly and start-up of the new steam generators.

The justifications requested by ASN in particular concerned the mechanical loadings for the design of the equipment, the performance of additional tests to confirm the mechanical properties of certain materials, the representativeness of the design methods to verify the mechanical strength of the equipment, or the adequacy of the methods for checking and detecting potential defects.

3.5.2 Notable findings relating to labour inspectorate duties

Oversight of occupational health and safety

With regard to occupational health and safety, the ASN inspections more specifically covered the following topics in 2014:
- monitoring of construction site activities, with particular attention being paid to lifting work and

risks linked to work being performed by several contractors simultaneously and to work at height;
- the use of Carcinogenic, Mutagenic or Reprotoxic chemical products, asbestos, or welding activities;
- fire protection measures as part of an integrated and coordinated approach to safety and Labour Code requirements;
- operating experience feedback from the viewpoint of occupational safety during Steam Generator Replacement operations;
- risk assessment and prevention in preparation for the operations requiring personnel entry inside the steam generators;
- mandatory checks on polar cranes in reactor buildings and the heavy-lift cranes in the fuel buildings.

Labour accident inquiries, which are always held in the event of a severe accident, were rare in 2014 and no fatal occupational accident occurred.

Monitoring the duration of work In 2014, the ASN labour inspectors continued their checks on compliance with the regulations on working times and on daily and weekly rest periods, mainly during the reactor outages. They once again observed breaches of maximum working hours and rest periods, for certain populations of technicians and managers required to work intensively during reactor outage periods.

Subcontracting

ASN closely monitors the criminal proceedings instigated on this topic in previous years, more specifically through regular contacts with the public prosecutor's offices. The labour inspectors also took part in several inspections jointly with the nuclear safety inspectors, to look at the quality of the work done by the contractors.

Criminal proceedings

The ASN labour inspectorate sent the various public prosecutor's departments concerned nineteen formal notices served on the NPPs in 2014.

3.5.3 Notable ndings relating to radiation protection of personnel

Radiation protection inspections

On March 2014, ASN carried out an in-depth inspection on radiation protection at the Gravelines NPP. Ten ASN inspectors examined the organisation and management of radiation protection, the satisfactory control of construction sites, the application of the ALARA approach (As Low As Reasonably Achievable – see point 1.1.6 of Chapter 2), the control of radiological cleanness and the management of radioactive sources.

ASN also carried out several inspections concerning the procedures for entering a controlled area in normal working overalls in certain NPPs (EVEREST approach) and sent EDF requests concerning the entry into force of the order of 8th October 2014 modifying the order of 15th May 2006 concerning the conditions for the demarcation of monitored and controlled areas, in particular requiring tightening up of the provisions for control of the radiological cleanness of the facilities on sites on which the EVEREST approach is in place.

TO BE NOTED

Personnel irradiation during work at the bottom of the pool

During reactor outages, the fuel is removed from the reactor core and transferred to the fuel building pool via a transfer tube. At the end of the outage, after the fuel elements have been reloaded, the licensee ensures that this transfer system is leaktight by installing a closure plate. This operation, which takes place in a compartment of the reactor building pool, entails a significant risk of exposure.

On 18th August 2014, following a series of material and organisational malfunctions in the preparation for and performance of the work, two members of a subcontractor company who were fitting the closure plate on the transfer tube for Gravelines NPP reactor 1, were exposed to a dose about ten times higher than anticipated, which meant that during a single operation, one of the staff members exceeded one quarter of the annual regulation limit of worker exposure, although without exceeding the annual limit. Owing to this excess dose, this event was rated level 1 on the International Nuclear Events Scale (INES).

On 2nd July 2014, two EDF subcontractor staff members who were installing a closure plate on the transfer tube of Gravelines reactor 5 were also exposed to a far higher dose than anticipated, although without exceeding one quarter of the annual limit.

Significant contamination events

Two significant contamination events (rated level 1 on the INES scale) were notified in the NPPs in 2014. They concern:
- the contamination of the nose of a staff member handling a bag of waste containing used filters from a ventilation system in the Belleville NPP, leading to exposure in excess of one quarter of the regulation limit per square centimetre of skin;
- the contamination of the cheek of a staff member during maintenance on the "dummy closure head" at the Le Blayais NPP, leading to exposure in excess of one quarter of the regulation limit per square centimetre of skin.

3.5.4 Notable ndings relating to the environmental impacts of NPPs and discharges

Revision of effluent discharge and water intake prescriptions

In 2014, ASN completed the review of the files concerning water intake and effluent discharges for the NPPs of Bugey and Saint-Alban, followed by those of Saint-Laurent and Fessenheim and it began that of Chinon, Cruas, Paluel and Le Blayais.

The ASN resolutions issued accordingly (see point 2.15.1) more specifically deal with the modifications made by EDF to the installations, such as changes to the chemical conditioning of the secondary system and the adoption of anti-scaling or biocidal treatment of the cooling systems (see point 1.1.4). They also take account of changes to the regulations.

ASN also continued its review of the EDF files concerning implementation on the NPPs of water intake systems designed to guarantee "ultimate makeup" water in the event of an accident, as prescribed by the "post-Fukushima" stress tests (see point 3.1).

Leaktightness defects on certain equipment

In the Gravelines NPP, leaktightness defects were observed on radioactive effluent tanks. In April 2014, ASN served formal notice on EDF to carry out repair work. ASN then checked this repair work. Leaktightness defects in certain demineralised water production plant retention basins were also detected in the Chinon and Civaux NPPs. ASN checked the repairs made on these retention basins by the licensee. These incidents led to no releases into the receiving environment.

Retention basins for tanks containing radioactive or hazardous substances and for collection of firefighting water

The regulations on the tanks containing radioactive or hazardous substances and those on the collection of firefighting water, require that EDF have sufficient retention volumes. At the request of ASN, EDF presented material and organisational provisions to reinforce the countermeasures in place or increase the available retention volumes.

4. ASSESSMENTS

4.1 Assessments of the overall performance of the NPPs in service

4.1.1 Nuclear safety assessment

Reactor operations

Management of operations is on the whole satisfactory. However, several activities were the origin of significant events in 2014. Their underlying causes lay in insufficient preparation, inadequate management of tag-outs or erroneous application or interpretation of operating documents. The ergonomics and accuracy of these documents could be improved. This situation reveals that too little account is still taken of the end-users in the design and verification of the operating and maintenance documents for the facilities. The operating documentation drafting process, in particular for that produced by the EDF head office departments, must be improved.

Although some improvements are visible with respect to 2013, efforts must be continued with regard to planning, preparation, periodic testing and interpretation of the results obtained. Although the shortcomings in the reference documentation partly explain the deviations observed in 2014, the skills of the parties concerned are not always able to prevent their effects, despite the improvements made by EDF to the personnel training programmes and the implementation of a mentoring system for young recruits. EDF must continue to strengthen the jobs and skills management system.

Emergency situations

Since 13th November 2014, the sites have adopted a new emergency organisation based on harmonised national baseline requirements. This update in particular enabled the nuclear rapid i intervention force (FARN) to be incorporated into the emergency organisation. These baseline requirements were implemented satisfactorily on all the sites.

The emergency management inspections carried out in 2014 confirmed that the sites had appropriated the on-site emergency plans. However, these inspections did show that the management of emergency situations could be improved, more specifically with regard to the management of the mobile equipment used in an emergency situation, the monitoring of the corrective measures identified during the emergency exercises and the actual evacuation exercises of contamination victims as provided for in the agreements between the hospitals and the NPPs, the implementation of which often proves to be incomplete.

Fire and explosion

In 2014, ASN carried out fourteen inspections on fire and explosion risk management in the NPPs. Following these inspections, ASN noted that the organisation is generally satisfactory when managing actual fires and that the relations between the sites and the departmental fire-fighting and emergency response services are good in the majority of cases.

However, generally speaking and despite the efforts made by a few sites, deviations linked to management of fire detection system inhibitions are observed, the integration of operating experience still needs to be improved and the management of the fire risk could be improved in certain waste and effluent processing buildings. Finally, if the situation has improved for a few sites, ASN hopes to see greater rigorousness in the management of fire permits and in the management of storage areas and fire zoning, points regarding which deviations are regularly noted. However, the number of fire outbreaks notified is down and most events have no real impact.

Fire exercise in an observation chamber at the EDF Training Centre in Nivillac (Morbihan), September 2014.

ASN also carried out inspections during the course of which it was able to observe that the new organisation on the sites concerning the explosion risk and the corresponding training should be intensified. Continuing efforts must be made in order to acquire an integrated approach to control of the explosion risk, in terms of both nuclear safety and worker protection.

TO BE NOTED

Three events concerning the explosion risk

ASN underlines three events in 2014 concerning the explosion risk, some of the lessons from which are still to be analysed and from which experience feedback is still to be implemented on the sites:
- on 23rd May, in a nuclear auxiliaries building at the Tricastin NPP, a worker was burned following the ignition of a hydrogen jet as a result of a leak from a sampling device;
- on 25th September at the Le Blayais NPP, an inerting error in the double wall of a pipe carrying hydrogen (inerting of the system in the neighbouring plant) at the time it was cut;
- on 12th November, in a gas storage facility at the Dampierre-en-Burly NPP, a leak from a rack containing hydrogen cylinders with ignition of the jet of hydrogen.

Maintenance activities

Although in the past EDF may have failed to sufficiently anticipate certain ageing issues or certain degradation modes, despite the existence of international experience feedback, ASN observed that there is improved advance detection of the need to replace obsolete equipment items. This allows earlier anticipation of the problem of obsolescence, which is becoming increasingly acute for analogue equipment and for certain types of sensors or actuators. ASN nonetheless remains vigilant with regard to the conditions for replacement of this equipment by equipment comprising electronic components initially designed for the non-nuclear industry and for which the development processes could potentially be less strict than those used in the field of nuclear safety.

With regard to the procurement of spares and equipment repairs, shortcomings in the satisfactory control of these activities were observed, in the same way as last year. However, fewer deviations were noted in 2014 than in 2013, which tends to show that the centralisation of spares on a single site has now reached a satisfactory stage of long-term development. However, some of the spares made available to the sites are still inappropriate or non-conforming. During reactor outages, for which the scheduled work cannot be postponed, this can lead to the installation of a spare which may be functionally compatible but is not qualified with respect to the safety requirements of the equipment on which it is installed.

EDF has implemented a specific multi-year action plan designed to reinforce the management of activities scheduled and carried out during maintenance outages of nuclear power generating reactors. This action plan has in fact enabled the licensee to carry out more serene management of the preparation and performance phases. However, EDF's efforts must be continued over the long-term, more particularly with respect to work organisation, the preparation of certain activities, schedule compliance and coordination of the worksites.

Equipment condition

The equipment maintenance and replacement programmes, the periodic safety review approach and the correction of conformity deviations should make it possible to check and ensure the ability of the equipment important for safety in an NPP to perform its functions.

During the course of its inspections, ASN observed considerable progress by the NPPs this year in terms of organisation and internal training of those involved in handling deviations, although it observed that there were still shortcomings in the implementation of and compliance with the rules issued by the EDF head office departments.

The sites must continue their efforts, in particular with regard to the identification and traceability of the deviations detected.

Over and above the individual handling of each deviation, the analysis methodology implemented by EDF for assessing the cumulative effect of deviations, pursuant to Article 2.7.1 of the Order of 7th February 2012 setting the general rules for BNIs, was examined by the GPR at a meeting in February 2014. During this examination, EDF made a number of undertakings which, by means of a more detailed and more reactive review of the deviations, enhances the assessment of their safety issues in order to more clearly identify and prioritise any additional subsequent measures required.

Finally, EDF has made progress in the way it manages maintained qualification of the equipment for accident conditions, in particular during preventive maintenance operations.

The first containment barrier

In 2014, the condition of the first barrier and its management were on the whole stable but certain points could nonetheless be improved. The organisation set up to prevent foreign material from entering the reactor coolant system was tightened but, on certain sites, it did not avoid a significant number of them being present. An increase in the number of leaking fuel assemblies by comparison with 2013 was also noted, even if the number of reactors concerned is the same. 2014 was also marked by the definition and implementation of measures to reduce risks linked to excessive oxidisation of fuel cladding made of Zircaloy-4 alloy. At ASN's request, EDF adopted measures to limit the oxidisation of the cladding, restricting control rod cluster movements to the strict minimum necessary once the calculated oxide thickness reaches 80 µm. These measures to reduce accident risks were considered by ASN to be adequate, pending complete replacement of the fuel assemblies with Zircaloy-4 cladding by the 2020 time-frame.

Two significant events concerning the control rod clusters also occurred in 2014:
- the considerable increase in the drop time of the control rod clusters in Nogent NPP reactor 2, linked to deformation of the assemblies. The reactor was shut down prior to the normal end of its operating cycle, which enabled the fuel to be renewed and the drop time of these clusters to be improved. ASN is however remaining vigilant with regard to the development of this situation;
- the separation of a control rod in the Tricastin NPP reactor 3, which had remained undetected for more than one reactor operating cycle. The assembly concerned was unloaded and the consequences for the other assemblies were negligible.

Finally, a number of incidents occurred in 2014 during work on the assemblies or their handling, such as the damage to a source control rod in Saint-Alban or an impact between two assemblies at the end of the transfer tube of Cattenom reactor 2. ASN considers that particular attention must be paid to these points.

Second containment barrier and pressure equipment

The pressure equipment in which the fluid in contact with the reactor fuel elements circulates constitutes the second containment barrier. The requirements of the order of 10th November 1999 concerning the monitoring of the operation of this equipment are correctly followed although shortcomings are frequently observed in the preparation of maintenance or inspection operations. The quality of the documentation needed to assess the condition of this equipment at reactor restart is also still regularly unsatisfactory, even if EDF is making efforts to improve. EDF's management of the second containment barrier is moving towards a satisfactory situation with the preventive strategy deployed in the programmes for replacement of the steam generators and the operations to keep their secondary parts clean.

The situation of the pressure equipment not involved in the second barrier:
- still needs to be improved for the nuclear pressure equipment which also plays a radioactive substances containment role. ASN still regularly makes observations concerning application of the Order of 12th December 2005 concerning nuclear pressure equipment. EDF has initiated an action plan to improve the situation;
- is satisfactory for non-nuclear pressure equipment, more specifically through the involvement of the inspection services recognised by the Prefect and tasked with ensuring application of the specific regulatory provisions. ASN maintains specific monitoring of these recognised services, with this recognition enabling them to adapt the content and frequency of the inspection programmes to the specific risks.

Third containment barrier

Overall management of the containment function

By comparison with 2013, the number of events concerning the third barrier dropped, in particular on the sites with an officer in charge of the "containment" function. Nonetheless, improvements are still expected with regard to the condition of the containment, of the third barrier and its components, more specifically concerning management of containment breaches in connection with the performance of work and the monitoring by EDF of the contractors tasked with checking static seals.

Single wall containments with an internal metal liner

The ageing of the 900 MWe reactor containments was examined in 2005 during the generic phase of the periodic safety review associated with their third ten-yearly outage inspection, in order to assess their leaktightness and mechanical strength. The tests on the containments performed in 2014 brought to light no particular problems liable to compromise their operation for a further ten years. More generally, the results of the ten-yearly tests of the reactor containments have hitherto shown leak rates in compliance with the regulatory criteria.

Double-wall containments

The test results for the double-wall containments performed during the first ten-yearly outages of the 1300 MWe reactors detected a rise in the leak rate from the inner wall of some of them, under the combined effect of concrete deformation and loss of pre-stressing of certain cables that was higher than expected in the design.

EDF then initiated significant work consisting in using a resin sealant locally to cover the interior surface of the inner wall of the most severely affected 1300 MWe reactors, but also reactors of the 1450 MWe plant series. The tests performed since this work, during the second ten-yearly outages of the 1300 MWe reactors and the first ten-yearly outages on the 1450 MWe series of reactors, showed that all the containments concerned complied with their regulation leak rate criteria.

ASN nonetheless remains vigilant with regard to the development of the leaktightness of these containments for which the design makes no provision for an integral metal liner. An analysis of the issues linked to the double-wall reactor containments was thus made by the GPR on 26th June 2013, in the run-up to the third ten-yearly outage inspections for the 1300 MWe reactors. ASN issued a ruling on this subject in June 2014 and will be attentive to compliance with the undertakings that EDF made on this occasion.

4.1.2 Evaluating human and organisational measures

Provisions concerning staff and organisations in operational activities

The organisation set up by EDF makes provision for a Human Factors (HF) Consultant position per pair of reactors. The EDF baseline requirements stipulate that the duties of the HF consultants be organised around three fields: take part in the site's operating experience feedback process, improve working situations and practices and develop the integration of human factors on the sites, more specifically by coordinating a network of correspondents in the departments. In reality, the duties of the HF consultants chiefly consist in taking part in the site's operating experience feedback process to varying degrees and in training EDF or contractor staff in practices to increase the reliability of human operations. However, some sites are beginning to deploy a network of local HF correspondents within the departments, coordinated by the HF consultant. The time allocated to the local correspondents for these duties is however limited and is often not specified and the composition and efficiency of these networks remain inadequate. The roles of the HF consultants could be extended to other organisational and human factors fields, such as taking account of the organisation and the needs of the personnel when making changes to systems or modifications to certain equipment. The position of the HF consultants and HF correspondents in the organisation of the sites must thus continue to be strengthened. ASN specifies that this expansion of their scope of intervention would need to be combined with consideration being given to the workforce to be allocated to this function on each of the sites.

The managers are on the whole strengthening their presence in the field, even if these field visits are sometimes more to check behavioural nonconformities by the workers or indeed the condition of the facilities, rather than to observe working situations which would allow the detection of possible improvements or areas in which worker training might be needed.

Considerable efforts have been made by EDF to develop the implementation of practices to improve reliability of operations within the framework of the national "human performanc" project. For ASN, application of the "human performance" project by the sites must be accompanied by other improvement measures specific to the sites, concerning organisation, safety management or working conditions.

Operating conditions

Despite improvements in terms of housekeeping of the premises (EDF's "Obtain exemplary facility conditions" project), ASN still observes numerous shortcomings concerning operating conditions in 2014. ASN was thus able to observe equipment that was unsuited to the tasks to be carried out, for example owing to their unavailability or their contamination. ASN also observed premises that were too small or inaccessible, signage errors or markings that were hard to read. The documents made available to the workers by EDF are regularly found to be inappropriate, incomplete or unsuitable. For several years, ASN has encountered this situation, which calls into question the documentary revision process used by EDF, in particular as these inadequacies can create difficult working conditions and impair performance, thus potentially contributing to the occurrence of significant events.

In addition, the workers' physical working environment (lighting, heat, noise) continues to create degraded working conditions. Some sites however are making significant efforts in this field.

Provisions concerning staff and organisations in operational reactor modification activities

Hardware and documentation modifications are mainly managed at the national level, so the sites do not always have the room for manoeuvre they might require to improve the working environment when a need is identified locally. The progress made by the sites is therefore generally through implementation of countermeasures rather than actually dealing with the problem itself.

At the national level, EDF has developed the SOH approach, the aim of which is to transform engineering practices at EDF, to take greater account of people and organisations in the changes made to the systems and in modifications to hardware and organisations, as of the design stage. ASN considers the philosophy of the SOH approach to be pertinent and important in guaranteeing the security of the facilities and the safety of the workers. However, the efforts made by EDF to deploy the SOH approach must be continued in order to achieve the hoped for effects.

Management of skills, qualifications and training

The skills and qualifications management in place on the sites is on the whole satisfactory and the management processes well documented and coherent. Most of the sites have set up local training committees involving the executive level, the management and the workers. One of these committees rapidly detects staff training requirements and, with the help of the production engineering training unit, creates short and specifically targeted training programmes according to the identified needs.

The training programmes are generally implemented satisfactorily and the deployment of academies for the different professional disciplines is highlighted as a strong point for the training of newcomers to the sites.

Inadequacies were however still found on certain sites by ASN during inspections, concerning forward-looking management of jobs and skills, even if, generally speaking, ASN notes the considerable efforts made by EDF in recruitment and training in order to anticipate the turnover of skills linked to worker retirement. On some sites, the staffing levels in certain professions are insufficient and could lead to a work overload that is highly prejudicial to safety and as well as to difficulties in implementation of the system of mentoring young recruits by more experienced staff. A number of inspections also highlighted the fact that the sites had difficulty in explaining the methodology used for estimating the number and level of the required skills, which leads ASN to question EDF's identification of the target staffing levels, and in particular the analysis of the corresponding potential weaknesses (for example increased workload).

Given the level of retirements expected in the coming years and the considerable work to be accomplished by EDF for, or subsequent to, the stress tests, ASN considers that EDF's recruiting and training efforts must be continued.

4.1.3 Health and safety assessment, professional relations and quality of employment

Improvements were observed by the labour inspectors concerning compliance with daily and weekly rest periods, showing progress by comparison with previous years. Nonetheless, EDF could further improve its compliance with ASN's requests concerning working periods, in particular owing to the absence of a system for counting the time worked by the management.

Better account is taken of certain professional risks, such as the risks linked to welding fumes and EDF's announced expansion of the role of the "zone managers" to include all conventional safety aspects for workers.

ASN also spotlights EDF's responsiveness in dealing with its requests concerning the conformity of the main handling cranes and certain cable-laying equipment. The ASN inspections nonetheless showed that in addition to the handling cranes, considerable work is required on the compliance of the machines with the requirements of the Labour Code.

Progress is still required in the management of multiple contractors working simultaneously (quality of prevention plans in particular) and the use of subcontracting (combatting the illegal loaning of labour). ASN also asked EDF to improve the distribution of operating experience and best practices between the sites.

4.1.4 Evaluation of radiation protection

In 2014, ASN carried out 28 inspections on worker radiation protection in the NPPs.

In 2014, the collective dosimetry per reactor was lower than in 2013 and is below EDF forecasts. This drop is partly due to progress in implementing the ALARA principle and partly due to the limitation of the number of days for which reactor maintenance outages are prolonged. The doses received by the workers are broken down as shown below in graphs 1, 2 and 3.

ASN considers that the average situation of the NPPs in 2014 concerning radiation protection could be improved with regard to a certain number of points:

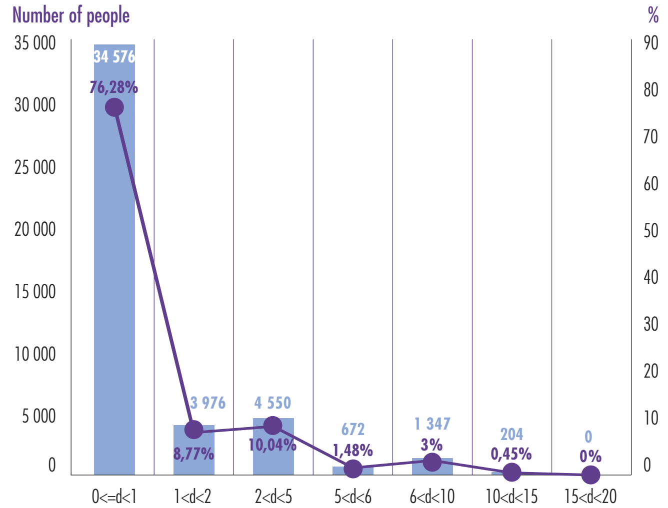
- after two unsatisfactory years, the control of industrial radiography work is improving but weaknesses persist in the organisation of management and the modification of the drawings used to define the demarcation of the operations zone, as well as in the quality of the walk-downs performed when preparing this work;
- rigorousness in the preparation of the work (in particular consideration of hot spots in the risk assessment and the evolution of the forecast dose), monitoring of the integrated doses by persons competent in radiation protection, the implementation of optimisation measures (tele-dosimetry in particular) and the behaviour of the workers when faced with electronic dosimeter alarms, are not up to the expected level. These inadequacies are the cause of far too many cases of individual dose targets being exceeded, or even significant exposure of the personnel, in particular when working at the bottom of the pool (see point 3.5.3);
- control of the dispersion of contamination inside the reactor building is progressing but still remains insufficient, especially owing to inadequate behaviour or worksite containment shortcomings;
- satisfactory control of limited stay areas is progressing but remains insufficient. Efforts are in particular needed concerning the management of radioactive waste and the identification of the activities concerned.

4.1.5 Assessment of provisions to control detrimental effects and environmental impact

In 2014, ASN carried out 57 inspections on the control of the detrimental effects and environmental impact of NPPs, mainly concerning the prevention of detrimental effects, environmental discharges and waste management.

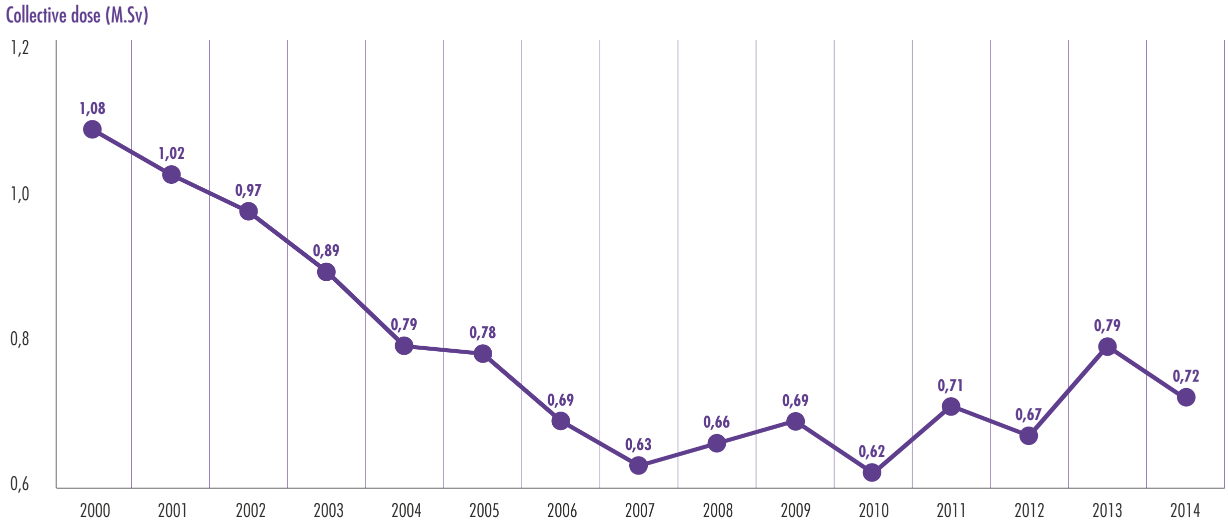
The organisation in terms of management of detrimental effects and the impact of NPPs on the environment is considered to be satisfactory on most sites, in particular through the implementation of structures that guarantee application of new regulatory requirements. The discharge forecasts established by the plants are based on internal operating experience but also feedback from the other sites, which is satisfactory. However, contractor monitoring was felt to be insufficient, more particularly concerning operations linked to monitoring

GRAPH 1: Breakdown of the population per dose range over the year 2014



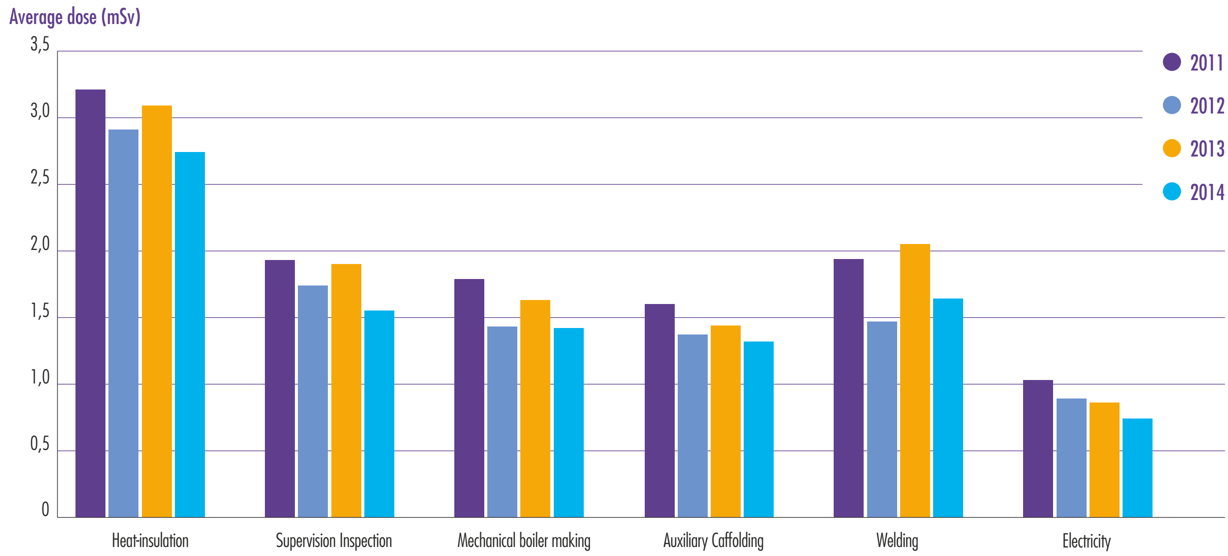
Source: EDF

GRAPH 2: Mean collective dose per reactor



Source: EDF

GRAPH 3: Evolution of mean individual dose according to categories of workers involved in reactor maintenance



Source: EDF

of the environment and of legionella and amoeba in the cooling systems. In addition, the way in which account is taken of operating experience differs widely between the sites.

Deviations in the operation and monitoring of the facilities are still observed. In particular, the detection and handling of deviations concerning the conformity of the facilities could be improved and on the majority of sites are even inadequate. The implementation of maintenance programmes (frequency or level of inspections) and the preparation of certain worksites, more specifically when they lead to the risk of spillage of radioactive or hazardous substances, are not always given sufficient attention by EDF. Finally, waste management could in most cases be improved, with frequent deviations from the operational baseline requirements.

ASN considers that the quality of the documentation concerning pollution prevention and the operating procedures in the facilities could be improved, in particular to take full account of European regulations on the classification and labelling of chemical products.

ASN observes that it sometimes takes too long to implement and assimilate the prescriptions regulating discharges and waste and the detrimental effects prevention and mitigation provisions of the Order of 7th February 2012 setting the general rules for BNIs and resolution 2013-DC-0360 of 16th July 2013.

Finally, EDF's approach for integrating the equipment and activities concerning control of detrimental effects and impacts from among the equipment and activities important for protection, defined by the Order of 7th February 2012, is insufficient and must more specifically be reinforced.

4.1.6 Analysis of operating experience

The operating experience feedback process

EDF's corrective action programme, which consists in running an analysis loop with processing of findings from the field, is continuing to be deployed on the sites. In addition to this programme, the sites are setting up an organisation to deal with significant events and operating experience communicated by the national level and by the other sites.

With regard to operating experience subsequent to a significant event, ASN observed that several sites were using a new analysis method proposed by the EDF head office departments. On several sites, the quality of the significant event reports received by ASN is improved when this new method is used. There are differences in the degree of involvement of the HF consultants in the reactive experience feedback process, which primarily comprises the analysis of the root causes, which are frequently organisational, and the identification, implementation and follow-up of corrective measures. In addition, depending on the sites, the analyses are unable systematically to extend as far as any organisational malfunctions, even when the HF consultants took part in these analyses. A frequent observation is that the corrective measures adopted by the sites are not always able to address the organisational malfunctions highlighted in the analyses.

Analysis of significant events statistics

In accordance with the rules concerning the notification of significant events (see point 3.4 of Chapter 4), EDF notified 640 significant safety events in 2014, 116 radiation protection events and 112 environmental protection events.

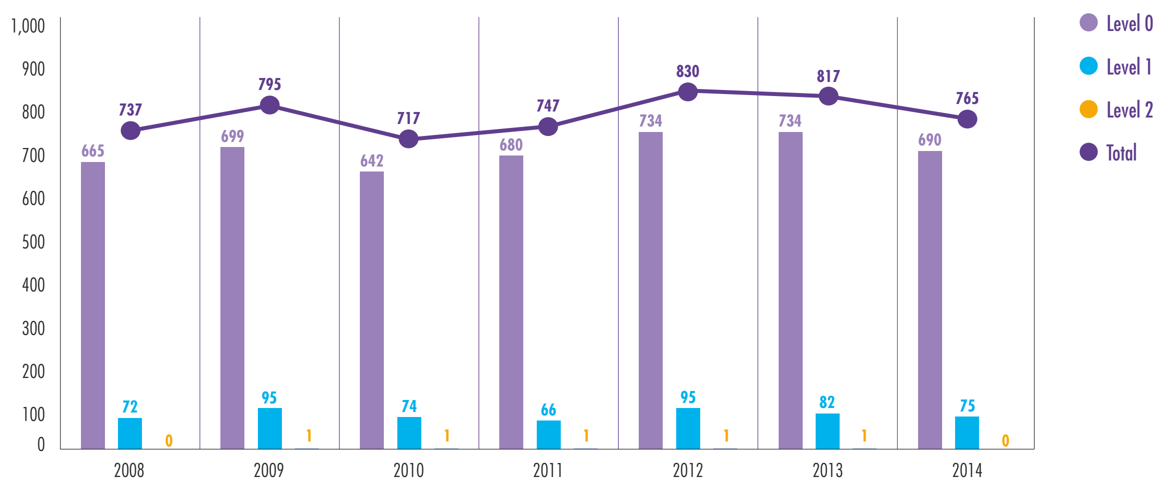
Graph 4 shows the trends in the number of significant events reported by EDF and rated on the INES scale since 2008. 765 events were rated on the INES scale in 2014.

Graph 5 shows the trends in the number of significant events per area concerned by notification since 2008: Significant Safety Events (ESS), Significant Radiation protection Events (ESR) and Significant Environmental Events (ESE).

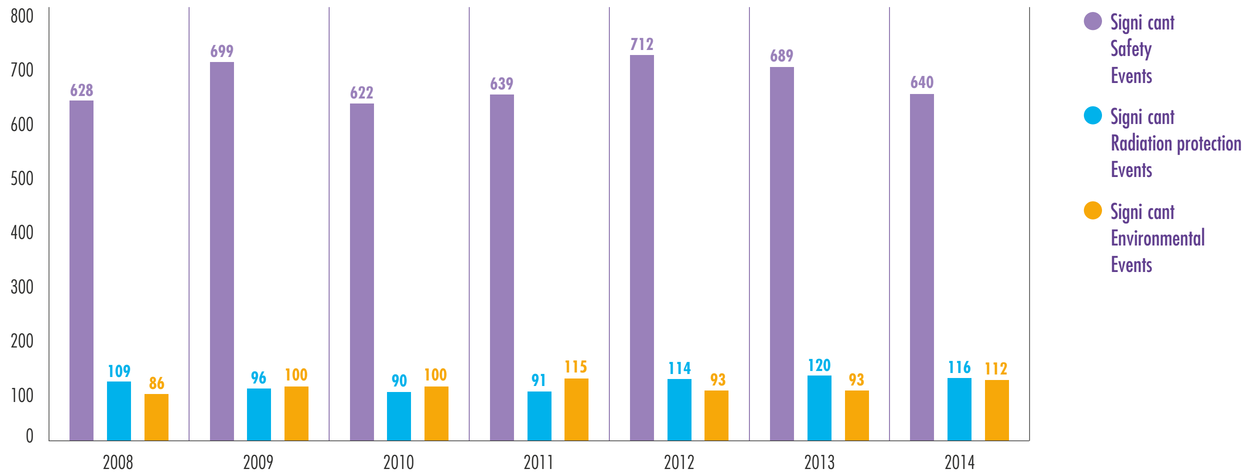
The number of ESS notified is 38%, down compared to 2013, confirming the downward trend initiated in 2013. If the origin of these events lies mainly in maintenance or operating faults, the reduction in the number of ESS is partly explained by the improved quality of the preparation of the work carried out when the reactor is shut down for maintenance. ASN nonetheless considers that the reliability improvement and optimisation practices implemented by EDF still offer room for significant improvements.

The number of ESR also fell by about 3.3%, compared to 2013, showing a reversal in the trend visible in previous years. This reduction is more specifically the consequence of improved control of industrial radiography work and better prevention of the risks of the dispersal of radioactive materials in the reactor building. On the other hand, the quality of the preparation of the work and the dosimetric monitoring

GRAPH 4: Trend in the number of significant events rated on the INES scale in EDF nuclear power plants from 2008 to 2014

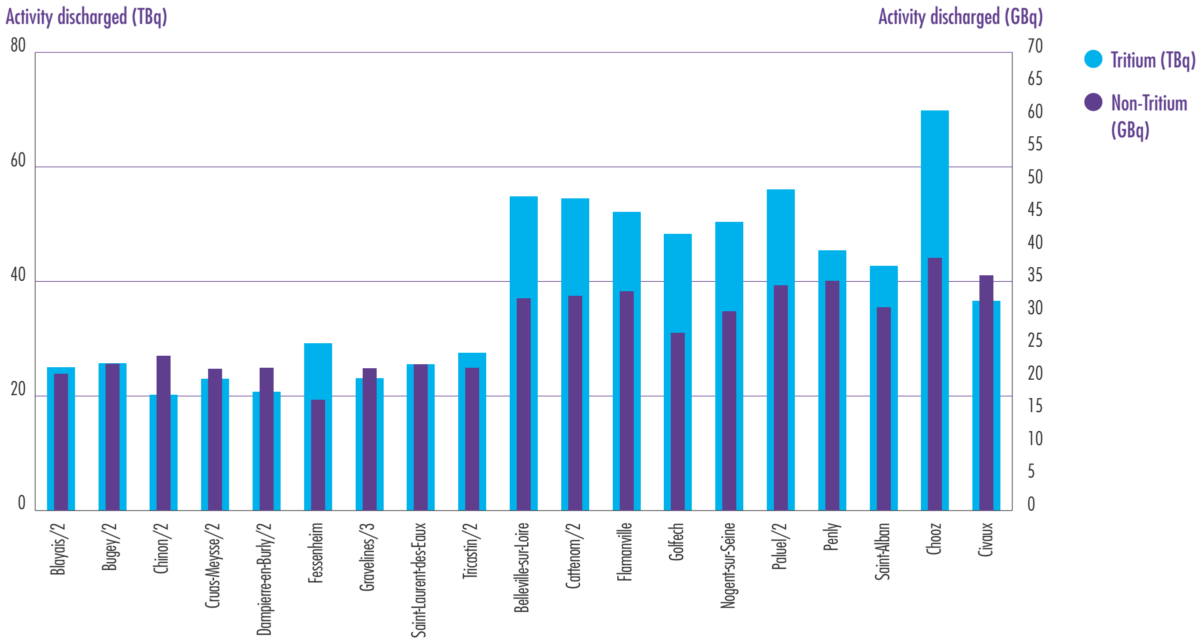


GRAPH 5: Trend in the number of significant events per domain in EDF nuclear power plants from 2008 to 2014



Events off the INES scale are also taken into account.

GRAPH 6: Liquid radioactive discharges for the NPPs in 2014



of the participants are still inadequate and are the root cause of numerous ESR.

The number of ESE rose significantly compared to 2013, up nearly 20.4%. The cause of this increase is a lack of satisfactory control of devices containing coolant fluids. This increase also reflects increased integration of environmental issues in the deviations identification process implemented by EDF.

The details of the significant events for each site are presented in Chapter 8.

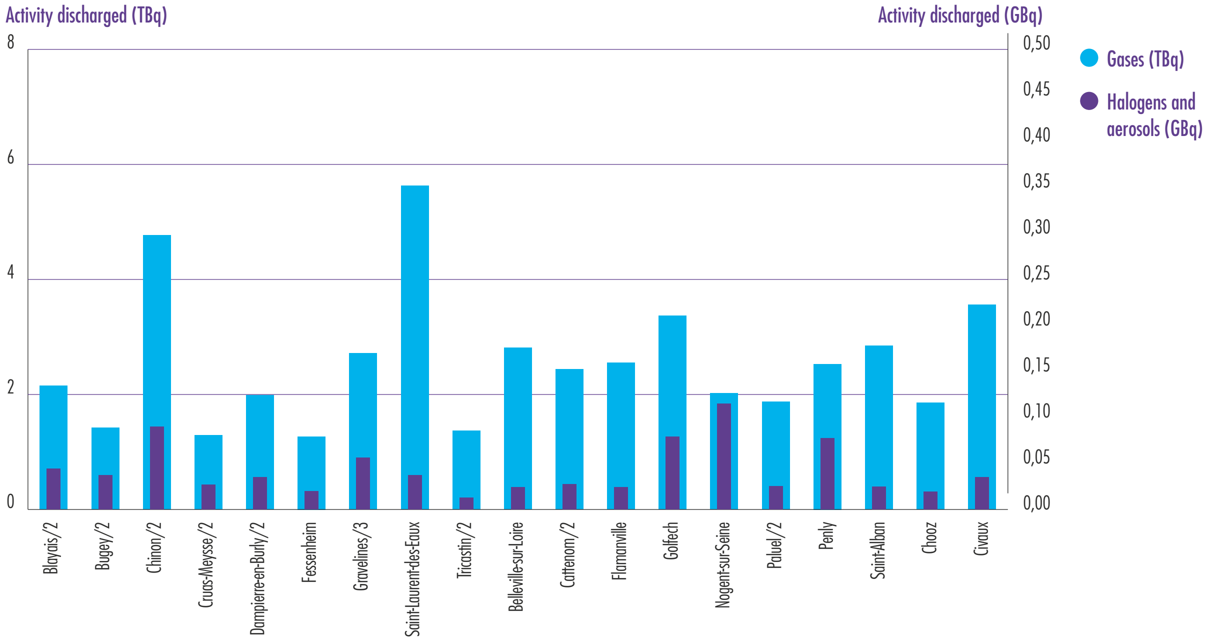
4.2 Evaluation of the manufacture of nuclear pressure equipment

Advancing industrial practices

ASN observes that the justifications and demonstrations provided by the manufacturers for new nuclear pressure equipment conformity assessments are still regularly unsatisfactory.

The order of 12th December 2005 concerning nuclear pressure equipment introduced a significant tightening

GRAPH 7: Gaseous radioactive discharges for the NPPs in 2014



up of the justification and monitoring of the design and manufacture of this equipment. It requires that the equipment manufacturers provide more justifications and demonstrations than before, in order to give stronger guarantees concerning the quality of this equipment.

ASN asks the manufacturers to modify their practices in order to bring them into line with the regulatory requirements.

Creating conditions favourable to greater independence on the part of the organisations approved by ASN for assessment of NPE conformity

The approved organisations play a major role in checking compliance with the regulatory requirements which apply to the design and manufacture of nuclear pressure equipment. They are directly or indirectly involved in the inspection of the manufacture of all nuclear pressure equipment, through the authorisations issued by ASN.

Further to ASN's 2014 monitoring of the approved organisations, no significant deviation liable to compromise the justification of their approval was observed. ASN however considers that the organisations it has approved for assessment of NPE conformity need to further reinforce their actions. In 2014, ASN took steps to create the conditions promoting their independence and their authority to help them fully exercise their responsibilities.

5. OUTLOOK

In 2015, ASN actions in the field of the oversight of NPPs will more specifically concern the following topics.

Periodic safety reviews

The beginning of the third ten-yearly outage inspections for the 1300 MWe reactors will mark the completion of the generic phase of their periodic safety review. Monitoring the implementation of the material and documentary modifications resulting from this review, during the ten-yearly inspection of the Paluel 2 reactor in 2015, is a particular challenge, given their scope and their nature, at a time of significant turnover between generations of staff. The experience feedback from this deployment has already identified lessons for the preparation and performance of the fourth periodic safety review for the 900 MWe reactors and the third periodic safety review for the 1450 MWe reactors, for which the generic phase will be intensified in 2015.

Experience feedback from the Fukushima Daiichi accident

Monitoring the implementation of the prescribed material and organisational measures enabling EDF to justify satisfactory control of the basic safety functions in extreme situations remains a priority for ASN. Pursuant to this monitoring, in late 2015 ASN will check that EDF's ability to activate mobile response resources and resources assigned to the nuclear rapid intervention force (FARN) has been extended to the Gravelines site, the only French site comprising six reactors.

ASN will pay particular attention to examining the design, construction and operating provisions adopted by EDF to address the prescriptions concerning the hardened safety core. This includes the review of the modification notification files for the facilities concerning the installation of an additional electricity generating set on each reactor and a new emergency centre for each site.

Oversight of the EPR reactor

OIn addition to the review of the detailed design of the Flamanville 3 EPR reactor, ASN is actively involved in the construction and start-up tests of this reactor on the site, in the engineering centres and at the EDF suppliers. The nuclear safety inspectors will continue with inspections at a sustained rate. 2015 will also see the beginning of the review of the commissioning authorisation application that EDF intends to submit in the spring. The review of this application will enable ASN to check that the requirements of the Flamanville 3 creation authorisation decree and the additional prescriptions it has issued are taken into account. ASN will also continue with the conformity assessments of the nuclear pressure equipment most important for safety.

Adaptation to the provisions of the green growth energy transition bill

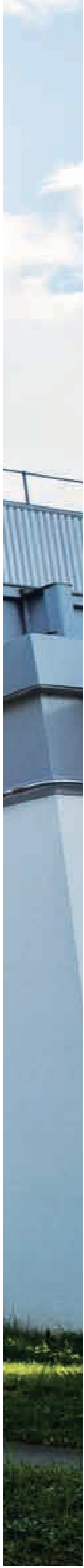
The green growth energy transition bill will lead to changes in the administrative procedures applicable to BNIs. One notable innovation is the principle of an administrative authorisation prior to the implementation of certain changes to a nuclear facility. The NPP reactors will also be subject to reinforced oversight of the periodic safety reviews on the occasion of their fourth ten-yearly inspections. ASN will thus be required to implement these new legislative provisions.

Experience feedback concerning nuclear pressure equipment regulations

ASN has initiated an experience feedback process concerning the nuclear pressure equipment regulations, which it will be continuing in 2015. This will lead to close contacts with the manufacturers, licensees and approved organisations concerning the justifications ASN expects to receive in order to demonstrate compliance with the requirements set by the regulations. ASN will also be continuing with the project to modify the Order of 10th November 1999 relative to the monitoring of operation of the main primary system and the main secondary systems of nuclear pressurised water reactors, to bring it into line with more recent texts.

13
NUCLEAR FUEL CYCLE INSTALLATIONS


asn



The fuel cycle begins with extraction of the uranium ore and ends with the disposal of a range of radioactive wastes arising from the spent fuel. In France, all the uranium mines have been closed since 2000, so the fuel cycle concerns the steps involved in the fabrication of the fuel and then its reprocessing once it has been used in nuclear reactors.

The fuel cycle plants correspond to all facilities performing conversion, uranium enrichment, design and fabrication of fuels for nuclear reactors, that is the front-end part of the cycle, as well as the reprocessing of spent fuel, that is the back-end part of the cycle. These facilities utilise nuclear material, transformed into fuel, based on uranium oxide or a mixture of uranium and plutonium oxides, the plutonium having been generated by burn-up of the enriched natural uranium fuel in power reactors.

The main fuel cycle facilities, namely Areva NC Pierrelatte (Comurhex,TU5/W), Eurodif, GB II, FBFC, Mélox, Areva NC La Hague, are owned by the Areva Group. ASN regulates these industrial facilities and considers that steps must be taken for all the fuel cycle facilities in the Group, so that safety and radiation protection are implemented coherently and in such a way as to promote best practices. ASN monitors the overall consistency of the fuel cycle in terms of safety and regulatory compliance. Areva must in particular demonstrate that its industrial fuel management choices do not compromise the safety of the facilities.

1. THE FUEL CYCLE

The uranium ore is extracted, then purified and concentrated into «yellow cake» on the mining sites. The solid yellow cake is then converted into uranium hexafluoride gas (UF_6). This raw material which will subsequently be enriched is made at the Areva NC plants in Malvési (Aude département) and Pierrelatte (Drôme département). The facilities in question – most of which are regulated under the legislation for installations classified on environmental protection grounds (ICPEs) - use natural uranium in which the uranium 235 content is around 0.7%.

Most of the world's NPPs use uranium which is slightly enriched in uranium-235. For example, the fleet of Pressurised Water Reactors (PWR) require uranium enriched to between 3 and 5% with the 235 isotope. The gas centrifuge process used by the Georges Besse II (GBII) plant, replaced the gaseous diffusion process, employed by the Eurodif plant until June 2012.

The process used in the FBFC plant at Romans-sur-Isère transforms the enriched UF_6 into uranium oxide powder. The fuel pellets manufactured with this oxide are clad to make fuel rods, which are then combined to form fuel assemblies. These assemblies are then placed in the reactor core where they release power by the fission of uranium-235 nuclei.

After about three to five years, the spent fuel is removed from the reactor and cooled in a pool, firstly on the reactor site and then in the Areva NC reprocessing plant at La Hague.

At this plant, the uranium and plutonium from the spent fuels are separated from the fission products and actinides. The uranium and plutonium are packaged and then stored for subsequent re-use. The radioactive waste produced by these operations is disposed of in a surface repository if it is low-level waste, otherwise it is placed in storage pending a final disposal solution.

The plutonium resulting from reprocessing is used either to manufacture fuel for fast neutron reactors or, in the Mélox plant in Marcoule, to manufacture MOX fuel (a mixture of uranium and plutonium oxides), used in particular in some of the French 900 MWe PWR reactors.

Map showing the location of the fuel cycle facilities

The main material flows are presented in table 1.

The existence of nuclear facilities which are necessary for the operation of the BNIs mentioned above must also be noted, in particular Socatri which handles the maintenance and decommissioning of nuclear equipment and the processing of nuclear and industrial effluent from the Areva Group companies in Tricastin, or from Somanu in Maubeuge, which provides off-site servicing and repairs for certain nuclear components.

TABLE 1: Fuel cycle industry movements in 2014

	MATERIAL PROCESSED			PRODUCT OBTAINED (1)		PRODUCT SHIPPED (2)		
INSTALLATION	**ORIGIN**	**PRODUCT**	**TONNAGE** (unless otherwise speci ed)	**PRODUCT**	**TONNAGE** (unless otherwise speci ed)	**PRODUCT**	**DESTINATION**	**TONNAGE** (unless otherwise speci ed)
Comurhex Pierrelatte (3)	SBNI Marcoule	Uranyl Nitrate	-	U_3O_8	-	-	-	-
Areva NC Pierrelatte Atelier TU5	Areva NC La Hague	Uranyl nitrate based on reprocessed uranium	4,527 t	U_3O_8	1,356 t	-	-	-
Areva NC Pierrelatte Usine W	URENCO	Depleted UF_6 of natural origin	2,465 t	U_3O_8	1,964 t	-	-	-
	Eurodif/SET		16,363 t		13,092 t			
Eurodif Pierrelatte (4)	Converters/ group extractions	UF_6 (derived from natural and depleted uranium)	-	UF_6 (natural and depleted)	52 t	UF_6 (natural and depleted)	Defluorination	4,522 t
	Prior group extractions	UF_6 (based on enriched uranium)	-	UF_6 (enriched uranium)	66 t	-	-	-
GB II Pierrelatte	Converters and Eurodif Production	UF_6 (natural)	9,989 t	UF_6 (depleted)	8,551 t	UF_6 (depleted)	Defluorination	8,551 t
				UF_6 (enriched uranium)	1,244 t	UF_6 (enriched uranium)	Fuel manufacturers	1,244 t
FBFC Romans-sur-Isère	SET, GB II, Eurodif, Areva NC, TENEX, SGCE, (Russia), URENCO	UF_6 (based on enriched uranium)	632.347 tU (5)	Fuel elements based on depleted uranium	0.539 tU	Fuel elements based on depleted uranium	TNPJVC (China)	131.56 tU
				Fuel elements based on enriched natural uranium	640.28 tU	Fuel elements based on enriched natural uranium	EDF	514.28 tU
							ELECTRABEL (Belgium)	20.42 tU
							ESKOM (South Africa)	25.97 tU
	CER ENSAM	DEU uranium (depleted or natural)	0.004 kgU	Fuel elements and targets for research reactors, scrap, samples	591.954 kgU	Fuel elements and targets for research reactors, scrap, samples	Lbo Garching (Germany), IES, CER ENSAM, CNRS, ECN PETTEN (Holland)	5.375 kgU
	United States		2.466 kgU					
	CNRS		0.558 kgU					
	CER ENSAM	Low-enrichment uranium (LEU)	0.008 kgU				NECSA (South Africa), Institut REZ (Czech Republic), ANSTO (Australia), CEN MOL (Belgium), CEA, CER ENSAM, ECN PETTEN (Holland), JMTR et KUR (Japan), MARIA (Poland)	478.086 kgU
	États-Unis	High-enrichment uranium (HEU)	15.488 kgU				FRM2 (Germany), CEA, ILL, CEN MOL (Belgium), Institut REZ (Czech Republic), ECN PETTEN (Holland), MARIA (Poland)	245.328 kgU
Mélox Marcoule	Areva NC Pierrelatte	UO_2 (based on depleted uranium)	201.87 tML (6)	Fuel elements MOX	129.69 tML	Fuel elements MOX	CNPE EDF	114.65 tML
	Areva NC La Hague	PuO_2	11.90 tML				FBFC-I Dessel	12.80 tML
							EPZ Borssele (Holland)	3.86 tML
Areva NC La Hague	**Fuels reprocessed in the La Hague plant**							
	EDF reactors, Caorso (Italy)	Spent fuel elements UOX/MOX on UP3-A	685.69 t (U+Pu)	Vitrified waste	1 101 CSD-V (7) 0 CSD-U (7)	Vitrified waste	Switzerland, Holland	84 CSD-V
	ANSTO (Australia), BR2 MOL (Belgium)	RTR spent fuel elements on UP3-A	0.120 t (U+Pu)	PuO_2	13.40 t	PuO_2	Mélox	12.95 t
	EDF reactors, EPZ Borssele (Holland)	UOX/MOX spent fuel elements UP2-800	531.46 t (U+Pu)	Uranyl Nitrate	1,174.02 t	Uranyl Nitrate	Pierrelatte plant	1,174.028 t
				Compacted waste	822 CSD-C (7)	Compacted waste	Switzerland	60 CSD-C
	Fuels stored in the La Hague plant pools							
	EDF reactors, EPZ Borssele (Holland)	UOX spent fuel elements	1,133.07 t (U+Pu)	-	-	-	-	-
	Phénix	RNR spent fuel elements		-	-	-	-	-
	CELESTINS	RTR spent fuel elements		-	-	-	-	-

(1) The products obtained may be shipped or stored in the facility concerned.
(2) The shipped products may have been obtained during the year 2013 or during previous years.
(3) The facilities have been shut down since 2008. In 2013, they reprocessed, produced or shipped no products.
(4) The facilities were shut down in May 2012. In 2013, they only reprocessed, produced or shipped products for operations in preparation for final shutdown of the facilities.
(5) tU: metric ton of uranium.
(6) tHM: ton equivalent heavy metal.
(7) CSD-V: Standard Vitrified Waste Package.
CSD-U: Standard Vitrified Waste Package containing Uranium-molybdenum fission products.
CSD-C: Standard Compacted Waste Package.

1.1 The front-end fuel cycle

Afin de permettre la fabrication de combustibles utilisables dans les réacteurs, le minerai d'uranium doit subir un certain nombre de transformations chimiques, de la préparation du « *yellow cake* » jusqu'à la conversion en hexafluorure d'uranium (UF_6), forme sous laquelle il est enrichi. Ces opérations se déroulent principalement sur le site du Tricastin, situé sur les départements de la Drôme et du Vaucluse, également connu sous le nom de site de Pierrelatte.

1.1.1 The facilities on the Tricastin site

In order to simplify the legal organisation of the Areva Group, a process was initiated in 2012 to merge the Areva subsidiaries on the Tricastin site. This process was completed for the Comurhex BNI in 2013. The change in licensee at Socatri initiated in 2013 was suspended at the request of Areva NC in 2014. On the Romans-sur-Isère site, Areva NP took over responsibility for operating FBFC in 2014.

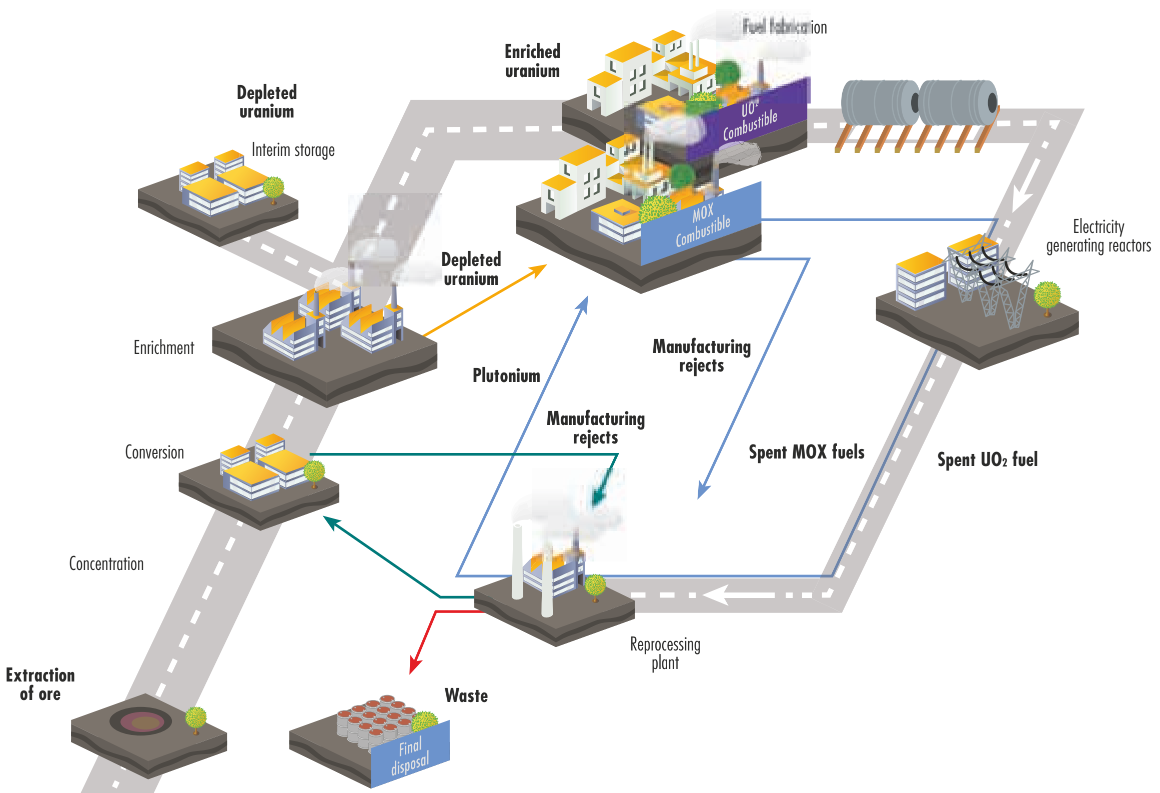
Furthermore, the management of the Tricastin site submitted an authorisation application to ASN on 13th July 2012 for implementation of an internal authorisation process, similar to that already in place on Areva's La Hague site. After a two-year review process, ASN approved this system in resolution 2014-DC-0460 of 23rd September 2014. This relieves the licensees of BNIs 93, 105, 138, 155 and 168 of the need to submit prior notification of modifications and operations considered to be "minor", as they comply with the criteria set by the resolution in question. The resolution requires that the licensees inform ASN of the anticipated programme of operations concerned, at least once a year, and send it an annual summary of the system. This resolution entered into force on 1st January 2015.

Areva NC TU5 facility and W plant - BNI 155

On the Pierrelatte site, Areva NC operates:
- the TU5 facility (BNI 155) for conversion of uranyl nitrate $UO_2(NO_3)_2$ produced by reprocessing spent fuel into uranium sesquioxide U_3O_8;
- the W plant (ICPE within the BNI perimeter) for conversion of depleted uranium hexafluoride (UF_6) into uranium sesquioxide (U_3O_8).

U_3O_8 is a stable solid compound able to guarantee safer uranium storage conditions than in liquid or gaseous form. BNI 155, called TU5, can handle up to 2,000 tonnes of uranium per year, enabling it to reprocess all the uranyl nitrate produced by the Areva plant at La Hague, thus meeting one of the nuclear safety objectives. Once converted, the uranium from

THE FUEL cycle



reprocessing is placed in storage on the Areva NC Pierrelatte site.

In 2012, a new periodic safety review was initiated for BNI 155 with the submission of the orientation file. The review report was transmitted on 28th November 2014.

ASN considers that the level of safety of Areva NC for BNI 155 and ICPE W has progressed in 2014.

The control of nuclear materials containment improved significantly, both during operating phases and during technical shutdowns. The licensee in particular took containment steps for the pneumatic transport lines for materials in powder form.

In addition, in response to the resolutions issued by ASN concerning reassessment of the safety of its facility, Areva NC completed the construction of a new and fully contained storage unit for hydrofluoric acid, improving risk prevention during product transfer operations. The licensee must remain vigilant during transition operations between the old and the new units.

The licensee will also be required to tighten up its practices concerning the connection and disconnection of containers of nuclear material in the nuclear facilities. A number of significant events occurred during these operations in 2014.

Finally, ASN notes a regular increase in the number of events occurring during the transport of radioactive substances since 2012 and asked Areva NC to tighten up its activities in this field.

Comhurex uranium hexafluoride preparation plant - BNI 105

On 1st January 2014, Areva NC took charge of operating BNI 105 and the Pierrelatte conversion plants, in place of Comurhex.

The perimeter of BNI 105 operated by Areva NC includes ICPEs not needed for operation of the BNI. Owing to the risks generated by these ICPEs for the safety of the BNI, ASN encompasses them within the scope of its oversight. These ICPEs are primarily devoted to the fluorination of uranium, in the form of uranium tetrafluoride (UF_4) into uranium hexafluoride (UF_6) so that it can be subsequently enriched. Each year, they produce about 14,000 tonnes of UF_6 from the UF_4 coming from the Areva NC Comurhex facility in Malvési (Aude département). They also produce chlorine trifluoride (ClF_3) for rinsing the diffusion cascade in the Georges Besse plant, in preparation for its final shutdown. This ICPE is one that requires authorisation and comprises institutional controls (Seveso) and is subject to the financial guarantees arrangement for making the facilities safe and, finally, is subject to the industrial emissions directive.

The production tool in the plant is currently being modernised, with the construction and then commissioning of the Comurhex II installations initially scheduled for 2015. Unit 61 already entered service in October 2013. The delays affecting these projects led Areva NC to ask ASN to allow continued operation of the old ICPE plants beyond July 2015. ASN has begun to review this request, recalling that continued operation could only be envisaged subject to an improvement in the level of safety in these installations and provided that their shutdown date was compatible with the process to control urban development around BNI 105 and with the strengthening of the facilities further to integration of the experience feedback from the Fukushima accident. ASN will issue a position statement in the first half of 2015. ASN also considers that Areva NC needs to reinforce its organisation for monitoring and controlling the safety requirements of these new facilities.

On 6th March 2014, the licensee submitted the final shutdown and decommissioning authorisation application file for the old conversion plants, which entered service in 1961 and were shut down in 2008. ASN asked the Minister responsible for Nuclear Safety to suspend the review of the application until such time as Areva NC has completed the file (see Chapter 15).

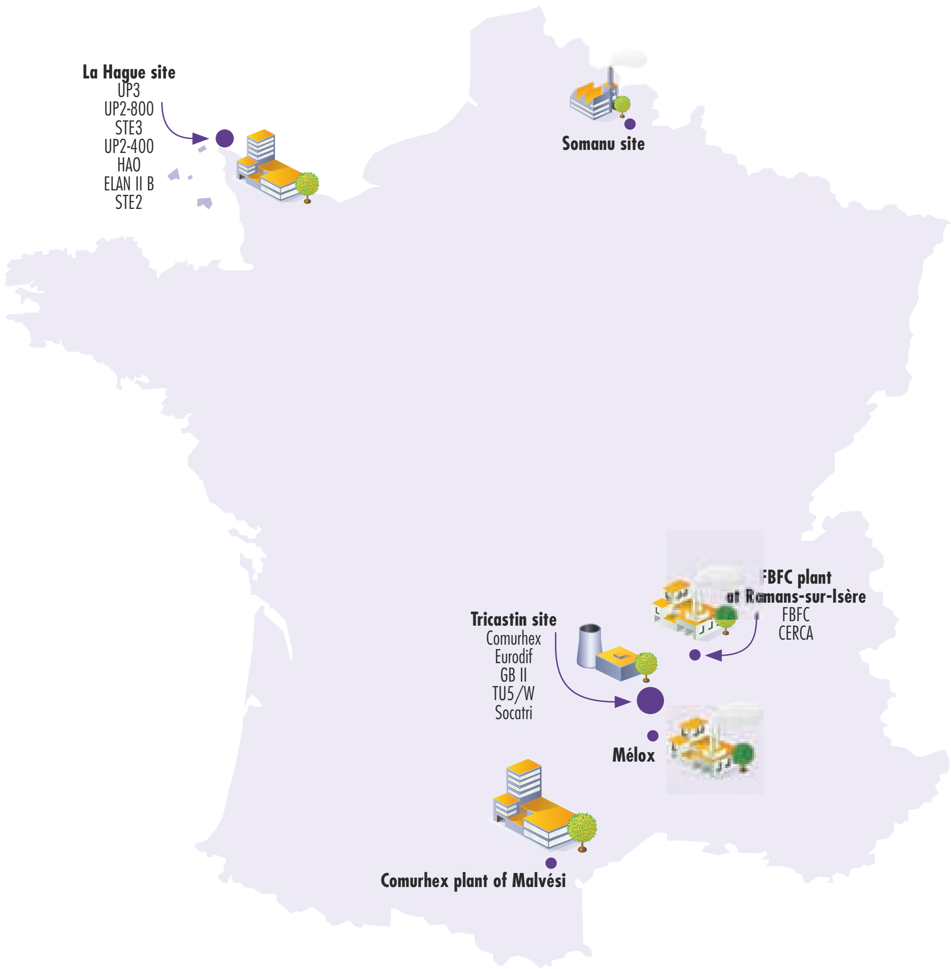
ASN considers that the licensee has an organisation designed to ensure compliance with the applicable rules for maintaining the safety of the BNI and the security of the ICPEs and that it has maintained its efforts to ensure satisfactorily rigorous operations. However, a number of significant events occurred in 2014 concerning the satisfactory control of the first containment barrier and radiological cleanness, despite the improvement works carried out in the structure n°400. ASN also considers that compliance with discharge control rules are also still an area for improvement.

In 2015, ASN will finalise the revision of the resolutions concerning discharges form legacy facilities and the authorisation of ICPEs.

The Eurodif gaseous diffusion enrichment plant – BNI 93

The Eurodif Production facility, licensed in 1977, mainly consisted of a plant for separation of the isotopes of uranium using the gaseous diffusion process, with a nominal annual capacity of 10.8 million separative work units. Decree 2013-424 of 24th May 2013 authorised the licensee to carry out the first intensive rinsing operations followed by venting of Eurodif (Prisme) which mainly consisted in repeated rinsing of the gaseous diffusion circuits with ClF_3, a toxic and hazardous substance, in order to extract virtually all the uranium deposited in the barriers. Before 31st March 2015, Areva NC must submit a final shutdown and decommissioning (MAD-DEM) authorisation application file. The licensee and

MAP showing the location of the fuel cycle facilities



ASN regularly meet to prepare this file, which raises particular problems linked to the size of the plant and the waste which will be produced during the decommissioning operations, more specifically the 130,000 tonnes of steel from the diffusers.

In this context of activity cessation and major organisational restructuring, ASN has observed a deterioration in Eurodif Production's safety level. Following repeated observations by ASN in 2013 and 2014, revealing shortcomings in terms of change management, compliance with safety requirements and operational rigorousness, Eurodif Production initiated an action plan in 2013 to reinforce its control of Social, Organisational and Human Factors (SOHF) and, in 2014 initiated a review of the conformity of the facilities and operating practices with the general operating rules. In 2014, ASN also noted that the new organisation designed to share a certain number of "support" activities on the Areva platform in Tricastin, in particular safety, radiation protection, the environment and security, was correctly incorporated into the organisation of the departments but that it needs to be consolidated both with regard to the definition of the scope of action of the various entities and with regard to the harmonisation of working practices and tools.

Owing to technical difficulties, the cascade venting operations were delayed and only started at the end of December 2014.

The Georges Besse II gas centrifuge enrichment plant - BNI 168

BNI 168, called Georges Besse II (GB II), licensed in 2007 and operated by the Société d'enrichissement du Tricastin (SET), is a plant enriching uranium by means of gas centrifugation. The principle of this process involves injecting UF_6 into a cylindrical vessel rotating at very high speed. The centrifugal force concentrates the heavier molecules (containing uranium-238) on the periphery, while the lighter ones (containing uranium-235) are recovered in the centre. By combining several centrifuges, creating what is known as a cascade, it is then possible to recover a stream enriched with fissile isotope 235 and a depleted stream. This process has two key advantages over the Eurodif gaseous diffusion process:

it consumes far less electrical energy (75 MWe as against 3,000 MWe for equivalent production) and is safer, because the quantities of material present in the centrifuge cascades are far smaller (6 tonnes in GB II instead of 3,000 tonnes in Eurodif) and are utilised in gas form at below atmospheric pressure.

The GB II plant comprises two separate enrichment units (South and North units) and a support unit, the REC II. In early 2009, ASN authorised commissioning of the South enrichment facility. Today, all the cascades in the South unit are in service.

The North facility is built along the same lines as the South facility but only contains six rather than eight modules and differs in that it can enrich the uranium resulting from reprocessing of spent fuel in the first pair of modules. The start-up authorization for this facility was given by ASN on 31st January 2013. The enrichment of uranium resulting from reprocessing requires prior authorisation by ASN. As at the end of 2014, five of the six modules were in operation. ASN considers that the level of safety of the Georges Besse II plant was satisfactory in 2014.

The Atlas facility project

In November 2011, Areva NC sent ASN a creation authorization application for a new BNI on the Tricastin site, called ATLAS. The purpose of this project is to bring together the activities currently performed by the industrial analysis laboratories specific to the various Areva facilities on the Tricastin and Romans-sur-Isère sites. This authorisation application, on which the environmental authority issued an opinion on 9th October 2013 and which was the subject of a public inquiry from 28th April to 28th May 2014, is currently being reviewed by ASN. The authorisation procedure should be completed in early 2015.

TO BE NOTED

Continued commissioning of the Georges Besse II plant

In a resolution dated 7th October 2014, ASN thus authorised start-up of the reception, sampling and packaging unit called REC II. Most of the main safety issues for BNI 168 are present in the REC II unit, owing to the use of UF_6 in liquid form for certain material transfer operations, therefore with toxicity and reactivity implications. It is considerably safer than its predecessor, the Eurodif DRP (or REC) unit, which it replaces.

The Écureuil facility project

In 2012, Areva submitted a safety options file for the Écureuil project for the creation on the Tricastin site of an extension to the storage capacity for U_3O_8 from reprocessing, using existing and previously delicensed buildings. ASN issued an opinion on the options file in October 2013. After taking steps to optimise the existing storage facilities on the site, making it possible to push back the storage saturation date from 2019 to 2021, Areva is today envisaging an alternative to the Écureuil project, which consists in putting up new, modular buildings which would allow extensions to be made. Areva envisages submitting a creation authorisation application for a new BNI in late 2015.

1.1.2 Nuclear fuel fabrication plants in Romans-sur-Isère

On completion of the uranium enrichment stage, the nuclear fuel is fabricated in various installations, depending on the type of reactor for which it is intended. The fabrication of fuels for electricity generating reactors involves the transformation of UF_6 into uranium oxide powder. In the FBFC plant, this powder is used to fabricate pellets which are then made into fuel rods, which in turn are grouped to form fuel assemblies. Some experimental reactors use highly enriched uranium in metal form. These fuels are manufactured by the CERCA plant at Romans-sur-Isère.

CERCA and FBFC, the two BNIs located on the Romans-sur-Isère site, have been operated by the Areva NP company since 1st January 2015.

The FBFC nuclear fuel fabrication plant – BNI 98

In recent years, the licensee has modified the organisation of the units and renovated the equipment. This renovation has in particular reduced the exposure of the workers through improved containment of the powders. FBFC nonetheless experienced difficulties, on the one hand concerning control of the ventilation flows (uranium-bearing material in the ducts) and on the other, concerning renewal of the industrial equipment. The licensee asked ASN several times to extend the operating life of the ageing equipment (powder homogeniser, sintering oven, etc.). ASN refused the latest extension application for the sintering ovens, in particular owing to insufficient compensatory measures.

The licensee is also late in finalising the renovation of the uranium-bearing scrap recycling facility (R1) more specifically with regard to containment and the fire and earthquake risk. ASN will be particularly attentive to the project completion deadlines.

At the same time, on 30th December 2014, the facility submitted a new version of its ten-yearly periodic safety report, completed further to ASN's requests concerning the incomplete file version submitted in 2013.

In-depth ASN inspection of the FBFC plant in Romans-sur-Isère, November 2014.

TO BE NOTED

ASN reinforces its monitoring of the FBFC plants

The ASN Commission considers that FBFC needed to significantly tighten up its operations and its safety management and called the plant's management and Areva to a hearing on 14th February 2014, asking for implementation of an ambitious action plan to improve the safety of the facility. FBFC met the first deadlines of the action plan transmitted.

The in-depth inspection which took place from 24th to 28th November 2014 concerned the rigorousness of the licensee's operations. ASN noted the priority given to safety since the beginning of 2014 and the proactive approach adopted, with the involvement of all the staff. The main conclusions of this inspection are that the licensee has acquired the means to improve the rigorousness of its operations, as expected by ASN. The reorganisation and the actions examined by ASN were relatively recent. The large number of measures identified will however need to be consolidated and retargeted in order to prioritise the measures which will allow compliance with the regulations, such as management of the modification process or monitoring of activities important for protection.

On the whole, ASN noted improvements in the licensee's organisation during the course of the eighteen inspections carried out in 2014. The licensee must nonetheless still deal with a large number of "legacy" dossiers.

The Cerca nuclear fuel fabrication plant – BNI 63

This plant is one of the oldest French nuclear facilities still in service. There are major nonconformities in the structures of the buildings and equipment by comparison with current safety standards, in particular in terms of the ability to withstand earthquakes, extreme climatic events and stability in the event of fire. Despite ASN's repeated reminders since the 2006 periodic safety review, Areva NP is struggling to initiate the necessary renovation work and has even mentioned the possibility of closing the facility within the next few years owing to its obsolescence and the cost involved in upgrading it. This is why, in a resolution of 9th January 2015, ASN decided to require work to ensure the conformity of these facilities or, failing which, the removal of all radioactive materials.

The activities carried out in the units are essentially manual (little or no automation), so organisational and human factors play a key role in the prevention of the criticality accident risk. Two significant criticality events rated level 1 on the INES scale (International Nuclear and Radiological Event Scale) which occurred one year apart, are a clear indication of the licensee's difficulty in satisfactorily managing this subject. Since 2014, the licensee has tightened up its monitoring practices and has implemented a plan to improve its control of the criticality risk, the effectiveness and sustainability of which will need to be verified.

In order to improve the regulatory oversight of the activities carried out within the facility and of its operating range, and following consultation of the licensee and the public, ASN will publish a resolution in 2015.

1.2 The back-end fuel cycle - reprocessing

1.2.1 Areva NC reprocessing plants in operation at La Hague

The La Hague plants, intended for reprocessing of spent fuel assemblies from nuclear power reactors, are operated by Areva NC.

The various facilities of the UP3-A and UP2-800 plants and of the STE3 effluent treatment station were commissioned from 1986 (reception and storage of spent fuel assemblies) to 1994 (vitrification facility), with most of the process facilities entering service in 1989-1990.

The decrees of 10th January 2003 set the individual reprocessing capacity of each of the two plants at 1,000 tonnes per year, in terms of the quantities of uranium and plutonium contained in the fuel assemblies before burn-up (in the reactor), and limit the total capacity of the two plants to 1,700 tonnes per year.

The limits and conditions for discharges and for water intake are currently defined by the order of 8th January 2007.

Operations carried out in the plant

The reprocessing plants comprise several industrial units, each of which performs a specific operation. There are thus the reception and storage installations for spent fuel, facilities for shearing and dissolving it, for chemical separation of fission products, uranium and plutonium, for purification of the uranium and plutonium and for treatment of effluents and conditioning of waste.

When they arrive in the plants, the spent fuel assemblies in their transport packagings are unloaded either under water in the spent fuel pool, or in a dry, leaktight, shielded cell. The assemblies are then stored in pools for cooling.

The assemblies are then sheared and dissolved in nitric acid to separate the pieces of metal cladding from the fuel substances. The pieces of cladding, which are insoluble in nitric acid, are removed from the dissolver, rinsed in acid and then water, and transferred to a packaging unit.

The nitric acid solution comprising the fuel substances is then processed in order to separate the uranium and plutonium from the fission products and other transuranic elements.

After purification, the uranium is concentrated and stored in the form of uranyl nitrate $UO_2(NO_3)_2$. It is intended for conversion into a solid compound (U_3O_8) in the Tricastin TU5 facility.

After purification and concentration, the plutonium is precipitated by oxalic acid, dried, calcined into plutonium oxide, packaged in sealed containers and placed in storage. The plutonium is then used in the fabrication of MOX fuel.

The effluents and waste generated by the operation of the plants

The fission products and other transuranic elements resulting from reprocessing are concentrated, vitrified and packaged in standard vitrified waste packages (CSD-V). The pieces of assembly cladding are compacted and packaged in standard compacted waste packages (CSD-C).

The reprocessing operations described in the previous paragraph also use chemical and mechanical processes, the operation of which generates gases and liquid effluents as well as solid waste.

The solid waste is also packaged on-site, either by compacting, or by encapsulation in cement. The solid radioactive waste from the reprocessing of spent fuel from French reactors is, depending on its composition, either sent to the low- and intermediate-level, short-lived waste repository at Soulaines (see Chapter 16) or stored on the Areva site at La Hague, pending a final disposal solution (in particular the CSD-V and CSD-C).

In accordance with Article L. 542-2 of the Environment Code concerning radioactive waste management, radioactive waste from the reprocessing of spent fuels of foreign origin is shipped back to its owners. It is however impossible to physically separate the waste according to the fuel from which it comes. In order to guarantee fair distribution of the waste among its various customers, the licensee proposed an accounting system for monitoring items entering and leaving the La Hague plant. This system, called Exper, was approved by order of the Minister responsible for Energy on 2nd October 2008.

The gaseous effluents are given off mainly during fuel assembly shearing and during the dissolving operation. These gaseous effluents are processed by scrubbing in a gas treatment unit. Residual radioactive gases, in particular krypton and tritium, are checked before being released into the atmosphere.

The liquid effluents are processed and generally recycled. After verification and in accordance with the discharge limits, certain radionuclides, such as iodine and tritium, are sent to the marine outfall pipe. The others are sent to on-site conditioning units (solid glass or bitumen matrix).

1.2.2 The current situation of the La Hague plants

Examination and follow-up of the periodic safety review files

In 2008, ASN examined the conclusions of the periodic safety review for BNI 118, which includes the Effluent Treatment Station (STE3), the solvent mineralisation facility (MDS-B) and the sea discharge outfall pipe. ASN is particularly attentive to licensee compliance with the undertakings made during this periodic safety review. ASN observed that, on the whole, the licensee is late in meeting its initial undertakings, in particular concerning the performance of conformity examinations on the facility and the processing of legacy waste.

In 2010, the licensee transmitted the periodic safety review report for BNI 116 (UP3-A plant) and started that of BNI 117 (UP2-800 plant). At the request of ASN, IRSN assessed the report submitted by Areva and presented the results of its assessment to the Advisory Committee for laboratories and plants (GPU) during six meetings from mid-2012 to March 2015.
- The first GPU meeting took place on 27th June 2012. It examined the method and the data used by Areva NC for the performance of this review, as well as the approach used to identify the Elements

UNDERSTAND

The installations at La Hague

The closed facilities in the final shutdown and decommissioning phase:
- **BNI 80:** Oxide High Activity facility (HAO)
  - HAO/North: Facility for underwater unloading and spent fuel storage
  - HAO/South: Facility for shearing and dissolving of spent fuel elements
- **BNI 33:** UP2-400 facility, first reprocessing unit
  - HA/DE: Facility for separation of uranium and plutonium from fission products
  - HAPF/SPF (1 to 3): Facility for fission product concentration and storage
  - MAU: Facility for uranium and plutonium separation, uranium purification and storage in the form of uranyl nitrate
  - MAPu: Facility for purification, conversion to oxide and initial packaging of plutonium oxide
  - LCC: Central product quality control laboratory
  - ACR: Resins packaging facility
- **BNI 38:** STE2 facility: collection, treatment of effluents and storage of precipitation sludge, and AT1 facility, prototype installation currently being decommissioned
- **BNI 47:** ELAN II B facility, CEA research installation currently being decommissioned

Installations in operation:
- **INB 116 :** UP3-A facility
  - T0: Facility for dry unloading of spent fuel elements
  - D and E pools: Pools for storage of spent fuel elements
  - T1: Facility for shearing of fuel elements, dissolving and clarification of solutions obtained
  - T2: Facility for separation of uranium, plutonium and fission products, and concentration/storage of fission product solutions
  - T3/T5: Facilities for purification and storage of uranyl nitrate
  - T4: Facility for purification, conversion to oxide and packaging of plutonium
  - T7: Facility for vitrification of fission products
  - BSI: Facility for plutonium oxide storage
  - BC: Plant control room, reagent distribution facility and process control laboratories
  - ACC: Hull and end-piece compaction facilities
  - AD2: Technological waste packaging facility
  - ADT: Waste transit area
  - EDS: Solid waste storage area
  - D/E EDS: Storage/removal from storage of solid waste
  - ECC: Facilities for storage and recovery of technological waste and packaged structures
  - E/EV South-East: Vitrified waste storage facility
  - E/EV/LH and E/EV/LH 2: extension of vitrified residues storage capacity
- **BNI 117**: usine UP2-800
  - NPH: Facility for underwater unloading and storage of spent fuel elements in pool
  - C pool: Pool for storage of spent fuel elements
  - R1: Fuel elements shearing, dissolving and resulting solutions clarification facility (including the URP: plutonium re-dissolution facility)
  - R2: Uranium, plutonium and fission product separation, and fission product solution concentration facility (including the UCD: alpha waste centralised processing unit)
  - R4: Facility for purification, conversion to oxide and initial packaging of plutonium oxide
  - SPF (4, 5, 6): Facilities for storage of fission products
  - BST1: Facility for secondary packaging and storage of plutonium oxide
  - R7: Facility for vitrification of fission products
  - AML - AMEC: Packaging reception and maintenance facilities
- **BNI 118:** STE3 facility: effluent recovery and treatment and storage of bituminised waste packages
  - D/E EB: storage of alpha waste
  - MDS/b: mineralisation of solvent waste

Important for Safety and how it was applied to BNI 116.
- The second GPU meeting was held on 12th June 2013 and examined operating experience feedback, more specifically concerning the incidents that had occurred.
- The third meeting of the Advisory committee took place on 14th January 2014 and was devoted to reviewing the safety of on-site transport operations carried out with the Hermes-Mercure and Navettes package models.
- The fourth meeting of the Advisory Committee on 26th March 2014 was devoted to reviewing the conformity of BNI 116 with its baseline safety requirements, the satisfactory control of the ageing of this facility and the safety of maintenance operations.
- The next two meetings of the GPU scheduled for March 2015 will be reviewing:
  - the safety reassessment conducted by the licensee, in particular in the light of changing regulations and best practices in the field of safety and radiation protection, as well as the lessons learned from operating experience feedback from the facility;
  - the programme of measures defined by the licensee to improve the safety of its facility, in order to rule on the level of safety of the UP3-A plant both now and for the next ten years.

The conclusions of the review will be the subject of an ASN resolution and a report to the Minister responsible for Nuclear Safety at the end of the review process.

ASN asked Areva NC to take account of experience feedback from examination of the UP3-A plant reassessment file when preparing the reassessment file for the UP2-800 plant, to be transmitted before 31st December 2015.

Internal authorisation systems for minor modifications

ASN approved the implementation of a system of internal authorisations for minor operations on the La Hague site in its 14th December 2010 resolution. This system provides for two internal authorisation levels, depending on the extent of the operations and the associated radiation protection and safety implications. Before a planned operation or modification is authorised, it is assessed - depending on its assigned level - by either a safety specialist independent of the requesting operating unit, or, for the most significant operations, an Internal Authorisations Assessment Committee (CEDAI). In 2014, ASN verified the correct operation of this system during specially dedicated inspections. In 2014, ASN also received operating experience feedback about the working of the internal authorisations system, which Areva was supposed to have transmitted after it had been in use for three years. This information will be of use in examining the application for revision of the internal authorisations system that Areva intends to submit in 2015, to integrate on the one hand the changes made following the ASN inspections and the Areva general inspection and, on the other, the new procedures in particular concerning the composition of the CEDAI and the criteria for identifying minor operations.

Areva NC monitoring of the status of evaporator capacity

In 2011, Areva NC brought to light several holes in the shell of an evaporator used to concentrate fission product solutions in the R7 unit. This evaporator could not be returned to service and needs to be replaced. In mid-2012, the licensee sent ASN a file presenting the safety options it had selected for the design of the new evaporator, to replace the old one. Examination of this file continued in 2014. The deployment of this new evaporator is today scheduled for about 2017.

Furthermore, in October 2014, high corrosion rates were observed on the fission product solutions concentration evaporators in the R2 unit. These rates are higher than those of the equipment design and higher than those observed on the same equipment in the T2 unit. ASN asked the licensee to explain this difference between the R2 and T2 units and to analyse the impact of this accelerated corrosion mechanism on the security of the plant's evaporator capacity for the coming years.

Radiation protection

In 2014, as in previous years, ASN considers that worker radiation protection in the La Hague plant is on the whole satisfactory. The staff of outside contractors, in particular those working on the final shutdown and decommissioning of the UP2-400 plant, are the most exposed workers in the facility. No occupational regulation dose was observed to have been exceeded in the La Hague facility in 2014.

1.2.3 Ongoing and future plant modi cations

Authorisation applications for processing of new types of fuels

The operating range of the plants is defined in the 12th May 1981 creation authorisation decrees for the plants on the La Hague site, updated in 2003 for each type of fuel assembly in the above-mentioned decree.

In 2011, Areva NC asked for authorisation to receive, store and reprocess MOX fuels from the Italian Trino and Garigliano reactors, in the UP3-A and UP2-800 plants on the La Hague site. It became apparent that the specific characteristics of the MOX fuels from the Garigliano NPP exceeded the range authorised by the modified creation authorisation decrees for the UP3-A and UP2-800 plants, meaning that their reprocessing at La Hague first required that the decrees be further modified. Areva NC intends to submit a modification application for the above-mentioned decrees.

As the MOX Trino fuels are compatible with the decrees in force, Areva NC asked for authorisation to receive, store and reprocess the fuel assemblies from the Trino NPP. This file is currently being examined by ASN.

In 2013, Areva NC applied for authorisation to extend the operating range of its facilities so that on the one hand it could receive and store fuel pins irradiated in the Phenix reactor, prior to reprocessing and, on the other, so that it could reprocess fuels based on Enriched Reprocessed Uranium (URE), while remaining with the operating range specified by the Decrees of 12th May 1981. These authorisations were issued by ASN in 2014 by the resolutions of 11th March 2014 and 24th April 2014 respectively.

In 2014, Areva NC also applied for ASN authorisation to extend the operating range of its plants to reprocess enriched natural uranium based fuels (UNE) resulting from "Galice" fuel management in EDF's reactors. This file is currently being examined by ASN.

An application for modification of the characteristics of the MOX fuels authorised for reception, storage and reprocessing in La Hague was also submitted, but without this compromising the operating range of the plants.

Implementation of new storage capacity for vitrified waste packages

The construction of the first vitrified waste storage extension on the La Hague site (EEVLH) in order to anticipate saturation of storage capacity for vitrified waste packages on the La Hague site (R7, T7 and EEVSE) which began in 2007, was completed in 2013. This extension comprises two pits, known as pits 30 and 40, each able to increase the existing facility's storage capacity by 4,199 packages.

Initially, only pit 30 was equipped with its storage shafts. After ASN authorisation in its resolution of 12th September 2013, this pit 30 was partially commissioned on 17th September 2013 with a storage capacity limited to six packages of vitrified waste per shaft. ASN considered that the safety demonstration did not allow it to go any further than this, in particular in terms of removal of the thermal power from the waste packages at full capacity. In 2014, the licensee completed its safety analysis in order to obtain a lifting of the current operating restrictions in the summer of 2015. This file is currently being reviewed by ASN.

The storage capacity projections for these packages show the need for a doubling of the current capacity by 2017-2018. On 4th June 2013, Areva NC sent the Minister in charge of nuclear safety a file applying for authorisation to modify the UP3-A (BNI 116) plant, in order to increase its storage capacity for standard vitrified waste containers (CSD-V):
- 4,199 additional spaces with the outfitting of pit 40 of the EEVLH extension;
- 8,398 additional spaces with the construction of the EEVLH 2 extension, an installation equivalent to EEVLH and comprising two new pits (pits 50 and 60).

This file is currently being reviewed by ASN and was the subject of an opinion by the environmental authority in September 2014. It will then be the subject of a public inquiry in 2015.

Implementation of new process in STE3

On 4th May 2012, Areva NC submitted a modification authorisation application for BNI 118 to the Minister responsible for Nuclear Safety. The purpose of this modification application is to allow processing and packaging of the sludges stored in the STE2 facility, by means of a new process to be utilised within an existing building of the STE3 facility, in place of one of the two bituminisation lines (line A).

This process will consist of the following:
- drying of the STE2 treatment sludges;
- compacting of the powder resulting from drying, in the form of pellets;
- packaging of the pellets in a package filled with an inert material (C5 package);
- storage of the C5 packages, pending opening of a long-term management solution.

This file is currently being reviewed by ASN. It was the subject of an opinion from the environmental authority on 5th June 2013 and a public inquiry from 22nd January 2014 to 21st February 2014. The decree modification procedure should be completed in the first half of 2015.

Complete renovation of energy production required for operation of the plants

In July 2012, Areva NC submitted a project to ASN for the complete renovation of the fleet of boilers that produce the energy necessary for operation of the La Hague plants. Areva NC plans to replace them with one wood biomass boiler and two new oil-burning boilers. These installations are subject to licensing as individual ICPEs, and to notification as equipment items necessary for the operation of a BNI, respectively. Areva effectively indicated in its file that the oil-burning boilers were sufficient to provide the energy necessary for safe operation of the plants, and that in the event of failure of the biomass boiler, the oil-burning boilers would immediately take over. This project, which requires an extension of the perimeter of BNI 117, is currently awaiting validation of the Local Urban Planning scheme (PLU) for the communes around the La Hague site.

The special fuels reprocessing unit project

In 2014, Areva also presented ASN with a project to install a new special fuels reprocessing unit (TCP). This unit would comprise new shearing and dissolving equipment, in particular for the spent fuels from test and research reactors and the Phenix reactor. The R&D studies linked to this project are still to be finalised.

With regard to the authorisation to receive and reprocess spent fuels from the Phenix reactor, Areva has undertaken to transmit a safety options file for this new reprocessing unit, before the end of 2015. This undertaking was taken up in the ASN resolution of 11th March 2014 which also prescribes the submission of an application for authorisation to modify the facility before 31st December 2018.

1.2.4 Recovery and packaging of legacy waste

The former UP2-400 plant has been finally shut down since 1st January 2004. The final shutdown and decommissioning operations for the UP2-400, HAO and STE2 facilities and the ELAN II B unit are described in detail in Chapter 15.

Unlike the on-line packaging of the waste generated by the new UP2-800 and UP3-A plants at La Hague, most of the waste generated by the first UP2-400 was stored without any permanent packaging. The operations involved in recovering this waste are technically difficult and require the use of considerable resources. The difficulties associated with the age of the waste, in particular the need for characterisation prior to any recovery and processing, confirm ASN's approach which, for any project, requires the licensees to assess the corresponding production of waste and make provision for processing and packaging as and when the waste is produced. The recovery of the waste contained in the old storage facilities on the La Hague site is also a precondition for the decommissioning and clean-out of these storage facilities.

The recovery of legacy wastes from the La Hague site is thus monitored particularly closely by ASN, mainly because of the major safety and radiation protection implications associated with it. Furthermore, recovery of the site's legacy waste is one of the Areva group's major commitments, made within the framework of the ministerial authorisations to start up new spent fuel reprocessing plants (UP3-A and UP2-800) in the 1990s.

The initial schedule for the recovery of these wastes drifted significantly in the 2000s and has continued to drift in recent years. ASN considers that the deadlines must no longer be pushed back, because the buildings in which this legacy waste is stored are ageing and no longer comply with current safety standards. ASN in particular considers that Areva NC must as rapidly as possible recover the legacy waste produced by operation of the UP2-400 facility, more specifically the sludges stored in the STE2 silos, the waste from the HAO and 130 silos and the fission products solutions stored in the SPF2 unit.

A final decision must be reached concerning disposal routes or new intermediate storage facilities, because their implementation involves large-scale projects: further postponement would jeopardise compliance with the deadlines set by the Environment Code, which states that the owners of intermediate level long-lived waste produced before 2015 must package it by 2030 at the latest.

TO BE NOTED

ASN oversees the recovery of legacy waste at La Hague

In the light of the points mentioned in the box opposite, ASN has since 2012 been drafting a resolution on the Waste Recovery and Packaging programme (RCD) aiming more specifically to regulate the progress and performance of this programme according to the safety implications of the operations. The preparation of this draft resolution entailed Areva NC being called to a hearing by the ASN Commission on 17th June 2014, during which ASN recalled that it would be particularly attentive to compliance with the deadlines concerning the RCD programme. The resolution concerning the legacy waste recovery and packaging operations was signed by the ASN Commission on 9th December 2014 following consultation of the public and the local information committee.

At ASN's request, Areva NC defined the safety priorities for these RCD operations:
- Priority 1 storage (highest priority):
  - in BNI 33: tanks 2720-10, 2720-20 and 2720-30 in the SPF2 unit;
  - in BNI 38: silo 130, silos 550-10 to 15 in the STE2-A unit and 550-17 in the STE-V unit;
  - in BNI 80: the HAO Silo;
- Priority 2 storage:
  - in BNI 33: settling tanks 1 to 5 in the "cladding removal" unit and 6 to 9 in the HA/DE unit, pits 217.01 and 217.02 of the "cladding removal" unit and the organised disposal pool (SOD) for gas-cooled reactor structural waste;
  - in BNI 38: silo 115;
  - in BNI 80: pools S1, S2 and S3 for organised hulls disposal (SOC);
- Priority 3 storage:
  - in BNI 33: area 791 in the plutonium intermediate level facility (MAPu);
  - in BNI 38: pits 2 and 26 in the North-West zone, the pit in building 128, building 119, the Parc aux Ajoncs and the trenches in the North-West zone;
  - in BNI 47: the elution columns and strontium titanate capsules;
  - in BNI 118: tanks 6523-50 and 6610-20 in the STE3 and MDSA units.

STE2 sludges

Since 2010, the scenario for the recovery and packaging of STE2 sludges has been stabilised and consists in transfer of the sludges to BNI 118 (STE3) for processing and packaging via a new process as yet to be built (see point 1.2.3). The recovery of these sludges should be completed no later than 31st December 2030 in accordance with the provisions of the Environment Code. The envisaged corresponding waste packages are called C5 packages.

In its resolution 2011-DC-0206 of 4th January 2011, ASN stipulated that it must first approve the production of this type of package, for which the design must take account of the risk of radiolysis leading to the production of hydrogen.

Silo 130

Further to the licensee's postponement of waste recovery from Silo 130 because of its outdated design and uncertainties as to the resistance of its civil engineering structure over time, ASN issued prescriptions on 29th June 2010 requiring that the licensee take compensatory safety measures, to be implemented before mid-2012. As these measures had not been taken by Areva NC before mid-2012, ASN served formal notice on the licensee to perform these operations before 9th December 2013 in a Resolution of 26th March 2013. In 2014, ASN ran a field check to ensure that the above-mentioned measures had been taken, which enabled it to lift its formal notice. An exercise simulating a leak from silo 130 was also carried out by the licensee in 2014, at the request of ASN, and confirmed the ability of the licensee's organisation to manage such a situation.

Old fission product solutions stored in the SPF2 unit in the UP2-400 plant

To package fission products from reprocessing of gas-cooled reactor fuel, in particular that containing molybdenum (UMo FP), the licensee has opted for cold crucible vitrification. The package thus produced is called CSD-U (UMo standard waste package).

The use of the cold crucible with legacy solutions was authorised by an ASN resolution of 20th June 2011. In 2013, the first CSD-U were produced but the cold crucible has remained unavailable since then owing to a technical problem. It is scheduled for restart in 2015.

Other legacy waste recovery and packaging projects

Among the other lower-priority legacy waste recovery and packaging projects, the following general points should be noted for 2014:
- continued R&D studies on the packaging processes for GCR and low granulometry type wastes;
- continuation of operations to recover drums from building 119;
- the application for authorisation to transfer the elution columns and strontium titanate capsules to improve the safety of the storage conditions and perform investigations.

TO BE NOTED

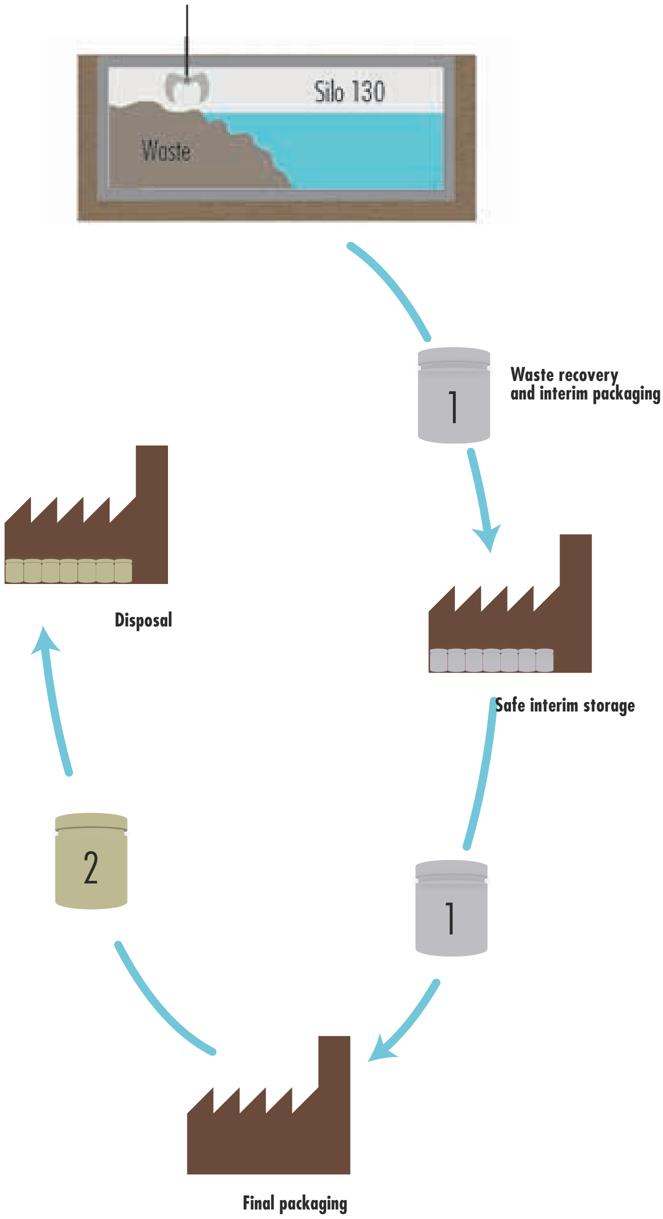
The RCD operations for silo 130

Silo 130 is situated within the perimeter of the site's old effluent treatment station. The silo 130 containment is underground. It is made of reinforced concrete and designed for dry storage of the solid waste generated by reprocessing of spent fuel from the gas-cooled reactor (GCR) plant series. As of 1973, the silo received waste of this type, until the 1981 fire which forced the licensee to flood the waste. The tightness of the silo thus filled with water is ensured by means of a containment barrier consisting of a steel liner.
Should its single containment barrier fail, silo 130 represents a risk of environmental contamination with radioactive materials. In its resolution of 29th June 1020, ASN thus required Areva NC to implement means of monitoring the tightness and mitigating the consequences of a possible leak from silo 130.

The RCD operations for silo 130 can be divided into two distinct phases (see diagram below):
- first step: waste recovery and safe interim storage; this first step, which takes several years and is designed to ensure rapid improvement of the safety of the current silo 130 by emptying it of its waste and storing it safely, pending the development of final disposal solutions; the package intended for interim packaging of the waste from silo 130 has not yet been finally determined;
- second step: final packaging and disposal of the waste; this second step intends to carry out final packaging of the waste from silo 130 in an appropriate disposal package and to dispose of this waste in a dedicated facility. If this disposal facility is not available at the time of final packaging of the waste, additional interim storage could prove necessary.

Areva NC is today focusing on building the recovery cell, for which the first work will start in early 2015. ASN set 1st July 2016 and 31st December 2022 as the latest dates for the beginning and end of the recovery operations for all the waste.

DIAGRAM of recovery and packaging operations



1. Interim package - 2. Final package

MOX fuel assembly being loaded into a shipment container in the Mélox plant in Bagnols-sur-Cèze.

1.3 The back-end fuel cycle: fabrication of MOX fuel

The Mélox uranium and plutonium-based fuel fabrication plant

BNI 151 Mélox, situated on the Marcoule nuclear site, operated by Areva NC, is today the world's only nuclear installation producing MOX fuel, which consists of a mixture of uranium and plutonium oxides.

The facility's periodic safety review file was sent by the licensee on 21st September2011. One of main issues which came out of the review was controlling worker exposure to ionising radiation and adaptation of the facility and its organisation to changes in the composition of the materials used. In its resolution of 15th July 2014, ASN stipulates that continued operation of the plant is dependent on compliance with the prescriptions for controlling the risk of worker exposure to ionising radiation, the criticality risk and the risk of fire. It in particular prescribes the oversight of the measures identified during the review and the undertakings made by the licensee.

In 2012, at the same time as the Tricastin site licensees, Mélox submitted an application for authorisation to implement an internal authorisations process. This authorisation was granted by the ASN resolution of 23rd September 2014.

In 2014, ASN notes the considerable work done by Areva NC in the working environment studies and the corresponding steps taken to optimise dosimetry. It also notes the progress made by the licensee in its monitoring of subcontracted operations. ASN nonetheless remains particularly attentive to ensuring that the organisation is adapted to the changes in the plant and to the occupational radiation protection optimisation measures taken.

ASN observed progress in the consideration given to radiation protection issues, the management of the criticality risk and the monitoring of outside contractors. ASN will nonetheless remain particularly attentive to these questions. The condition of the barriers and the rigorousness of operations are considered to be satisfactory. ASN considers that the robustness of the first barrier must remain a priority, with continued improvements concerning containment failures.

2. INTEGRATION OF THE EXPERIENCE FEEDBACK FROM THE FUKUSHIMA DAIICHI ACCIDENT

All of the fuel cycle facilities were dealt with as a priority in the light of the experience feedback from the Fukushima accident. The licensees supplied stress test reports in September 2011 for all facilities and sites, with the exception of Cerca (BNI 63) for which the report was submitted in September 2012.

In its resolutions of 26th June 2012, ASN set additional prescriptions for the Areva Group facilities assessed in 2011, in the light of the conclusions of the stress tests. These prescriptions more specifically require the implementation of a hardened safety core of material and organisational provisions designed to prevent a severe accident or limit its spread, mitigate large-scale releases and enable the licensee to fulfil its emergency management duties. The licensee is more specifically required to propose the level characterising the extreme natural hazards to be considered in the design and sizing of the hardened safety core equipment.

ASN reviewed the proposals from the Areva group to define the hardened safety core and its functions, including for the Cerca plant in Romans-sur-Isère.

The ASN resolutions of 9th January 2015 prescribe the hazard levels and associated requirements for the hardened safety core and the deadlines for deployment of this hardened safety core.

At the same time, ASN in 2014 continued to review the responses to the prescriptions in the resolutions of 26th June 2012, for which the deadlines were staggered. During inspections, ASN also runs checks in the field to ensure that the post-Fukushima improvements have been implemented. In 2014, ASN also checked that the Romans-sur-Isère and Tricastin sites had complied with the provisions of the formal notice resolution of 27th July 2013. These prescriptions concern the deployment of alternative solutions or necessary modifications to the existing emergency management premises, to allow management of an emergency following a seismic or flooding event, until such time as robust premises are built.

3. REGULATING THE NUCLEAR FUEL CYCLE FACILITIES

ASN regulates the fuel cycle facilities at different levels:
- the main steps in the life of nuclear facilities;
- the organisation of the licensees through inspections conducted on the ground;
- fuel cycle consistency;
- operating experience feedback within the fuel cycle BNIs.

This part specifies how the steps taken by ASN apply generally to the fuel cycle facilities.

3.1 The main steps in the life of nuclear facilities

When the facilities undergo a significant modification or make the transition to the final shutdown and decommissioning phase, ASN is responsible for reviewing these modifications and submits the relevant decrees for these changes to the Government. ASN thus establishes prescriptions for these main steps. Finally, ASN also reviews the safety files specific to each BNI, paying attention to their integration into the broader framework of laboratory and plant safety (see point 2 and Chapter 15).

Areva is continuing to implement the regulatory requirements concerning performance of the periodic safety reviews of the installations belonging to the group. This first series of periodic safety reviews should be completed before the end of 2017 and is a significant development for the Areva facilities and complies with the provisions of Article L.593-18 of the Environment Code. The review of the methodology and the conclusions of the review of the UP3-A facility on the La Hague site presented by the licensee should be an opportunity for Areva to improve its process for the future periodic safety reviews. ASN will be attentive to ensuring that on the submission of each new file, satisfactory account is taken of experience feedback from the previous ones, particularly that concerning UP3-A, with regard to identification of the elements important for protection (EIP) and the associated requirements defined.

Examining the measures taken by the head office departments in terms of safety

ASN's regulatory actions also cover the Areva head office departments, which are responsible for the group's safety, radiation protection and environmental protection policy. ASN looks at how they draft and ensure the implementation of this policy in the various establishments within the group. In 2014, ASN continued with the actions taken in 2013 concerning on the one hand the identification of the systems, structures and components of the hardened safety core as part of the post-Fukushima process and, on the other, integration into the BNI baseline safety requirements of the new provisions of the Order of 7th February 2012, more specifically with regard to the identification of the elements important for protection and their associated safety requirements, on-site transport operations and controlling the impact of nuisances generated by the facilities.

3.2 Particular regulatory actions conducted in consultation with the Defence Nuclear Safety Authority

Given the probable declassification of the Tricastin INBS and ASN's takeover of responsibility for oversight of these facilities, ASN and the Defence nuclear safety authority (ASND) are attempting to maintain a degree of consistency that is as comprehensive as possible in the application of the safety and radiation requirements for the facilities under their respective responsibility on the Tricastin site. Most of the facilities under the responsibility of ASND have been shut down or are being decommissioned, and should shortly be considered to be civil facilities. The facilities to be eventually decommissioned are those which at present process the effluents and waste for the entire site, as well as all the uranium storage facilities, the activities of which will be taken up by the Trident unit within the Socatri facility (see Chapter 14) and by another facility currently under development.

ASN and ASND have set up a working group to clarify the steps involved in ASN's takeover of the regulation of the safety of activities on this site. It has been decided that the takeover would take place progressively, as and when the regulatory situation of each facility is clarified, after its periodic safety review. The working group sent its first conclusions concerning the management of the change in the administrative status of these facilities to the two regulatory authorities at the end of 2010. The delicensing process has been started for the first step. This process should end by the year 2018. The working group is currently reviewing the facilities on a case by case basis in order to assess the processes which will enable them to be returned to civil management.

3.3 The licensee's organisation and management structure for fuel cycle nuclear installations

For each installation, ASN verifies that the organisation and resources deployed by the licensee that enable it to assume this responsibility. It issues an opinion or recommendations regarding the chosen organisation and may issue prescriptions on specific identified points if it considers that they present shortcomings in terms of internal inspection of safety and radiation protection, or that they are inappropriate.

ASN primarily observes the working of the organisations put into place by the licensees through inspections, including those devoted to safety management.

During the forthcoming periodic safety reviews of the Areva plants, ASN will be examining the processes which could not be examined as part of the overall safety management review, for which ASN sent Areva its conclusions on 21st September 2012. ASN will review the information submitted, taking account of the answers provided during the first review. A final opinion will be issued on all the national and local management processes following all of these reviews, which will take place in 2018.

ASN also carried out the annual inspection of the Areva head office departments on 18th December 2014, concerning the topic of group-level safety oversight tools and "Safety Excellence" training. ASN was thus able to check that the objectives set out for implementation of Areva's safety policy are actually giving rise to action plans and indicators defined with the licensees. The major undertakings are being monitored by the Areva Board, while the other measures or undertakings are being monitored by the Group's safety department. Steps to improve the safety culture have also been initiated for those positions with responsibility for safety. These measures must be continued and reinforced.

3.3.1 Taking account of social, organisational and human factors

Formalisation of the way Social, Organisational and Human Factors (SOHF) are taken into account really began in 2005-2006 for the fuel cycle installations, with the drafting of internal policies specific to each licensee. This approach began to be centralised within the Areva Group as of 2008, which is when the Group's head office departments started employing SOHF specialists. Since then, a national policy has been developed and is being gradually deployed among the group's licensees. The GPU meeting held in 2011 on safety management at Areva also enabled development and follow-up of the SOHF measures adopted. ASN considers that this approach must be continued for it to fully bear fruit. Most of the various licensees within the Areva Group are now staffed with persons competent in SOHF.

During the course of 2014, Areva drafted a guide to the ways and means of integrating SOHF into decommissioning activities, as well as a guide for self-assessment of the nuclear safety culture. The group also produced a note on the integration of SOHF into the BNI periodic safety reviews. A number of procedures were drafted to determine the organisation or practices of the licensees, more specifically concerning buying and the management of the regulated subjects with safety implications. A six-monthly summary of the operating experience feedback process was set up, supplemented by a transverse qualitative assessment of significant events related to subcontracting.

3.4 Fuel cycle consistency

ASN monitors the overall consistency of the industrial choices made with regard to fuel management, from both the safety and the regulatory viewpoints. To do this, on the basis of the "cycle impact" file transmitted by EDF and drafted with the main fuel cycle stakeholders, Areva and Andra every ten years, ASN reviews the consequences for the various steps of the fuel cycle of EDF's strategy to use new fuel products in its reactors and new fuel management processes.

The issue of long-term management of spent fuel, mining residues and depleted uranium is examined taking account of the unforeseen variables and uncertainties attached to these industrial choices. In the short and medium terms, ASN intends to ensure that saturation of the spent fuel storage capacities in the NPPs or in the Areva La Hague pools - as has been observed in other countries - is anticipated and prevented, so that the licensees do not use old facilities with lower safety standards as an interim solution. ASN is assisted in this approach by the Ministry in charge of Energy, which it consults in particular to obtain information relative to materials traffic or industrial constraints that could, for example, have consequences for safety.

ASN asked EDF to undertake a forward-looking study in cooperation with the fuel cycle companies, demonstrating compatibility between changes in fuel characteristics and their management and developments in fuel cycle installations. In order to maintain an overall and constantly appropriate view of the fuel cycle, these data must be periodically updated. For any new utilisation of the fuel, EDF must demonstrate that it has no unacceptable effect on the fuel cycle installations.

In 2014, EDF reached a new agreement with Areva for the management of reprocessing-recycling traffic over the period 2013-2020 and, allowing for contingencies, for the development of a long-term vision for forward-looking management of the fuel cycle plants, including end-of-life operations.

An overall revision of the "cycle impact" file, the aim of which is to present *"a safety file concerning the impact on the fuel cycle facilities of the changes envisaged by EDF… "* which makes it possible *"to identify the points for which additional justification is required or for which authorisation applications are to be submitted […] with a level of detail appropriate to this forward-looking ten-year assessment approach, with an analysis of the available studies in order to demonstrate that the options presented are acceptable"* was transmitted in 2008. This file was examined on 30th June 2010 by the Advisory Committees for Laboratories and Plants (GPU) and for Waste (GPD), on the basis of a report presented by IRSN. The DGEC (General Directorate for Energy and Climate) and members of the Advisory Committees for Nuclear Reactors (GPR) and for Transport (GPT) took part in this analysis.

Following the review of the "cycle impact" file transmitted by EDF in 2008, ASN tightened up its oversight of the consistency of the cycle and its modifications, requesting update notices every two years and asking EDF to transmit a new version of the "cycle impact" file updated for the 2016 time-frame. ASN underlined four major points in its letter of 5th May 2011:
- the need to carry out a true sensitivity study, to take into account, among other things, the variability of electricity grid power demands;
- the need to assess the margins in terms of underwater spent fuel storage capacity, until the year 2020 and beyond;
- the development of EDF's fuel management strategies, particularly after the virtually complete abandonment of «high burn-up fraction» fuel management options;
- the change in the radiological content of the materials used, when they come from the reprocessing of spent fuel.

ASN also wanted the following to be put into perspective:
- the storage capacities for depleted uranium (due to the increase in the enrichment capacity) and for reprocessed uranium, as the saturation of available space cannot be totally ruled out in this latter case;
- the availability of the different packages proposed for the transport of radioactive substances.

During the period 2012 to 2014, EDF answered most of these requests. On 30th June 2014, EDF in particular transmitted the two-yearly monitoring update notice for the French fuel cycle and its developments.

ASN will also work on defining the content of the new "cycle impact" file, scheduled for submission in 2016. It will inform EDF and Areva of what it expects, more specifically in terms of anticipating the risk of saturation of EDF's fuel building pools and the spent fuel storage pools at La Hague.

In 2014, ASN conducted an inspection on the La Hague site on the topic of spent fuel storage management. This inspection concluded that management was on the whole satisfactory.

4. ASN INTERNATIONAL ACTIONS

ASN enjoys regular discussions with its foreign counterparts to share best practices for regulating the nuclear safety of fuel cycle facilities.

Bilateral exchanges with the ONR, the British safety regulator, continued with the bilateral review of the stress tests conducted on the French and British reprocessing plants at La Hague and Sellafield. ASN also discussed methods for managing strategic materials, in particular on the Sellafield site, which is comparable to that at La Hague.

ASN also held discussions with the American NRC (Nuclear Regulatory Commission), concerning ongoing research programmes into the prevention of accidents related to spent fuel reprocessing operations, based on the assumption of the development of a closed fuel cycle in the United States.

5. OUTLOOK

Cross-disciplinary aspects

ASN will be initiating a new process for examining safety and radiation protection management in the Areva group on the basis of the answers to the first review phase which ended in 2011. It will notify Areva of its requirements, with a view to an examination in 2018.

ASN will be particularly attentive to the implementation of the internal authorisation systems approved in 2014 for the Tricastin and Mélox sites, in addition to that already in place at La Hague.

ASN will continue to monitor the implementation of the additional safety measures required following the stress tests, more specifically the Areva proposals concerning the definition of systems, structures and components robust to extreme hazards and the management of emergency situations, in particular in compliance with the new prescriptions issued at the end of 2014.

Finally, it will continue with its checks to ensure correct integration into the BNI operating baseline requirements of the new provisions of the order of 7th February 2012.

Fuel cycle consistency

In 2015, ASN will continue to monitor the "Cycle impact" file and its annual updates. ASN focuses in particular on monitoring the level of occupancy of the spent fuel underwater storage facilities (Areva and EDF). It asked EDF to examine the impact on the anticipated saturation dates for these storage facilities of the shutdown of a reactor, of a possible modification in the spent fuel reprocessing traffic, as well as the solutions envisaged for delaying these dates. In 2015, ASN will hold discussions with EDF to set the scope of the next "cycle impact" file expected for June 2016.

ASN considers that the saturation of the storage facilities must be anticipated (pools at La Hague and fuel building pools for the EDF reactors) and that Areva and EDF must rapidly define a management strategy going beyond 2030.

ASN will also continue to monitor the files associated with fuel cycle consistency, notably the creation of a BNI dedicated to the storage of uranium from reprocessing on the Tricastin site (Écureuil) and of EEVLH 2 concerning the storage capacity for vitrified waste packages from spent fuel reprocessing, respectively, but also the changes in the composition of the MOX fuels.

Tricastin site

In 2015, ASN will finalise the review of the Atlas BNI creation authorisation application and will continue its review of the modification of the Socatri facility as part of the Trident project (see Chapter 14). ASN will pay particular attention to the reorganisation of nuclear waste management on the site, pending the construction of the Trident unit.

ASN will continue to monitor the reorganisation of the Tricastin platform to ensure that these major organisational changes have no impact on the safety of the various BNIs on the site.

ASN will finalise the review of the periodic safety review file for the TU5 facility.

ASN will be vigilant in ensuring that the decommissioning authorisation application file for the Eurodif plant, to be submitted before the end of March 2015, gives a detailed description and justification of the operations necessary for the decommissioning and post-operational clean-out of the facility. ASN will also keep a watchful eye on compliance with the facility's new baseline safety requirements and the conditions for implementation of the Prisme project operations, and the use of ClF_3 in particular.

Romans-sur-Isère site

Areva NP still needs to carry out major conformity work on several buildings.

Given the malfunctions observed by ASN in recent years, ASN will continue with close surveillance of the facility in 2015 in order to ensure that this licensee's nuclear safety performance is improved. It will be attentive to compliance with the deadlines for performance of the work defined in the facility's safety improvement plan and the revision of its safety baseline requirements. It will also ensure implementation of the improvements planned under the stress tests.

The reports presenting the conclusions of the ten-yearly safety reviews carried out on the two facilities on the site and submitted in late 2014 for BNI 09 and expected in late 2015 for BNI 63, will be reviewed to enable ASN to reach a conclusion with regard to the conditions for authorisation of possible continued operation of these facilities for the next ten years.

Mélox plant

Further to the conclusions of the periodic safety review on the facility and the ASN position statement of July 2014 regarding the continued operation of the Mélox plant, the licensee is required to implement action plans, more specifically with regard to controlling the criticality risk and radiation protection measures, in particular in terms of dosimetry. ASN will monitor the licensee's compliance with its undertakings and the ASN prescriptions.

In addition, the changes to fuel management for power reactors requiring adaptation of the characteristics of the MOX fuel, will be a subject of interest for ASN with regard to safety. Areva NC will be required to demonstrate that these changes have no consequences for the safety of the facility and, as necessary, will submit the necessary modification files.

La Hague site

For the La Hague plants, ASN considers that efforts must be continued for the recovery and packaging of legacy waste on the site in order to meet the prescribed deadlines. Within the framework of the periodic safety reviews of the facilities, 2015 should see the continued implementation of the process to identify the operational elements important for protection and to improve the general operating rules of these plants. With regard to the periodic safety review of the UP3-A plant, the last two meetings of the Advisory Committee are scheduled for the first quarter of 2015. The conclusions of the review will be the subject of an ASN resolution and a report to the Minister responsible for Nuclear Safety.

The periodic safety review report for the UP2-800 plant will be submitted by Areva NC at the end of 2015.

With regard to the forthcoming process changes in the La Hague facility, ASN attaches particular importance to replacement of the R7 evaporator, which will improve the availability of the facility's evaporating capacity, as well as to the TCP project, which will make it possible to process several special fuel assemblies and thus postpone saturation of the storage pools. Analysis of the event observed on the evaporators in the R2 unit should also be a priority for the licensee.

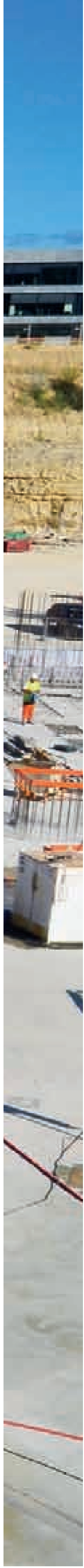
ASN will also be vigilant in ensuring that all the fuels received in the Areva NC plant are intended for processing in accordance with the plant's authorisation decrees.

With regard to the recovery of legacy waste, ASN will be attentive to any changes in Areva's industrial strategy which could lead to non-compliance with the ASN prescriptions concerning the recovery and removal of waste from silo 130 and the STE2 and HAO sludges. ASN already issued prescriptions to this effect in 2010 for Silo 130 and in 2014 for the RCD programme as a whole. 2015 will thus be marked by ASN's verification of the licensee's implementation of the above-mentioned regulatory provisions.

Finally, ASN will complete its review of the significant modification applications concerning STE3 for processing of sludges from STE2 and concerning UP3-A for EEVLH 2.

14

NUCLEAR RESEARCH AND MISCELLANEOUS INDUSTRIAL FACILITIES



This chapter presents ASN's assessment of the safety of civil research and industrial BNIs not directly linked to the nuclear power generating industry. These BNIs are operated by the Alternative Energies and Atomic Energy Commission (CEA), by other research organisations (for example the Laue-Langevin Institute, the ITER organisation, the Ganil) or by industrial firms (for instance CIS bio international, Synergy Health or Ionisos, which operate facilities producing radio-pharmaceuticals or industrial irradiators).

These research and development activities began in the late 1940s in France. They support medical and industrial activities, more specifically the fuel cycle, nuclear power generation, reprocessing and waste disposal and cover the entire spectrum of fundamental and applied research. The variety of the activities covered and their past history explains the wide diversity of facilities concerned.

The safety principles applicable to these facilities are identical to those applied to power reactors and nuclear fuel cycle facilities, while taking account of their specificities with regard to risks and potential implications.

1. CEA INSTALLATIONS

The CEA centres comprise various BNIs devoted to research (experimental reactors, laboratories, etc.) and their support facilities (waste storage facilities, effluent treatment stations, etc.). Research at CEA focuses on areas such as the lifetime of operating power plants, future reactors, nuclear fuel performance, or the reprocessing and packaging of nuclear waste.

Point 1.1 below lists the generic subjects which marked the year 2014. Point 1.2 describes topical events in the various CEA installations currently operating. The facilities undergoing clean-out or decommissioning are covered in chapter 15 and those devoted to the management of waste and spent fuel are covered in chapter 16.

1.1 Generic subjects

Through inspection campaigns, analysis of the lessons learned from operation of the facilities, or the review of files, ASN identifies generic topics on which it questions and monitors CEA. Generic subjects on which ASN focused in 2014 were:
- the continued integration of experience feedback from the Fukushima Daiichi accident (see point 1.1.1);
- the progress of CEA's major commitments (see point 1.1.3);
- the periodic safety reviews of the CEA facilities (see point 1.1.4).

During the course of 2014, ASN called CEA to hearings concerning:
- the progress of its strategic plan, in particular in terms of the creation, commissioning, final shutdown and decommissioning of its facilities (see Chapter 15);
- the Jules Horowitz (see point 1.2.2) and Astrid (see point 1.3) reactor projects;
- the tritium contamination incident in the buildings of the 2M Process company in Saint-Maur-des-Fossés.

1.1.1 Experience feedback from the Fukushima Daiichi accident

Further to the Fukushima Daiichi accident, ASN undertook stress tests of civil nuclear facilities. The approach was to assess the safety margins in the facilities with regard to the loss of electrical power, or cooling, as well as a combination thereof, and with regard to extreme natural risks going beyond the risk levels included in their Initial design.

In May 2011, ASN issued a resolution requiring CEA to conduct stress tests on the BNIs considered to have the greatest potential consequences in the light of the Fukushima Daiichi accident (batch 1). For CEA's four experimental reactors (Osiris, Phenix, Masurca and the RJH) as well as the RHF, ASN set additional prescriptions in its resolutions of June 2012 in the light of the conclusions of the stress tests. The need to implement a hardened safety core of organisational and material provisions was identified.

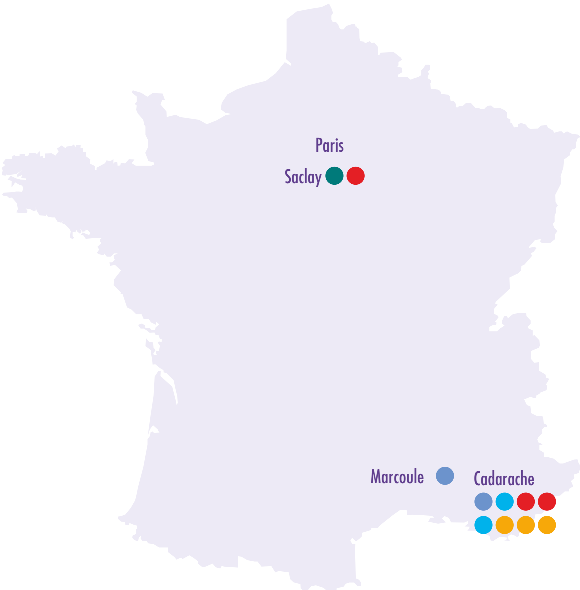
The stress tests approach continued for a second group (batch 2) of 22 facilities considered to be "lower priority" (see figure 1). These include CEA's research facilities such as Chicade, LECA, MCMF, Cabri, Orphee, Atalante, as well as the emergency management resources on the Cadarache and Marcoule sites. The need to define a hardened safety core was identified only for Orphée.

On 8th January 2015, ASN issued resolutions clarifying the requirements associated with the hardened safety cores for the facilities and centres which so require, more specifically in terms of scheduling.

For the Saclay site, CEA released its stress tests report on 30th June 2013; it is currently being reviewed by ASN.

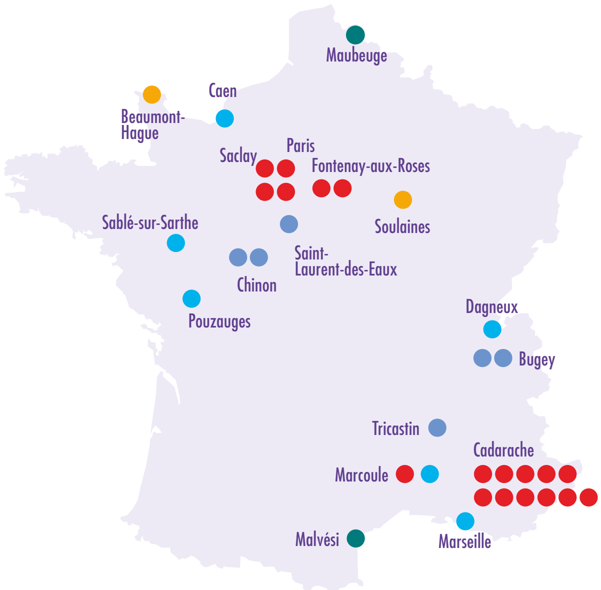
Finally, of the thirty or so other facilities of lesser importance (batch 3), ASN set out a calendar on 21st November 2013 for CEA to submit the stress test reports, a process which will run until 2020.

FIGURE 1: Research facilities of CEA, ITER and the CIS bio international plant concerned by the stress tests reports submitted in september 2012 (batch 2)



- **3 CEA experimental reactors**
  - Rapsodie, Cadarache (1967 - 40 MWth)
  - Cabri, Cadarache (1972 - 25 MWth)
  - Orphée, Saclay (1978 - 14 MWth)
- **2 CEA laboratories**
  - Atalante, Marcoule
  - LECA, Cadarache
- **2 research facilities at Cadarache**
  - Chicade, CEA
  - ITER, ITER Organisation (under construction)
- **3 CEA storage facilities in Cadarache**
  - MCMF, Central Store of Fissile Material
  - Pégase, radioactive fuel and wastes
  - Waste storage area
- **1 plant**
  - CIS bio international, Saclay: production of radionuclides for pharmaceutical use

FIGURE 2: Research facilities concerned by the stress tests (batch 3)



- **18 CEA facilities**
  - 11 BNIs at Cadarache
  - 4 BNIs at Saclay
  - 2 BNIs at Fontenay-aux-Roses
  - Diadem (Marcoule)
- **6 EDF facilities**
  - MIR (Chinon et Bugey)
  - BCOT (Tricastin)
  - AMI (Chinon)
  - The Saint-Laurent-des-Eaux silos
- **6 accelerators and irradiators**
  - Ganil (Caen)
  - Ionisos (Dagneux, Sablé-sur-Sarthe, Pouzauges)
  - Synergy Health (Chusclan, Marseille)
- **2 LLW/ILW waste storage facilities (Andra)**
  - Aube disposal centre (CSA) (Soulaines)
  - Manche disposal centre - CSM (Beaumont-Hague)
- **2 AREVA group facilities**
  - Écrin (Comurhex Malvési)
  - Somanu (Maubeuge)

1.1.2 Management of nuclear safety and radiation protection at CEA

ASN monitors management of safety at CEA at several levels:
- working with the General Administrator, ASN verifies CEA's compliance with its major commitments, in particular with regard to planned new facilities, upgrading of older facilities, final shutdown and decommissioning of old facilities and waste management, especially in terms of compliance with the specified time-frames, and the consideration of safety and radiation protection issues in CEA's overall management;
- with respect to the Nuclear Safety and Protection Division (DPSN) and the General and Nuclear Inspection Division, ASN is developing a national global approach to generic subjects; ASN is also examining how the DPSN defines CEA's nuclear safety and radiation protection policy and assesses internal monitoring work performed by the General and Nuclear Inspection Division;
- with regard to the centres, ASN reviews the files specific to each BNI, paying particular attention to their consistency with CEA's policy; in this respect, it in particular reviews the conditions in which safety management measures are carried out.

1.1.3 Monitoring of CEA's compliance with its main nuclear safety and radiation protection commitments

In 2006, ASN stated that it wanted to see rigorous monitoring of the commitments with the highest safety implications, by means of a CEA high-level oversight tool, in particular for the decision-making process. In 2007, CEA therefore presented ASN with a list of "major commitments".

Despite the delays in meeting certain commitments, the results of the application of this arrangement show several positive points. It allows targeted tracking of priority actions, which have a clearly set deadline. Any extension to the deadline must be duly justified and discussed with ASN. In 2014, the following commitments were in particular implemented:
- commissioning of Agate (see Chapter 16) to control the environmental impact of the Cadarache centre;
- the removal of fissile material from the Masurca disposal and handling building (see point 1.2.4).

To date, 21 of the 27 major commitments defined since 2007 have been met. In 2014, ASN asked CEA to look at the possible definition of new major commitments.

1.1.4 Periodic safety reviews

Many CEA installations began operating at the beginning of the 1960s. The equipment in these installations is ageing. Furthermore, it has been subject to modification on several occasions, sometimes without any overall review of its safety. Since 2006, the Environment Code has required a safety review of each installation every ten years. The periodic safety reviews for CEA's facilities have been scheduled according to a calendar approved by ASN. Fourteen CEA installations will therefore be required to submit a safety review file in 2016 and 2017, representing a significant workload.

In general, the periodic safety reviews can require the licensee or ASN to define extensive upgrading work in areas where safety regulations and requirements have changed, in particular regarding earthquakes, fire protection and containment. ASN oversees all the work and requalification procedures, in accordance with principles and a schedule that it itself approves. Following the periodic safety reviews, ASN can define prescriptions to govern continued operation. Finally, for certain facilities, a shutdown date may be set by ASN. This decision by the licensee to shut down the installation at the end of operations is the result either of the excessive difficulty involved in performing the safety improvements needed to bring it into line with the safety requirements applicable to the more recent installations, or the disproportionate cost of these improvements. ASN is then attentive to compliance with the associated deadlines.

1.1.5 Revision of the prescriptions concerning water intake and ef uent discharges

The water intake and effluent discharges on the Fontenay-aux-Roses site are regulated by the ministerial orders dating from 1988. The obsolescence of these texts, which do not take account of changes to the facilities in the centre, their activities and the resulting changes in the discharges, led ASN to issue a resolution requiring CEA to submit a file to prepare for updating of the prescriptions. CEA submitted an initial file in December 2012. Examination of the file transmitted shows that it does not contain all the expected data and cannot therefore be accepted as-is. Finally, in October 2014, CEA transmitted the updated and complete file. It is currently being reviewed.

With regard to the Marcoule site, the liquid discharges from the civil BNIs are currently treated by the Secret Basic Nuclear Installation (SBNI), except for Centraco which has its own treatment facility and its own outlet discharge pipe. In 2012, CEA was authorised to continue to discharge liquid and gaseous effluents and to intake and consume water for the operation of the

Marcoule SBNI. It should be noted that the water intake by the SBNI also supplies all the nuclear facilities on the Marcoule platform. ASN is completing its review of the applications for updating of the prescriptions regulating water intake and effluent discharges for the BNIs and in 2015 will set limit values and define procedures for the discharge of liquid and gaseous effluents and the intake and consumption of water by the BNIs on the site.

More specifically following ASN's observation of a number of malfunctions in the management of the liquid and gaseous effluents in the Cadarache centre, CEA submitted a modification file in May 2014 concerning the entire Cadarache centre. ASN is reviewing this file, which will lead to a revision of the prescriptions regulating effluent discharges and transfers and setting the environmental monitoring procedures.

1.2 Topical events in CEA research facilities

1.2.1 CEA centres

Cadarache Centre

The Cadarache Centre is located at Saint-Paul-lez-Durance, in the Bouches-du-Rhone *département*. It employs about 5,000 people and occupies a surface area of 1,600 hectares. As part of CEA's strategy of specialising its centres, the Cadarache site deals mainly with nuclear energy. Twenty BNIs are situated on it. The purpose of these Cadarache centre installations is R&D to support and optimise existing reactors and to design new generation systems. The Cadarache centre also takes part in the launch of a number of new projects, in particular the construction of the RJH.

ASN considers that the BNIs in CEA's Cadarache centre are operated in generally satisfactory conditions of safety. ASN noted that the action plans implemented by CEA for the areas of improvement identified in 2013, such as monitoring of outside contractors, management of inspections and periodic tests and in-service monitoring of pressure equipment, enabled significant progress to be made and it considers that this process must be continued. ASN also notes the progress made in the integration of social, organisational and human factors (SOHF), the organisation of maintenance and protection against fire and external hazards. Progress is however still required for management of tag-outs, the use of temporary instructions and post-maintenance qualification of equipment. ASN underlines that CEA devoted considerable effort to the lessons learned from the Fukushima Daiichi accident and has met ASN's first requirements in this respect.

Saclay Centre

The Saclay centre is located about 20 km from Paris in the Essonne *département*. This centre occupies an area of 223 hectares and employs about 6,000 staff. Since 2006, it has been home to CEA headquarters.

This centre has focused mainly on material sciences since 2005, from fundamental to applied research in a wide variety of fields and disciplines, such as physics, metallurgy, electronics, biology, climatology, simulation, chemistry and the environment. The purpose of applied nuclear research is to optimise the operation and safety of the French nuclear power plants and to develop future nuclear systems.

The centre houses eight BNIs as well as an office of the French national institute for nuclear science and technology (INSTN), a training Institute, and two Industrial companies: Technicatome, which designs nuclear reactors for naval propulsion, and CIS bio international (see point 3.2).

ASN considers that the BNIs in the CEA centre are operated in generally satisfactory conditions of safety. CEA must however remain vigilant in maintaining operational rigorousness in the BNIs.

ASN considers that the monitoring of outside contractors is on the whole good in the centre, but that there are discrepancies between the facilities. Even if for some BNIs, such as BNI 35 (Stella – see Chapter 16), a well-structured approach is now in place, other BNIs, in particular BNI 72 (ZGDS – see Chapter 16), must still progress further, especially in establishing monitoring programmes and ensuring the traceability of field inspections.

ASN also observed the implementation of the measures planned following the detection of several deviations concerning the devices for monitoring radioactive gaseous releases from the facilities in 2013. CEA must continue this approach, in particular with regard to the traceability of the maintenance performed on these devices and the monitoring of the contractor responsible for this maintenance. ASN noted that failures in the gaseous releases measurement devices once again occurred in 2014.

Finally, CEA must remain attentive to maintaining the containment of pipes carrying radioactive or hazardous substances. In 2014, two events led to discharges outside the BNIs but which remained confined within the centre.

TO BE NOTED

Urban development of the Saclay plateau

The CEA centre and the artificial radionuclides production plant (UPRA, BNI 29 operated by CIS bio international, see point 3.2) are located on the Saclay plateau where major urban development and public transport projects are planned as part of the Grand Paris programme.

The bus lane project was the subject of a declaration of public interest in August 2012. This project required a minor modification to the perimeter of BNI 29. The technical review concerned the risks arising from the transport system itself as well as from the fact of bringing the fencing closer to the UPRA buildings. The samples taken from the land bordering the perimeter of the facility revealed no soil pollution. This review ended with decree 2014-1412 of 27th November 2014.

Planned future line 18 of the Grand Paris metro has more serious implications than the bus lane, while the radiological consequences of accidents affecting the Osiris reactor and the UPRA are currently the design basis for control of urban development on the plateau. It is in this context that ASN asked the licensees to assess the compatibility of this line 18 with the design basis accidents for the Saclay centre's emergency plans, in particular taking account of the shutdown of the Osiris reactor in 2015 or the iodine inventory in CIS bio international. These assessments are still in progress and should be completed in 2015. ASN will then review them.

Marcoule centre

The Marcoule centre is the CEA centre for the back-end nuclear fuel cycle and in particular for radioactive waste. It plays a major role in the research being conducted pursuant to the Programme Act of 28th June 2006 on the sustainable management of radioactive materials and waste. Civil and defence nuclear facilities are installed here, along with two CEA BNIs in Marcoule, Atalante (research laboratory) and Phenix (reactor). CEA has also submitted a creation authorisation application for a nuclear waste storage facility (Diadem, see Chapter 16), the review of which should be completed in 2015.

The site also comprises three other BNIs, not operated by CEA: the Gammatec irradiator, Melox (see Chapter 13) and Centraco (see Chapter 16).

In 2014, as in previous years, ASN considered that the safety management of the BNIs in the Marcoule centre operated by CEA was on the whole satisfactory. The inspections carried out on the centre's management and on the civil BNIs revealed no significant deviation.

The CEA Marcoule centre was inspected by ASN four times in 2014, including two inspections jointly with the defence nuclear safety authority. They found that emergency management in the centre had been improved, in particular with a new monitoring and emergency fall-back building and that the consequences of external hazards such as earthquakes or fires are correctly assessed.

Fontenay-aux-Roses centre

The two BNIs in this centre are currently being decommissioned (see Chapter 15).

Grenoble centre

The CEA BNIs in this centre are currently being decommissioned (see Chapter 15).

1.2.2 Research reactors

The purpose of experimental nuclear reactors is to contribute to scientific and technological research and to supporting operation of the nuclear power plants. Each reactor is a special case for which ASN has to adapt its monitoring while ensuring that safety practices and rules are applied and implemented. In this respect, the last few years have seen the development of a more generic approach to the safety of these facilities, inspired by the rules applicable to power reactors. This approach in particular concerns the safety assessment based on "operating conditions" (postulated initiating events) and the safety classification of the associated equipment. This has led to significant progress in terms of safety. It is now used for the periodic safety reviews on existing installations as well as for the design of new reactors.

Critical mock-ups

Masurca reactor (Cadarache)

The Masurca reactor (BNI 39), whose creation was authorised by a decree dated 14th December 1966, is intended for neutron studies – chiefly on the cores of fast neutron reactors – and the development of neutron measurement techniques. This installation has been shut down for conformity work since 2007. The reactor core has been completely unloaded and the fuel has been stored since then in the fissile materials Storage and Handling Building (BSM). The stress tests performed, more specifically in the seismic field, confirmed the need to build a new BSM and, in the meantime, to transfer the fissile material to the Magenta facility (BNI 169), which is built to earthquake design standards.

The removal from storage operations took place from April 2013 to October 2014 and are now complete. ASN monitored these operations, which consisted in handling several thousand objects of small size and low volume, which could potentially generate criticality risks and physical protection problems. It considers that the operations were carried out correctly.

In 2015, CEA should be transmitting the review file for the facility and a significant modification authorisation application to build the new storage building.

EOLE and Minerve reactors (Cadarache)

The EOLE reactor (BNI 42), whose construction was authorised by the decree of 23rd June 1965, is intended for neutron studies of light water reactor cores. It is able to reproduce a neutron flux representative of that of the power reactor cores, through the use of very small scale experimental cores.

The Minerve reactor (BNI 95), whose transfer from the Fontenay-aux-Roses research centre to the Cadarache research centre was authorised by the decree of 21st September 1977, is situated in the same hall as the EOLE reactor. It is devoted to effective cross-section measurements.

ASN considers that the two critical mock-ups, situated in the same building, have limited potential safety consequences, primarily linked to the storage of fissile materials, and are operated rigorously by CEA.

The examination of the second periodic safety review of these two critical mock-ups, which began in February 2010, was carried out on the whole satisfactorily, except for the earthquake part, which was submitted late by CEA. The examination of the periodic safety review file enabled improvements to be identified for management of the criticality risk and the handling operations and confirmed the facility's vulnerability with respect to the seismic risk.

The ASN resolution of 30th October 2014 therefore makes continued operation of these two critical mock-ups conditional upon the removal from storage of most of the nuclear materials and the performance of reinforcement work before the end of 2017 to enable it to withstand a historically probable earthquake. The reinforcement of the building to withstand a safe shutdown earthquake, which corresponds to the current requirement level, is stipulated for the end of 2019, should CEA wish to continue with operations after this date.

Irradiation reactors

The Osiris reactor and its ISIS critical mock-up (Saclay)

The Osiris pool-type reactor (BNI 40) has an authorised power of 70 megawatts thermal (MWth). It is primarily intended for technological irradiation of structural materials and fuels for various power reactor technologies. It is also used for a few industrial applications, in particular the production of radionuclides for medical uses, including molybdenum-99 (^{99}Mo). Its critical mock-up, the ISIS reactor, with a power of 700 kWth, is essentially used for training purposes today. These two reactors were authorised by a decree dated 8th June 1965.

ASN considers that the reactor operating conditions were satisfactory. The licensee also implemented most of the modifications and studies prescribed by the ASN resolution of 26th June 2012 following the stress tests.

ASN nonetheless considers that the licensee must be vigilant in its management of storage and waste processing units, in monitoring equipment such as hydrocarbon piping, which caused a pollution incident in early 2014 and in the robustness of certain operational provisions.

TO BE NOTED

Shutdown of the Osiris reactor (Saclay)

While the ASN resolution of 2008 duly noted CEA's undertaking to cease all activities at Osiris by the end of 2015, CEA has since 2011 repeatedly expressed its desire to continue operations, with variable time-frames. Given the small scale and the time-frames given for the safety improvement work proposed by CEA and that the reactor core melt scenario is a design basis scenario for the various intervention and response plans for the Saclay plateau, where urban development is accelerating, ASN published its position on this subject in its resolution of 25th July 2014:

"ASN is not in favour of continued operation of the Osiris facility beyond 2015 owing to the current level of safety of this reactor.

However, for the period 2016-2018, ASN could examine an approach which would scale down operation of the Osiris reactor, with its sole purpose being to counter the shortage of ^{99}Mo. An approach such as this would entail:
- the confirmation by the health authorities of a proven health risk owing to such a shortage of metastable technetium 99, a radionuclide resulting from the decay of ^{99}Mo and used in medical nuclear diagnostic examinations;
- operation of the Osiris reactor for periods strictly corresponding to these proven and confirmed health risk situations;
- operation of the Osiris reactor strictly for the production of ^{99}Mo, to the exclusion of any other activity;
- appropriate reinforcement of the safety of the Osiris reactor;
- special measures to manage organisational and human factors to ensure the safety of a facility, the operation of which should in principle be episodic and limited, and which could take place in parallel with operations to prepare for subsequent decommissioning".

The shutdown of the reactor in late 2015 has subsequently been confirmed by the Government and CEA transmitted the updated decommissioning plan for the facility at the end of 2014 and should then submit a decommissioning authorisation application file in 2016.

Jules Horowitz Reactor (RJH) (Cadarache)

With the support of several foreign partners, CEA is building a new research reactor owing to the ageing of the European irradiation reactors currently in service, which are scheduled for shutdown in the short to medium term. The RJH (BNI 172) will be able to carry out work similar to that done by the Osiris reactor. It does however comprise a number of significant changes with regard to both the possible experiments and the level of safety.

Further to the Creation Authorisation decree of 12th October 2009, the ASN resolution of 27th May 2011 set prescriptions for the design and construction of the BNI. After constructing the building containment and reactor pit, authorised by the ASN resolutions of 5th July 2011 and 1st December 2011, the civil engineering operations continued in 2014 with construction of the nuclear annexes building and pouring of the concrete for the dome which, once completed, will signal the end of the reactor building structural works. Work continued on installing the reactor pit liner, which started in late 2013, as did installation of the shielded experimentation cells.

ASN inspection on the Jules Horowitz reactor (RJH) construction site, November 2014.

In 2014, the inspections on this construction site included checks on the steps taken by CEA to deal with the anomalies detected in 2013 concerning the positioning of the plates supporting the reactor pit liner. ASN considers that the RJH reactor construction site is organised rigorously and efficiently.

ASN is also continuing regular discussions with CEA in order to check the measures requested following analysis of the preliminary safety report and in preparation for the review of the future commissioning authorisation application.

Although the RJH incorporates experience feedback from the other experimental reactors, the stress tests prescribed by the ASN resolution of 26th June 2012 led CEA to identify improvements to reinforce the robustness of the facility and secondly to propose a "hardened safety core". An ASN resolution on this proposal was adopted on 8th January 2015.

Neutron source reactors

Orphée reactor (Saclay)

The Orphée reactor (BNI 101), with an authorised power of 14 MWth, is a pool-type research reactor, using heavy water as the moderator. It was authorised by the decree of 8th March 1978 and its first divergence dates from 1980. It is equipped with nine horizontal channels, tangential to the core, enabling nineteen neutron beams to be used. These beams are used to conduct experiments in fields such as physics, biology and physical chemistry. The reactor also has ten vertical channels for the introduction of samples to be irradiated in order to produce radioisotopes or special materials and to carry out analysis by activation. The neutron radiography installation is used for non-destructive testing of certain components.

Following the latest periodic safety review, ASN authorised continued operation of the reactor until 2019. ASN checks that CEA is meeting the commitments made within the context of this review. On 8th January 2015, ASN also prescribed the creation of a hardened safety core and its associated provisions.

ASN considers that the level of safety of the facility is on the whole satisfactory. ASN notes that the work to replace a flux thimble in 2014 took place on the whole in good conditions.

Finally, 2014 was marked by an event concerning the risk linked to the presence of legionella bacteria in the cooling towers. ASN considers that the licensee conducted a high quality analysis and that the numerous measures identified should lead to an improvement in the prevention of the microbiological risk.

Test reactors

Cabri reactor (Cadarache)

The Cabri reactor (BNI 24), created on 27th May 1964, is used for experimental programmes aimed at better understanding nuclear fuel behaviour in the event of a reactivity accident. The reactor is operated by CEA. For the purposes of new research programmes, modifications to the facility were authorised by the decree of 20th March 2006. The reactor's sodium loop was replaced by a water loop in order to study the behaviour of high burn-up fraction fuels in accident situations representative of those that could be encountered in a pressurised water reactor.

First criticality of the modified installation and performance of the first experimental test will be two steps that require ASN authorisation. CEA now intends to submit the authorisation application for initial divergence of the reactor core in 2015. ASN is continuing its review of the safety files prior to this application and asked CEA for additional data, notably on the demonstration of the seismic resistance of certain structures and qualification of the reactor ultimate shutdown system.

The specific methodology adopted by the licensee for this facility did not lead to the definition of a hardened safety core during the stress tests. The examination by the French Institute for Radiation Protection and Nuclear Safety (IRSN) and the Advisory Committee for laboratories and plants (GPU) showed no need to define such a hardened safety core. An ASN resolution of 8th January 2015 nonetheless regulates the operation of the facility in order to limit the risks linked to certain extreme natural hazards.

Phébus reactor (Cadarache)

The Phébus reactor (BNI 92), the creation of which was authorised by the decree of 5th July 1977, enabled tests to be performed concerning the severe accidents that could affect pressurised water reactors. Following the final test performed in 2004, CEA began work to prepare for decommissioning of the facility and post-operational clean-out of the experimentation systems. Further to the unexpected presence of tritium in the gaseous effluents from the facility on 9th March 2011, CEA identified the last campaign of experiments as being the cause of the leak. In response to a request from ASN, CEA indicated that it had not identified a technical solution for discharge and submitted an application to ASN in 2014, which would lead to a modification of the resolutions setting the site's discharge limits.

CEA informed ASN by letter in November 2013 that it wanted to devote the next few years to preparations for final shutdown and the compilation of a final shutdown and decommissioning application file for the facility. The definition of the decommissioning preparation operations was the subject of technical discussions between ASN and CEA in 2014. CEA must submit the final shutdown and decommissioning authorisation application file for the facility no later than 2017.

Teaching reactor

ISIS reactor (Saclay)

With Osiris, this is one of the two reactors in BNI 40 (see "Osiris reactor"). ASN authorised the operation of this mock-up until 2019.

1.2.3 Laboratories

The irradiated materials and spent fuel assessment laboratories

These laboratories are investigative tools available to the nuclear licensees. From the safety viewpoint, these installations must meet the standards and rules of the fuel cycle nuclear installations, but this safety approach also has to be proportionate to the specific risks presented.

Active Fuel Examination Laboratory (LECA) (Cadarache)

The LECA (BNI 55) was commissioned in 1964 and is a laboratory for both destructive and non-destructive examination of spent fuels from various types of nuclear power plants or research reactors, and of irradiated structures or instruments.

Following the 2001 periodic safety review, an upgrade programme was carried out by CEA, in particular concerning the seismic resistance of the civil engineering. In 2014, CEA transmitted the file presenting the conclusions of the periodic safety review for the installation which it wishes to continue to operate. This subject is currently being examined by ASN.

The LECA extension Treatment, Clean-out and Reconditioning Station (STAR) (Cadarache)

The STAR facility (BNI 55) is a high-activity laboratory comprising shielded cells. It was designed for the stabilisation and reconditioning of irradiated fuel rods with a view to storing them in the CASCAD facility. It also carries out destructive and non-destructive examinations on spent fuels. Its creation was authorised by the decree of 4th September 1989 and its definitive commissioning was declared in 1999.

On completion of the analysis of the periodic safety review file in June 2009, ASN indicated that it had no objection to the continued operation of the facility, and authorised the extension of its operating range, thereby enabling CEA to recondition new types of fuel.

ASN verifies CEA's compliance with the commitments made within the context of the periodic safety review.

In order to reduce the risks of items being dropped during handling operations, the licensee presented a number of planned modifications and equipment additions (STEP project). In a resolution of 13th May 2014, ASN regulated the implementation of the new operating procedures associated with this project.

Laboratory for Research and Experimental Fabrication of Advanced Nuclear Fuels (LEFCA) (Cadarache)

The LEFCA (BNI 123), commissioned in 1983, is a laboratory in charge of conducting studies on plutonium, uranium, actinides and their compounds in a variety of forms (alloys, ceramics, composites, metal, etc.) with a view to their applications in nuclear reactors. The LEFCA carries out studies aimed at understanding the behaviour of these materials in the reactor and at various stages in the fuel cycle. It also produces devices for experimental irradiation designed to test the behaviour of these materials, as well as carrying out stabilisation and reconditioning of uranium and plutonium bearing materials.

Following the latest safety review, ASN issued a resolution in 2010, modified in 2012, prescribing the implementation of a groundwater drainage system before 30th September 2015, to preclude the risk of soil liquefaction in the event of an earthquake. The work, which is currently being completed, has encountered no major obstacles since that concerning the methods for drilling of the drains at the beginning of the work in 2011. ASN will remain vigilant concerning the quality of the commissioning preparation work, more specifically in terms of equipment monitoring and maintenance.

ASN also notes the continued reception, repackaging and temporary storage of some of the materials from Masurca.

Moreover, the report on the new periodic safety review of the facility, transmitted in December 2013, is currently being examined. It should be noted that this takes place in a specific context, because in early 2014, CEA decided to transfer the R&D activities from the LEFCA to the Atalante facility (BNI 148 – CEA Marcoule site). At the request of ASN, CEA in December 2014 transmitted its strategy for the use of the facility for the coming ten years and intends to submit a final shutdown and decommissioning authorisation application in 2020.

Spent Fuel Testing Laboratory (LECI) (Saclay)

The Spent Fuel Testing Laboratory (LECI - BNI 50) was the subject of a notification on 8th January 1968, and a Creation Authorisation Decree for the PELECI extension dated 30th May 2000. The role of this laboratory is to investigate irradiated materials from nuclear facilities. The main research programmes carried out at LECI concern the behaviour of structural materials under irradiation, corrosion, ceramics and subjects related to the irradiation of fuel rods in Osiris. The LECI also has a role to provide support for the delicensing of the Saclay centre, more specifically with regard to the removal of fuel from other facilities. The LECI thus repackaged the SENA rods from BNI 72 (ZGDS).

ASN considers that the level of safety of the facility is on the whole satisfactory. However, the licensee must maintain a high level of vigilance with regard to the rigorousness of its operations. Deviations from the baseline requirements were detected concerning the monitoring of certain dose rates and the performance of inspections and periodic tests.

CEA submitted a periodic review file at the end of December 2013. In the first half of 2014, ASN requested additions to this file, which is currently being examined.

This facility also accommodates a shielded cell (Celimene, building 619) which has not been used since the end of 1993. For the time being, CEA envisages its decommissioning by 2024. Its decommissioning plan will be reviewed during the examination of the next periodic safety review file.

Research and development laboratories

Alpha facility and Laboratory for Transuranian Elements Analysis and Reprocessing Studies (Atalante) (Marcoule)

The main purpose of the Atalante facility (BNI 148), created in the 1980s, is to conduct research and development concerning the recycling of nuclear fuels, the management of ultimate waste, the exploration of new concepts for fourth generation nuclear systems and design studies.

The last periodic safety review of the facility took place in 2007. In 2014, ASN observed that all the measures resulting from the periodic safety review had been Implemented by CEA. CEA is required to submit the new periodic safety review file.

ASN considers that the level of safety of Atalante is on the whole satisfactory. ASN is particularly vigilant concerning topics related to safety management and to SOHF owing to the numerous activities that take place in the facility and the development projects (in particular the transfer of activities from the LEFCA). With regard to control of the fire risk and even if ASN has observed significant progress, it considers that considerable efforts need to be devoted by the licensee to the operational management of the local first aid teams, to the use and checking of fire permits and to monitoring of fire loads.

The Chicade installation (Cadarache)

Chicade (BNI 156) (Chemistry, Waste Characterisation) is a facility for research and development on low and intermediate level waste. This work mainly concerns:
- the destructive and non-destructive characterisation of radioactive objects, waste sample packages and irradiating objects;
- the development and qualification of nuclear measurement systems;
- the development and implementation of chemical and radiochemical analysis methods;
- assessment and monitoring of waste packaged by the waste producers.

Creation of the facility was authorised by the decree of 29th March 1993 and its definitive commissioning was authorised in 2003.

2014 was marked by a short-circuit during an intervention by an inspection organisation, leading to a temporary but total loss of the electrical power supply which did not compromise the static containment of the facility. In addition and on the occasion of the earthworks performed outside the controlled zone, slightly contaminated waste and rubble was found. The presence of this legacy waste and rubble was detected through the deployment of a working protocol that was scrupulously followed by the licensee.

1.2.4 Fissile material stores

The Central Fissile Material Warehouse (MCMF) (Cadarache)

Built in the 1960s, the MCMF (BNI 53) is a storage warehouse for enriched uranium and plutonium. Its main duties are reception, storage and shipment of non-irradiated fissile materials pending reprocessing, whether intended for use in the fuel cycle or temporarily without any specific purpose.

Given the inadequate seismic design of the facility, ASN asked CEA to remove the nuclear materials it contained. The commissioning of the Magenta facility meant that removal of materials from MCMF could continue. The transfer to Magenta slowed down in 2014 owing to the priority given to completion of the comparable operations on Masurca.

In 2016, CEA should transmit the safety review files for the facility and the final shutdown and decommissioning authorisation application. ASN will be vigilant in ensuring that the preparation of these files by the licensee does not lead to any delay in the removal from storage operations and that it tightens up its organisation in this respect. A file presenting the orientations of the periodic safety review should be transmitted by CEA in June 2015. ASN considers that the licensee must take the steps necessary for the production of these files and tighten up its organisation in order to meet its objectives. Finally, ASN considers that operations in the MCMF facility are both well-organised and efficient. The same operational rigorousness will need to be maintained in order to meet the removal from storage deadline.

The Magenta facility (Cadarache)

The Magenta facility (BNI 169), which replaces the MCMF, is dedicated to the storage of non-irradiated fissile material and the non-destructive characterisation of the nuclear materials received.

The Magenta Creation Authorisation Decree was signed on 25th September 2008. ASN authorised the facility's commissioning in its resolution of 27th January 2011.

ASN considers that operations in the Magenta facility are both well-organised and efficient. ASN did however observe a delay in the licensee's transmission of up-to-date baseline safety requirements for this facility.

In 2014, the facility received nuclear materials that had been removed from storage in MCMF and Masurca.

1.2.5 The Poseidon irradiator

The Poseidon facility (BNI 77) at Saclay, created by the decree of 7th August 1972, is an irradiator consisting of a cobalt-60 source storage pool, surmounted over half its surface area by an irradiation bunker. The facility also features a submersible chamber and a test cell. The Poseidon facility is used for research and development activities relating to the behaviour of materials under radiation. The main risk in the facility is that of exposure to ionising radiation owing to the presence of very high level sealed sources.

The examination of the periodic safety review, for which the complete file was transmitted in June 2013, is continuing in parallel with that of the stress tests. Subsequent to these examinations, ASN will specify the preconditions for continued operation. ASN considers that the safety of the facility is satisfactory, the operating conditions are correct and the follow-up of the periodic inspections and tests appropriate. The bunkers do however show signs of cracking, which requires very strict monitoring.

DIAGRAM of a BNI creation decree drafting procedure

MAIN STEPS in the procedure for drafting a BNI Creation Authorisation Decree
(Decree 2007-1557 of 2nd November 2007)

Submission of the creation authorisation application file by the licensee
(Articles 7 to 11 of decree 2007-1557)
Main items in the file: impact assessment, risk management study and preliminary safety assessment report

Acknowledgement of receipt by the Ministry responsible for nuclear safety

If not acceptable

Acceptability of licensee's application file:
- Examination by ASN (with technical help from IRSN)
- **Position statement in a letter from the Ministry responsible from nuclear safety**

Opinion of the Environmental Authority

If there are to be effluent discharges:
- application of Article 37 of the Euratom Treaty
- Opinion of the European Commission

Review of the entire file organised by ASN, with technical help from IRSN:
Possibility of requesting the opinion of the Advisory Committees of Experts (GPE):
- GPE called on by ASN
- Appraisal by IRSN, presented to the GPE
- Undertakings made by licensee on the basis of the appraisal conclusions
- **Opinion of the GPE**
- **Possible requests by ASN**

Public inquiry:
(Articles 12 and 13 of decree 2007-1557)
Opinion of the Prefect, plus possible recommendations, sent to the Ministry responsible for nuclear safety and presenting the conclusions of consultations such as:
- **Conclusion of the public inquiry**
- **Opinion of the CLI**
- **Other opinions**

Production of the preliminary draft of the decree, based on:
- The general regulations applicable
- The licensee's application file
- The conclusions of the review
- The opinion of the Prefect, in particular the conclusions and recommendations presented at the public inquiry and in the opinion of the CLI.

Consultation of the licensee concerning the preliminary draft of the decree (consultation deadline = 2 months)

Possible modification of the draft decree taking account of the observations made by the licensee during the consultation

If so desired, hearings of the licensee and the CLI by the ASN Commission
(Article 14 of decree 2007-1557 and ASN resolution 2010-DC-0179 of 13th April 2010)

Possible modification of the draft decree, following the hearings

ASN contacted by the Ministry responsible for nuclear safety concerning the draft decree *(Article 15 of decree 2007-1557)*

ASN opinion on the draft decree *(Article 15 of decree 2007-1557)*

Decree and associated publications *(Articles 16 and 17 of decree n°2007-1557)*

Following the Creation Authorisation Decree *and pursuant to Article 18 of decree 2007-1557*, **ASN issues a resolution containing technical requirements,** concerning:
- **the design and construction of the BNI**
- **the discharge limits**
- **other requirements** *(prevention and mitigation of accidents, detrimental effects, management and disposal of waste, etc.)*

These resolutions can take account of:
- the application file (preliminary safety assessment report or impact assessment)
- the licensee's undertakings in response to the review
- the requests made by ASN following the review
- the recommendations given in the Prefect's opinion
- the conclusions of the public inquiry
- the opinion of the CLI, etc.

EXAMPLE: creation authorisation application for the ITER BNI

1st submission: January 2008
- considered unacceptable

2nd submission: March 2010

Acceptability subject to additional impact assessment data: letter in December 2010

Additional data submitted by the licensee in December 2010

Opinion of the environmental authority in March 2011

Opinion of the EC in June 2012

Technical review:
- licensee's undertakings of 10/11/11 and 13/01/12
- opinion of the GPE of 12/12/2011
- written requests made by ASN on 15/06/2012

Public inquiry:
- Minister asks the Prefect to submit the file to public inquiry: letter of 03/05/2011
- public inquiry from 15/06/11 to 04/08/11
- conclusion of the public inquiry on 09/09/2011
- opinion of the CLI of 21/07/2011

Consultation of the licensee:
from 26/07/2012 to 26/09/2012

Note: CEA was also involved in the consultation in the light of its future role in decommissioning of the ITER BNI and the management of the waste.

Hearing of the licensee and of the CLI:
end of October 2012

ASN contacted by the Ministry on the draft decree: 23/10/2012

ASN's favourable opinion on the draft decree: 06/11/2012

ITER BNI authorisation decree: 09/11/2012

Examples for the EPR and RJH:
- ASN resolution 2008-DC-0114 of 26th September 2008 concerning the design and construction of the EPR.
- ASN resolution 2011-DC-0226 of 27th May 2011 concerning the design and construction of the Jules Horowitz reactor.

1.2.6 Waste and ef uent storage and treatment facilities

The waste and effluent storage and treatment facilities are addressed in Chapter 16.

1.2.7 Installations undergoing decommissioning

The CEA facilities undergoing decommissioning, as well as the CEA decommissioning strategy, are covered in Chapter 15.

TO BE NOTED

ASN opinion on the safety orientations for the Astrid prototype

The first orientations envisaged for the design of Astrid were presented in a safety guidelines document (DOrS) which was submitted to ASN in 2012 in advance of the regulatory procedures. This DOrS precedes the transmission of a possible Safety Options File (DOS) envisaged by CEA for 2015 and is also well upstream of the BNI creation authorisation application procedure.

After obtaining the opinion of the Advisory Committee for nuclear reactors (GPR) concerning this DOrS, ASN informed CEA, in a letter dated 10th April 2014, of the demonstrations that would need to be provided following the procedure, so that it could issue a position statement on the safety of the Astrid project. For ASN, this reactor must offer a level of safety at least equivalent to that of the third generation reactors (the EPR in France), incorporate the improvements resulting from the lessons learned from the Fukushima Daiichi accident and, as a prototype of a fourth generation plant series designed to provide significant safety gains, enable reinforced safety options and provisions to be prepared and tested. At this stage, ASN considers that the orientations presented in the DOrS satisfactorily take account of the experience feedback from operation of the sodium-cooled fast neutron reactors. ASN has no objection to CEA continuing with its project, on the basis of the orientations it proposed and the undertakings it made during the course of the review, and provided that the additional requirements it expressed in its letter of 10th April 2014 are taken into account.

1.3 Planned facilities

The purpose of the ASTRID project (Advanced Sodium Technological Reactor for Industrial Demonstration), currently at the design phase, is to produce a prototype reactor for which the technical options can be extrapolated to a possible generation IV electricity generating reactor by about 2040. This project, run by CEA in association with EDF and Areva, is designed to meet the requirement specified in the 28th June 2006 Act for commissioning of such a prototype before 2020. Astrid would be a sodium-cooled fast neutron reactor (FNR-Na) with a power of 600 MWe, connected to the grid. The FNR-Na technology is one of the six identified and envisaged for the generation IV reactors. A comparative round-up of these technologies, produced by the French nuclear stakeholders, was also reviewed by the GPR at the request of ASN on 10th April 2014.

1.4 ASN's general assessment of CEA actions

The results of 2014 and ASN's assessment of each facility are detailed per region in Chapter 8 and in point 1.2 for research facilities in operation, in Chapter 15 for the facilities being decommissioned and in Chapter 16 for the waste processing and storage facilities.

2014 was marked by discussions concerning the closure of old CEA facilities (Osiris, ÉOLE, Minerve, etc.). ASN recalled its positions and CEA clarified its shutdown and decommissioning schedule for a number of its facilities, as well as that for the oversight of the fourteen periodic safety reviews upcoming in 2016/2017. ASN underlined that the performance of these numerous reviews associated with the preparation of the final shutdown and decommissioning authorisation application files represents a major safety issue, which will require significant resources on the part of CEA. CEA's compliance with the deadlines set for its major undertakings has improved. CEA also agreed to give fresh impetus to this approach in order to share the main nuclear safety issues to be dealt with over the coming decade. ASN will also be vigilant with respect to the actual initiation of the decommissioning work for those facilities for which final shutdown has been notified, in accordance with French regulations (see Chapter 15).

ASN considers that the level of safety in the facilities operated by CEA is on the whole satisfactory, in particular the operation of its experimental reactors. ASN considers that CEA must reinforce its surveillance and its oversight of external contractors in a context of large-scale subcontracting.

2. NON-CEA NUCLEAR RESEARCH INSTALLATIONS

Experience feedback from the Fukushima Daiichi accident

The RHF high flux reactor at the Laue-Langevin Institute (ILL) is among the stress tests "batch 1" priority facilities for which the lessons learned from the Fukushima Daiichi accident are to be incorporated (see point 1.1.1).

The "batch 2" facilities include the ITER thermonuclear fusion installation currently under construction at Cadarache and the plant operated by CIS bio international in Saclay. The nuclear licensees of the batch 2 facilities submitted their stress test reports in 2012. They were reviewed and then examined by the GPR and GPU on 3rd and 4th July 2013. For ITER, ASN issued a position statement on this assessment in a letter in 2014. Given the gaps in the initial file, ASN was unable to issue a position statement on the stress tests report from CIS bio international, but will do so in 2015, taking account of the additional data supplied after formal notice in 2013.

Finally, for the facilities of lesser importance, a schedule for submission of the stress tests, no later than at the next periodic ten-yearly safety review, was prescribed by the resolutions of 17th December 2013 (see figure 2).

2.1 Large National Heavy Ion Accelerator

The Ganil (National Large Heavy Ion Accelerator) (BNI 113) economic interest group, situated in Caen (Calvados *département*), is a laboratory conducting research into the structure of the atom, which was authorised by the decree of 29th December 1980 to create an accelerator, and, by the decree of 6th June 2001, to operate an extension. This research facility produces, accelerates and distributes ion beams with various energy levels. The intense high-energy beams produce strong fields of ionising radiation when they circulate in the rooms, activating the materials in contact, which then emit radiation even after the beams have stopped. Irradiation thus constitutes the main risk.

In order to be able to produce heavy "exotic nuclei"[1], the Ganil applied in July 2009 for a modification to the authorisation decree for its facility so that it could set up the Spiral 2 project in it for the production of exotic ions (linear accelerator and building housing the associated experimental areas, exotic ion production buildings). By decree on 7th May 2012, the Ganil was authorised to deploy phase 1 of this project. A partial commissioning license was issued for phase 1 of this project on 30th October 2014. Complete commissioning should take place by mid-2015. Finally, ASN is completing its examination of the periodic safety review of the facility and is preparing resolutions regulating discharges from the facility.

ASN considers that the Ganil IEG has been able to adapt its organisation in order to satisfactorily deal with several major dossiers at the same time, such as its first periodic safety review and the commissioning of phase 1 of Spiral 2. ASN however considers that the licensee needs to improve the definition of the steps to ensure conformity with the order of 7th February 2012 and initiate the implementation of the action plan arising from the periodic safety review.

2.2 The high flux reactor (RHF) at the Laue-Langevin institute

The RHF (BNI 67), in Grenoble, operated by the ILL, provides neutrons used for experiments in the fields of physics and biology. This reactor was authorised by the decree of 19th June 1969, modified by the decree of 5th December 1994, and has a maximum power of 58.3 MWth, operating continuously in 50-day cycles. The reactor core is cooled by heavy water contained in a reflective tank, which is itself immersed in a light water pool.

Until August 2014, the ILL reactor had been shut down for reactor safety reinforcement work started in 2013, with ambitious deadlines, in the light of experience feedback from Fukushima Daiichi. ASN considers that the work has continued in satisfactory conditions, more particularly with regard to contractor oversight, but that the ILL needs to progress further in the traceability of this monitoring. During its inspections, ASN observed that reactor restart was carried out meticulously. Nonetheless, not all the scheduled improvement works were completed before reactor restart, so ASN notified the ILL that the reinforcement work needed to be performed in accordance with the stipulated deadlines and the undertakings made by the licensee. ASN also served formal notice on the ILL to comply with certain regulatory requirements applicable to the reactor nuclear pressure equipment. The ILL took steps to comply with this formal notice by transmitting a large volume of files on the intended modifications. ASN will rule on the acceptability of the proposed measures in 2015.

1. The "exotic nuclei" are nuclei which do not exist naturally on Earth. They are created artificially in the Ganil for nuclear physics experiments on the origins and structure of matter.

2.3 European Organization for Nuclear Research (CERN) installations

The European Organization for Nuclear Research (CERN) is an international organisation whose role is to carry out purely scientific and fundamental research programmes concerning high energy particles. A tripartite agreement signed by France, Switzerland and CERN entered into effect on 16th September 2011. The oversight of nuclear safety and radiation protection was previously managed through bilateral agreements.

For the CERN, 2014 was marked by the end of a long technical outage to consolidate the interconnections of the superconductor magnets, to allow higher-power operation of the LHC accelerator in 2015. ASN in particular conducted a joint visit with the Swiss federal office of public health (OFSP) concerning the maintenance and modification work linked to the LS1.

ASN and the OFSP approved the site's nuclear waste management study and the safety file for a new linear accelerator, built in the CERN and called Linac 4.

An agreement for information notification and sharing between the organisations concerning significant events and their rating on the INES scale was also drawn up.

2.4 The ITER project

ITER (BNI 174) is an experimental installation, the purpose of which is scientific and technical demonstration of controlled thermonuclear fusion energy obtained with magnetic confinement of a deuterium-tritium plasma, during long-duration experiments with a significant power level (500 MWe for 400 s). This international project benefits from financial support from China, South Korea, India, Japan, Russia, the European Union and the United States. The headquarters agreement between ITER and the French state was signed on 7th November 2007 and the creation of the BNI was authorised by the decree of 9th November 2012. The ASN resolution of 12th November 2013 sets prescriptions more specifically concerning the design and construction of the facility, in order to implement and supplement the requirements already defined by the authorisation decree. Construction work continued in 2014.

The concrete pouring operation in the central part of the upper basemat was submitted to ASN for prior approval in accordance with the resolution of 12th November 2013. Although initially scheduled for April 2013, this upper basemat pouring step was postponed several times owing to the difficulties experienced by the licensee in the design, sizing and above all in the production of the prior demonstration. After several successive versions of the demonstration file and numerous technical exchanges, ASN gave its approval in the resolution of 10th July 2014. These operations were completed on 27th August 2014. The next step will be the construction of the walls of the tokamak complex.

ASN inspection on the ITER construction site.

The first equipment was delivered to the facility in 2014 and other items are currently being manufactured. In July 2014, ASN carried out an inspection in Russia on the monitoring of outside contractors involved in the design and manufacture of the coil protection equipment.

ASN considers that the project's organisation and safety are satisfactory. A number of efforts were made in the monitoring of the chain of outside contractors, but ASN hopes to see further significant improvements in the oversight of and compliance with the requirements defined for certain contractors. ASN considers that the licensee must continue its efforts and its inspections in order to control the entire outside contractor chain, which is complex owing to its international nature. The development of a common safety culture and assimilation of the French regulations by all outside contractors remain an important area for progress for this licensee. These points were recalled by the ASN Chairman during a presentation to the ITER board in November 2014.

In 2014, the licensee was required to produce numerous additional data and demonstrations as part of the follow-up to the review of its creation authorisation application. These items are undergoing review and others are expected at later dates. ASN will be particularly attentive to the quality of the demonstrations and justifications expected, as well as to compliance with the associated transmission deadlines. Additional data were also requested in an ASN letter dated 2nd June 2014 concerning the stress tests performed within the context of experience feedback from the Fukushima Daiichi accident.

3. THE OTHER NUCLEAR INSTALLATIONS

ASN's main focus in 2014 was monitoring of the follow-up to the periodic safety review of the CIS bio international facility.

3.1 Industrial ionisation installations

Irradiators sterilise medical devices, foodstuffs, pharmaceutical raw materials, etc., by irradiating them with gamma rays emitted from sealed cobalt-60 sources. The irradiation cells are made from reinforced concrete, designed to protect the environment. The sealed sources are either placed in the lowered position, stored in a pool under a thickness of water which protects the workers in the cell, or are placed in the raised position to irradiate the items to be sterilised. The main risk in these facilities is irradiation of the personnel.

The Ionisos group operates three industrial ionisation facilities located in Dagneux (BNI 68), Pouzauges (BNI 146) and Sablé-sur-Sarthe (BNI 154). ASN considers that the licensee must continue its efforts to detect deviations and ensure compliance with the deadlines set for the handover of files or requests for additional data. The three periodic safety reviews for the Ionisos facilities must be carried out no later than November 2017 and the licensee must also submit a stress tests report by this same deadline. The first periodic safety review concerns the Sablé-sur-Sarthe facility, for which the file is expected by 30th June 2015.

Synergy Health operates the Gammaster (BNI 147) irradiator in Marseille and the Gammatec (BNI 170) on the Marcoule site, for which commissioning was authorised on 17th December 2013. The first year of operation of this facility was marked by requests for improvements from ASN more specifically concerning the biological protection of the experimental bunkers – which was originally under-sized in the design – and by the difficulties experienced by the licensee in the production of its water intake and effluent discharge file. The stress tests report prescribed by ASN was submitted by the licensee and is currently being reviewed.

3.2 The radio-pharmaceutical production facility operated by CIS bio international

CIS bio international is a key player on the French market for radiopharmaceutical products used for both diagnosis and therapy. Most of these radionuclides are produced in BNI 29 (UPRA) at Saclay. This facility also recovers used sealed sources which had been used for radiotherapy and for industrial irradiation. By decree on 15th December 2008, CIS bio international was authorised to succeed CEA as operator of BNI 29.

ASN considers that CIS bio international is still experiencing considerable difficulty in managing large-scale operations and that safety performance must make significant progress.

Further to the previous periodic safety review, ASN in 2013 prescribed measures that included reinforcing fire risk management. In 2014, the ASN inspectors found that the two deadlines for compliance with these provisions had not been met and served formal notice. ASN then served formal notice on CIS bio international, on 6th May 2014 and 24th July 2014 to ensure conformity, in association with a strict schedule, namely to install automatic fire extinguishing systems in various parts of the facility containing radioactive materials. Moreover, pending the performance of the work, ASN prescribed the implementation of interim measures to reinforce fire risk management.

The ASN inspectors found that CIS bio international was not in conformity with the three deadlines defined for 2014 in the formal notice and thus issued a violation report. In two resolutions, ASN began a process to impound sums corresponding to the cost of the work. CIS bio international is challenging these decisions and has appealed. ASN considers that CIS bio international must take all necessary steps to perform this conformity work concerning the fire risk within the prescribed time.

ASN also considers that the licensee must in particular improve the performance of many actions to improve the plant's level of safety, defined in the BNI's periodic safety review, if it is to meet the deadlines to which it is committed. A large amount of work to improve safety, which has been in progress for several years, is still not completed.

ASN will be particularly attentive to compliance by the licensee, CIS bio international, with its own undertakings and the regulatory prescriptions by which it is bound. ASN will also be attentive to the pertinence of the new organisation set up in order to turn the situation around. In 2015, ASN will therefore maintain reinforced surveillance and monitoring of the facility.

3.3 Maintenance facilities

Three Basic Nuclear Installations handle nuclear maintenance activities in France.

The facility of the *Société de maintenance nucléaire* (Somanu, subsidiary of Areva) in Maubeuge (Nord *département)*

Authorised by the decree of 18th October 1985 (BNI 143), this facility specialises in the repair, maintenance and appraisal of equipment coming mainly from the primary cooling systems of pressurised water reactors and their auxiliaries, excluding fuel elements.

On 30th December 2011, the licensee sent ASN the first ten-yearly safety review report for its facility; it is currently being examined. This examination shows considerable shortcomings in the conformity check and the safety reassessment. ASN will give its conclusions in 2015.

On 30th June 2014, Somanu submitted an application file for modification of its Creation Authorisation Decree, in order to take account of the gaseous discharges from the facility. This file is accompanied by an updated impact assessment.

ASN asked Somanu and Areva to anticipate the workload involved in the actions to be carried out for the follow-up to the periodic safety review and for examination of the modification file.

The Clean-out and Uranium Recovery Facility (IARU) operated by Socatri, a subsidiary of Areva, situated in Bollène (Vaucluse *département)*

The activities of BNI 138, operated by Socatri, can be divided into four sectors:
- repair and decontamination (dismantling/reassembly, decontamination, mechanical work, maintenance for disposal or refurbishment);
- effluent treatment (in particular that from the Eurodif plant) via the STEU (treatment of uranium-bearing effluents for recovery in the form of uranate) and STEF (final treatment with production of metal hydroxide sludges) stations;
- waste treatment and conditioning (sorting, crushing, compacting, disposal, etc.);
- storage and transport.

Socatri receives contaminated equipment in containers and vessel heads on behalf of the EDF Tricastin operational hot unit (BCOT) (building 852). Socatri carries out sorting, reconditioning and crushing of waste from small producers on behalf of the French national agency for radioactive waste management (Andra).

Following the last periodic safety review and in the resolution of 8th July 2014, ASN made continued operation of the facility conditional upon compliance with the prescriptions primarily concerning the ability of the buildings to withstand external hazards and management of the criticality risk. The licensee also made undertakings within the context of the periodic safety review, some of which were postponed. ASN asked the licensee to tighten up its organisation in this field.

Finally, during 2014, Socatri submitted a new version of the significant modification file for the facility, concerning the implementation of new waste processing activities, including the creation of the new Tricastin nuclear waste integrated processing unit (Trident). This dossier is currently being examined.

In 2014, ASN more particularly examined compliance with the provisions of the new resolutions of July 2013 concerning the procedures and limits for the environmental discharges from the facilities. These provisions are on the whole well applied, even if the licensee has not correctly scheduled all the planned inspections. Moreover, even if the licensee's organisation for monitoring periodic inspection and test activities has been correctly determined, ASN found shortcomings in compliance with the frequencies and the steps to be taken in the event of a nonconformity. In addition, the pooling of the safety and logistics responsibilities on the platform affected the organisation of Socatri. The implementation of this new organisation did not meet its objectives in full. ASN is thus anticipating consolidation of this organisation to ensure its deployment in satisfactory conditions.

Tricastin Operational Hot Unit (BCOT)

The BCOT (BNI 157) was authorised by decree on 29th November 1993. This facility, also situated in Bollène, is intended for maintenance and storage of equipment and tools from PWR reactors, except for fuel elements. This facility is operated by EDF.

ASN considers that the level of safety of the BCOT is satisfactory. However, ASN observed that the licensee experienced difficulties in 2014 in the transport of dangerous substances and considers that EDF needs to improve its monitoring of these activities. Start-up of the machine for cutting the used control rod guide tubes of PWR reactors operated by EDF, installed in 2013, was postponed owing to technical problems. With regard to the old reactor vessel heads, two were still present in the facility at the end of 2014, with their removal to Andra being scheduled for 2015.

Finally, ASN is completing its examination of the facility's periodic safety review file, submitted by EDF in 2010, supplemented in 2011 and 2013, and will issue its conclusions in 2015.

3.4 Inter-regional fuel warehouses (MIR)

EDF has two inter-regional fuel warehouses, on the Bugey site in the Ain *département* (BNI 102) and at Chinon in the Indre-et-Loire *département* (BNI 99). These facilities were respectively authorised by the decrees of 2nd March 1978 amended, and 15th June 1978 amended. EDF uses them to store new nuclear fuel assemblies (only those made of uranium oxide of natural origin) pending loading into the reactor.

ASN considers that the licensees of the two sites must reinforce the robustness of their organisation to keep the general operating rules up to date, ensure that they are followed and monitor the associated actions.

The safety cases will need to be consolidated as part of the reviews and stress tests requested by the resolution of 17th December 2013. These files must be submitted to ASN in early 2015.

4. OUTLOOK

A wide variety of research and other facilities are monitored by ASN. ASN will continue to oversee the safety and radiation protection of these installations as a whole and compare practices per type of installation in order to choose the best ones and thus encourage operating experience feedback. ASN will also continue its work to develop a proportionate approach when considering the issues involved in the facilities.

With regard to the stress tests, ASN will ensure compliance with the deadlines prescribed in its resolutions of 26th June 2012 and 8th January 2015. ASN will issue a position statement in 2015 for the final facilities of batch 2 without a hardened safety core and will examine the stress tests reports for the batch 3 facilities which were sent in 2014 (Saclay site, Poseidon, Gammatec) or which will be sent in 2015 (Ionisos) (see point 1.1.1).

Concerning CEA

ASN considers that the "major commitments" approach, implemented by CEA since 2006, is on the whole satisfactory and should be continued and enhanced, more specifically by the adoption of new "major commitments" by CEA.

Generally speaking, ASN will remain vigilant in ensuring compliance with the commitments made by CEA, both for its facilities in service and those being decommissioned. Should it prove necessary, ASN will issue prescriptions, as was the case for removal from storage on the EOLE and Minerve facilities. Similarly, ASN will remain vigilant in ensuring that CEA performs exhaustive periodic safety reviews of its facilities so that ASN can conduct its examination in satisfactory conditions and so that the safety of the facilities benefits from the necessary improvements.

ASN will be particularly attentive to compliance with the deadlines for transmission of the decommissioning authorisation application files for CEA's old facilities which have been or will shortly be shut down (Phébus, Osiris, MCMF, Pégase). The Rapsodie reactor, the situation of which is described in Chapter 15, is also concerned as are the following waste processing facilities (Chapter 16): the Parc BNI in Cadarache, the effluent treatment station (BNI 37) in Cadarache, the ZGDS (BNI 72) (solid waste management zone) in Saclay. The drafting of all these decommissioning files and then performance of these decommissioning operations represents a major challenge for CEA, for which it must make preparations as early as possible. Finally, ASN will monitor CEA's preparations for final shutdown of the Osiris reactor at the end of 2015.

In 2015, ASN intends to:
- continue with surveillance of the operations on the RJH construction site and prepare for examination of the future commissioning authorisation application;
- rule on restart of the Cabri reactor;
- begin examination of the significant modification authorisation application for Masurca;
- complete its examination of the periodic safety review files for the LECI, Poséidon, LEFCA facilities and decide on the conditions for their possible continued operation;
- continue to examine the periodic safety review files for the LECA and Masurca facilities;
- prepare to examine the options file for the Astrid facility, after issuing its conclusions in 2014 on the main safety orientations of the project.

Concerning the other licensees

ASN intends to continue to pay particularly close attention to ongoing projects, that is ITER and the Ganil extension.

ASN will complete its examination of the periodic safety review files for the Ganil, BCOT and Somanu facilities and will decide on the conditions for their possible continued operation. ASN will continue to examine the periodic safety review files for Ionisos and will initiate that of the MIR.

Finally, in 2015, ASN will maintain its close surveillance of the radiopharmaceuticals production plant operated by CIS bio international, with regard to the following points:
- increased operational rigour and safety culture;
- performance of the work prescribed for continued operation of the plant following its last periodic safety review;
- compliance with the undertakings made by the licensee in respect of the periodic safety review and not as yet honoured.

15

SAFE DECOMMISSIONING OF BASIC NUCLEAR INSTALLATIONS


asn

The term decommissioning covers all the technical and administrative activities carried out following the final shutdown of a nuclear facility, in order to achieve a final predefined status in which all the hazardous and radioactive substances have been removed from the facility. These activities can include, for example, equipment dismantling operations, post-operational clean-out of premises and ground, destruction of civil engineering structures, treatment, packaging, removal and disposal of waste, whether radioactive or not.

This phase in the life cycle of the facilities is characterised by rapid changes in the state of the facilities and changes in the nature of the risks.

In 2014, about thirty nuclear installations of all types (electricity generating or research reactors, laboratories, fuel reprocessing plants, waste treatment facilities, etc.), were shut down or were undergoing decommissioning in France.

Decommissioning operations are usually long-term undertakings that represent a real challenge for the licensees in terms of project management, maintaining skills currency and coordinating the various types of work which often involve many specialised companies. The risks associated with nuclear safety and radiation protection must be considered with the necessary rigour, in the same way as the conventional risks associated with any construction site and the risks linked to the loss of the design and operating memory due to the long duration of this phase, which often lasts more than ten years. The size of the current French nuclear fleet, which will have to be decommissioned at the end of its operating cycle, and the ongoing debates on the energy transition make decommissioning a major challenge for the future, to which all the stakeholders must devote sufficient resources.

The regulations relative to the decommissioning of Basic Nuclear Installations (BNI) were clarified and supplemented as of 2006 through Act 2006-686 of 13th June 2006 relative to transparency and security in the nuclear field, which is now codified, and then through the decree of 2nd November 2007 and the order of 7th February 2012. ASN is continuing the development of the regulatory framework and the doctrine applicable to this phase of the BNI life cycle.

The year 2014 was marked by the publication of the final shutdown and decommissioning authorisation decree for the Ulysse installation operated by CEA (French Alternative Energies and Atomic Energy Commission) in its Saclay centre, the end of the examination of the final shutdown and decommissioning authorisation application for the Phénix NPP operated by CEA in its Marcoule centre and the preparation of a draft guide for the management of land polluted by the activities of a basic nuclear installation, whose publication is planned for 2015. The SILOE reactor was delicensed in January 2015.

1. TECHNICAL AND LEGAL FRAMEWORK FOR DECOMMISSIONING

1.1 Decommissioning risks

The risks presented by the facility when in operation change as its decommissioning progresses. Even if certain risks, such as criticality, quickly disappear, others, such as those related to radiation protection or conventional safety (numerous contractors working together, falling loads, work at height, and so on) gradually become more important. The same goes for the fire or explosion risks (due to the cutting up of structures using thermal techniques that generate heat, sparks and flames).

The decommissioning of a facility leads to the production of large volumes of waste which must be properly managed to limit the risks relating to safety and radiation protection.

ASN also believes that management of the waste resulting from decommissioning operations is crucial for the smooth running of the decommissioning programmes (availability of disposal routes, management of waste streams). This subject receives particular attention when evaluating the overall decommissioning strategies and the waste management strategies established up by the licensees at ASN's request.

Decommissioning operations can therefore only begin if appropriate disposal routes are available for all the waste liable to be produced. The example of the decommissioning of EDF's first-generation reactors is a good illustration of this problem (see point 2.1.4).

French policy for the management of very low-level radioactive waste does not include a system of clearance levels for this waste, but requires that it be managed in a specific route so that it remains isolated and traceable. This is why, with regard to the possible recycling of the waste resulting from decommissioning, ASN is attentive to the application of French doctrine for radioactive waste which states that contaminated waste or waste that could have been contaminated in the nuclear sector may not be reused outside this sector. However, ASN supports initiatives to recycle this waste in the nuclear sector, and the National Radioactive Material and Waste Management Plan (PNGMDR) for 2013-2015 (see chapter 16) includes a recommendation to this effect.

Similarly, the risks associated with Social, Human and Organisational Factors (SHOF) (due to changes in organisation with respect to the operating phase, frequent use of outside contractors, and risks associated with loss of memory) must be taken into account.

Lastly, the sometimes rapid changes in the physical state of the installation and the risks it presents raise the question of ensuring that the means of surveillance used are adequate and appropriate at all times. It is often necessary, either temporarily or lastingly, to replace the centralised means of operating surveillance by other more appropriate means of surveillance.

1.2 The ASN doctrine concerning decommissioning

1.2.1 Immediate dismantling

International Atomic Energy Agency (IAEA) has defined two possible decommissioning strategies for nuclear facilities, following final shutdown:
- deferred dismantling: the parts of the installation containing radioactive materials are maintained or placed in a safe state for several decades before actual decommissioning operations begin (the "conventional" parts of the installation can be decommissioned as soon as the installation is shut down);
- immediate dismantling: decommissioning is started as soon as the installation is shut down, without a waiting period, although the decommissioning operations can extend over a long period of time.

IAEA considers that safe enclosure (or entombment), which consists in placing the parts of the installation containing radioactive substances in a reinforced containment structure for a period that enables a sufficiently low level of radiological activity to be reached with a view to releasing the site, is no longer a possible decommissioning strategy, but may be justified in exceptional circumstances.

Many factors can influence the choice of one decommissioning strategy rather than another: national regulations, social and economic factors, financing of the operations, availability of waste disposal routes, decommissioning techniques, qualified personnel, personnel present during the operating phase, exposure of the personnel and the public to ionising radiation resulting from the decommissioning operations, etc. Consequently, practices and regulations differ from one country to another.

Today, in accordance with IAEA recommendations, French policy aims to ensure that BNI licensees adopt an immediate dismantling strategy.

This principle now figures in the regulations applicable to BNIs (order of 7th February 2012). Since 2009 it had been included in the doctrine established by ASN with regard to the decommissioning and delicensing of BNIs, and since 2010 in ASN Guide No.6 relative to the final shutdown, decommissioning and delicensing of BNIs. ASN supports the inclusion of this principle in the legislation. It has been incorporated by the French government in the green growth energy transition bill (PLTECV).

This strategy moreover avoids placing the technical and financial burden of decommissioning on future generations. At present, the leading French licensees have all made a commitment to immediate dismantling of the installations currently concerned.

GREEN GROWTH ENERGY TRANSITION BILL

This bill, in the version voted by the National Assembly, incorporates the principle of immediate dismantling into the Environment Code and renovates the decommissioning procedure by making a clearer distinction between final shutdown of the facility - which is the responsibility of the licensee who must declare it to ASN beforehand - and its decommissioning, the conditions of which are prescribed by the State on the basis of a file submitted by the licensee.

Consequently, the bill stipulates that:
- when the licensee plans to definitively stop the operation of all or part of its installation, it must notify the Minister responsible for Nuclear Safety and ASN at least two years before the planned shutdown date, or as quickly as possible if the shutdown is implemented with shorter notice for reasons justified by the licensee.
- the licensee is no longer authorised to operate the installation as from final shutdown of the installation;
- the licensee is obliged to submit its decommissioning file no later than two years after giving notification of its intention to definitively shut down its installation;
- any installation that has been shut down for at least two years is considered to be definitively shut down and must be decommissioned (this period can however be extended to five years under special circumstances).

The Senate has moreover added legislative provisions concerning preservation of the memory of sites on which BNIs have been operated.

1.2.2 Complete clean-out

The decommissioning and post-operational clean-out operations for a nuclear installation must progressively lead to the elimination of the radioactive substances resulting from the activation phenomena and/or of any contamination deposits or migrations, in both the structures of the installation premises and the ground of the site.

The structure clean-out operations are defined on the basis of the prior updating of the facility's waste zoning plan which identifies the areas in which the waste produced is, or could be, contaminated or activated. As the work progresses (for example after cleaning the surfaces of a room using appropriate products), the "possible nuclear waste production areas" are downgraded to "conventional waste areas".

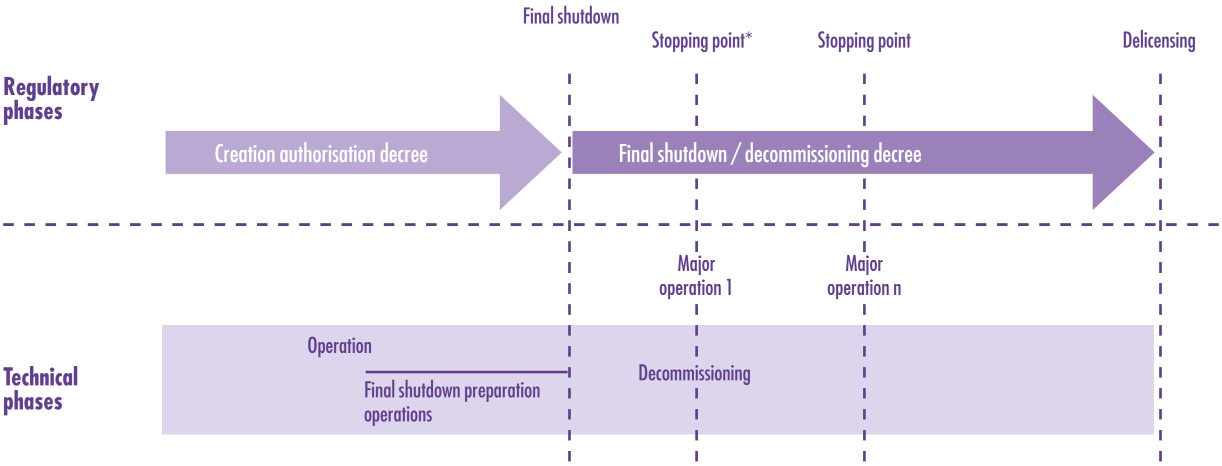
In its doctrine established in 2009, ASN recommends the application of post-operational clean-out and decommissioning practices that aim to attain a final state in which all the hazardous and radioactive substances have been removed from the installation. This principle was reaffirmed in the 4th October 2012 version of the basic principles of ASN's doctrine concerning the management of polluted sites by radioactive substances. Should this procedure be difficult to apply due to the characteristics of the site, it is in any case necessary to go as far as reasonably possible in the clean-out process and to provide elements, whether technical or economic, proving that the clean-out operations cannot be taken further and are compatible with the actual or planned use of the site. In this case, as a prerequisite to delicensing of the installation, the licensee must present and justify the envisaged means of ensuring control of the risk of exposure. Preservation of the memory and the application of usage restrictions through active institutional controls can then be introduced to supplement the measures.

ASN has proposed that this principle be incorporated at legislative level in the PLTECV in the following form: *"the final state reached must be such that it eliminates the risks or inconveniences that the site may represent for the interests mentioned in Article L. 593-1 1 of the Environment Code on account of the past utilisation of the installation or, failing this, to reduce them as much as possible given the best methods and techniques available under economically acceptable conditions and the projected reuse of the site or the buildings."*

ASN is working on the updating of its technical guide relative to structure clean-out operations (ASN Guide No.14, available on *www.asn.fr)* with a view to publication in 2015. It had been issued in 2010 in draft form pending publication of the order of 7th February 2012 and the resolution on the study of management of the waste produced in basic nuclear installations. The provisions of this guide have already been implemented on numerous installations with diverse characteristics, such as research reactors, laboratories, fuel manufacturing plant, etc. In 2014, ASN also produced a draft guide on cleaning out the ground in nuclear installations. It will be made available for consultation by the stakeholders for publication in 2015.

1.3 Decommissioning regulatory framework

PHASES in the life of a BNI



** Stopping point: operation identified in the MAD-DEM decree but not authorised because insufficiently described in the initial safety analysis report submitted with the MAD-DEM authorisation application. The performance of this operation requires prior approval by ASN, in the form of a resolution by the Commission, based on a detailed safety analysis report prior to performance of the operation.*

Once the licensee has decided to proceed with final shutdown and decommissioning of its facility, it can no longer refer to the regulatory framework set by the creation authorisation decree nor the baseline safety requirements associated with the operating phase. The final shutdown and decommissioning of a nuclear installation must be authorised by a new decree issued after consulting ASN. This decree sets out, among other things, the main decommissioning steps, the decommissioning end date and the final state to be attained.

The diagram below illustrates the corresponding regulatory procedure.

In order to avoid fragmentation of the decommissioning projects and improve their overall consistency, the dossier submitted to support the final shutdown and decommissioning application must explicitly describe all the planned operations, from final shutdown to attainment of the targeted final state and, for each step, must describe the nature and scale of the risks presented by the facility as well as the envisaged means of managing them.

Since the Order of 7th February 2012 came into force, the regulations explicitly state that the planned time between final shutdown of the installation and its decommissioning shall be justified and shall be as short as possible. They moreover state that the final state attained on completion of decommissioning shall ensure the prevention of risks and negative effects for public health and safety and the protection of nature and the environment.

The decommissioning phase may be preceded by a final shutdown preparation stage, provided for in the initial operating licence. This preparatory phase in particular allows removal of part of the radioactive substances as well as preparation for the decommissioning operations (readying of premises, preparation of worksites, training of staff, etc.). It is also during this preparatory phase that installation characterisation operations can be carried out: production of radiological maps, collection of pertinent data (operating history) with a view to decommissioning, etc.

As part of its oversight duties, ASN monitors the implementation of the decommissioning operations as prescribed by the final shutdown and decommissioning decree.

The Environment Code provides for – as is the case for all other basic nuclear installations – the safety of a facility undergoing decommissioning to be reviewed periodically, usually every 10 years. ASN's objective, through these periodic safety reviews, is to check that the level of safety of the installation remains acceptable until it is delicensed, with the implementation of measures proportionate to the risks presented by the installation during decommissioning.

On completion of decommissioning, a nuclear facility can be delicensed by an ASN resolution approved by the Minister responsible for Nuclear Safety. It is then removed from the list of BNIs and is no longer subject to the BNI system. To support its delicensing application, the licensee must provide a dossier demonstrating that the envisaged final state has indeed been reached and describing the state of the site after decommissioning (analysis of the state of the soil and remaining buildings or equipment, etc.). Depending on the final state reached, ASN may make delicensing of a BNI subject to the putting in place of active institutional controls. These may set a certain number of restrictions on the use of the site and buildings (use limited to industrial applications for example) or precautionary measures (radiological measurements to be taken in the event of excavation, etc.).

In 2010 ASN published Guide No.6 which:
- explains the regulatory procedure established by the decree of 2nd November 2007;
- clarifies what ASN expects with regard to the content of certain items of the final shutdown and decommissioning authorisation application files, particularly the decommissioning plan;
- explains the technical and regulatory aspects of the various phases leading to delicensing (preparation for final shutdown, decommissioning, delicensing).

An update of this guide integrating the provisions of the published regulatory texts and the experience feedback since 2010 is planned for 2015.

1.4 The financing of decommissioning and radioactive waste management

1.4.1 The legislative and regulatory provisions

Articles L. 594-1 to L. 594-14 of the Environment Code define the system for ring-fencing funds to meet the costs of decommissioning nuclear facilities and managing the spent fuel and the radioactive waste. This system is clarified by Decree 2007-243 of 23rd February 2007 amended and the order of 21st March 2007 concerning the securing of financing of nuclear costs.

It aims to secure the funding for nuclear costs in compliance with the "polluter-pays" principle. It is therefore up to the nuclear licensees to take charge of this financing, by setting up a dedicated portfolio of assets capable of meeting the expected costs. They are obliged to submit three-yearly reports and annual update notices to the Government. Provisioning is ensured under the direct control of the State, which analyses the situation of the licensees and can prescribe measures should it be found to be insufficient or inappropriate. In any case, the nuclear licensees remain responsible for the satisfactory financing of their long-term costs.

These costs are divided into five categories:
- decommissioning costs, except for long-term management of radioactive waste packages;
- spent fuel management costs, except for long-term management of radioactive waste packages;
- cost of recovering and packaging legacy waste (RCD), except for long-term management of radioactive waste packages;
- cost of long-term management of radioactive waste packages;
- cost of surveillance following disposal facility closure.

The costs involved must be assessed using a method based on an analysis of the options that could be reasonably envisaged for the operation, on a conservative choice of a reference strategy, on consideration of residual technical uncertainties and performance contingencies, and on consideration of operating experience feedback.

An agreement signed between ASN and the General Directorate for Energy and Climate (DGEC) whereby ASN ensures the surveillance of these long-term costs, defines:
- the conditions in which ASN produces the opinions it is required to issue pursuant to Article 12, paragraph 4 of the above-mentioned decree of 23rd February 2007, on the consistency of the strategies for decommissioning and management of spent fuels and radioactive waste;
- the conditions in which the DGEC can call on ASN expertise pursuant to Article 15, paragraph 2 of the same decree.

1.4.2 Review of the reports submitted by the licensees

The third three-yearly reports were submitted in 2013 and formed the subject of ASN opinion 2013-AV-0198 of 9th January 2014.

In this opinion, ASN recommends as a general rule that the licensees:
- implement harmonised approaches for the declaration of decommissioning costs;
- take into account the costs of remediation of contaminated ground, favouring the complete clean-out of sites;
- assess the impact on the unavailability of waste treatment, packaging and storage facilities on the evaluation of the costs;
- assess the impact of the modifications of their installations induced by the conclusions of the stress tests and the periodic safety reviews on the decommissioning strategy, and hence on the evaluation of the costs;

- re-evaluate the costs of implementing long-term management solutions for high-level waste and intermediate-level, long-lived waste, on the basis of the latest technical design options of the deep geological disposal (see chapter 16).

The opinion also contains specific recommendations concerning each licensee.

In 2014, the licensees transmitted the first discounting notes for the third three-yearly reports on which ASN gave an opinion to the DGEC on 18th December 2014. In addition to the points put forward in its opinion of 9th January 2014, ASN urges the licensees to include the final shutdown preparation operations in their decommissioning costs, as these are an integral part of the decommissioning operations of an installation. ASN has also drawn the attention of the DGEC to the hypothesis considered by CIS bio international of a start of decommissioning in 2078, which is not credible in the light of the conclusions of the last periodic safety review of the installation and its age. Eventual findings on the operating lifetime of CIS bio international's current installations show that it would be prudent to adopt a final shutdown date at the latest during the next ten years for the evaluation of the decommissioning costs. ASN recommends that CIS bio international updates without delay the discounting of its costs mentioned in Article L. 594-1 of the Environment Code, taking into account a more realistic operating time.

1.5 Experience feedback from the Fukushima Daiichi accident

To take into account the experience feedback from the nuclear accident that occurred at the Fukushima Daiichi nuclear power plant in Japan, ASN asked the BNI licensees to carry out stress tests, including on installations undergoing decommissioning.

With regard to EDF, at the request of ASN, the stress test reports for the BNIs undergoing decommissioning (Chinon A1, A2 and A3, Saint-Laurent-des-Eaux A1 and A2, Bugey 1, Chooz A, Superphénix, Brennilis) and the Fuel evacuation facility (APEC) (Creys-Malville) were submitted on 15th September 2012. ASN gave its conclusions on 10th October 2014. It considered that the procedure followed complied with the specifications and asked for further information relative to the seismic risk in the APEC and the gas-cooled reactors, and the flood risk in the gas-cooled reactors. EDF has already committed itself to taking several of these demands into account.

With regard to the installations of CEA, the Plutonium technology facility (ATPu) (Cadarache) currently undergoing decommissioning was the subject of resolution No. 296 of 26th June 2012 setting out additional requirements in the light of the conclusions of the stress tests.

In addition to the generic requirements, ASN asked CEA to keep up to date the estimated quantities of fissile materials present in each area within the ATPu. ASN did not however consider it necessary to set "hardened safety core" requirements for this BNI.

ASN resolution of 26th June 2012, issued subsequent to the transmission on 15th September 2011 of the stress tests report for the Phénix reactor (Marcoule), sets out additional requirements to reinforce the robustness of the installation against extreme situations, notably by establishing a "hardened safety core". The ASN resolution of 8th January 2015 also sets additional prescriptions specifying the requirements applicable to the "hardened safety core" of the Phénix reactor and the management of emergency situations.

ASN has not issued prescriptions for the Rapsodie reactor (Cadarache), for which the report was issued on 13th September 2012. Nevertheless, CEA has undertaken to review the scenario of a sodium-water reaction induced by rainfall occurring further to an extreme earthquake having caused severe structural failure of the BNI buildings. The corresponding study was submitted at the end of 2014 at the request of ASN.

The report for the irradiated materials unit (AMI) operated by EDF at Chinon was submitted on 6th June 2014 and is currently being examined.

The experience feedback from the Fukushima Daiichi accident will be taken into account for the facilities of lesser importance later on, notably during the next periodic safety reviews for Procédé and Support BNIs (Fontenay-aux-Roses).

The installations whose decommissioning work is sufficiently far advanced, or whose potential source term is very low and for which delicensing is very close, are not concerned by the stress tests.

1.6 The international action of ASN in the area of decommissioning

ASN participated in various international actions relating to decommissioning in 2014.

It contributed in particular to the WENRA "Waste and decommissioning" working group which in June 2013 published a report identifying the reference safety levels applicable to the decommissioning of nuclear installations. These reference safety levels must be transposed into the national regulations of each of the WENRA member countries. Publication of the order of 7th February 2012 allowed a number of these safety levels to be transposed, relating to safety management in particular, but other measures still have to be specified in ASN resolutions, notably the resolutions relative to the studies of waste management in the installations and to decommissioning, currently under preparation.

ASN is also a member of the International Decommissioning Network (IDN) coordinated by IAEA and as such keeps itself informed of the international projects.

It has contributed in particular since 2012 to the CIDER (Constraints to Implementing Decommissioning and Environmental Remediation) Project, which aims to identify and develop aids to overcome the difficulties that member countries can encounter in site decommissioning and rehabilitation projects.

Lastly, within the framework of its bilateral relations with its counterparts, ASN participated in 2014 in a round table organised by the Belgian nuclear safety authority on the theme of decommissioning, during which it presented the experience feedback from the decommissioning projects conducted in France.

2. SITUATION OF NUCLEAR INSTALLATIONS UNDERGOING DECOMMISSIONING IN 2014

Some thirty installations in France are currently being decommissioned (see map opposite).

2.1 EDF nuclear installations

2.1.1 The decommissioning strategy of EDF

The decommissioning strategy of EDF, the first version of which was submitted to ASN at its request in 2001, presents the decommissioning programme for the first-generation nuclear power plants (NPP) and the state of reflections on the decommissioning strategy for the fleet currently in operation.

As requested by ASN, EDF submitted an update of the decommissioning strategy for its reactors in October 2013. This file is currently being examined and will be reviewed by the advisory committee of experts in 2015. ASN had asked EDF beforehand to include a study of the alternative solutions for graphite waste management in order to avoid making decommissioning of the gas-cooled reactor vessels more dependent on the commissioning of the low-level long-lived (LL-LL) waste disposal facility. It nevertheless notes that where decommissioning of gas-cooled reactors is concerned, the question of the disposal route for graphite waste can complicate the correct implementation of this immediate dismantling strategy.

The ASN commission heard EDF on this issue on 9th December 2014. It will adopt a position in 2015 on the need to prescribe firstly the date for opening the gas-cooled reactor vessels and secondly a feasibility study for the creation of storage facilities for managing the LL-LL graphite waste. The reason for this is that the examinations of the safety of the installations and the review of EDF's decommissioning and waste management strategy are in progress and will be completed during 2015. Furthermore, Andra (French national agency for radioactive waste management) must submit a report on the technical feasibility of an LL-LL storage facility, with or without the possibility of accepting EDF waste containing graphite.

In addition to this, as part of the follow-ups to the examination of EDF's generic programme for the continued operation of the reactors in service beyond their fourth periodic safety review, ASN had asked EDF in June 2013 to communicate its projected deadlines for the shutdown of the reactors currently in service. EDF has not yet responded to this request.

2.1.2 Internal authorisations

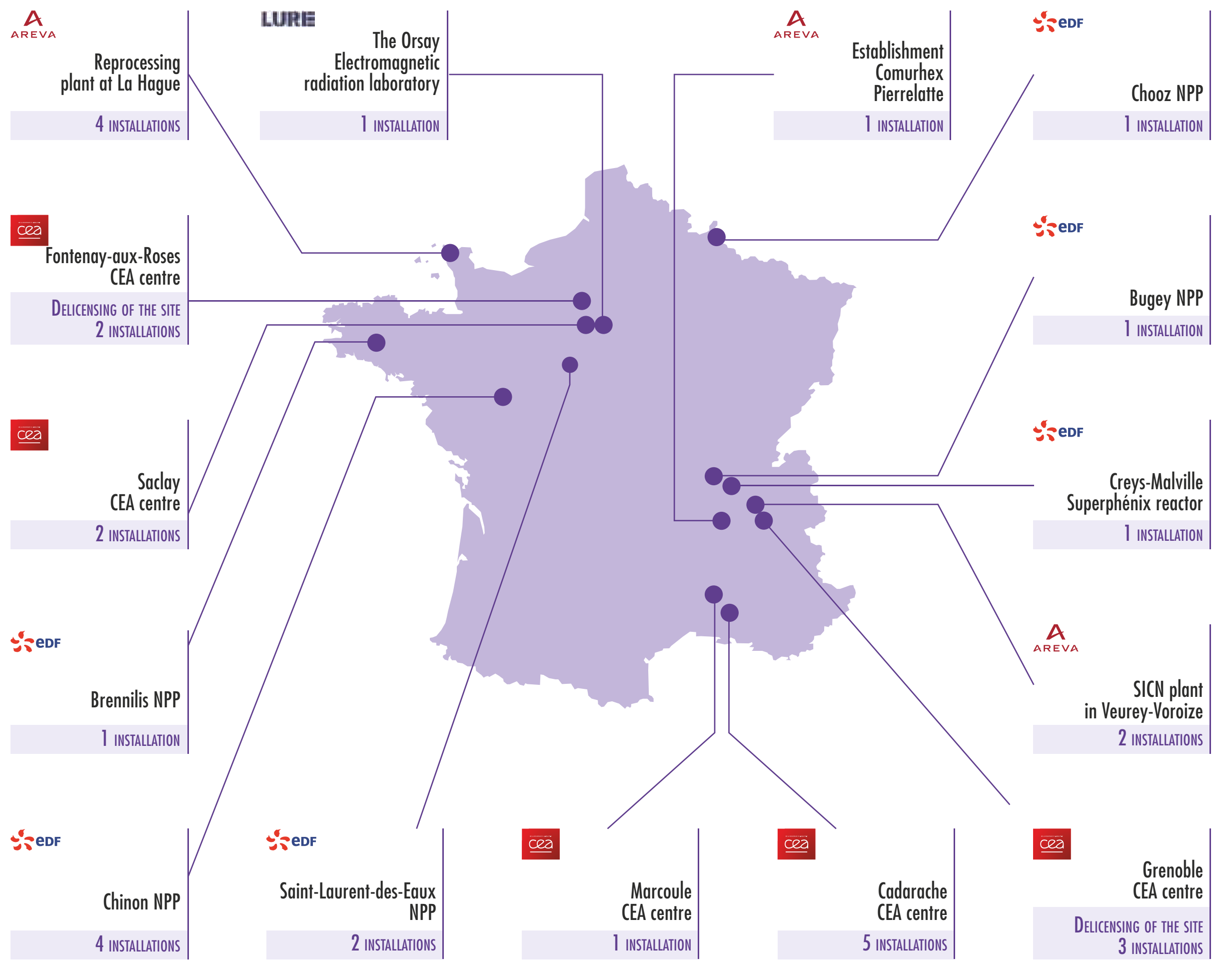
The system of internal authorisations is governed by the decree of 2nd November 2007 (see chapter 3) and the resolution of 11th July 2008. The aim of implementing a system of internal authorisations in the basic nuclear installations is to consolidate the prime responsibility of the operator with regard to nuclear safety and radiation protection, one of the fundamental principles of the safety of activities involving risks being that the person or entity carrying them out is responsible for them. For operations of minor importance it introduces flexibility in the updating of the baseline safety requirements of the facilities, whose state changes rapidly during decommissioning. ASN authorised the system of EDF internal authorisations relating primarily to reactors undergoing decommissioning through a resolution of 15th April 2014.

2.1.3 The Brennilis NPP

The Brennilis power plant is an industrial prototype of a heavy water-moderated, carbon dioxide-cooled NPP, which was shut down in 1985.

By decree of 31st October 1996, the installation became a storage facility for its own equipment and was renamed EL4-D. Partial decommissioning operations were carried out from 1997 to mid-2007 (plugging of circuits, dismantling of certain heavy water and carbon dioxide circuits and electromechanical components, demolition of non-nuclear buildings, etc.) under this

FACILITIES shut down or undergoing decommissioning in 2014



decree. EDF became responsible for plant operation under a decree of 19th September 2000.

The decree of 9th February 2006 authorising EDF to proceed with the complete decommissioning of the installation was cancelled by the *Conseil d'État* (State Council) on 6th June 2007.

A new partial decommissioning authorisation decree was signed on 27th July 2011. Today, decommissioning of the installation is continuing under this decree: cleaning up of the ground situated around the effluent treatment plant (STE), decommissioning of the STE, decommissioning of the heat exchangers. EDF will have to submit a new file to obtain authorisation for the complete decommissioning of this installation. EDF must inform ASN of the planned schedule at the beginning of 2015.

During 2014, EDF continued – under generally satisfactory conditions of safety – the authorised decommissioning operations, namely the treatment of the soils (very slightly contaminated) around the STE, installation of the climatic protection and the

ASN inspection on the ground clean-out worksite around the Brennilis effluent treatment plant in 2014.

containment air-lock for the nuclear demolition of the civil engineering structures and decommissioning of the first heat exchanger (eight cylinders) in the reactor containment. ASN considers that the site's organisation for radiation protection and for monitoring outside contractors on the work sites is satisfactory, but that the management of conventional waste on the new excavation area can be improved.

2.1.4 The gas-cooled reactors

These first-generation reactors functioned with natural uranium as the fuel and graphite as the moderator. They were cooled by gas. The last reactor to be shut down was the Bugey 1 reactor in 1994.

EDF changed decommissioning strategy in 2001 by switching from a deferred dismantling to an immediate dismantling strategy. However, essentially further to the difficulties Andra encountered in creating a disposal facility for the low-level long-lived (LL-LL) waste, the time frames given in the EDF's decommissioning strategy file, which was updated in 2013, were pushed back by almost 20 years with respect those given in the 2001 file. ASN is examining this file and will adopt a position on the acceptability of the EDF's proposed strategy for the decommissioning of the gas-cooled reactors (see point 2.1.1).

Moreover, a file concerning the seismic behaviour of the gas-cooled reactor vessels was submitted to ASN by EDF jointly with the update of the reactor decommissioning strategy in 2013. This file is currently being examined.

Bugey 1 reactor

Complete decommissioning of the facility, for which final shutdown became effective in 1994, was authorised by decree of 18th November 2008.

ASN set the prescriptions and limits concerning the Bugey nuclear site's water intake and effluent discharge limits in resolutions of 15th July 2014. The renewal of the prescriptions was necessary more particularly to integrate the Bugey 1 reactor decommissioning operations.

Lastly, in order to implement the work to extract operating waste from the chamber, planned in 2016, EDF submitted a safety file to ASN in 2014, and this file is currently being examined.

The decommissioning work outside the reactor vessel continued in 2014 along with the preparatory work for extraction of the operating waste contained in the reactor vessel. ASN considers that decommissioning is proceeding under generally satisfactory conditions of safety and that EDF's monitoring of subcontractor companies is rigorous, but that it must remain vigilant given the occurrence of two significant safety and radiation protection events linked to noncompliance with procedures.

Chinon A1, A2 and A3 reactors

The former Chinon A1, A2 and A3 reactors were shut down in 1973, 1985 and 1990 respectively.

Reactors A1 and A2 were partially decommissioned and transformed into storage facilities for their own equipment (Chinon A1 D and Chinon A2 D). These operations were authorised by the decrees of 11th October 1982 and 7th February 1991 respectively. Chinon A1 D is currently partially decommissioned and has been set up as a museum since 1986. Chinon A2 D is also partially decommissioned and accommodates the Intra group (robots and machines for intervening on accident-stricken nuclear installations).

The complete decommissioning of the Chinon A3 reactor was authorised by decree of 18th May 2010. The preparatory work for complete decommissioning was started by the licensee in mid-2011. ASN gave its approval in 2012 for the decommissioning work on the exchangers (first step in decommissioning of the facility) of the Chinon A3 reactor, which is in progress.

A file concerning the renewal of the prescriptions regulating water intakes and effluent discharges is currently being examined by ASN. This file takes into account shutdown of the AMI for decommissioning.

ASN considers that the level of safety of the nuclear facilities of the former Chinon NPP is satisfactory.

EDF's monitoring of outside contractors in 2014 was judged satisfactory, particularly on the high-risk work that the decommissioning of the exchangers represents, and must be maintained in 2015. ASN notes positively that the actions and commitments made following the in-depth inspection in 2013 have been implemented. The ASN inspections in 2014 have again revealed shortcomings in the integration into the applicable baseline requirements of the modifications relative to work conditions.

Saint-Laurent-des-Eaux A1 and A2 reactors

Complete decommissioning of the facility, which comprises two reactors and for which final shutdown was declared in 1994, was authorised by decree of 18th May 2010.

A file concerning the renewal of the prescriptions regulating water intakes and effluent discharges is currently being examined by ASN.

Since 2013, EDF has been carrying out expert appraisals inside the vessel of reactors A2 and A1.

The resulting data have served to produce a file substantiating the resistance of the structures of these reactors, which is currently being examined. In addition to this, EDF is continuing to remove contaminated legacy effluents and waste and carrying out preparatory work prior to decommissioning outside the vessel of reactor A2.

ASN considers that the level of safety of the nuclear installations of the former Saint-Laurent-des-Eaux NPP is satisfactory on the whole, particularly with regard to the monitoring of outside contractors. ASN observes in particular an improvement in EDF's waste management through the operating instructions and the upkeep of the storage areas. ASN is now expecting to see significant progress in the treatment and removal of "legacy" waste and regrets the large number of unforeseeable difficulties that cause installation decommissioning to fall behind schedule.

2.1.5 Chooz A reactor (Ardennes NP)

This reactor was the first pressurised water reactor built in France. It was shut down in 1991. The decommissioning of this power plant foreshadowed the future decommissioning of pressurised water reactors, the technology of the French nuclear power reactors currently in operation.

For partial decommissioning of the reactor, the decree of 19th March 1999 authorised the modification of the existing facility to convert it into a storage facility for its own equipment left on site and thus create a new BNI called CNA-D. Its complete decommissioning was authorised by decree of 27th September 2007.

After decommissioning the steam generators and the primary system, ASN, through its resolution of 3rd March 2014, authorised decommissioning of the reactor vessel which is planned to start in 2016. EDF will carry out the preparatory work for this decommissioning in 2015.

ASN considers that the Chooz reactor A decommissioning operations are proceeding under satisfactory conditions of safety. In the area of radiation protection, and particularly the prevention of internal contamination risks, ASN observed a lack of rigour in 2014, notably with regard to the monitoring of outside contractors. The licensee therefore took major steps in this area during 2014 and decontaminated the vaults concerned.

Decommissioning of Chooz A.

2.1.6 The Superphénix reactor and the fuel evacuation facility (APEC)

The Superphénix fast neutron reactor, a sodium-cooled industrial prototype, is located at Creys-Malville.

It underwent final shutdown in 1997. This installation is associated with another BNI, the fuel evacuation facility (APEC), which consists primarily of a storage pool in which the spent fuel removed from the Superphénix reactor vessel is stored, and storage for packages of soda concrete from the sodium treatment installation (TNA).

With regard to the Superphénix reactor, EDF completed the hydrolysis treatment of the sodium from the reactor primary and secondary systems in 2014. The TNA installation was definitively shut down in 2014 after functioning for five years. At the end of 2014, EDF sent ASN an application for authorisation to begin the residual sodium treatment operations and to start filling the reactor vessel with water. The Superphénix periodic safety review file is expected in early 2016. In this context, in 2014 ASN stated its position on the orientations of this next safety review.

With regard to the fuel evacuation facility (APEC), the maximum storage capacity for the soda concrete packages from the TNA was reached at the end of 2014. EDF will submit the periodic safety review file for the APEC in early 2016. ASN gave its opinion on the orientations of this periodic safety review in 2014.

ASN considers that the safety of Superphénix decommissioning operations and of APEC operation is satisfactorily ensured. ASN observed progress in 2014 with regard to operating rigour and monitoring of performance of the maintenance operations and of the periodic tests. EDF must however ensure that the deviations detected through the maintenance plans or periodic tests are addressed within acceptable time frames.

In 2014, ASN lifted the formal notice served in 2012 to reinforce the emergency situation management resources, particularly with regard to the hosting of the external emergency response teams. The Creys-Malville site must nevertheless remain vigilant with the tracking of the training and maintaining of skills of the personnel liable to be the initial on-site contact for the external emergency response teams.

2.1.7 Irradiated material facility (AMI)

This facility (BNI 94) situated on the nuclear site of Chinon (Indre-et-Loire *département*) was notified and commissioned in 1964, and is operated by EDF. Its main purpose is to carry out reviews and assessments of activated or contaminated materials from PWR reactors.

As ASN considered that the renovation project presented in 2004 would not allow long-term continuation of operation, EDF undertook in 2006 to initiate final shutdown of the facility no later than 2015. The creation of the LIDEC, taking over the assessment activities from the AMI on the same Chinon site, regulated by the system applicable to Installations Classified on Environmental Protection grounds (ICPE), was authorised by order of the Prefect in October 2010. The activities will be gradually transferred in 2015. ASN will be particularly attentive to the management of the transfer of this activity to the new facility. Operation of the irradiated material facility (AMI) was marked by the application of a remediation plan requested by ASN in 2013 after it had observed significant organisational malfunctions. The effects of these malfunctions were still being felt at the beginning of 2014. ASN will therefore remain attentive to the improvement in the operating safety of the facility in 2015.

In June 2013 EDF submitted the final shutdown and decommissioning application file for the AMI and supplemented it in June 2014. This file will be presented for public inquiry in 2015 with a view to publishing the final shutdown and decommissioning decree in 2016, subject to the conclusions of the examination of the file. As part of the preparation for final shutdown, the licensee has also developed provisions for the packaging and storage of the legacy waste still present in the facility pending its removal to the appropriate management routes. ASN is attentive to the performance of the legacy waste recovery and packaging operations which must continue until 2016, given the lateness accumulated over the last few years. Lastly, in June 2014 the licensee submitted the stress tests report required by ASN resolution of 17th December 2013. This report is currently being examined by ASN.

2.2 CEA installations

At the request of ASN, CEA delivered an interim report in 2011 on the updating of its decommissioning strategy, justifying the chosen deadlines and explaining the reasons, technical or otherwise, behind the delays with respect to the schedule. In response, ASN reiterated its position concerning the priority given to immediate dismantling, the clean-out levels to be reached, the use of institutional controls, and recalled the schedule objectives for certain decommissioning operations.

ASN has asked CEA to submit a new complete version of its decommissioning strategy, which CEA plans to do in 2016.

2.2.1 Fontenay-aux-Roses centre

CEA's first research centre, located in Fontenay-aux-Roses (Hauts-de-Seine *département*) since 1946, is continuing to move away from nuclear activities in order to concentrate on research into the life sciences.

The CEA Fontenay-aux-Roses centre comprises two BNIs, namely Procédé (BNI 165) and Support (BNI 166). BNI 165 housed the research and development activities on nuclear fuel reprocessing, transuranium elements, radioactive waste and the examination of irradiated fuels. These activities were stopped in the 1980s-1990s. BNI 166 is a facility for the characterisation, treatment, reconditioning and storage of legacy radioactive waste and waste from the decommissioning of BNI 165.

The decommissioning of these two installations was authorised by the decrees of 30th June 2006. The initial planned duration of these decommissioning operations was about ten years. CEA has informed ASN that, due to the strong presumptions of radioactive contamination underneath one of the buildings and unforeseen difficulties, the decommissioning operations will be extended at least until 2021 for the Procédé installation and 2025 for the Support installation.

CEA planned to submit an authorisation application file in June 2015 to modify the decrees of 30th June 2006, particularly with regard to the decommissioning deadlines and the final state. This file will be subject to a public inquiry.

Furthermore, in application of ASN resolution of 2nd February 2012, CEA submitted a file in early 2013 with a view to revising the order regulating discharges in order to update it and incorporate the decommissioning operations. ASN's examination of this file revealed significant shortcomings, which led CEA to submit a revised file in October 2014. It is currently being examined. Lastly, the site's on-site emergency plan was updated at the end of the first quarter of 2012 then again in July 2014. It is currently being examined.

ASN considers that the level of safety of the facilities of the CEA Fontenay-aux-Roses centre can be substantially improved in many aspects, particularly in the area of fire risk control. ASN considers that CEA must significantly improve work preparation, whether associated with operating activities, inspection and periodic tests, maintenance or more specific work activities. Control of the interfaces between the various players of CEA and its outside contractors to limit the risks associated with organisational and human factors also remains an area for improvement. Furthermore, the upkeep of the premises other than the clean-out / decommissioning work site, and the management of waste and chemical products resulting from the past and current operation of the two BNIs, were found to represent weak points, particularly with regard to the fire risk.

Lastly, since the publication in 2011 of the resolution subjecting certain operations relative to the decommissioning of the Pétrus shielded cells line to ASN authorisation, CEA has still submitted no applications. The successive postponed submissions of the authorisation application files when these operations represent one of the major risks in the decommissioning of BNI 165 is not satisfactory. ASN will be particularly attentive to compliance with the submitted schedules.

2.2.2 The Grenoble centre

The CEA centre in Grenoble was inaugurated in January 1959.

Activities associated with the development of nuclear reactors were carried out there before being gradually transferred to other CEA centres in the 1980's. Now the Grenoble centre conducts its research and development in the fields of renewable energies, health and microtechnology. In 2002 the CEA centre in Grenoble launched a site delicensing programme.

The site housed six nuclear facilities which were gradually shut down and entered the decommissioning phase with a view to their ultimate delicensing. Delicensing of the Siloette reactor was declared in 2007 and that of the Mélusine reactor in 2011.

ASN considers that the safety of the decommissioning and post-operational clean-out of the installations in CEA's Grenoble centre was on the whole satisfactory in 2014.

Radioactive effluent and solid waste Treatment Station and Decay Storage facility (STED)

The final shutdown and decommissioning operations of the STED (BNI 36) and the interim radioactive waste decay storage facility (BNI 79) were authorised by the decree of 18th September 2008 which prescribed a term of 8 years for the completion of decommissioning activities.

All the buildings have been destroyed in compliance with the abovementioned decree.

The main operations still to be carried out concern the decontamination of the ground.

In 2014, CEA told ASN it was having technical difficulties in cleaning out the "diamond" zone and the area to the north of it, where radiological contamination persisted despite the excavations carried out. CEA more specifically informed ASN of its intention not to continue the ground remediation operations. This issue is currently under examination.

Active Material Analysis Laboratory (LAMA)

This laboratory conducted post-irradiation studies of uranium and plutonium based nuclear fuels, and structural materials from nuclear reactors until 2002. Decommissioning of the LAMA was authorised by decree on 18th September 2008.

The significant radiation protection event involving the incidental exposure of a worker of a subcontractor company in 2013 on the LAMA laboratory clean-out work site was downgraded to level 1 on the INES scale in 2014 following the ASN appraisal of the event.

With the LAMA clean-out operations completed, an inspection to check that the clean-out objectives had been reached was carried out in 2014 and revealed the presence of a contamination area which CEA must treat.

Siloé reactor

Siloé is an old research reactor used mainly for technological irradiation of structural materials and nuclear fuels.

CEA was authorised to carry out the decommissioning operations by decree of 26th January 2005.

The work was completed in 2013. Delicensing of the waste zoning of the Siloé BNI was declared in 2014. The Siloé BNI 20 was delicensed by resolution of 9th January 2015.

2.2.3 The Cadarache centre installations undergoing decommissioning

Rapsodie reactor and Fuel Assembly Shearing Laboratory (LDAC)

The experimental reactor Rapsodie is the first sodium-cooled fast neutron reactor built in France. It functioned until 1978. A reactor vessel sealing defect led to its final shutdown in 1983.

Decommissioning operations have been undertaken since then but were partly stopped further to a fatal accident (explosion) that occurred in 1994 when washing out a sodium tank. At present the core has been unloaded, the fuel evacuated from the installation, the fluids and radioactive components have been removed and the reactor vessel contained. The reactor pool has been emptied, partially cleaned out and decommissioned. In addition, 23 tonnes of frozen sodium are stored and must be removed to the CEA Marcoule centre for treatment.

CEA sent ASN its complete decommissioning authorisation application in December 2014.

The periodic safety review file for the installation is expected in early 2015. Examination of the periodic safety review file jointly with that of the decommissioning file will provide the opportunity to check that the measures to control ageing are compatible with the decommissioning strategy envisaged by the licensee, and in particular with the projected duration of the entire decommissioning project.

The work currently being performed by CEA chiefly involves renovation, clean-out and decommissioning operations limited to specific equipment items, along with waste removal operations. ASN considers that the routine operating tasks are carried out regularly and that the premises are on the whole well kept, despite the fact that operating rigour could be improved in certain aspects relating to waste management. The measures taken by CEA to ensure the removal by 2018 of the sodium-containing waste still present in the installation are also closely monitored by ASN.

The purpose of the LDAC, located within the Rapsodie BNI, was to perform inspections and examinations on irradiated fuels from the fast-neutron reactors. This laboratory has been shut down since 1997 and partially cleaned out. Its decommissioning is included in the decommissioning project for the entire BNI.

Enriched Uranium Processing Facilities (ATUEs)

Until 1995, the ATUEs converted uranium hexafluoride from the enrichment plants into sinterable oxide, and ensured the chemical reprocessing of waste from the manufacture of fuel elements. The facility was also equipped with a low level organic liquid incinerator. Production in the facilities ended in July 1995 and the incinerator was shut down at the end of 1997.

The installation's final shutdown and decommissioning authorisation decree of 8th February 2006 prescribed work completion in 2011. After having observed that the decommissioning operations were stopped and that CEA had not followed up its request to submit a new authorisation application file to complete decommissioning, ASN served CEA with a compliance notice on 6th June 2013. In February 2014 CEA submitted a new application for authorisation to complete the decommissioning and clean-out operations. Considering that this file meets the conditions set in the compliance notice resolution, ASN suspended the notice resolution by a resolution on 29th April 2014. ASN nevertheless informed the Minister responsible for Nuclear Safety, to whom it had referred this file, that the licensee had to provide, before the end of 2014, various complements to this file, particularly relative to the planned clean-out methodology, so that ASN could continue its examination. These complements were submitted in December 2014 and are currently being examined.

The plutonium technology facility (ATPu) and the chemical purification laboratory (LPC)

The ATPu produced plutonium-based fuel elements, initially intended for fast neutron or experimental reactors and then, as of the 1990s, for pressurised water reactors using MOX fuel. The activities of the LPC were associated with those of the ATPu: physical and chemical checks and metallurgical examination of plutonium-based products, processing of effluents and waste contaminated with alpha emitters.

The two facilities were shut down in 2003.

CEA is the nuclear licensee for these facilities. Areva NC has been the industrial operator responsible for operation of the facilities since 1994 and is also responsible for their decommissioning until CEA takes over this latter activity, which is planned for the second half of 2015.

Decommissioning of these two BNIs was authorised by the decrees of 6th March 2009. Two ASN resolutions of 26th October 2010 define the technical prescriptions governing the decommissioning operations.

With regard to the ATPu, after resuming the decommissioning activities authorised by ASN in June 2012, the operations to clean-out, cut up and reduce the volume of the glove boxes present in the twelve cells, and the packaging of the resulting waste, continued and are planned to last until June 2015.

With regard to the LPC, within the framework of the decommissioning decree, the cryogenic treatment unit decommissioning operations authorised by ASN resolution of 20th October 2011 are in progress. The decommissioning operations on the active tanks and the associated equipment, authorised in 2011 and 2012 and started in 2013, continued in 2014 and are nearing completion.

The implementation of the measures taken by CEA following the compliance notice resolution of 19th February 2013 concerning the monitoring of Areva NC and the management of the skills associated with decommissioning safety was closely followed by ASN, notably through inspections carried out in October 2013 and February 2014 which showed that CEA had realised the importance of the issues and had undertaken the necessary corrective actions.

In 2015 ASN will remain attentive to the situation of these two BNIs with regard to social, organisational and human factors, and will see to the long-term continuation of the progress registered so that the resuming of decommissioning activities by CEA after the departure of the industrial operator Areva NC, scheduled for mid-2015, takes place under satisfactory conditions of safety.

ATPu decommissioning work site.

2.2.4 The Saclay centre installations undergoing decommissioning

The decommissioning operations carried out on the site concern two BNIs in final shutdown state and three BNIs in operation but with sections that have stopped their activity and on which preparatory operations for final shutdown are being carried out. They also concern two ICPEs (installations classified on environmental protection grounds), EL2 and EL3, which were previously BNIs but which have not been completely dismantled due to the absence of a disposal route for low-level long-lived waste. Their delicensing in the 1980's from BNI status to ICPE status, in compliance with the regulations of that time, would note be possible today.

High-Activity Laboratory (LHA)

The LHA comprises three buildings housing several laboratories which were intended for research into or the production of various radionuclides, and technical premises. On completion of the decommissioning and clean-out work authorised by decree on 18th September 2008, only two laboratories currently in operation should ultimately remain under the ICPE system.

These two laboratories are the laboratory for the chemical and radiological characterisation of effluents and waste, and the packaging and storage facility for the recovery of unused sources.

The decommissioning of the cells, tanks and liners present in the intercell yards of the BNI continued. After a preparatory phase, decommissioning of the TOTEM shielded chain, which was stopped in 2012, started again. The first operations to clean out the civil engineering of the decommissioned cells are also going to start.

ASN considers that the level of safety of BNI 49 is satisfactory. ASN does nevertheless consider that efforts must be maintained in the management of deviations and the upkeep of the premises, particularly the conventional waste and equipment storage areas. It also notes that the installation is still having difficulties in mastering the operation of the gaseous discharge monitoring devices installed at the outlets. Lastly, through a resolution of 17th March 2014, ASN gave CEA formal notice to comply with certain provisions relative to lightning and the management of liquid effluents. The follow-up implemented by CEA were all satisfactory.

ASN gave its agreement in 2014 for the implementation of the general clean-out methodology applicable to all the cells apart from cells No.3, 5 and 14, for which the clean-out methods are still being studied; the clean-out work for each cell will be carried out under an internal authorisation. In August 2014, CEA requested the modification of certain discharge outlets in order to allow decommissioning of the main exhaust fan. This file is currently being examined.

ASN will continue to be particularly vigilant with regard to the correct application of the monitoring provisions already implemented by CEA in the operation, the decommissioning and the clean-out of the installation, which involve a large amount of subcontracting.

Ulysse reactor

This reactor was used for training and for experiments. Its operational shutdown was announced in 2007. The final shutdown and decommissioning authorisation decree for the BNI was published on 18th August 2014 and provides for a five-year decommissioning period.

TO BE NOTED

Publication of the decree authorising decommissioning of the Ulysse reactor (Saclay)

During the examination of the final shutdown and decommissioning application file for the Ulysse reactor, CEA proposed a new organisation involving complete subcontracting of the decommissioning and operational management operations for the installation. This proposal raised numerous questions on the part of ASN, the CLI (Local Information Committee) and the public.

In 2014 ASN issued a favourable opinion on the draft final shutdown and decommissioning decree, underlining that this opinion was specific to the particular context of the decommissioning of Ulysse, particularly with regard to the size of the installation and the limited nuclear safety and radiation protection risks it represents, and in no way prejudges the position of ASN with regard to the principles of subcontracting organisation envisaged by the CEA.

2.2.5 The Marcoule centre installations undergoing decommissioning

Phénix reactor

The Phénix reactor, built and operated by CEA, is a sodium-cooled fast neutron reactor demonstrator. It was definitively shut down in 2009. The decommissioning authorisation application file was submitted in December 2011. Within the framework of the examination of this decommissioning application, CEA also anticipated the plant's next periodic safety review by submitting its file to ASN at the end of 2012.

As part of the examination of this decommissioning authorisation application, the Advisory Committee for laboratories and plants met on 12th November 2014 and considered the plant's decommissioning procedures to be acceptable, in particular the option of processing sodium that can be poured by transforming it into an aqueous sodium hydroxide solution then into diluted sodium chloride. On the basis in particular of the opinion of this committee and the consultations, ASN will complete its examination and in the first quarter of 2015 will develop a draft decommissioning authorisation decree for the reactor.

The preparation operations for final shutdown of the Phénix reactor continued during 2014 and essentially concerned putting out of service secondary or conventional systems and fitting out future premises or workshops necessary for the decommissioning (NOAH work site, very low level (VLL) waste room). Special handling operations enabled experimental devices to be removed from the reactor core. Large components (intermediate heat exchangers, primary and secondary pumps) have been washed, packaged and placed in storage at Marcoule. They will be shipped to the Aube very-low-level waste disposal centre at a later date.

The inspections carried out in 2014 by ASN focused on the criticality risks, the risks associated with external hazards, the delivery of licenses and the inspections and periodic tests in the power plant. ASN has asked CEA to make a number of improvements.

2.3 Areva installations

The situation of the UP2-400 complex is described in chapter 13. This complex comprises the former spent fuel reprocessing plant UP2-400 (BNI 33) and the associated units, shut down since 2004, namely the Effluent Treatment Plant STE2A (BNI 38), the Oxide High Activity Facility HAO (BNI 80), and the ELAN IIB installation (BNI 47), which manufactured caesium-137 and strontium-90 sources until 1973.

2.3.1 The UP2-400 spent fuel reprocessing plant and associated facilities

The HAO (High Activity Oxide) facility (BNI 80)

BNI 80 ensured the first stages of the reprocessing of spent oxide nuclear fuels: reception, storage then shearing and dissolution. The dissolution solutions produced in BNI 80 were then transferred to the UP2-400 industrial plant in which the subsequent reprocessing operations took place. BNI 80 comprises five facilities:
- HAO North, fuel unloading and storage site;
- HAO South, in which the shearing and dissolution operations were carried out;
- the filtration building, which accommodates the filtration system for the pool of the HAO South facility;
- The HAO silo, in which are stored the hulls and end-pieces in bulk, fines coming essentially from shearing, resins and technological waste resulting from operation of the HAO facility from 1976 to 1997;
- the SOC (organised storage of hulls) comprising three pools in which the drums containing the hulls and end-pieces are stored.

The decommissioning of the HAO was authorised by decree of 31st July 2009. The first stage in the work which aims at carrying out the majority of the HAO South facility decommissioning operations is in progress. The HAO North facility, which is still in operation, will be decommissioned in a second phase.

The waste recovery and packaging project (RCD) currently under way in the HAO silo and the SOC represents the first stopping point in the decommissioning of the installation. ASN authorised Areva NC to proceed with preparatory operations through a resolution of 13th March 2013, and to proceed with the construction of the recovery and packaging unit through a resolution of 10th June 2014. ASN is examining the file relative to the RCD operations for which the major issues are the process for final packaging of the waste and the earthquake resistance of the HAO silo once empty.

ASN is moreover vigilant with regard to the implementation times for these operations, which must be completed before 31st December 2022. In 2014 it observed the good progress in the preparatory operations which should allow construction of the waste recovery and packaging unit to start in 2015.

Further to these inspections, ASN has observed a lack of operating rigour, particularly in the monitoring of the updates of the safety baseline requirements and has asked Areva NC to implement a plan of action to remedy this.

BNI 80 moreover underwent a periodic safety review for which the conclusions report was sent to ASN at the end of 2013 and is currently undergoing an examination which will be finalised in 2015.

BNI 33, 38 and ELAN IIB (BNI 47)

The ÉLAN IIB facility (BNI 47) was dedicated to the manufacture of sources of caesium-137 and strontium-90 between 1970 and 1973.

In October 2008, Areva NC submitted three final shutdown and decommissioning authorisation applications for BNIs 33 (UP2-400), 38 (STE2 and AT1 facility) and 47 (ELAN IIB).

On completion of the technical examination, ASN considered that the decommissioning measures defined by Areva NC showed nothing unacceptable with regard to safety, radiation protection or the management of waste and effluents.

Nevertheless, this examination did reveal the necessity for the licensee to provide a large number of additional studies. Consequently, only those operations for which the information in the safety cases was considered sufficient could be authorised.

The three decrees authorising starting of the final shutdown and decommissioning operations for the three BNIs date from 8th November 2013. The decrees concerning BNIs 33 and 38 only authorise partial decommissioning, whereas the decree concerning BNI 47 authorises complete decommissioning of the installation.

TO BE NOTED

ASN resolution 2014-DC-0471 of 2nd December 2014 concerning the nal shutdown and decommissioning operations of BNIs 33, 38, and 47

Areva NC was authorised to start the final shutdown and decommissioning operations of BNIs 33, 38 and 47 of the Areva NC La Hague site by decrees of 8th November 2013.

The decree concerning BNI 47 (ELAN IIB facility) authorises complete decommissioning of the installation. The decrees relative to BNIs 33 and 38 (UP2-400 and STE2), however, are partial decommissioning decrees, because the licensee's application file lacked sufficient information to authorise all the planned operations. Consequently, the decrees relative to BNIs 33 and 38 provide for Areva NC to submit, before 30th June 2015, a new complete decommissioning application file for each of the two BNIs, focusing in particular on the operations not authorised at present.

Following the publication of the abovementioned decrees, ASN issued a resolution on 2nd December 2014 stipulating its expectations concerning the content of the future complete decommissioning application files for BNIs 33 and 38 and setting Areva NC additional requirements relative to the safety of the decommissioning of the three BNIs

The operations carried out in 2014 essentially concern the clean-out and removal of the glove boxes of the intermediate-level plutonium facility (MAPu), the preparation of decommissioning of the dissolvers of the high activity / dissolution extraction (HA/DE) facility, performance of the operations prior to oxalic acid rinsing in the high-level fission products (HAPF) facility and conducting various investigations and radiological mappings.

2.3.2 Comurhex plant at Pierrelatte

The plant mainly produced uranium hexafluoride (UF_6) for the fabrication of nuclear fuel. Alongside this main activity, Comurhex produced various fluorinated products such as chlorine trifluoride.

The production of UF_6 from natural uranium was carried out in a part of the plant subject to ICPE regulations, while the production of UF_6 from reprocessed uranium was carried out in a part of the plant constituting a BNI.

This part, BNI 105, which was definitively shut down in 2008, essentially comprises two units:
- the 2000 unit, which transformed reprocessed uranyl nitrate $UO_2(NO_3)_2$ into uranium tetrafluoride (UF_4) or uranium sesquioxide (U_3O_8);
- the 2450 unit, which transformed the UF_4 from the 2000 unit into UF_6. This UF_6 was used to enrich the reprocessed uranium for recycling in reactors.

As part of the simplification of the Areva group's organisation, BNI 105 is operated by Areva NC further to the authorisation to change licensee delivered by the decree of 1st October 2013 and by ASN resolution of 29th October 2013.

In May 2011 the BNI 105 licensee had submitted a first final shutdown and decommissioning application file which had been judged incomplete. In February 2014 Areva NC submitted a new final shutdown and decommissioning authorisation application. In summer 2014, ASN informed the Minister responsible for Nuclear Safety, who had referred this file to ASN, that further information was necessary in order to continue the examination.

2.3.3 SICN plant in Veurey-Voroize

The former nuclear fuel fabrication plant of Veurey-Voroize, operated by the Société Industrielle de Combustible Nucléaire (SICN - Areva Group) consists of two nuclear facilities, BNIs 65 and 90. Fuel fabrication activities were definitively stopped in the early 2000's. The decrees authorising the decommissioning operations date from 15th February 2006. The decommissioning work has now been completed.

The site nevertheless displays limited residual contamination of the soil and groundwater, the impact of which is acceptable for its envisaged future use (industrial). ASN has therefore asked the licensee to submit, as a prerequisite to delicensing, an application for the implementation of active institutional controls designed to restrict the use of the soil and groundwater and to guarantee that the land usage remains compatible with the state of the site.

SICN submitted this file to the Isère *département* Prefect's office in March 2014, and the delicensing application file for the two BNIs to ASN. The delicensing will not be able to be declared until these active institutional controls have been effectively put in place by the Prefect of the Isère *département*, following the examination procedure which includes a public inquiry.

2.4 Other installations

The Electromagnetic radiation laboratory (LURE)

The electromagnetic radiation laboratory (LURE), located at the heart of the Orsay campus, was an installation producing synchroton radiation (high-power X-rays) for a wide variety of research applications. It comprised six particle accelerators. CNRS (French National Centre for Scientific Research), the LURE licensee, was authorised to proceed with final shutdown and decommissioning by decree on 14th April 2009.

The decommissioning operations were completed in 2010.

As provided for by the abovementioned decree, the Clio and Phil accelerators will be kept in activity; moreover, two areas subsist with residual activity linked to the presence of the electron converters. The cleaning out of these areas required the destruction of part of the civil engineering calling into question the mechanical strength of the building as a whole, therefore during the examination it had been planned to put biological protections in place.

The licensee submitted its decommissioning file in spring 2011. A procedure to introduce active institutional controls to restrict access to the areas that housed the former converters was initiated by the prefecture of the Essonne *département*. The public inquiry was held at the beginning of Summer 2014. The requisite consultations prior to the delicensing decision were initiated at the same time.

3. OUTLOOK

The main actions ASN will carry out in 2015 will firstly be the continuing development of the regulatory framework for decommissioning, and secondly the close monitoring of certain installations.

ASN thus plans to:
- prepare the amendments of the decree of 2nd November 2007 made necessary by the entry into force of the green growth energy transition bill and the provisions relative to the decommissioning reform and the experience feedback on the final shutdown and decommissioning procedure acquired since 2007;
- formalise additional requirements in a draft resolution relative to decommissioning;
- supplement the series of guides relative to the decommissioning procedure, the clean-out of structures and the remediation of soils in BNIs by updating Guide No.6, by publishing the final version of Guide No.14 and by publishing the soil remediation guide that it prepared in 2014;
- finish examining the delicensing procedures for the LURE and SICN installations;
- finish examining the final shutdown and decommissioning authorisation application for the Phénix NPP;
- continue examining the final shutdown and decommissioning authorisation application files for the AMI, Comurhex and the ATUEs;
- start examining the final shutdown and decommissioning authorisation application files for the installations involving high stakes such as Eurodif and the UP2-400 plant at La Hague;
- implement actions with respect to the decommissioning strategy of EDF and more particularly the decommissioning of the gas-cooled reactors.

APPENDIX 1

LIST of Basic Nuclear Installations delicensed as at 1st March 2015

INSTALLATION LOCATION	BNI	TYPE OF INSTALLATION	COMMISSIONED	FINAL SHUTDOWN	LAST REGULATORY STATUS	CURRENT STATUS
IDE Fontenay-aux-Roses (FAR)	(former BNI 10)	Reactor (500 kWth)	1960	1981	1987: removed from BNI list	Decommissioned
TRITON FAR	(former BNI 10)	Reactor (6.5 MWth)	1959	1982	1987: removed from BNI list and classified as ICPE	Decommissioned
ZOÉ FAR	(former BNI 11)	Reactor (250 kWth)	1948	1975	1978: removed from BNI list and classified as ICPE	Confined (museum)
MINERVE FAR	(former BNI 12)	Reactor (0.1 kWth)	1959	1976	1977: removed from BNI list	Dismantled at FAR and reassembled at Cadarache
EL2 Saclay	(former BNI 13)	Reactor (2.8 MWth)	1952	1965	removed from BNI list	Partially decommissioned, remaining parts confined
EL3 Saclay	(former BNI 14)	Reactor (18 MWth)	1957	1979	1988: removed from BNI list and classified as ICPE	Partially decommissioned, remaining parts confined
PEGGY Cadarache	(former BNI 23)	Reactor (1 kWth)	1961	1975	1976: removed from BNI list	Decommissioned
CÉSAR Cadarache	(former BNI 26)	Reactor (10 kWth)	1964	1974	1978: removed from BNI list	Decommissioned
MARIUS Cadarache	(former BNI 27)	Reactor (0.4 kWth)	1960 at Marcoule, 1964 at Cadarache	1983	1987: removed from BNI list	Decommissioned
LE BOUCHET	(former BNI 30)	Ore processing	1953	1970	Removed from BNI list	Decommissioned
GUEUGNON	(former BNI 31)	Ore processing	1965	1980	Removed from BNI list	Decommissioned
STED FAR	BNI 34	Processing of liquids and solid waste	Before 1964	2006	2006: removed from BNI list	Integrated into BNI 166
HARMONIE Cadarache	(former BNI 41)	Reactor (1 kWth)	1965	1996	2009: removed from BNI list	Destruction of the ancillaries building
ALS	(former BNI 43)	Accelerator	1958	1996	2006 : removed from BNI list	Cleaned out - institutional controls**
SATURNE	(former BNI 48)	Accelerator	1966	1997	2005 : removed from BNI list	Cleaned out - institutional controls**
ATTILA* FAR	(former BNI 57)	Reprocessing pilot	1968	1975	2006 : removed from BNI list	Integrated into BNIs 165 and 166
LCPU FAR	(former BNI 57)	Plutonium chemistry laboratory	1966	1995	2006: removed from BNI list	Integrated into BNIs 165 and 166
BAT 19 FAR	(former BNI 58)	Plutonium metallurgy	1968	1984	1984: removed from BNI list	Decommissioned
RM2 FAR	(former BNI 59)	Radio-metallurgy	1968	1982	2006: removed from BNI list	Integrated into BNIs 165 and 166
LCAC GRENOBLE	(former BNI 60)	Fuels analysis	1975	1984	1997: removed from BNI list	Decommissioned
STEDS FAR	(former BNI 73)	Radioactive waste decay storage	1989		2006: removed from BNI list	Integrated into BNI 166
ARAC SACLAY	(former BNI 81)	Fabrication of fuel assemblies	1981	1995	1999: removed from BNI list	Cleaned out
IRCA	(former BNI 121)	Irradiator	1983	1996	2006: removed from BNI list	Cleaned out - institutional controls**
FBFC PIERRELATTE	(former BNI 131)	Fuel fabrication	1990	1998	2003: removed from BNI list	Cleaned out - institutional controls**

LIST of Basic Nuclear Installations delicensed as at 1st March 2015

INSTALLATION LOCATION	BNI	TYPE OF INSTALLATION	COMMISSIONED	FINAL SHUTDOWN	LAST REGULATORY STATUS	CURRENT STATUS
SNCS OSMANVILLE	(former BNI 152)	Ioniser	1983	1995	2002: removed from BNI list	Cleaned out - institutional controls**
MIRAMAS URANIUM WAREHOUSE	(former BNI 134)	Uranium-bearing materials warehouse	1964	2004	2007: removed from BNI list	Cleaned out - institutional controls**
SILOETTE GRENOBLE	(former BNI 21)	Reactor (100 kWth)	1964	2002	2007: removed from BNI list	Cleaned out - institutional controls**
MÉLUSINE GRENOBLE	(former BNI 19)	Reactor (8 MWth)	1958	1988	2011: removed from BNI list	Cleaned out
STRASBOURG UNIVERSITY REACTOR	(former BNI 44)	Reactor (100 kWth)	1967	1997	2012: removed from BNI list	Cleaned out - institutional controls over site memory
SILOÉ GRENOBLE	(former BNI 20)	Reactor (35 MWth)	1963	2005	2015: removed from BNI list	Cleaned out - institutional controls over site memory

**Attila: reprocessing pilot located in a unit of BNI 57.*
***Institutional controls: passive institutional controls were applied to the plots concerned.*

APPENDIX 2

LIST of Basic Nuclear Installations finally shut down as at 1.03.2015

INSTALLATION LOCATION	BNI	TYPE OF INSTALLATION	COMMISSIONED	FINAL SHUTDOWN	LAST REGULATORY ACTS	CURRENT STATUS
CHOOZ AD (FORMERLY-CHOOZ A)	163 (former BNIs 1, 2, 3)	Reactor (1,040 MWth)	1967	1991	2007: amendment of the MAD-DEM decree	Decommissioning in progress
CHINON A1D (FORMERLY-CHINON A1)	133 (former BNI 5)	Reactor (300 MWth)	1963	1973	1982: CHINON A1 confinement decree and creation of the CHINON A1 D storage BNI	Partially decommissioned, remaining parts confined Integrated in BNI (museum)
CHINON A2 D (FORMERLY-CHINON A2)	153 (former BNI 6)	Reactor (865 MWth)	1965	1985	1991: partial decommissioning decree for CHINON A2 and creation of the CHINON A2 D storage BNI	Partially decommissioned, remaining parts confined Integrated in BNI
CHINON A3 D (FORMERLY-CHINON A3)	161 (former BNI 7)	Reactor (1,360 MWth)	1966	1990	2010: final shutdown and decommissioning (MAD-DEM) decree	Decommissioning in progress
RAPSODIE Cadarache	25	Reactor (40 MWth)	1967	1983		Preparation for final shutdown
EL4-D (FORMERLY-EL4 BRENNILIS)	162 (former BNI 28)	Reactor (250 MWth)	1966	1985	1996: decree ordering decommissioning and creation of the EL-4D storage BNI 2006: amendment of the MAD-DEM decree 2007: decision of the *Conseil d'État* (State Council) cancelling the 2006 decree 2011: partial decommissioning decree	Partially decommissioned, remaining parts confined Integrated in BNI. Decommissioning in progress again
SPENT FUEL REPROCESSING PLANT (UP2) LA HAGUE	33	Transformation of radioactive substances	1964	2004	2013: partial MAD-DEM decree	Decommissioning in progress
STE2 LA HAGUE	38	Effluent treatment facility	1964	2004	2013: partial MAD-DEM decree	Decommissioning in progress
STED AND HIGH LEVEL WASTE STORAGE UNIT (Grenoble)	36 and 79	Waste treatment and storage facility	1964/1972	2008	2008: amendment of the MAD-DEM decree	Decommissioning in progress
BUGEY 1	45	Reactor (1,920 MWth)	1972	1994	2008: amendment of the MAD-DEM decree	Decommissioning in progress
ST-LAURENT A1	46	Reactor (1,662 MWth)	1969	1990	2010: final shutdown and decommissioning (MAD-DEM) decree	Decommissioning in progress
ST-LAURENT A2	46	Reactor (1,801 MWth)	1971	1992	2010: final shutdown and decommissioning (MAD-DEM) decree	Decommissioning in progress
ÉLAN IIB La Hague	47	Caesium-137 source fabrication	1970	1973	2013: final shutdown and decommissioning (MAD-DEM) decree	Decommissioning in progress
HIGH ACTIVITY LABORATORY (LHA) SACLAY	49	Laboratory	1960	1996	2008: amendment of the MAD-DEM decree	Decommissioning in progress
ATUE Cadarache	52	Uranium processing	1963	1997	2006: amendment of the MAD-DEM decree	Decommissioning in progress
LAMA Grenoble	61	Laboratory	1968	2002	2008: amendment of the MAD-DEM decree	Decommissioning in progress

LIST of Basic Nuclear Installations finally shut down as at 1.03.2015

INSTALLATION LOCATION	BNI	TYPE OF INSTALLATION	COMMISSIONED	FINAL SHUTDOWN	LAST REGULATORY ACTS	CURRENT STATUS
SICN VEUREY-VOROIZE	65 and 90	Fuel fabrication Plant	1963	2000	2006: amendment of the MAD-DEM decree	Decommissioning in progress
HAO (HIGH LEVEL OXIDE) FACILITY (La Hague)	80	Transformation of radioactive substances	1974	2004	2009: amendment of the MAD-DEM decree	Decommissioning in progress
ATPu CADARACHE	32	Fuel fabrication plant	1962	2003	2009: amendment of the MAD-DEM decree	Decommissioning in progress
LPC CADARACHE	54	Laboratory	1966	2003	2009: amendment of the MAD-DEM decree	Decommissioning in progress
SUPERPHÉNIX CREYS-MALVILLE	91	Reactor (3,000 MWth)	1985	1997	2009: amendment of the MAD-DEM decree	Decommissioning in progress
COMURHEX PIERRELATTE	105	Uranium chemical transformation plant	1979	2009		Preparation for final shutdown
LURE	106	Particle accelerators	To 1956 at 1987	2008	2009: amendment of the MAD-DEM decree	Decommissioning in progress
PROCÉDÉ FAR*	165	Grouping of former process installations	2006		2006: amendment of the MAD-DEM decree	Decommissioning in progress
SUPPORT FAR*	166	Waste packaging and processing	2006		2006: amendment of the MAD-DEM decree	Decommissioning in progress
ULYSSE SACLAY	18	Reactor (100 kW)	1967	2007	2014: amendment of the MAD-DEM decree	Decommissioning in progress
PHÉNIX MARCOULE	71	Reactor (536 MWth)	1973	2009		Preparation for final shutdown

**Fontenay-aux-Roses: creation of BNIs 165 and 166, in place of BNIs 34, 57, 59, 57, 59 and 73 and implementation of shutdown and decommissioning operations on BNIs 165 and 166 following the grouping of the buildings for the Fontenay-aux-Roses site delicensing project.*

16

RADIOACTIVE WASTE AND CONTAMINATED SITES AND SOILS

This chapter presents the role and actions of ASN in the management of waste generated by activities involving radioactive substances and the management of sites polluted by radioactive substances. It describes in particular the steps taken to define and determine the main radioactive waste management orientations and the controls carried out by ASN with respect to nuclear safety and radiation protection in facilities involved in the management of radioactive waste. It also presents the steps taken by ASN concerning sites contaminated by radioactive substances and how they are managed.

The term radioactive waste implies radioactive substances for which no subsequent use is planned or envisaged. These substances can come from both nuclear activities and non-nuclear activities in which the radioactivity naturally contained in substances, which are not used for their radioactive properties, may have been concentrated by the processes employed.

A site contaminated by radioactive substances is any site, either abandoned or in operation, on which natural or artificial radioactive substances have been or are employed or stored in conditions such that the site constitutes a hazard for health and the environment. Contamination by radioactive substances can be the result of industrial, medical or research activities.

A noteworthy event in 2014 was the submission of the conclusions of the public debate on “Cigéo”, the deep geological repository project of Andra (French National Agency for Radioactive Waste Management). The public debate commissions published their assessment and report of the debate on 12th February 2014. Through a decision of its board of directors on 5th May 2014, Andra decided to continue the project with the introduction of a number of modifications. ASN welcomes the fact that Andra has decided to submit a safety options file to it in 2015, and ASN has informed it of its expectations regarding this file.

Another noteworthy event in 2014, in the context of the action plan on the management of waste rock from the former uranium mining sites, was the discovery of a house in Bessines-sur-Gartempe (Haute-Vienne *département*) displaying very high radon concentrations. This discovery showed the need supplement Areva Mines’ strategy for inventorying the waste rock in the public domain by an approach that takes into account the presence of residential premises in the vicinity of areas where waste rock has been identified.

1. RADIOACTIVE WASTE

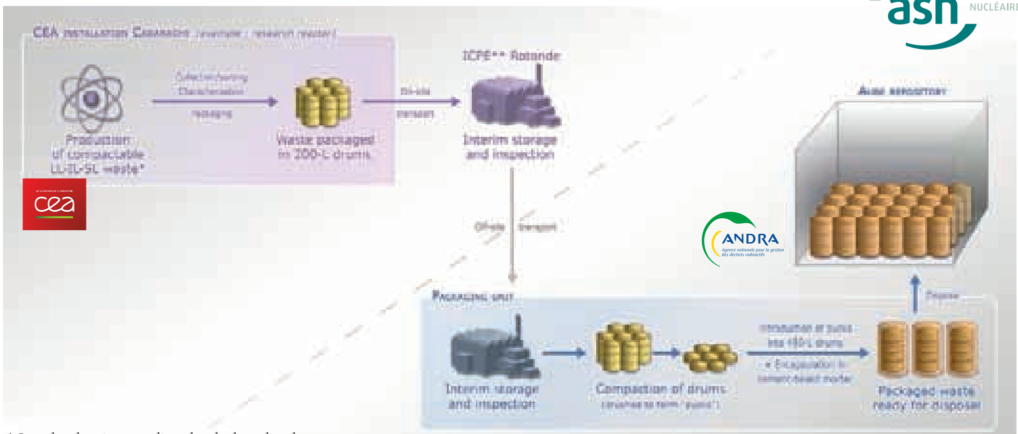
Nuclear activities produce waste which must be managed in accordance with specific and stringent conditions. Pursuant to the provisions of the Environment Code, the producers of spent fuel and radioactive waste are responsible for these substances, without prejudice to the liability of those who hold these substances in their role as persons or entities responsible for nuclear activities. Moreover, waste producers must pursue the objective of minimising the volume and harmfulness of their waste, both before production by appropriate design and operation of the facilities and after production, by appropriate sorting, treatment and packaging.

The different forms of radioactive waste differ widely in their radioactivity (specific activity, nature of the radiation, half-life) and their physical and chemical form (scrap metal, rubble, oils, etc.).

Two principal parameters can be used to assess the radiological risk that radioactive waste represents: firstly the activity, which contributes to the toxicity of the waste, and secondly the half-life of the radionuclides present in the waste which determines the required waste containment time. A distinction is therefore made between very low, low, intermediate and high level waste, on the one hand, and on the other very short-lived waste (whose activity level is halved in less than 100 days) resulting mainly from medical activities, short-lived waste (chiefly containing radionuclides whose activity level is halved in less than 31 years) and long-lived waste (which contains a large quantity of radionuclides whose activity level is halved in more than 31 years).

Each type of waste requires the implementation of an appropriate and safe management solution in order to control the risks it represents, particularly the radiological risk.

DIAGRAM of the management route for radioactive waste



* Low-level or intermediate-level, short-lived waste
** Installation classified on environmental protection grounds

UNDERSTAND

A management route for radioactive waste

Safe management of the radioactive waste produced necessitates the setting up of management routes adapted to the different waste categories.

Such routes comprise all the operations involved from production of the waste through to disposal: characterisation, sorting, processing, packaging, transport, storage* and disposal. In some cases these operations can be repeated, for example if several packaging operations carried out in different facilities are required.

Each step in these routes must be carried out safely. Each entity involved in the route is moreover responsible for the safety of the facilities it operates and the activities it performs.

And yet it is also necessary to take into account the fact that all the operations in these routes – operations which may be carried out by different licensees – are interdependent. Each element must therefore be chosen to be compatible with the others and allow the optimisation of the whole.

It is for this reason that ASN asks the waste producers to define the management routes chosen for each type of waste and regularly analyses the waste management strategies implemented by each licensee. Furthermore, the National Plan for Radioactive Materials and Waste Management (PNGMDR) sets out the broad orientations for setting up these routes and asks the licensees to work on optimising the distribution of the waste between management routes.

** The storage of radioactive materials or waste consists in placing these substances for a temporary period in a facility specially fitted out for the purpose, pending their retrieval. The disposal of radioactive waste consists in placing these substances in a facility specially fitted out to conserve them, potentially definitively, in compliance with the principles stipulated in Article L. 542-1 of the Environment Code.*

1.1 Radioactive waste management regulatory framework

Radioactive waste management falls within the general waste management framework defined in book V, part IV, chapter I of the Environment Code and its implementing decrees. The particular requirements concerning radioactive waste were introduced by Act 91-1381 of 30th December 1991 on research into high level, long-lived waste, and by the Planning Act 2006-739 of 28th June 2006 on sustainable management of radioactive waste, called the "Waste Act", which gives a legislative framework to management of all radioactive materials and waste (these acts are extensively codified in book V, part IV, chapter II of the Environment Code).

This Waste Act has set a new calendar for research into high and intermediate-level, long-lived (HL and IL-LL) waste and a clear legal framework for ring-fencing the funds needed for decommissioning and for the management of radioactive waste. It also provides for the drafting of the PNGMDR (National Plan for Radioactive Materials and Waste Management), which aims to periodically assess the radioactive materials and waste management policy and determine its prospects. It also extends the missions of Andra. Finally, it prohibits the disposal in France of foreign waste and defines rules specifying the conditions for the return of waste resulting from the reprocessing in France of spent fuel or waste from abroad.

1.1.1 Production of radioactive waste in installations regulated by ASN

ASN does not regulate all the activities associated with radioactive waste management. Thus, nuclear activities associated with national defence are regulated by the ASND (Defence Nuclear Safety Authority). Furthermore, some radioactive waste management facilities that do not fulfil the conditions defined in Decree 2007-830 of 11th May 2007 relative to the nomenclature of Basic Nuclear Installations (BNI) can have the status of ICPE (installations classified on environmental protection grounds) and be placed under the control of the Prefects, or be licensed by ASN under the Public Health Code.

Decree 2014-996 of 2nd September 2014 changes the nomenclature of classified installations and the attribution of competences in the management of radioactive substances in the classified installation: the licensing of radioactive substances in sealed form (called sealed sources) is now governed solely by the Public Health Code and is therefore regulated by ASN. The licensing of radioactive substances in non-sealed form and of radioactive waste is governed by the Environment Code if the volume present in the facility exceeds 10 m^3, and by the Public Health Code if the volume is less than this.

The production of radioactive waste in the BNIs

In France, the management of radioactive waste in BNIs is governed in particular by the Order of 7th February 2012 setting the general rules relative to BNIs, of which Part VI concerns waste management.

A noteworthy characteristic of the French regulations is that there are no clearance levels[1]. In concrete terms, application of this doctrine leads, in BNIs, to the establishment of a waste zoning plan which identifies the zones in which the waste produced is or could be contaminated or activated.

As a protective measure, the waste produced in these zones is considered radioactive and must be managed using specific routes; this means that this waste can only be recycled in the nuclear domain. Waste from other parts of the installation, once confirmed as being free of radioactivity, is sent to authorised routes dedicated to the management of hazardous, non-hazardous or inert waste, depending on its properties.

The regulations also require licensees to conduct waste studies, indicating the targets with regard to prevention, reduction at source, harmfulness of the waste and the means implemented to reduce waste volumes and harmfulness through sorting and appropriate treatment and packaging.

A draft ASN resolution, made available for consultation from 18th August to 26th September 2014 and submitted to the CSPRT (Higher Council for the Prevention of Technological Risks) in March 2015, will detail the content of the waste studies and the general principles according to which the waste zoning plan must be drawn up and can be modified. This draft resolution shall be finalised in the 1st half of 2015.

Production of radioactive waste by a nuclear activity authorised under the Public Health Code

Article R. 1333-12 of Public Health Code states that the management of effluents and waste contaminated by radioactive substances originating from all nuclear activities related to medicine, human biology, or biomedical research and entailing a risk of exposure to ionising radiation must be examined and approved by the public authorities. ASN resolution 2008-DC-0095 of 29th January 2008 lays out the technical rules to be met by the disposal of effluents and waste contaminated or potentially contaminated by radionuclides owing to a nuclear activity. ASN published a guide (guide No. 18) to the application of this resolution in January 2012.

1.1.2 The national inventory of radioactive materials and waste

Article L. 542-12 of the Environment Code tasks Andra with *"establishing, updating every three years and publishing the inventory of radioactive materials and waste present in France, along with their location on the national territory"*

The national inventory was last published in June 2012 and presents information concerning the quantities, nature and locations of radioactive materials and waste as at the end of 2010, plus the forecasts for the end of 2020 and the end of 2030. A prospective exercise was also conducted considering two contrasting scenarios for France's long-term energy policy. This inventory is a source of information for the PNGMDR.

ASN is a member of the steering committee that oversees the production of this inventory. The inventory of radioactive materials and waste as at the end of 2013 will be published in mid-2015.

1. Activity thresholds below which it would be possible to consider that very low-level waste produced in a nuclear facility could be managed in a conventional disposal route without a requirement for traceability.

1.1.3 The French National Plan for the Management of Radioactive Materials and Waste

Article L.542-1-2 of the Environment Code requires the production of the French National Plan for the Management of Radioactive Materials and Waste (PNGMDR), which is revised every three years and serves to *"review the existing management procedures for radioactive materials and waste, to identify the foreseeable needs for storage and disposal facilities, specify the necessary capacity of these facilities and the storage durations and, for radioactive waste for which there is as yet no final management solution, to determine the objectives to be met"*. The main provisions of the plan are then set by decree.

The last plan published covers the 2013-2015 period. Decree No.2013-1304 of 27th December 2013 sets out the corresponding prescriptions.

Presentation of the OPECST (Parliamentary Office for the Evaluation of Scientific and Technological Choices) assessment report to the Senate at the PNGMDR meeting on 18th December 2014.

1.2 ASN's role in the radioactive waste management system

The public authorities, and ASN in particular, are attentive to the fact that there must be an operational management route for all radioactive waste and that each step of waste management is carried out under safe conditions. ASN thus considers that the development of management routes appropriate to each waste category is of vital importance and that any delay in the search for long-term waste disposal solutions will increase the volume and size of the storage areas in the facilities and the inherent risks. ASN takes care, particularly within the framework of the PNGMDR but also by regularly assessing the licensees' waste management strategy, to ensure that the system made up by all these routes is optimised through an overall and coherent approach to the management of radioactive waste. This approach must take into account all the safety, radiation protection, traceability and waste volume minimisation issues.

Finally, ASN considers that this management approach must be conducted in a manner that is transparent for the public and involves all the stakeholders. This plan is produced within the pluralistic working group co-chaired by ASN and the DGEC (General Directorate for Energy and Climate) as described in chapter 2.

ASN also publishes the PNGMDR and a synthesis of it on its website, along with the minutes of the abovementioned working group's meetings and its various opinions.

1.2.1 Oversight of the BNIs

With regard to radioactive waste management, ASN's oversight and inspection activities aim at verifying on the one hand correct application of the waste management regulations on the production sites and on the other hand the safety of the facilities dedicated to radioactive waste management (waste reprocessing, packaging storage and disposal facilities).

These activities are described in this chapter as well as in Chapters 8 and 13.

1.2.2 Oversight of the packaging of waste packages

Regulations

The Order of 7th February 2012 defines the requirements associated with waste packaging. Producers of radioactive waste are instructed to package their waste taking into account the requirements associated with their subsequent management, and more particularly their acceptance at the disposal facilities.

ASN has begun writing a draft resolution specifying the requirements regarding waste packaging for disposal and the conditions of acceptance of waste packages in the disposal BNIs.

This text will be made available for consultation by the stakeholders and the public in 2015.

Production of waste packages intended for existing disposal facilities

The waste package producers prepare an approval application file based on the acceptance specifications of the disposal facility that is to receive the packages. Andra delivers an approval formalising its agreement on the package manufacturing process and the quality of the packages. Andra verifies the conformity of the packages with the delivered approvals by means of audits and monitoring actions on the package producers' premises and on the packages received at its facilities.

Waste packages intended for projected disposal facilities

With regard to disposal facilities currently being studied, the waste acceptance specifications have of course not yet been defined. Andra therefore cannot issue approvals to govern the production of packages for LLW-LL (low-level, long-lived waste), HLW (high-level waste) or ILW-LL (intermediate-level, long-lived waste) type waste.

Consequently, the production of waste packages for a disposal facility currently being studied is subject to ASN authorisation on the basis of a file called "packaging baseline requirement". This file must demonstrate that the packages display no unacceptable behaviour under the disposal conditions on the basis of existing knowledge and the currently known requirements of the disposal facilities being studied.

This provision also avoids delaying waste retrieval and packaging operations.

Checks and inspections

Alongside Andra's surveillance of approved packages, ASN checks that the licensee correctly applies the requirements of the approval and has a satisfactory command of the packaging processes. For waste packages intended for disposal facilities still being studied, ASN applies particular vigilance to ensuring that the packages comply with the conditions of the issued authorisations.

ASN also ensures through inspections that Andra takes adequate steps to verify the quality of the packages accepted in its disposal facilities. This is because ASN considers that Andra's role in the approvals issuing process and in monitoring the waste package producers is vital in guaranteeing the package quality necessary to comply with the safety case of the waste repositories.

1.2.3 Drafting recommendations for sustainable waste management

ASN issues opinions on the studies submitted in application of the decree setting the requirements of the PNGMDR. ASN can also give the Government its recommendations concerning the disposal projects for long-lived radioactive waste.

1.2.4 Developing the regulatory framework and issuing prescriptions to the licensees

ASN can issue statutory resolutions. Thus, the provisions of the Order of 7th February 2012 defining the general regulations applicable to BNIs which concern the management of radioactive waste will be more specifically applied in ASN resolutions on the subjects of waste management in BNIs, storage of radioactive waste, waste packaging and radioactive waste disposal facilities.

Lastly, ASN is consulted for its opinion on draft regulatory texts relative to radioactive waste management.

More generally, ASN issues requirements relative to the management of waste from the BNIs. These requirements are set out in ASN resolutions which are subject to public consultation and published on its web site.

1.2.5 Evaluation of the nuclear nancial costs

The regulatory framework designed to ring-fence the financing of nuclear facility decommissioning costs or, for radioactive waste disposal facilities, the final shutdown, maintenance and surveillance costs, in addition to the cost of managing spent fuel and radioactive waste, is described in Chapter 15 (see point 1.4).

1.2.6 ASN's international action in the area of waste

ASN participates in the work of WENRA (Western European Nuclear Regulators' Association) aiming at harmonising nuclear safety practices in Europe by defining "reference safety levels" which must be transposed into the national regulations of its member countries. As such, the WGWD (Working Group on Waste and Decommissioning) is more specifically tasked with defining reference levels concerning the safety of radioactive waste and spent fuel storage and of radioactive waste repositories. ASN has established a plan of action to transpose these reference safety levels. It is based more specifically on the ASN resolutions that will detail the provisions of the Order of 7th February 2012 defining the general regulations applicable to BNIs.

Finally, ASN is a participant in the International Atomic Energy Agency's (IAEA) Waste Safety Standards Committee (WASSC), whose role is to draft and then approve the international standards defined by IAEA, particularly concerning the management of radioactive waste. It also takes part in the work of ENSREG (European Nuclear Safety Regulators Group) group 2 which is assigned to subjects relative to radioactive waste management.

ASN also participates in projects of a technical nature with the European Union (SITEX) and IAEA (GEOSAF, HIDRA).

Lastly, ASN coordinated the authoring of the French national report on the implementation of the obligations of the Joint Convention, which was sent to IAEA in October 2014. This report presents the implementation of the obligations of the Joint Convention by all the French actors concerned. It also details the developments in the European and French regulatory frameworks, in the spent fuel and radioactive waste management policies, and the issues raised by the decommissioning of nuclear facilities. The report also specifies the new steps taken by France to integrate the lessons learned from the Fukushima Daiichi accident. It will be examined from 11th to 22nd May 2015 in Vienna.

ASN's international actions are presented more generally in Chapter 7 covering international relations.

1.3 Long-term management solutions for radioactive waste

1.3.1 Disposal of very-low-level (VLL) waste

CIRES (industrial centre for nuclear waste collection, storage and disposal), located in the towns of Morvilliers and La Chaise in the Aube *département* and operated by Andra, includes a disposal facility for very-low-level (VLL) waste. This facility, which has ICPE status, has been operational since 2003.

At the end of 2014, the volume of waste in the CIRES repository was about 279,000 m^3, or 43% of the authorised capacity (650,000 m^3).

The latest production estimates for VLL waste indicate that the needs will exceed the capacity planned for when the centre was designed. However, the annual VLL waste production streams have been lower than forecasted in the last few years.

The PNGMDR 2013-2015 requires that Andra propose a comprehensive industrial scheme by mid-2015 that meets the new VLL waste disposal capacity requirements.

1.3.2 Disposal of low and intermediate-level, short-lived waste (LL/IL-SL)

The majority of low and intermediate-level short-lived (LL/IL-SL) waste is disposed of in surface disposal facilities operated by Andra. Once these facilities are closed, they are subject to surveillance during an "oversight phase" set by convention at 300 years. The facility safety case – which is updated periodically, including during the oversight phase – must show that at the end of this phase the residual activity contained in is such that human and environmental exposure levels are acceptable, even in the event of a significant loss of the containment properties of the facility.

There are two such repositories in France.

The Manche repository - BNI 66

The Manche waste disposal facility (CSM), which was commissioned in 1969, was the first radioactive waste repository operated in France. 527,225 m^3 of waste packages are emplaced in it. Disposal of waste in the CSM repository stopped in July 1994 and it entered the monitoring phase in January 2003.

ASN considers that the state and the operation of the facilities are satisfactory. Andra must continue its efforts to reinforce the stability of the cover and to eliminate the residual infiltrations of water into repository at the edge of the membrane. An interim review of the modifications of the repository cover is to be presented by 2015.

Aube repository - BNI 149

Authorised by the Decree of 4th September 1989, the Aube repository (CSA) took over from the Manche repository (CMS), benefiting from the experience gained with it.

This facility, situated in Soulaines-Dhuys (Aube *département*), has a disposal capacity of one million cubic metres of LL/ILW-SL. The operations authorised on the facility include waste packaging by injection of mortar into metal crates of 5 m^3 or 10 m^3 volume, or by compacting 200-L drums.

At the end of 2014, the volume of waste in the repository was about 292,000 m^3, or 29% of the authorised capacity. In the context of the PNGMDR 2013-2015, Andra has been asked to produce for mid-2015 a forward-looking filling schedule for the CSA, presenting in particular the anticipated development of the occupation of the repository's radiological capacity.

ASN notes that in 2014 Andra began the facility modification work to allow X-ray imaging inspections, tritium degassing checks and destructive tests (core sampling of low level packages) on the site,

The Aube LL/ILW repository.

in addition to the non-destructive checks already carried out (visual, radiological, dimensional, gamma spectrometry checks). ASN is favourable to the idea of Andra acquiring its own high-performance inspection resources to ensure the quality of the packages received in its facilities.

Commissioning of this inspection facility, planned for 2016, will require ASN approval.

Furthermore, in the light of experience feedback from the operation of the disposal facilities, ASN has given its agreement for the modification of their design and conditions of utilisation for the construction of section No.9, whose commissioning is planned for early 2016.

ASN considers that the CSA repository is operated satisfactorily.

1.3.3 Management of high and intermediate-level, long-lived waste (HL/ILW-LL)

The "Waste" Act of 28th June 2006 states that research into the management of high and intermediate-level, long-lived radioactive waste (HL/ILW-LL) should be pursued in three complementary directions: separation and transmutation of long-lived radioactive elements, storage, and reversible disposal in a deep geological repository, in continuity with the Act of 30th December 1991. ASN considers that studies in these three directions are on the whole proceeding satisfactorily.

Separation/Transmutation

Separation/transmutation processes aim to isolate and then transform long-lived radionuclides in radioactive waste into shorter-lived radionuclides or even stable elements. The transmutation of the minor actinides contained in the waste is liable to have an impact on the size of the disposal facility, by reducing both the heating power of the packages placed in it and the repository inventory. But despite this, the impact of disposal on the biosphere would not be significantly reduced.

Under the Waste Act and the PNGMDR, CEA submitted a report at the end of 2012 assessing the industrial prospects of the separation/transmutation processes. ASN issued an opinion on this file on 4th July 2013.

ASN considers that the expected gains from the transmutation of minor actinides in terms of safety, radiation protection and waste management do not appear to be decisive given in particular the resulting constraints on the fuel cycle facilities, the reactors and the transport operations, which would involve highly radioactive materials at all stages of the fuel cycle.

Storage

The Waste Act states that storage studies must be carried out by Andra so that *"no later than 2015, new storage facilities can be created or existing facilities modified, to meet the needs, particularly in terms of capacity and duration"*.

The needs to extend or create storage facilities must be anticipated and listed. ASN notes that uncertainties subsist with regard to the schedule for commissioning a deep geological disposal facility, the delivery time frames that Andra will adopt, and the acceptability of certain waste packages. ASN is thus attentive to ensuring that the holders of HL/IL-LL waste have storage facilities with sufficient margins regarding the storage capacities and possible storage times.

Andra is tasked with gathering and building on experience feedback from the construction and operation of the existing facilities or those being developed, and for conducting research on the behaviour of the materials used for the construction of the storage structures and the package materials as well as oversight techniques, with a view to optimising the durability, the monitoring, the removal of heat and, if necessary, the versatility of these storage facilities.

The PNGMDR 2013-2015 required Andra to produce, after consultation with Areva, CEA and EDF and before 31st December 2014, recommendations for the design of storage facilities to complement the disposal process. ASN will examine this file in 2015.

Reversible deep geological disposal

The studies of deep geological disposal fit into the guidelines of Article L. 542-1-2 of the Environment Code, namely that *"after storage, ultimate radioactive waste which, for nuclear safety or radiation protection reasons, cannot be disposed of on the surface or at shallow depth, shall be disposed of in a deep geological repository"*.

The Waste Act assigns Andra the task of siting and designing a deep geological disposal facility, which is considered to be a BNI and therefore subject to ASN oversight.

Principle

Deep geological disposal of radioactive waste consists in placing packages of radioactive waste – without the intention of retrieving them – in an underground facility situated in a deep geological formation whose characteristics ensure the containment of the radioactive substances present in the waste. Such a disposal facility – unlike storage facilities – must be designed such that long-term safety is ensured passively, that is to say without depending on human actions (such as monitoring or maintenance activities) which require institutional control, the durability of which cannot be guaranteed beyond a limited period of time. Lastly, the depth of the disposal structures must be such that they cannot be significantly affected by the expected external natural phenomena (erosion, climate change, earthquakes, etc.) or by "normal" human activities.

Under these conditions, in its opinion of 1st February 2006, ASN considers deep geological disposal to be an *"unavoidable definitive management solution"*.

Underground laboratory of Meuse/Haute-Marne

Studies on deep geological disposal necessitate research and experiments in an underground laboratory. Andra has been operating such an underground laboratory within the Bure municipality since 1999.

ASN issues recommendations concerning the research and experiments, and ascertains through follow-up inspections that they are carried out using processes that guarantee the quality of the results.

Safety guide

In 1991 ASN published basic safety rule RFS III-2-f defining the objectives to be set in the design and works phases for final disposal of radioactive waste in deep geological formations, in order to ensure safety after the operational life of the repository.

In 2008 it published an update of this document which became safety guide No.1.

Technical instructions

Under the Act of 30th December 1991 through until 2006, and then under the Waste Act of 28th June 2006 and the PNGMDR, Andra has carried out studies and submitted reports and files on deep geological repository. These studies and reports have been examined by ASN - referring in particular to the safety guide of 2008 - and it has issued an opinion on them.

ASN has thus examined the files submitted by Andra in 2005 and at the end of 2009. ASN gave the Government its opinion on these files on 1st February 2006 and 26th July 2011.

Andra is continuing its work and ASN examines the files submitted to it to measure the progress of Andra's studies and work since the abovementioned files were examined.

ASN thus gave an opinion on 16th May 2013 on four documents submitted by Andra between 2009 and 2012 concerning the PIGD (Industrial Waste Management Programme) and the results of the 3D seismic campaign carried out in 2010, a progress report requested as part of the PNGMDR on the development of an operational model of release of radionuclides by spent fuel from EDF reactors under disposal conditions and the replies formulated by Andra further to an independent study conducted at the request of the Bure CLIS (local information and monitoring committee) by an American institute, the IEER (Institute for Energy and Environmental Research).

In 2014 ASN also examined a file named "Cigéo Project - closure structures" submitted by Andra. ASN has observed that Andra has on the whole upgraded the concepts of the closure systems and the related research programmes in a manner that fosters obtaining conclusive information on their feasibility by the deadline for submission of the creation authorisation application. ASN nevertheless underlines that information concerning the substantiation of the performance targets assigned to these structures, their industrial feasibility and the proof of the performance of the chosen concepts still has to be provided. ASN informed Andra of its observations in a letter dated 9th October 2014, so that they could be taken into account in the safety options file Andra has said it will submit in 2015, and in the future creation authorisation application file.

Authorisation process

The process for examining a creation authorisation application for a deep geological repository has not started and will not start until Andra submits an authorisation application. According to the schedule provided for in the Waste Act, this file was to be submitted in 2015.

Following submission of the conclusions of the public debate, Andra proposed a change to this schedule through a deliberation of its board of directors on 5th May 2014.

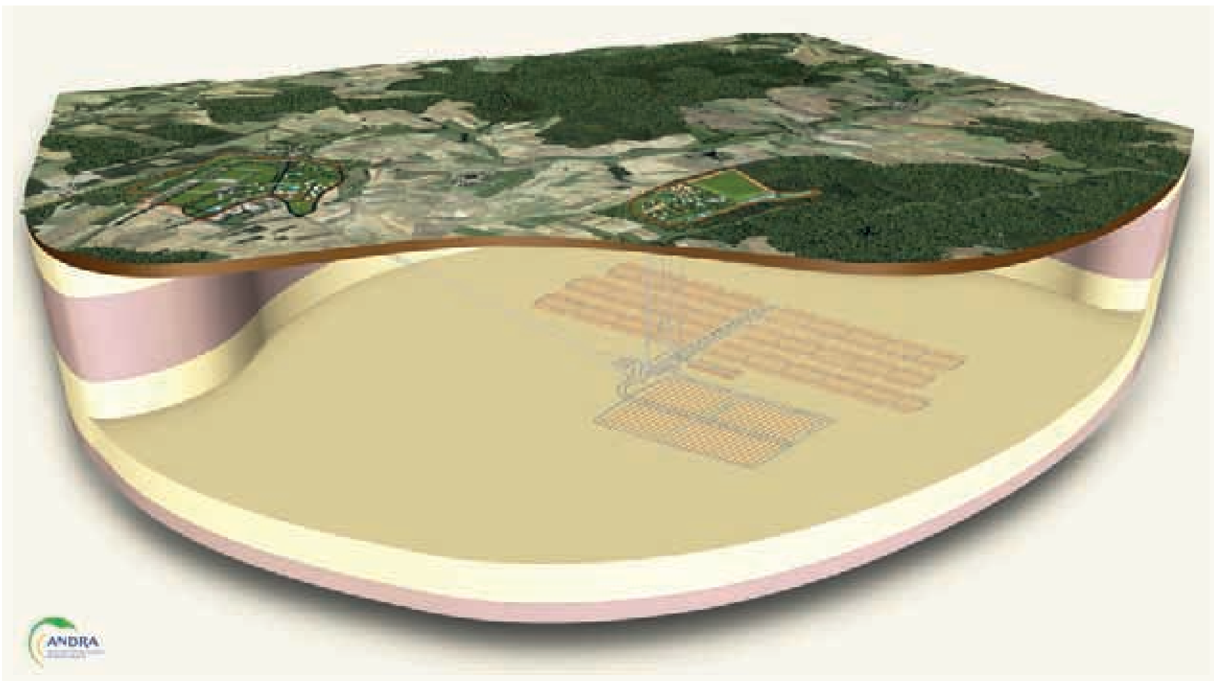
On the basis of this new schedule, in 2015 Andra would submit a proposed master plan for the operation of Cigéo along with a safety options file and a retrievability technical options file. The creation authorisation application file for this facility should then be submitted at the end of 2017.

ASN welcomes Andra's decision to submit a safety options file to it, as it considers that this contributes to the pursuance of an organised and controlled step-wise development process.

On 19th December 2014, ASN informed Andra of its expectations regarding the content of this file and the elements it must contain for its examination to take place. ASN more specifically asked Andra to ensure the completeness of the file with regard to the notion of disposal system[2] defined in the abovementioned ASN safety guide. ASN also asked that the file provide a detailed presentation of the objectives, concepts and principles adopted to ensure the safety of the facility in operation and over the long term at the different phases of the facility's life cycle.

2. The system of disposal in deep geological formation comprises the waste packages, the disposal facility and the geological environment. The disposal facility comprises the waste package disposal structures and the access structures.

SCHEMATIC of the Cigéo facilities



TO BE NOTED

Conclusions and follow-ups to the public debate

On completion of the public debate, the Board of Directors of Andra deliberated on 5th May 2014 on the principle and the conditions of continuation of the Cigéo project. Andra decided to continue its studies on this project with a view to submitting, at the end of 2017, a creation authorisation application for a deep geological radioactive waste disposal facility. Andra is moreover proposing new procedures for the development of its project.

With regard to the notion of "pilot industrial phase":

Prior to routine operation of its facility, Andra plans for what it refers to as a "pilot industrial phase". During its technical reviews, ASN had underlined the importance of a gradual "ramp-up" phase for the installation before routine operation. It had also specified that Andra should conduct in-situ tests on a representative scale.

ASN considers that this "pilot industrial phase" is, as far as the principles are concerned, capable of meeting these requirements. However, Andra must clarify its objectives.

ASN also considers that the regulations should detail the supervision of this phase and the conditions of transition to a routine operation phase.

With regard to reversibility:

The reversibility of deep geological disposal is a requirement contained in the Environment Code. It should be specified in a future act. Andra has undertaken to submit in 2015 a file to ASN presenting the main technical options to ensure the retrievability of the emplaced waste packages.

ASN considers that the notion of reversibility must not only guarantee retrievability, in other words the possibility of retrieving the waste packages already emplaced for a given period of time, but also that the facility is adaptable in order to guarantee the possibility of modifying the previously adopted provisions during the construction and operation of the disposal facility. As such, ASN considers that Andra must demonstrate that a change in the waste inventory intended for deep geological disposal further to - for example - a political decision in terms of energy policy leading to the direct disposal of spent fuel, does not call into question the safety of disposal.

To ensure that these safety issues are integrated beginning with the design phase, ASN considers that it is essential that the technical requirements associated with reversibility bedefined prior to submission of the creation authorisation application for such a disposal facility.

ASN inspection on the surface sealing test site in Saint-Dizier, April 2014.

1.3.4 Management of low-level, long-lived waste (LLW-LL)

Low-level long-lived waste (LLW-LL) comprises two main categories: graphite waste resulting from the operation of the graphite-moderated gas-cooled reactor (UNGG) nuclear power plants, and radium-bearing waste, from the radium industry and its offshoots.

Other types of waste fall into this category, such as certain bituminised effluents, substances containing radium, uranium and thorium with low specific activity, as well as certain disused sealed radioactive sources.

The PNGMDR 2013-2015 requires that the different actors involved carry out studies to enable the Government to provide guidelines relative to the management of LLW-LL in 2016.

The PNGMDR thus requires that Andra submit by mid-2015 a report containing:
- proposals of choices of management scenarios for graphite and bituminous waste, notably with the possibility of reinitiating the search for a site for an "intact cover disposal" type repository or not;
- a feasibility file for the project for a "reworked cover disposal"[3] type disposal facility, the types of waste to be disposed of in it and the schedule for its deployment.

3. Reworked cover disposal is disposal at shallow depth achieved by open-cast excavation of a layer with a clayey or marly component to reach the storage level. Once filled, the vaults are covered by a layer of compacted clay followed by a protection layer of planted vegetation reconstituting the site's natural level.

At the same time, the PNGMDR asks holders of LLW-LL to make progress in the characterisation of their waste and in the processing possibilities, particularly with regard to graphite waste and some types of bitumen-solidified waste.

1.4 Socodei melting/incineration facility

The Centraco low-level waste processing facility (BNI 160), located in Codolet near the Marcoule site (Gard *département*), is operated by Socodei, a subsidiary of EDF. The purpose of the Centraco facility is to process low or intermediate level waste by melting down metal waste or incinerating incineratable waste such as the clothing worn by staff intervening in nuclear facilities (gloves, suits), oils, solvents, resins, etc. The melting process consists in treating primarily ferrous metal waste (valves, pumps, pipes, tools, etc.) generated by the maintenance and decommissioning of nuclear facilities. This facility was authorised by a decree dated 27th August 1996 and was commissioned in 1999.

On 12th September 2011, an explosion in the melting furnace killed one employee and injured four others, one seriously. A judicial inquiry was opened at the same time as ASN was carrying out its investigations. ASN contributes to the inquiry as technical expert. Without prejudice to any measures that may be taken under the judicial procedure, ASN made its authorisation a prerequisite for restarting the melting and incineration furnaces, which were shut down following the accident.

ASN authorised Socodei to restart the incineration furnace in June 2012. In addition to this, ASN completed the periodic safety review of this part of the facility in 2014 and set new prescriptions for Socodei in a resolution of 17th July 2014. ASN also gave its authorisation to extend the operating capacity of the facility, called “Centraco 2”, which results in an increase in the specific activities of the waste received and in the total quantity of waste that can be processed in the facility.

The licensee wants to restart the melting furnace in the first half of 2015 and submitted an authorisation application file for restarting the furnace in February 2014. This file contains, in addition to an update of the periodic safety review of the melting furnace, the conclusions of the analysis of the causes of the explosion and the technical and organisational measures taken to prevent the recurrence of such an accident.

1.5 The radioactive waste management strategies of the nuclear licensees

ASN requires that licensees define a management strategy for all the radioactive waste produced in their facilities and periodically evaluates this strategy.

These management strategies can be based on facilities specific to each licensee but also on facilities operated by other licensees (Andra and Socodei), described earlier.

The waste management procedures adopted by the three main waste producers are presented below.

1.5.1 CEA waste management

Types of waste produced by CEA

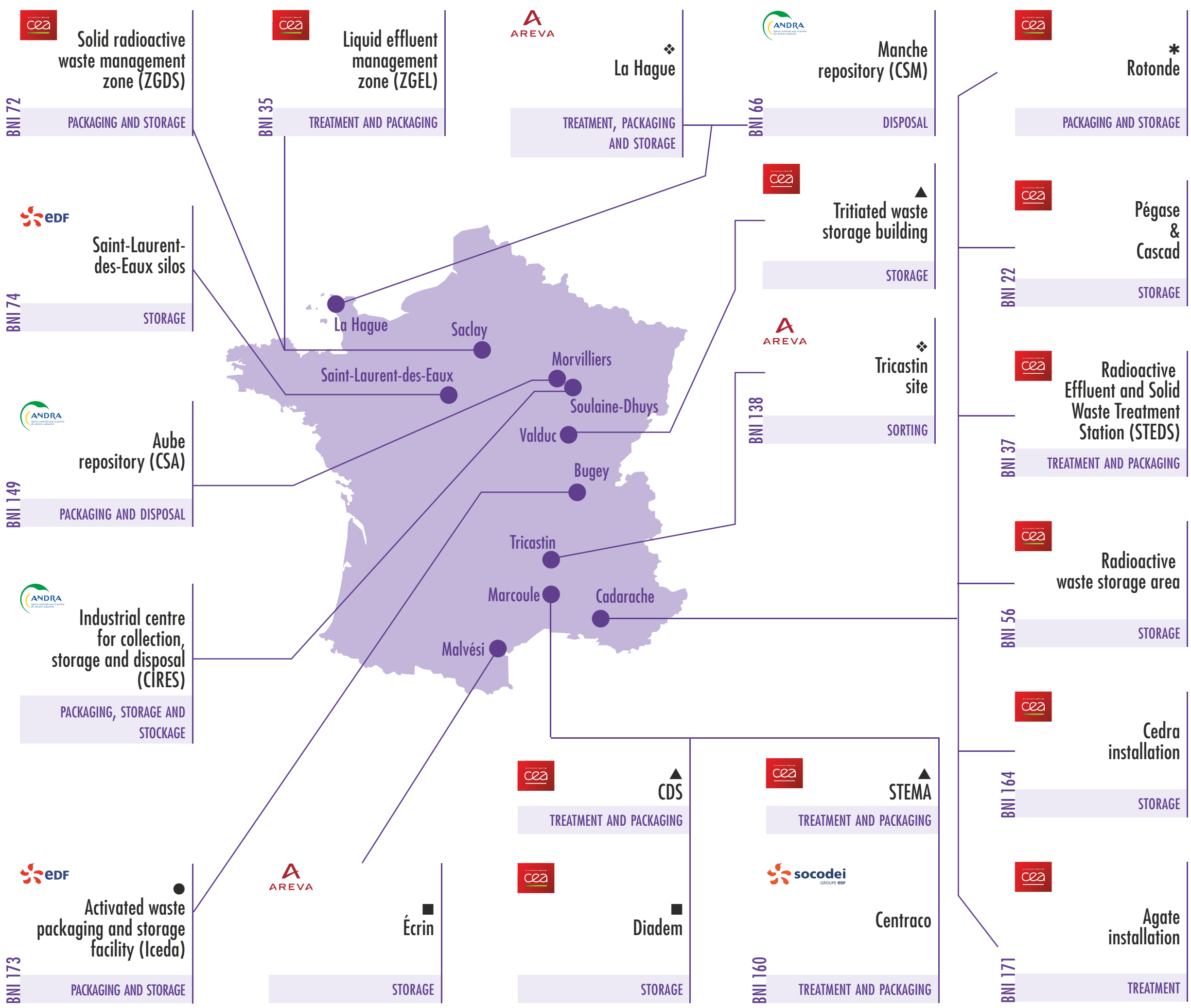
CEA operates diverse installations covering all the activities associated with the nuclear cycle, ranging from laboratories and plants involved in research on the fuel cycle to experimental reactors. CEA also carries out numerous decommissioning operations.

Consequently, the types of waste produced by CEA are varied and include more specifically:
- standard waste resulting from the operation of the research facilities (protective garments, filters, metal parts and components, liquid waste, etc.);
- waste resulting from legacy waste retrieval and packaging projects (sodium, magnesium and mercury-bearing waste);
- decommissioning waste following the final shutdown and decommissioning of facilities (graphite waste, rubble, contaminated soils, etc.).

The contamination spectrum of this waste is also varied: presence of alpha emitters in activities relating to fuel cycle research, beta-gamma emitters for operational waste from the experimental reactors.

CEA has specific facilities for managing this waste (processing, packaging and storage). It is to be noted that some of these facilities are shared between all the CEA centres, such as the liquid effluent treatment station in Marcoule or the solid waste treatment station in Cadarache.

MAP of France showing the main facilities involved in radioactive waste management



● Waiting for commissioning * Comes under the status of ICPE ❖ See chapter 13 on the nuclear fuel cycle
■ Creation authorisation decree (DAC) pending ▲ Comes under the status of SBNI

ASN's opinion on CEA's waste management strategy

ASN's examination of CEA's strategy, which was concluded in 2012, showed that waste management on the whole had improved since the previous examination in 1999. The CEA's organisation and the implementation of management tools must enable it to evaluate the movements of waste produced in the coming years, and in particular to forecast the storage and transport packaging needs.

Nevertheless, given the diversity of the projects and the corresponding waste produced, disparities in the quality of the results have been observed, particularly with regard to the management of long-lived intermediate-level solid waste and low or intermediate-level liquid waste.

Since then, CEA has provided responses to the majority of the 34 commitments made further to the examination of its file. ASN will examine these responses before the next complete examination of CEA's waste management strategy planned for 2020.

The issues and implications

The two main issues for CEA with regard to radioactive waste management are:
- bringing new waste processing and storage facilities on-line or renovating existing ones within a time frame compatible with its commitments to shut down old installations whose level of safety no longer complies with current requirements;
- the management of certain legacy waste retrieval and packaging projects

As in the preceding years, ASN observes the difficulty CEA has in fully controlling these two issues and conducting all the associated projects at the same time.

Facilities operated by CEA to support this strategy

New facility projects

Diadem project

After having provided a safety options file in November 2007, CEA submitted an authorisation application file in April 2012 for the creation of a facility to store irradiating IL-LL waste that cannot be stored in Cedra. The waste in question comes chiefly from the decommissioning of the Phénix installation (see chapter 15) and the sites of Saclay and Fontenay-aux-Roses.

Updated in May 2013, this file was submitted to the General Council for the Environment and Sustainable Development (Environmental Authority) which gave its opinion in October 2013, then to a public inquiry from 10th June to 17th July 2014, resulting in an unreserved favourable opinion on 14th August 2014. The building permit for the facility was delivered on 11th September 2014.

ASN will adopt a position on the creation authorisation for this facility in 2015.

On 29th October 2014, ASN consulted its competent advisory committees of experts on the file submitted by the licensee to support is creation authorisation application.

CEA plans to put this facility into service in the first half of 2018.

Facilities in operation

On the Cadarache site

- **Agate installation (BNI 171)**

The function of the Agate facility, which was authorised by decree on 25th March 2009, is to concentrate, through evaporation, radioactive aqueous liquid effluents chiefly containing beta- and gamma-emitting radionuclides. The resulting concentrates must then be conditioned in the liquid effluents treatment station of Marcoule.

ASN authorised commissioning of this facility on 29th April 2014. An end-of-startup file incorporating the experience feedback from the first year of operation of the facility will be submitted by CEA at the end of 2015 and examined by ASN.

The first batches of effluents were accepted by the facility and the first evaporation campaign was carried out in 2014. ASN notes that the periodic inspections and tests, particularly those concerning the negative pressure cascades, are not sufficiently well mastered. Although the measures for monitoring outside contractors need to be improved, ASN considers that the organisational set-up, which takes good account of the social, organisational and human factors (SOHF), can ensure a satisfactory level of safety.

- **Cedra installation (BNI 164)**

The purpose of the Cedra facility, which was authorised by the decree of 4th October 2004, is to process intermediate-level, long-lived waste (ILW-LL) and store ILW-LL packages with a low and intermediate dose rate. This storage would be for a period of 50 years, pending the commissioning of an appropriate disposal route.

ASN authorised commissioning of the first section of the storage facility for low-level waste (two storage buildings) and intermediate-level waste (one storage building) in April 2006. ASN specified the conditions for commissioning the sections not built to date in a resolution of 22nd July 2014. At the end of May 2014, the filling rate was 32% for the LLW halls and 28% for the ILW hall. Thus, according to CEA's projections, the new storage sections will not be commissioned before 2027.

ASN has accepted to reduce the percentage of packages monitored each year from 20% to 5% on the basis of experience feedback and in view of the dosimetric risks. ASN will nevertheless be vigilant with regard to the licensee's defining the criteria for selecting the packages to monitor. The measures adopted by the licensee with regard to organisation and traceability can ensure a satisfactory level of safety.

- **Cascad installation (BNI 22)**

The Cascad facility, which was authorised by the decree of 4th September 1989, is used for the dry storage of spent fuel. In June 2014 about 80% of the storage wells were occupied.

Through a resolution of 8th July 2014, ASN authorised storage for a further ten years of the spent fuels that have been present in the facility for more than fifteen years. This resolution is without prejudice to the conclusions of the next periodic safety review of the installation, planned for 2017.

ASN's assessment of the operating safety of the Cascad facility and the meeting of CEA's commitments is positive on the whole, but it remains vigilant with regard to the licensee's commitments concerning the long-term operation of the facility.

On the Saclay site

- **Stella installation (BNI 35)**

BNI 35, declared by CEA by letter on 27th May 1964, is dedicated to the treatment of radioactive liquid effluents. By decree of 8th January 2004, CEA was authorised to create an extension in the BNI, called Stella, for the purpose of treating and packaging low-level short-lived aqueous effluents from the Saclay centre. These effluents are concentrated by evaporation then immobilised in a cementitious matrix in order to produce packages acceptable by Andra's surface waste disposal centres.

The concentration process was put into service in 2010, but the appearance of cracks in the first packages led ASN to limit the packaging operations. CEA has thus only packaged certain effluents coming from one of the installation's tanks that contains 40 m^3 of concentrates.

ASN considers that CEA must continue the studies and discussions with Andra to obtain the approvals allowing the packaging of the concentrates and the transfer of the packages produced to the Aube disposal centre.

Renovation or shutdown of old facilities

On the Cadarache site

- **Radioactive Effluent and Solid Waste Treatment Station (BNI 37)**

The function of BNI 37, which was declared by CEA by a letter dated 27th May 1964, is the treatment and packaging of liquid and solid radioactive waste. As this old BNI consists of two independent facilities – the solid waste treatment station (STD) and the effluents treatment station (STE) –, ASN has informed CEA that the registering of this facility in 2015 would lead to the separation into two independent BNIs.

With regard to the STD, CEA wants to ensure the long-term operation of this facility, which nevertheless displays substantial shortcomings in terms of earthquake resistance and fire risk control. The licensee has given ASN the file presenting the conclusions of the periodic safety review of the facility in 2012 and indicating the safety options relative to its renovation. The competent Advisory Group of experts examined this file in 2014 and ASN will give a position statement in 2015 on the conditions of continued operation of this facility. ASN notes the importance of this facility in CEA's waste management strategy and considers it necessary for the facility reinforcement work to be carried out as soon as possible. Whatever the case, this work will have to be completed by 2020. ASN will thus be particularly attentive to the meeting of the commitments made further to the periodic safety review of the facility concerning containment, fire and the seismic risk.

ASN also considers that the management of safety on this installation must be improved, particularly as concerns operating rigour and meeting commitments. Thus, although significant improvements have been noted in the management of the periodic inspections and tests, ASN remains extremely vigilant, particular concerning the interfaces with the general services of the centre and the monitoring of outside contractors. Considerable improvements are also required in the measures for ensuring reliable management of padlocking.

With regard to the STE, this facility stopped receiving radioactive effluents as of 1st January 2012, in accordance with an ASN resolution of 27th January 2011 and the operation of the STE treatment units ceased on 31st December 2013. CEA must start the decommissioning of this part of the installation as soon as possible. It must therefore transmit the decommissioning authorisation application file in 2017.

Spent fuel and legacy waste and effluents recovery operations

On the Saclay site

- **Solid radioactive waste management zone (BNI 72)**

BNI 72, which was authorised by Decree on 14th June 1971, serves for waste storage and packaging as well as waste retrieval from small-scale nuclear activities[4] (sources, scintillating liquids, ion exchange resins) and storage of radioactive sources.

ASN notes that for several years now the licensee has been having difficulty in significantly improving the tracking of and compliance with the prescriptions set by ASN (characterisation of sources, updating of the safety report, etc.) and the commitments made during the periodic safety review or inspections. ASN does nevertheless note some improvements, notably the implementation of a procedure that has enabled CEA to prioritise the accomplishing of its commitments according to the stakes they represent.

CEA has also undertaken to shut down the installation's waste processing units and to remove the spent fuel stored in the pool and the concrete storage structures by 2017. To this end, in 2014, CEA sent ASN files relative to the removal from storage of the radioactive substances stored in the installation and must submit its final shutdown and decommissioning authorisation application file in 2015 at the latest. Lastly, ASN considers that CEA must take appropriate measures to manage the waste from the Saclay site after shutting down this installation.

ASN considers that, although the safety of the installation remains satisfactory on the whole, it is vital for CEA to maintain constant vigilance to ensure there are no

4. Small-scale nuclear activities are all installations using ionising radiation but not covered by the BNI regime. Small-scale nuclear activities concern many fields such as medicine (radiology, radiotherapy, nuclear medicine), human biology, research and industry.

delays in performing the actions required in the coming years that involve serious safety stakes (removal of spent fuel, waste and sealed sources from the installation, preparation for final shutdown and decommissioning) and that substantial technical, financial and human resources must be deployed for this installation. Progress is also required in the effectiveness of monitoring outside contractors.

- **Liquid effluent management zone (BNI 35)**

The decree of 8th January 2004 authorising the creation of Stella (see above) required CEA to remove old effluents stored in tanks MA500 and HA4 of BNI 35 within ten years. CEA was unable to meet this deadline due to technical difficulties in the retrieval and packaging of this waste. Indeed, only half of the initial source term had been removed (19 256 GBq in 2004) as at 8th January 2014. ASN does nevertheless note that all the radioactive organic effluents contained in tank HA4, which presented greater safety risks, had been removed by the end of 2013.

Through a resolution of 15th July 2014, ASN prescribed new retrieval deadlines for these effluents and obliged CEA to have them removed by the end of 2018, with intermediate milestones at the end of 2014, 2015 and 2016.

ASN notes that CEA continued these operations in 2014.

<u>On the Cadarache site</u>

- **Radioactive waste storage area (BNI 56)**

The installation comprises six pits, five trenches and hangars containing primarily intermediate-level, long-lived waste (ILW-LLL) from the operation or decommissioning of the CEA's installations which cannot be disposed of at the CSA repository. The installation also includes storage areas for very-low-level (VLL) legacy waste, which is characterised and packaged at the STARC ICPE, then transferred to the CIRES.

The waste present on the installation must be retrieved as soon as possible, packaged and stored in appropriate facilities (Cedra in particular). Retrieval of the waste from the pits and trenches requires the setting up of new processes, the safety of which will be evaluated as part of the final shutdown and decommissioning file for the installation that will be submitted in 2017. CEA will also submit to ASN the report presenting the conclusions of the installation's periodic safety review in 2015.

ASN notes the lateness in the projects for retrieving and packaging the waste stored at this installation in view of difficulties associated with the technical complexity of the retrieval solutions to be devised as well as contractual difficulties in the management of outside contractors. ASN nevertheless considers that significant improvements have been made in safety management at this installation over the last few years.

- **Pégase installation (BNI 22)**

The Pégase reactor entered service on the Cadarache site in 1964 and was operated for about ten years. By Decree on17th September 1980, CEA was authorised to reuse the Pégase facilities to store spent fuel elements.

The Pégase installation is now a facility for storing irradiated fuel elements in the pool and for radioactive substances and materials.

This installation does not meet the current storage standards and must stop functioning. Consequently, removal of the spent fuel and stored waste began in January 2006, and CEA must submit a final shutdown and decommissioning authorisation application file for the installation by 2020. All the drums containing plutonium-bearing waste have been processed, repackaged and shipped to the Cedra facility. ASN considers that an important milestone has been passed and that CEA must continue the retrieval of the fuel elements stored in the Pégase pool as rapidly as possible.

Of the 900 spent fuel cartridges initially present in the pool in 2004, 700 have now been processed and evacuated. CEA plans removing a further 70 spent fuel cartridges not coated with Araldite by the end of 2016. Removal of the remaining fuel, part of them being coated with Araldite, from storage requires the finalising of a reprocessing process that is currently being developed on the Star facility.

ASN's assessment of the operating safety of Pégase is positive on the whole, but it remains vigilant with regard to the licensee's commitments concerning the short- and medium-term future of this facility.

1.5.2 Areva waste management

ASN's opinion on Areva's waste management strategy

The spent fuel reprocessing plant at La Hague produces most of Areva's radioactive waste. The waste present on the La Hague site comprises on the one hand the waste resulting from reprocessing of the spent fuel, which generally comes from nuclear power plants but also from research reactors, and on the other, the waste resulting from operation of the various facilities on the site. Most of this waste remains the property of the licensees who have their spent fuel reprocessed (whether French or foreign).

Areva's Tricastin site also produces waste associated with the upstream activities of the cycle, essentially contaminated by alpha emitters.

The last waste management strategy review for Areva NC La Hague took place in 2005. ASN asked Areva to submit in 2016 a file presenting the waste management strategy for the group as a whole, then its practical application on the La Hague and Tricastin sites.

The issues and implications

The main issues relating to the management of waste from the licensee Areva concern:
- the safety of the storage facilities for the legacy waste present on the La Hague site. ASN has effectively observed recurrent lateness in the retrieval of legacy waste at La Hague (see chapter 13);
- the defining of solutions for waste packaging, in particular for legacy waste.

As concerns this second point, Article L. 542-1-3 of the Environment Code requires that IL-LL waste produced before 2015 be packaged no later than the end of 2030. ASN therefore reminded Areva of the need to define and finalise solutions for packaging this waste within a time frame enabling the 2030 deadline to be met. These solutions will require the prior approval of ASN in accordance with the provisions of Article 6.7 of the Order of 7th February 2012 (see point 1.2.2).

Within the framework of the waste retrieval and packaging operations, Areva NC is examining packaging solutions that necessitate the development of new processes, particularly for the following IL-LL waste:
- the sludge from the STE2 facility;
- the alpha technological waste coming primarily from the La Hague and MELOX plants, which is not suitable for surface disposal.

For other types of IL-LL waste resulting from the waste retrieval and packaging operations, Areva NC is examining the possibility of adapting existing processes (compaction, cementation, vitrification). The associated packaging baseline requirements have not yet been examined by ASN.

Facilities operated by Areva

The waste management strategy of Areva is based essentially on the La Hague site. Like all the fuel cycle installations, this site is presented in Chapter 13.

Ecrin installation

The Areva NC plant on the Malvési site has been converting natural uranium from the mines into uranium tetrafluoride (UF_4) since 1960. The waste from the process is managed on the Malvési site by lagooning, after neutralisation with lime, in settling ponds (B1 to B6) and evaporation ponds (B7 to B12). This waste chiefly contains natural radionuclides. However, some traces of artificial radionuclides resulting from spent fuel reprocessing, which was carried out in the facility until 1983, have been detected in ponds B1 and B2 which have been out of use since 2004. Consequently these two ponds come under the BNI regulatory framework.

Areva NC has submitted a creation authorisation application file for the Ecrin BNI. ASN sent the conclusions of the technical examination to the licensee on 19th September 2014. The public inquiry was held from 21st November to 30th December 2013 and drafting of the authorisation decree is in progress and will be completed in the first half of 2015.

In the framework of the 2010-2012 PNGMDR, Areva NC submitted a study at the end of 2011 proposing safe long-term management routes for the waste currently stored in the B1 and B2 settling ponds on its Malvési site, along with the management procedures for the new waste produced by the operation of the Malvési facilities. ASN opinion 2012-AV- 0166 of 4th October 2012 on the submitted study underlines the need to distinguish the long-term management of the waste already produced from the management of the waste produced in the future. The 2013-2015 PNGMDR requires that Areva NC continue to characterise the legacy waste in order to refine the radiological and chemical study and the feasibility studies concerning the disposal options for this legacy waste.

1.5.3 EDF waste management

EDF waste management strategy

The waste produced by EDF nuclear power plants is activated waste (from reactor cores) and waste resulting from their operation and maintenance. To this can be added some legacy waste and waste resulting from ongoing decommissioning operations. EDF is also the owner, for the share attributed to it, of HL and IL-LL waste resulting from spent fuel reprocessing in the Areva La Hague plant.

Activated waste This waste notably comprises control rod assemblies and poison rod assemblies used for reactor operation. This is IL-LL waste that is produced in small quantities. This waste is currently stored in the NPP pools pending transfer to the Iceda facility.

Operating and maintenance waste

Some of the waste is processed by the Centraco facility in Marcoule in order to reduce the volume of ultimate waste.

The other types of operational and maintenance waste are packaged on the production site then shipped to the CSA or CIRES repositories for disposal (see points 1.3.1 and 1.3.2). This waste contains beta and gamma emitters, and few or no alpha emitters.

At the end of 2013, EDF submitted a file presenting its waste management strategy. Examination of this file by the competent Advisory Committees of experts is planned for 2015.

The issues and implications

The main issues related to the EDF waste management strategy concern:
- the management of legacy waste. This primarily concerns structural waste (graphite sleeves) from the graphite-moderated gas-cooled reactor fuels. This waste could be disposed of in a repository for LLW-LL (see point 1.3.4). It is stored primarily in semi-buried silos at Saint-Laurent-des-Eaux. Graphite waste is also present in the form of stacks in the gas-cooled reactors currently being decommissioned.
- changes linked to the fuel cycle. EDF's fuel use policy (see Chapter 12) has consequences for the fuel cycle installations (see chapter 13) and for the quantity and nature of the waste produced. This subject was examined by the Advisory Committee of Experts for Nuclear Reactors (GPR) and the Advisory Committee of Experts for Laboratories and Plants (GPU) on 30th June 2010. Following this examination, in its letter of 5th May 2011, ASN asked EDF to implement a more rigorous policy for managing its storage capacity for substances before their disposal or their treatment or reprocessing. More specifically with regard to waste, EDF must for example ensure that the available packaging containers can meet the disposal needs.

Facilities operated by EDF to support this strategy

- **Iceda (BNI 173)**

The purpose of the Iceda facility, authorised by decree on 23rd April 2010, is to process and store activated waste from operation of the EDF installations and from the decommissioning of the first-generation reactors and of the Creys-Malville NPP.

The civil engineering operations are 90% completed but at present have been suspended.

They are to be resumed in 2015 following the decision of 4th December 2014 of the administrative court of appeals of Lyon which quashed the judgement of 13th December 2011 of the administrative tribunal of Lyon which had cancelled the building permit for the facility.

ASN conducted an inspection on 9th September 2014 to verify the surveillance exercised by EDF and the contractor responsible for construction during the suspension of work on the site. The surveillance is deemed sufficient given the risks involved, but EDF must increase its involvement in it.

- **Saint-Laurent-des-Eaux silos (BNI 74)**

The installation, which was authorised by the decree of 14th June 1971, comprises two silos which are used to store irradiated graphite sleeves (LLW-LL) from the operation of the graphite-moderated gas-cooled reactors of Saint-Laurent A. The static containment of this waste is ensured by the concrete structures of the silo bunkers which are sealed by a steel liner. In 2010 EDF installed a geotechnical containment around the silos, reinforcing the control of the risk of dissemination of radioactive substances, which is the main risk that the installation presents.

Operation is limited to surveillance and maintenance measures (inspections and radiological monitoring of the silos, checking there is no water ingress, checking the relative humidity, the dose rates in the vicinity of the silos, the activity of the water table, monitoring the condition of civil engineering structures).

Examination of the file submitted by EDF in 2010 as part of the periodic safety review of the facility was completed in 2014. ASN considers that, subject to EDF meeting its commitments made within the framework of this examination, the safety measures - particularly those concerning the control of the risks of dissemination of radioactive material - are on the whole satisfactory. The commitments made by the licensee essentially concern the surveillance of the condition of the civil engineering structures and the reassessment of the behaviour of the silos in the event of an earthquake.

1.6 Management of waste from small-scale nuclear activities

1.6.1 Management of waste from non-BNI nuclear activities

The issues and implications

The use of unsealed sources in nuclear medicine, biomedical or industrial research creates solid and liquid waste: small laboratory equipment used to prepare sources, medical equipment used for administration, leftovers of meals eaten by patients who have received diagnostic or therapeutic doses, etc. Radioactive liquid effluents also come from source preparation as well as from the patients who eliminate the radioactivity administered to them by natural routes.

The diversity of waste from small-scale nuclear activities, the large number of establishments producing it and the radiation protection issues involved have led the public authorities to regulate the management of the waste generated by these activities.

Management by Andra of waste from non-BNI nuclear activities

Article L. 542-12 of the Environment Code entrusts Andra with a public service mission for waste produced by small-scale nuclear activities. Yet Andra was not equipped with its own facilities for the management of waste from small-scale nuclear activities. Consequently, Andra made agreements with other nuclear licensees, and CEA in particular, which stores waste on the Saclay site.

Andra started reconfiguring the route in 2012 by creating at CIRES, situated in the towns of of Morvilliers and La Chaise, a collection centre and a storage facility for waste from small producers other than nuclear power plants. These facilities received their first waste in autumn 2012.

Nevertheless, the tritiated solid waste will be managed in a storage facility operated by CEA and shared with the waste from ITER (INTERMED project).

ASN considers that the approach adopted by Andra will be sufficient to meet the duties entrusted to it under Article L. 542- 12 of the Environment Code and that this must be continued. In the framework of the 2013-2015 PNGMDR, Andra has been asked to identify the investments needed to guarantee the sustainability of the waste management solutions for small producers.

Management of used sealed sources considered as waste

Sealed sources are used for medical, industrial, research and veterinary applications (see Chapters 9 and 10). When they reach end of life, and if their suppliers do not envisage their reuse in any way, they are considered as radioactive waste and must be managed as such.

The management of sealed sources considered as waste, and their disposal in particular, must take into consideration the dual constraint of concentrated activity and a potentially attractive nature in the event of human intrusion after loss of the memory of a disposal facility. This therefore limits the types of sources that can be accepted in the disposal facilities, particularly if they are surface facilities.

The 2013-2015 PNGMDR requires CEA - which will ensure the secretariat of a working group led jointly by the DGPR (General Directorate for Risk Prevention) and the DGEC (General Directorate for Energy and Climate) - to submit to the Government for 31st December 2014 a work synthesis report covering:
- continuation of Andra's study of the conditions of acceptance of these sealed sources in disposal facilities;
- consolidated batching of used sealed sources in order to determine a reference solution for each batch;
- with regard to the existing disposal centres, Andra's assessment of the conditions for acceptance of used sealed sources, if necessary modifying the acceptance specifications although without compromising the safety of the disposal centres;
- a study of the requirements in terms of treatment and packaging facilities to enable them to be accepted in existing or planned disposal centres;
- a study of the requirements in terms of interim storage facilities;
- optimised technical and economic planning of the conditions for acceptance and elimination of used sealed sources, in the light of the availability of processing, storage and disposal facilities and transport constraints.

1.6.2 Management of waste containing enhanced natural radioactivity

Some professional activities using raw materials which naturally contain radionuclides but which are not used for their radioactive properties, may lead to an increase in specific activity in the resulting products, residues or waste. This is known as technologically enhanced natural radioactivity. The majority of these activities are (or were) regulated by the ICPE regime and are listed by the order of 25th May 2005 concerning professional activities involving raw materials naturally containing radionuclides not used for their radioactive properties.

Waste containing enhanced natural radioactivity can be accepted in various types of facilities, depending on its specific activity:
- in a waste disposal facility authorised by prefectural order if the conditions of acceptance provided for in the circular of 25th July 2006 relative to classified installations "Acceptance of waste containing enhanced or concentrated natural radioactivity in the waste disposal facilities" are fulfilled;
- in the very low level waste disposal facility, CIRES;
- in a storage facility. Some of this waste is waiting for a disposal route, in particular the commissioning of a disposal centre for long-lived, low level waste.

Four hazardous waste disposal facilities are authorised to receive waste containing enhanced natural radioactivity, namely:
- Villeparisis in Ile-de-France, authorised until 31st December 2020, for an annual capacity of 250,000 t/year;
- Bellegarde in Languedoc-Roussillon, authorised until 4th February 2029, for an annual capacity of 250,000 t/year until 2018 and 105,000 t/year beyond this;
- Champteussé-sur-Baconne in Pays de la Loire, authorised until 2049, for an annual capacity of 55,000 t/year;
- Argences in Basse-Normandie, authorised until 2023, for an annual capacity of 30,000 t/year.

The 2013-2015 PNGMDR requires the implementation of regulatory changes in order to improve knowledge of the deposits of enhanced naturally radioactive waste and improve its traceability.

The transposition of Directive 2013/59/Euratom of 5th December 2013 setting the basic standards for radiation protection provides for a reinforcement of the provisions applicable to radiation of natural origin, and notably to human activities involving the presence of natural sources of radiation that lead to a notable increase in the exposure of workers or the public, and therefore including the activities of industries involving enhanced natural radioactivity. Their scope of application will extend to substances, products and materials that naturally contain radionuclides (potassium-40 and chains of uranium-238 and 235 and of thorium-232) at a level necessitating a radiation protection verification. The currently applicable regulations concerning activities involving enhanced natural radioactivity could therefore be modified or supplemented within the framework of this transposition.

1.6.3 Management of mining residues and mining waste rock from the old uranium mines

Uranium mines were worked in France between 1948 and 2001, producing 76,000 tons of uranium. Exploration, mining and processing work was carried out on about 250 sites in France spread over 27 *départements*. Ore processing was carried out in 8 plants. The former uranium mines are now almost all under the responsibility of Areva Mines.

The working of uranium mines produced two categories of products:
- mining waste rock, that is to say the rocks excavated to gain access to the ore; the quantity of mining waste rock extracted is estimated at about 167 million tonnes;
- static or dynamic processing residues, which are the products remaining after extraction of the uranium from the ore. In France, these residues represent 50 million tonnes spread over 17 disposal sites. The radioactivity measurements carried out on the disposal sites give values of the same order as the measurements taken in the environment of the site.

The regulatory context

The uranium mines and their annexes, and their conditions of closure, are covered by the mining code.

The disposal facilities for radioactive mining residues are governed by section 1735 of the ICPE nomenclature.

Furthermore, the Minister of the Environment and the ASN Chairman issued a circular on 22nd July 2009 defining a plan of action relative to the management of

Waste rock stockpile

Waste rock embankment

the former uranium mines comprising the following lines of work:
- monitor the former mining sites;
- improve understanding of the environmental and health impact of the former uranium mines and their surveillance;
- manage the mining waste rock (better identify the uses and reduce impacts if necessary);
- reinforce information and consultation.

Most of the mining waste rock remains on the site where it was produced (mine in-fill, redevelopment work or spoil heaps). Nonetheless, 1 to 2% of the mining waste rock may have been used as backfill, in earthworks or for road beds in public places situated near the mining sites.

Although the transfer of waste rock to the public domain has been traced since 1984, knowledge of transfers prior to 1984 remains incomplete.

ASN and the Ministry of the Environment, in the framework of the action plan of the Circular of 22nd July 2009, asked Areva Mines to inventory the mining waste rock reused in the public domain in order to verify the compatibility of uses and to reduce the impacts if necessary.

Areva Mines has thus deployed a plan of action comprising three broad phases:
- aerial overflight around the former French mining sites to identify radiological singularities;
- inspection on the ground of areas identified in the overflight to confirm the presence of waste rock;
- treatment of areas of interest incompatible with the land usage.

The second phase of this action plan was completed in 2014. The resulting inventory maps are provisional maps submitted for public consultation. Members of the public are asked to communicate their observations to correct or supplement the maps on the basis of their memory of the utilisations of waste rock, where applicable. The definitive maps are associated with remediation action proposals if necessary. Work has already been carried out in 2014 on sites classified as priorities on the basis of the radiological impact study. All these operations are under the administrative surveillance of the Prefect, on the basis of proposals from the Regional Directorate for the Environment, Planning and Housing (DREAL). ASN provides assistance for the radiation protection of the workers and the public and the management routes. In this context it encourages the complete clean-out of the sites when this is technically possible and asks that any other procedure implemented be justified with regard to this strategy. Furthermore, it is particularly vigilant to the cases that could give rise to exposure of persons, particularly to radon, in order to identify and deal with any cases similar to that of the house of Bessines-sur-Gartempe. Lastly, it ensures that the actions are carried out in complete transparency with maximum involvement of the local actors.

TO BE NOTED

Case of the house in Bessines-sur-Gartempe

A heliborne measurement survey conducted in 2010 identified a house in Bessines-sur-Gartempe (Haute-Vienne *département*) as potentially having mining waste rock in its courtyard, which was subsequently confirmed by investigations on the ground. The building, formerly a petrol station, was converted into a residential house at the end of the 1990s. In March 2014, when carrying out complementary investigations to determine the work to undertake, Areva Mines detected abnormally high concentrations of radon inside the house. The measured concentrations were about 40 to 90 times higher than the mean value observed in houses in the region (200 Bq/m^3). Directive 2013/59/Euratom relative to basic radiation protection standards specifies thresholds in this respect (chapter 3). The presence of cyclone-separated* sand and gravel from mine tailings in the foundations of the house and in its garden was subsequently confirmed by Areva Mines. This cyclone-separated sand and gravel, which has a high radium content (4 000 Bq/kg) was the source of the high concentrations of radon inside the house. The family living in the house has been rehoused. All the people having stayed in the house underwent medical examinations to verify firstly that they had not suffered internal contamination (whole-body radiation measurement and radiotoxicological tests), and secondly to evaluate the health risks for the occupants according to their exposure, particularly the children looked after on account of the residents' child-minding activity. According to IRSN (French Institute of Radiation Protection and Nuclear Safety), *"the risk assessments determined that, although the people having lived in the house for more than ten years have a considerably increased risk of death from lung cancer, the risk for the children who were looked after is much lower due to the much shorter exposure time"***.

Further to requests from the Ministry of the Environment and ASN, Areva Mines has changed its plan of action for waste rock management in order to better identify the existence of similar cases.

** The cyclone-separated sand and gravel represents the coarse fraction of the residue (0.15 to 50 mm) made up of the minerals that withstood chemical attack. This sand and gravel was reused as backfill for underground mining works or a constituent material for residue disposal site embankments.*
*** IRSN appraisal report PRP-HOM/2014-00005 rev.1*

The long-term behaviour of the mining residue disposal sites

Redevelopment of the uranium processing residue disposal sites consisted in placing a solid cover over the residues to provide a protective barrier to limit the risks of intrusion, erosion, dispersion of the stored products and the risks of external and internal (radon) exposure of the surrounding populations.

The 2013-2015 PNGMDR, on the basis of ASN Opinion 2012-AV-0168 of 11th October 2012, requires that the studies conducted by Areva Mines be continued and taken to greater depth, particularly with regard to:
- the strategy chosen for the changes in the treatment of water collected from former mining sites;
- a doctrine for assessing the long-term integrity of the embankments surrounding the residue disposal sites;
- the comparison of the surveillance data and the results of modelling to improve the relevance of the systems of surveillance and evaluation of the long-term dosimetric impact of the residue disposal sites;
- the evaluation of the long-term dosimetric impact of the mining waste rock piles and the mining waste rock in the public domain in relation to the results obtained in the context of the Circular of 22nd July 2009.

Mining site of Bois Noirs Limouzat.

Long-term management of the former mining sites

ASN is contributing to a technical guide on the management of the former uranium mining sites that is currently being prepared under the coordination of the Ministry responsible for the environment. It shall more particularly respond to several recommendations resulting from the report of the Limousin Pluralistic Expert Group (GEP) of September 2010: it will address the administrative status of the sites, the procedures for stopping mining work and the requirements in terms of redevelopment in the long-term perspective.

The Pluralistic Expert Group (GEP), the involvement and the informing of the stakeholders

Set up in 2005, the Limousin Pluralistic Expert Group (GEP) in September 2010 submitted a first report containing its recommendations concerning the short, medium and long term management of former uranium mining sites in France to the Minister responsible for the Environment and the Chairman of ASN. ASN and the Ministry responsible for the environment are thus engaged in a plan of action dedicated to the implementation of these recommendations.

A second report was submitted to the Minister in 2013; it presents the results drawn from the presentation of the GEP's conclusions and recommendations to the local and national consultative bodies and an evaluation of the implementation of its recommendations. The GEP considers its involvement to have brought positive results and notes that its recommendations remain fully relevant.

ASN and the Ministry responsible for the environment have proposed the creation of a network of experts from the site monitoring commissions who would be assigned expertise missions on questions of both local and national scope where justified by the societal aspect.

In 2014 ASN continued its involvement in the steering committee for the national inventory of uranium mining sites MIMAUSA (Memory and impact of uranium mines: summary and archives, available on *www.irsn.fr*). This mining site inventory was updated in summer 2013; it provides access to all the environmental assessments submitted by Areva on account of the circular of 22nd July 2009. It will ultimately be supplemented by a mining waste rock inventory.

2. MANAGEMENT OF SITES AND SOILS CONTAMINATED BY RADIOACTIVITY

A site contaminated by radioactive materials is defined as any site, either abandoned or in operation, on which natural or artificial radioactive substances have been or are employed or stored in conditions such that the site constitutes a hazard for health and the environment.

Contamination by radioactive substances can be the result of industrial, medical or research activities involving radioactive substances. It can concern the places where these activities are carried out, but also their immediate or more remote vicinity. The activities concerned are generally either "nuclear activities" as defined by the Public Health Code, or activities concerned by technologically enhanced natural radioactivity, as covered by the order of 25th May 2005.

However, most of the sites contaminated by radioactive substances and today requiring management in fact concern past industrial activities, dating back to a time when radioactive hazards were not perceived in the same way as at present. The main industrial sectors from which the radioactive contamination identified today originated are: radium extraction for medical and parapharmaceutical needs, from the early 20th century up to the end of the 1930s; the manufacture and application of luminescent radioactive paint for night vision and the industries working ores such as monazite or zircons. Sites contaminated by radioactive substances are managed on a case-by-case basis, requiring a precise diagnosis of the site and the contamination.

Several inventories of contaminated sites are available to the public and are complementary: Andra's national inventory, which is updated every 3 years and comprises the sites identified as contaminated by radioactive substances (the June 2012 edition is available on *www.andra.fr*) as well as the databases accessible from the web portal of the Ministry responsible for the environment *(www.sites-pollues.ecologie.gouv.fr)* and dedicated to contaminated sites and soils.

In October 2012, ASN finalised its doctrine specifying the fundamental principles it has adopted for the management of sites polluted by radioactive substances. It thus considers that the reference procedure to adopt, when technically possible, is to completely clean out sites contaminated with radioactivity, even if the human exposure induced by the radioactive contamination seems limited.

ASN also believes that the solution involving the contamination being maintained in-situ can only be an interim solution or reserved for cases in which complete clean-out cannot be envisaged owing, in particular, to the volume of waste to be excavated.

ASN also considers that the management of contaminated sites requires public involvement when choosing the solution adopted, in order to create a climate of trust and minimise conflicts.

ASN also points out that in application of the "polluter-pays" principle written into the Environment Code, those responsible for the contamination are responsible for financing the operations to rehabilitate the contaminated site and to remove the waste resulting from these operations. If the responsible entities default, Andra, on account of its public service remit and by public requisition, ensures the rehabilitation of radioactive contaminated sites.

Lastly, ASN reiterates in its doctrine for the management of radioactive contaminated sites that any stance adopted by ASN is duly justified and presented in complete transparency to the stakeholders and the audiences concerned.

2.1 Regulatory framework

Article 542-12 of the Environment Code specifies that Andra is tasked in particular with collecting, transporting and dealing with radioactive waste and rehabilitating sites with radioactive contamination at the request of and expense of those responsible, or when requisitioned by the Government if those responsible for this waste or these sites have defaulted. Andra thus has a state subsidy which contributes to financing the missions of public interest entrusted to it. The French National Funding Commission for Radioactive Matters (CNAR), was set up within Andra in 2007.

It is chaired by the Director-General of Andra and includes representatives of the Ministries responsible for the environment, energy and health, of ASN, of IRSN, of the Association of Mayors of France, of environmental defence associations and qualified personalities.

The commission met in 2014, more specifically to decide on the allocation of public funds for the management of contaminated sites considered to be high priorities, such as Orflam-Plast in Pargny-sur Saulx, a clock-making site in Charquemont, the Gif-sur-Yvette site rehabilitation project, and the characterisation project for sites in Colombes, Champlay and Nogent-sur-Marne.

Orflam-Plast site in Pargny-sur-Saulx.

GREEN GROWTH ENERGY TRANSITION BILL

The creation of a system of active institutional controls governing the management of land, constructions or structures that could cause human exposure to the harmful effects of ionising radiation and justifying radiation protection monitoring.

In the version voted by the French National Assembly, part VI of the Green Growth Energy Transition Bill entitled "Reinforcing nuclear safety and information of the citizens", authorises the Government to enact by ordinance measures to create a system of active institutional controls relating to nuclear substances – as already exists for the ICPEs and the BNIs – when radioactive substances remain on a plot of land or in a building (due to contamination by radioactive substances, after decontamination or in the presence of naturally radioactive materials) in order to conserve the memory with a view to future uses and to define, if necessary, restrictions on use or prescriptions governing the future development or demolition work.

Circular DGS/SDEA1/DGEC/DGPR/ASN No. 2008-349 of 17th November 2008 of the Minister responsible for the Environment relative to the management of certain radioactive waste and sites with radioactive contamination describes the applicable procedure for the management of contaminated radioactive sites governed by the ICPE system and the Public Health Code, whether the party responsible is solvent or not. Whatever the case, the Prefect relies on the opinion of the classified installations inspectorate, ASN and the ARS (Regional Health Agency) to validate the site rehabilitation project, and issues a prefectural order to govern implementation of the rehabilitation measures.

ASN may thus be called upon by the services of the Prefectures and the classified installations inspectors to give its opinion on the clean-out objectives of a site. Chapter 8 details the various demands concerning contaminated sites and soils to which the ASN divisions responded. The Ministry responsible for the environment plans to update this circular in 2015. ASN will be involved in this work.

2.2 The Radium Diagnosis operation

In October 2010, the State decided to carry out diagnoses in order to detect and if necessary treat any radium contamination resulting from past activities. Discovered by Pierre and Marie Curie in 1898, radium has been used in certain medical (the first cancer treatments) and craftwork activities (clock-making until the 1950s, due to its property of radioluminescence; manufacture of lightning arresters and cosmetic products). These medical or craft activities may have left traces of radium on certain sites.

The diagnosis of the sites having accommodated an activity that used radium is a continuation of the many actions engaged by the State in recent years, such as the rehabilitation of sites on which research and radium extraction activities were carried out at the beginning of the 20th century, or the retrieval of radioactive objects from private households, etc.

This operation is free of charge for the occupants of the places concerned: the diagnosis consists in taking systematic measurements to detect the presence of any traces of radium or to confirm the absence of radium. These measurements are performed by a team of IRSN specialists, accompanied by an ASN coordinator, who first of all makes contact with the occupant in order to describe the operation. On completion of the diagnosis, the occupants are informed verbally of the results, with subsequent written confirmation by post. If traces of contamination are detected, rehabilitation operations are performed by Andra free of charge, with the agreement of the property owners. Ultimately, each person concerned is given a certificate guaranteeing the results of the operation.

New addresses were added to the initial list as the diagnosis operation progressed, with more than 160 sites in France being concerned by the end of 2014.

At the end of 2014, twenty-nine sites in Ile-de France and one site in Annemasse had been examined. The Annemasse site was diagnosed before the operation was launched in the Rhône-Alpes region, at the owner's request because a real estate transaction was envisaged in the near future.

Eight of the 29 sites in Ile-de-France were excluded outright because the buildings are too recent with respect to the period of potential manipulation of radium to be able to display any radioactive contamination.

More than 420 diagnoses have been carried out by IRSN since the operation began; in effect, the majority of the sites involve either one building with many apartments or several individual plots. The fact that the occupants were informed and that the operation was free of charge were vital factors in obtaining the occupants' agreement.

There were only nine refusals out of more than 420 diagnoses performed.

These diagnoses led to twenty-five rehabilitation and renovation operations (twenty-one in Ile-de-France and four in Annemasse).

Radium diagnosis operation site.

More than four years after the operation started, experience feedback shows that it is relatively well accepted by the occupants and environmental protection associations. The vast majority of the premises diagnosed are clear of radiological contamination. The contamination levels recorded are low and confirm that there is no health risk; the maximum dosimetry received is less than 2.4 mSv/year (added value), which is approximately the same order of magnitude as the dose received per year by the French population from naturally occurring sources of radioactivity.

The engagement of further diagnosis operations has been suspended in Ile-de-France since March 2014 at the request of the Ministry responsible for the environment, in order more specifically to modify the conditions of performance of the operation. ASN would like the diagnoses to be resumed rapidly in order to finalise the operation in Ile-de-France and start diagnoses in other regions. ASN considers moreover that ambitious treatment targets must be maintained for the contaminated sites.

2.3 ASN's international action in the management of contaminated sites and soils

ASN has participated since 2012 in the meetings of the International Working Forum on Regulatory Supervision of Legacy Sites[5] (RSLS) organised by International Atomic Energy Agency (IAEA). The aim of this forum is to promote interchanges between the various organisations responsible for regulating and monitoring "legacy sites" in order to identify the sites' needs in terms of management and means for preventing the creation of future "legacy sites".

Moreover, ASN contributes to the work carried out under the CIDER project (Constraints to Implementing Decommissioning and Environmental Remediation programmes) initiated in 2012 by IAEA. This project aims to identify the main difficulties that contracting parties can encounter, particularly in site rehabilitation, and proposing aids for overcoming them.

In 2014, ASN continued its collaboration with the United States Environmental Protection Agency (US-EPA), tasked with managing the "Superfund" programme to protect American citizens against the risks associated with sites polluted by abandoned or unmonitored hazardous waste and particularly sites contaminated by radioactive substances.

3. OUTLOOK

ASN broadly considers that the French radioactive waste management system, based on a specific body of legislative and regulatory texts, a national plan for the management of radioactive materials and waste (PNGMDR) and an agency dedicated to the management of radioactive waste (Andra) that is independent from the waste producers, is capable of regulating and implementing a structured and coherent national waste management policy. ASN considers that all waste must eventually have access to safe management, more specifically to a disposal solution. The updating of the PNGMDR, which should take place at the end of 2015, will be an opportunity to review progress and set new short- and medium-term objectives.

5. International forum on the regulations for sites contaminated by radionuclides, presenting a risk for health and/or the environment and which are a subject of concern for the Authorities.

The regulations concerning the management of radioactive waste

ASN broadly considers that the French radioactive waste management system, based on a specific body of legislative and regulatory texts, a national plan for the management of radioactive materials and waste (PNGMDR) and an agency dedicated to the management of radioactive waste (Andra) that is independent from the waste producers, is capable of regulating and implementing a structured and coherent national waste management policy. ASN considers that there must eventually be safe management for all waste, more specifically by means of a disposal solution. The updating of the PNGMDR, which should take place at the end of 2015, will be an opportunity to review progress and set new short- and medium-term objectives.

The regulations concerning the management of radioactive waste ASN will contribute to the drafting of the ordinance – coordinated by the Minister responsible for Energy – transposing Council Directive 2011/70/ Euratom of 19th July 2011 establishing a community framework for the responsible and safe management of spent fuel and radioactive waste. This transposition will in particular allow the establishing of a procedure enabling the administrative authority to requalify materials as radioactive waste and to reinforce the administrative and penal sanctions in this field.

In 2015, ASN will finalise the resolutions concerning the study of waste management, the inventory of waste produced in the BNIs and the packaging of radioactive waste. It will draw up draft resolutions concerning radioactive waste disposal facilities and radioactive waste storage facilities as well as a draft guide to application of the resolution concerning waste studies. These draft texts will be made available for consultation by the stakeholders and the public in 2015.

ASN will also be vigilant in ensuring that the work to transpose Directive 2013/59/Euratom of 5th December 2013 setting basic radiation protection standards does not call into question the French policy in which there are no clearance levels for waste from basic nuclear installations while at the same time reinforcing oversight of waste containing enhanced natural radioactivity.

Concerning licensee waste management strategies

ASN periodically assesses the strategies implemented by the licensees to ensure that each type of waste has an appropriate management route and that the different routes are mutually coherent.

ASN in particular remains attentive to ensuring that the licensees have the necessary treatment or storage capacity for managing their radioactive waste and anticipate sufficiently far in advance the construction of new facilities or renovation work on older facilities. In 2015, ASN will continue to closely monitor the legacy waste or spent fuel retrieval and packaging operations, focusing on those presenting the most significant safety implications.

In this respect, ASN will assess EDF's waste management strategy in 2015 and will receive Areva's waste management strategy in 2016.

With regard to CEA, ASN will be vigilant in ensuring that the licensee meets its commitments concerning the final shutdown of its old installations that no longer comply with safety requirements, and in particular the calendar for submitting the final shutdown and decommissioning files (BNI 56 in 2017, BNI 72 in 2017, the liquid effluents part of BNI 37 in 2017). ASN will also be attentive to the progress of the strategic projects for the decommissioning and legacy waste retrieval operations (Diadem, the solid waste part of BNI 37, management of waste on the Saclay site).

Concerning low-level, long-lived waste (LLW-LL)

ASN considers that it is vital to move forward in setting up management routes for low-level long-lived radioactive waste. The submission by Andra in mid-2015 of the report required by the PNGMDR is an essential and strategic step in setting up such routes. ASN considers it necessary that, following the examination of this report, the Government set new objectives for the commissioning of management solutions for this waste. Furthermore, depending on the results of this report, the waste producers may have to speed up the implementation of alternative strategies if their waste is not compatible with Andra's project.

Concerning the high and intermediate-level, long-lived waste (HL/ILW-LL)

With regard to the "Cigéo" project for disposal of high and intermediate-level, long-lived waste, ASN notes that a key step in the development of the project was reached in 2014, when Andra launched the preliminary design phase and published its conclusions of the public debate held on this project. Andra will be submitting several major files in 2015, namely a safety options file, a retrievability technical options file, a preliminary version of the waste acceptance specifications and a master plan for the development of the project and operations. These files together will constitute the first overall dossier on the safety of the facility since 2009. ASN will give its opinion on these documents and will attach particular importance to the safety options file.

ASN again underlines that it is important for the waste producers to make progress in the packaging of their waste, particularly as regards waste resulting from the waste retrieval and packaging operations, and notes that this preliminary version of the waste acceptance specifications drafted by Andra will enable the requirements concerning the future waste packages to be detailed.

The Cigéo project is thus entering an industrial phase in which the responsibility of the various actors and stakeholders must comply with the requirements of the Environment Code and the BNI system.

The reassessment of the cost of disposal of this type of waste is a major step that will reinforce the robustness of the system put in place to ring-fence the funds necessary for the long-term management of radioactive waste. ASN recommends that this cost be updated regularly, particularly when submitting a creation authorisation application file, and that the cost of disposal of the substances that could possibly be placed in deep geological disposal but which are not included in the current project inventory – spent fuels in particular – should also be estimated.

Finally, in 2015, ASN will publish its initial view on the reversibility of a deep geological disposal facility, more specifically with regard to the need to take account of the possibility of adapting the disposal facility to a potential change in the inventory of waste emplaced.

Concerning the management of the former uranium mining sites and polluted sites and soils

With regard to the former uranium mining sites, in 2015 ASN will endeavour to address the requests of the DREALs (Regional Directorates for the Environment, Planning and Housing) regarding the Areva Mines action plan for the management of mining waste rock. It will focus in particular on the management of potentially sensitive situations, especially with regard to the radon risk. It will ensure that the measures are taken in complete transparency and with maximum involvement of local actors and it will continue its work on the management of former mining sites, in collaboration with the Ministry responsible for the environment.

As far as the contaminated sites and soils are concerned, ASN will continue in 2015 to state its position on the projects for the rehabilitation of contaminated sites on the basis of the principles of the doctrine it published in October 2012 and will work with the Ministry responsible for the environment on the revision of Circular DGS/SDEA1/DGEC/DGPR/ASN No. 2008-349 of 17th November 2008 relative to the management of certain types of radioactive waste and radioactive contamination sites on the basis of its experience feedback. It will also maintain its investment in the operational management of the Radium Diagnosis operation. It will pursue its action in collaboration with the government departments concerned and the other stakeholders.

ASN will also continue its involvement in international work on these subjects, in particular with IAEA, ENSREG, WENRA, and bilaterally with its counterparts.

APPENDIX A
List of Basic Nuclear Installations delicensed as at 31.12.2014

To regulate all civil nuclear activities and installations in France, ASN has set up a regional organisation relying on 11 divisions based in Bordeaux, Caen, Châlons-en-Champagne, Dijon, Lille, Lyon, Marseille, Nantes, Orléans, Paris and Strasbourg.

The Paris division is also responsible for activities in Martinique, Guadeloupe, French Guyana, Réunion, Mayotte and Saint-Pierre and Miquelon. The Caen and Orléans divisions are responsible for BNI regulation in the Brittany and Ile-de-France regions respectively. This organisation enables ASN to conduct its missions over the whole of metropolitan France and its the overseas départements, regions and territories and the overseas collectivities (DROM-COM).

A Basic Nuclear Installation (BNI) is one that, by its very nature or owing to the quantity or activity of the radioactive substances it contains, is subject to specific regulatory arrangements as defined by the TSN Act of 13th June 2006 (now codified in books I and V of the Environment Code by Order 2012-6 of 5th January 2012). These installations must be authorised by decree issued following a public inquiry and an ASN opinion. Their design, construction, operation and decommissioning are all regulated.

The following are considered to be BNIs:
1. Nuclear reactors;
2. Large installations for the preparation, enrichment, fabrication, treatment or storage of nuclear fuels or the treatment, storage or disposal of radioactive waste;
3. Large installations containing radioactive or fissile substances;
4. Large particle accelerators.

Except for nuclear reactors, which are all BNIs, Decree 2007-830 of 11th May 2007 concerning the list of Basic Nuclear Installations sets thresholds, for each category, determining the point at which they become subject to the BNI system.

For technical or legal reasons, the concept of a basic nuclear installation can cover a number of different physical situations: for example in a nuclear power plant, each reactor may be considered as a separate BNI, or a given BNI might in fact consist of two reactors. Similarly, a fuel cycle plant or a CEA centre can comprise several BNIs. These different configurations do not alter the regulatory conditions in any way.

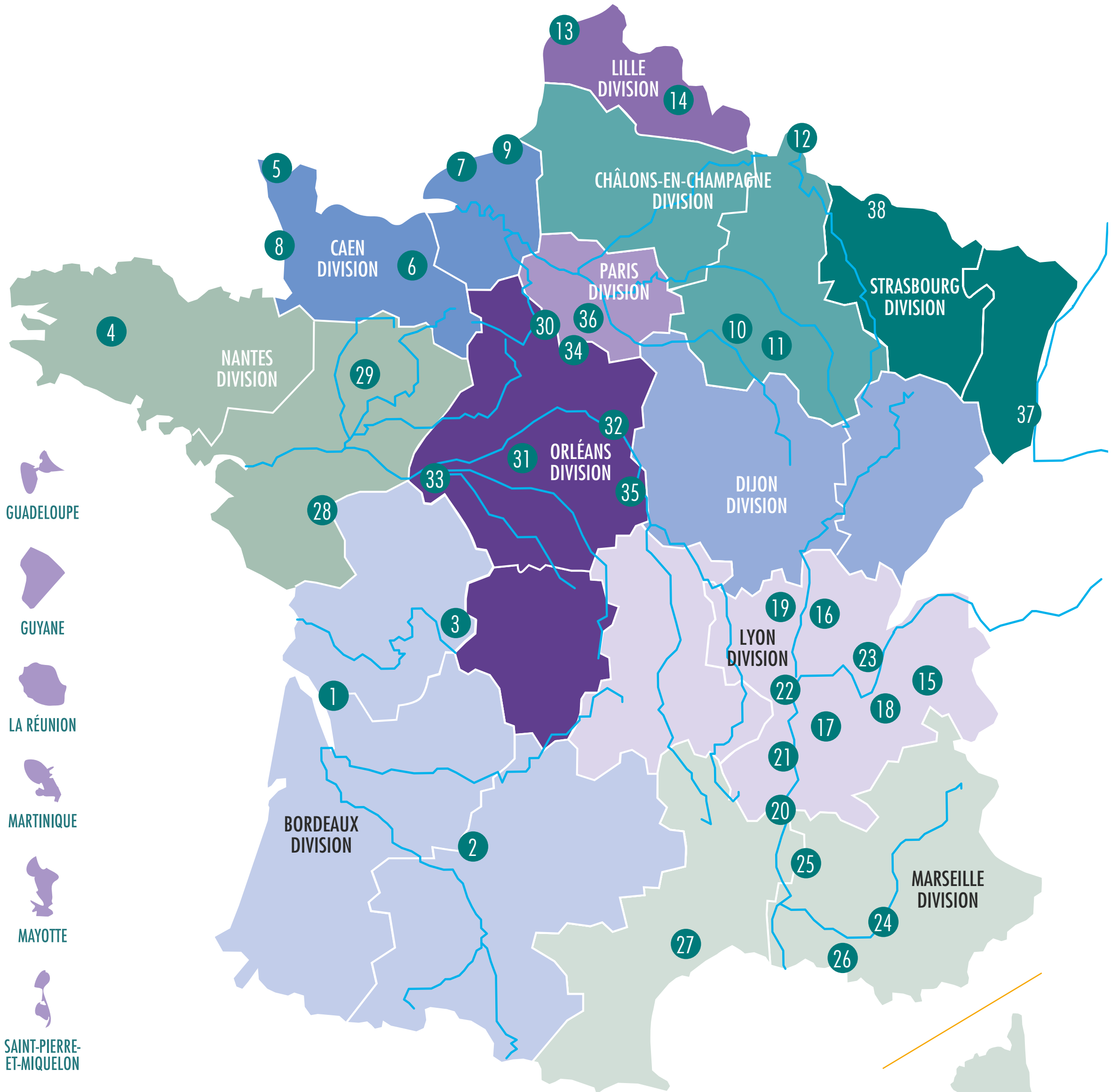
The following are subject to the BNI system:
- facilities under construction, provided that they are the subject of a creation authorisation decree;
- facilities in operation;
- facilities shut down or undergoing decommissioning, until they are delicensed by ASN.

As at 31st December 2014, there were 125 BNIs (legal entities).

The declared BNIs are those which existed prior to publication of Decree n° 63-1228 of 11th December 1963 concerning nuclear installations and for which said decree did not require authorisation but simply notification to the Minister in charge of Atomic Energy. The notified BNIs are those which existed prior to the publication of decree 63-1228 of 11th December 1963 concerning nuclear facilities and for which neither said decree nor the TSN Act of 13th June required authorisation but simply notification on the basis of the acquired rights (see Articles 33 and 62 of the TSN Act, codified in Articles L. 593-35 and L. 593-36 of the Environment Code).

The missing BNI numbers correspond to facilities that figured in previous issues of the list, but which no longer constitute BNIs further to their delicensing (see chapter 15) or their licensing as new Basic Nuclear Installations.

SITES REGULATED by the ASN divisions



Bordeaux division
1 ▲ Blayais 2 ▲ Golfech 3 ▲ Civaux

Caen division
4 ▲ Brennilis 5 Factory ■ La Hague 6 ○ Caen 7 ▲ Paluel
8 ▲ Flamanville 9 ▲ Penly

Châlons-en-Champagne division
10 ▲ Nogent-sur-Seine 11 ■ Soulaines-Dhuys 12 ▲ Chooz

Lille division
13 ▲ Gravelines 14 ○ Maubeuge

Lyon division
15 ● Grenoble 16 ▲ ○ Bugey 17 Factory Romans-sur-Isère
18 Factory Veurey-Voroize 19 ○ Dagneux 20 ▲ Factory ○ Tricastin
21 ▲ Cruas-Meysse 22 ▲ Saint-Alban 23 ▲ Creys-Malville

Marseille division
24 ● Cadarache 25 ▲ Factory ● Marcoule 26 ○ Marseille
27 ○ Narbonne

Nantes division
28 ○ Pouzauges 29 ○ Sablé-sur-Sarthe

Orléans division
30 ● Saclay 31 ▲ Saint-Laurent-des-Eaux
32 ▲ Dampierre-en-Burly 33 ▲ ○ Chinon 34 ● Orsay
35 ▲ Belleville-sur-Loire 36 ● Fontenay-aux-Roses

Strasbourg division
37 ▲ Fessenheim 38 ▲ Cattenom

Type of installation
▲ Nuclear power plant
Factory
● R&D laboratory
■ Disposal of waste
○ Other

SITE NAME	NAME AND LOCATION OF THE INSTALLATION	LICENSEE	TYPE OF INSTALLATION	BNI
LOCATION OF INSTALLATIONS REGULATED BY THE BORDEAUX DIVISION				
1 BLAYAIS	BLAYAIS NUCLEAR POWER PLANT (reactors 1 and 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors	86
1 BLAYAIS	BLAYAIS NUCLEAR POWER PLANT (reactors 3 and 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors	110
2 GOLFECH	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	Reactor	135
2 GOLFECH	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	Reactor	142
3 CIVAUX	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 86320 Civaux	EDF	Reactor	158
3 CIVAUX	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 86320 Civaux	EDF	Reactor	159
LOCATION OF INSTALLATIONS REGULATED BY THE CAEN DIVISION				
4 BRENNILIS	MONTS D'ARRÉE EL4D 29218 Huelgoat	EDF	Reactor undergoing decommissioning	162
5 LA HAGUE	SPENT FUEL REPROCESSING PLANT (UP2) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances (decommissioning In progress)	33
5 LA HAGUE	EFFLUENT AND SOLID WASTE TREATMENT STATION (STE2) AND SPENT NUCLEAR FUELS REPROCESSING FACILITY (AT1) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances (decommissioning In progress)	38
5 LA HAGUE	ELAN IIB FACILITY 50107 Cherbourg	AREVA NC	Transformation of radioactive substances (decommissioning In progress)	47
5 LA HAGUE	MANCHE WASTE REPOSITORY (CSM) 50448 Beaumont-Hague	ANDRA	Disposal of radioactive substances (under surveillance)	66
5 LA HAGUE	HAO (HIGH LEVEL OXIDE) FACILITY 50107 Cherbourg	AREVA NC	Transformation of radioactive substances (decommissioning in progress)	80
5 LA HAGUE	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP3 A" 50107 Cherbourg	AREVA NC	Transformation of radioactive substances	116
5 LA HAGUE	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP2 800" 50107 Cherbourg	AREVA NC	Transformation of radioactive substances	117
5 LA HAGUE	LIQUID EFFLUENT AND SOLID WASTE TREATMENT STATION "STE3" 50107 Cherbourg	AREVA NC	Transformation of radioactive substances	118
6 CAEN	NATIONAL LARGE HEAVY ION ACCELERATOR (GANIL) 14021 Caen Cedex	GIE GANIL	Particle accelerator	113
7 PALUEL	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor	103
7 PALUEL	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor	104
7 PALUEL	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany - Barville	EDF	Reactor	114
7 PALUEL	PALUEL NUCLEAR POWER PLANT (reactor 4) 76450 Cany- Barville	EDF	Reactor	115
8 FLAMANVILLE	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	Reactor	108
8 FLAMANVILLE	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	Reactor	109
8 FLAMANVILLE	FLAMANVILLE NUCLEAR POWER PLANT (reactor 3 - EPR) 50830 Flamanville	EDF	Reactor	167
9 PENLY	PENLY NUCLEAR POWER PLANT (Reactor 1) 76370 Neuville-lès-Dieppe	EDF	Reactor	136
9 PENLY	PENLY NUCLEAR POWER PLANT (Reactor 2) 76370 Neuville-lès-Dieppe	EDF	Reactor	140

SITE NAME	NAME AND LOCATION OF THE INSTALLATION	LICENSEE	TYPE OF INSTALLATION	BNI
LOCATION OF INSTALLATIONS REGULATED BY THE CHÂLONS-EN-CHAMPAGNE DIVISION				
⑩ NOGENT-SUR-SEINE	NOGENT NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor	129
⑩ NOGENT-SUR-SEINE	NOGENT NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor	130
⑪ SOULAINES-DHUYS	AUBE WASTE REPOSITORY (CSA) 10200 Bar-sur-Aube	ANDRA	Radioactive waste surface repository	149
⑫ CHOOZ	CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet	EDF	Reactor	139
⑫ CHOOZ	CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet	EDF	Reactor	144
⑫ CHOOZ	ARDENNES NUCLEAR POWER PLANT CNA-D 08600 Givet	EDF	Reactor undergoing decommissioning	163
LOCATION OF INSTALLATIONS REGULATED BY THE LILLE DIVISION				
⑬ GRAVELINES	GRAVELINES NUCLEAR POWER PLANT (reactors 1 and 2) 59820 Gravelines	EDF	Reactors	96
⑬ GRAVELINES	GRAVELINES NUCLEAR POWER PLANT (reactors 3 and 4) 59820 Gravelines	EDF	Reactors	97
⑬ GRAVELINES	GRAVELINES NUCLEAR POWER PLANT (reactors 5 and 6) 59820 Gravelines	EDF	Reactors	122
⑭ MAUBEUGE	NUCLEAR MAINTENANCE FACILITY 59600 Maubeuge	SOMANU	Nuclear maintenance	143
LOCATION OF INSTALLATIONS REGULATED BY THE LYON DIVISION				
⑮ GRENOBLE	SILOE 38041 Grenoble Cedex	CEA	Reactor undergoing decommissioning	20
⑮ GRENOBLE	EFFLUENT AND SOLID WASTE TREATMENT STATION 38041 Grenoble Cedex	CEA	Transformation of radioactive substances (decommissioning in progress)	36
⑮ GRENOBLE	ACTIVE MATERIALS ANALYSIS LABORATORY (LAMA) 38041 Grenoble Cedex	CEA	Utilisation of radioactive substances (decommissioning in progress)	61
⑮ GRENOBLE	HIGH FLUX REACTOR (RHF) 38041 Grenoble Cedex	Institut Max von Laue Paul Langevin	Reactor	67
⑮ GRENOBLE	DECAY INTERIM STORAGE FACILITY 38041 Grenoble Cedex	CEA	Storage of radioactive substances (decommissioning in progress)	79
⑯ BUGEY	BUGEY NUCLEAR POWER PLANT (reactor 1) BP 60120 - 01155 Lagnieu Cedex	EDF	Reactor undergoing decommissioning	45
⑯ BUGEY	BUGEY NUCLEAR POWER PLANT (reactors 2 and 3) BP 60120 - 01155 Lagnieu Cedex	EDF	Reactors	78
⑯ BUGEY	BUGEY NUCLEAR POWER PLANT (reactors 4 and 5) BP 60120 - 01155 Lagnieu Cedex	EDF	Reactors	89
⑯ BUGEY	BUGEY INTER-REGIONAL WAREHOUSE BP 60120 - 01155 Lagnieu Cedex	EDF	Storage of new fuel	102
⑯ BUGEY	ACTIVATED WASTE PACKAGING AND STORAGE INSTALLATION (ICEDA) 01120 Saint Vulbas	EDF	Packaging and interim storage of radioactive substances	173
⑰ ROMANS-SUR-ISÈRE	FUEL ELEMENTS FABRICATION PLANT 26104 Romans-sur-Isère	AREVA NP	Fabrication of radioactive substances	63
⑰ ROMANS-SUR-ISÈRE	NUCLEAR FUELS FABRICATION UNIT 26104 Romans-sur-Isère	AREVA NP	Fabrication of radioactive substances	98
⑱ VEUREY-VOROIZE	NUCLEAR FUELS FABRICATION PLANT 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances (decommissioning in progress)	65
⑱ VEUREY-VOROIZE	PELLET FABRICATION FACILITY 38113 Veurey-Voroize	SICN	Fabrication of radioactive substances (decommissioning in progress)	90
⑲ DAGNEUX	DAGNEUX IONISATION PLANT Z.I. Les Chartinières 01120 Dagneux	IONISOS	Utilisation of radioactive substances	68
⑳ TRICASTIN	TRICASTIN NUCLEAR POWER PLANT (reactors 1 and 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors	87

SITE NAME	NAME AND LOCATION OF THE INSTALLATION	LICENSEE	TYPE OF INSTALLATION	BNI
20 TRICASTIN	TRICASTIN NUCLEAR POWER PLANT(reactors 3 and 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors	88
20 TRICASTIN	GEORGES BESSE PLANT FOR URANIUM ISOTOPE SEPARATION BY GASEOUS DIFFUSION (EURODIF) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Transformation of radioactive substances	93
20 TRICASTIN	URANIUM HEXAFLUORIDE PREPARATION PLANT (COMURHEX) 26130 Saint-Paul-Trois-Châteaux	AREVA NC	Transformation of radioactive substances	105
20 TRICASTIN	URANIUM CLEAN-UP AND RECOVERY FACILITY 26130 Saint-Paul-Trois-Châteaux	SOCATRI	Factory	138
20 TRICASTIN	INSTALLATION TU 5 BP 16 - 26701 Pierrelatte	AREVA NC	Transformation of radioactive substances	155
20 TRICASTIN	TRICASTIN OPERATIONAL HOT UNIT (BCOT) BP 127 - 84504 Bollène Cedex	EDF	Nuclear maintenance	157
20 TRICASTIN	GEORGES BESSE 2 PLANT FOR CENTRIFUGAL SEPARATION OF URANIUM ISOTOPES 26702 Pierrelatte Cedex	SET	Transformation of radioactive substances	168
21 CRUAS-MEYSSE	CRUAS NUCLEAR POWER PLANT (reactors 1 and 2) 07350 Cruas	EDF	Reactors	111
21 CRUAS-MEYSSE	CRUAS NUCLEAR POWER PLANT (reactors 3 and 4) 07350 Cruas	EDF	Reactors	112
22 SAINT-ALBAN	SAINT-ALBAN/SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor	119
22 SAINT-ALBAN	SAINT-ALBAN/SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor	120
23 CREYS-MALVILLE	SUPERPHENIX REACTOR 38510 Morestel	EDF	Fast-neutron reactor undergoing decommissioning	91
23 CREYS-MALVILLE	FUEL STORAGE FACILITY 38510 Morestel	EDF	Storage of radioactive substances	141
LOCATION OF INSTALLATIONS REGULATED BY THE MARSEILLE DIVISION				
24 CADARACHE	TEMPORARY DISPOSAL FACILITY (PEGASE) AND SPENT NUCLEAR FUEL DRY STORAGE INSTALLATION (CASCAD) 13115 Saint-Paul-lez-Durance Cedex	CEA	Storage of radioactive substances	22
24 CADARACHE	CABRI 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	24
24 CADARACHE	RAPSODIE/LDAC 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	25
24 CADARACHE	PLUTONIUM TECHNOLOGY FACILITY (ATPu) 13115 Saint-Paul-lez-Durance Cedex	CEA	Fabrication or transformation of radioactive substances (decommissioning in progress)	32
24 CADARACHE	EFFLUENT AND SOLID WASTE TREATMENT STATION 13115 Saint-Paul-lez-Durance Cedex	CEA	Transformation of radioactive substances	37
24 CADARACHE	MASURCA 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	39
24 CADARACHE	EOLE 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	42
24 CADARACHE	ENRICHED URANIUM PROCESSING FACILITY (ATUE) 13115 Saint-Paul-lez-Durance Cedex	CEA	Fabrication of radioactive substances (decommissioning in progress)	52
24 CADARACHE	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE 13115 Saint-Paul-lez-Durance Cedex	CEA	Storage of radioactive substances	53
24 CADARACHE	CHEMICAL PURIFICATION LABORATORY 13115 Saint-Paul-lez-Durance Cedex	CEA	Transformation of radioactive substances (decommissioning in progress)	54
24 CADARACHE	ACTIVE FUEL EXAMINATION LABORATORY (LECA) AND SPENT FUEL REPROCESSING, CLEAN-OUT AND REPACKAGING STATION (STAR) 13115 Saint-Paul-lez-Durance Cedex	CEA	Storage of radioactive substances	55
24 CADARACHE	RADIOACTIVE WASTE INTERIM STORAGE AREA 13115 Saint-Paul-lez-Durance Cedex	CEA	Storage of radioactive substances	56
24 CADARACHE	PHEBUS 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	92

SITE NAME	NAME AND LOCATION OF THE INSTALLATION	LICENSEE	TYPE OF INSTALLATION	BNI
24 CADARACHE	MINERVE 13115 Saint-Paul-lez-Durance Cedex	CEA	Reactor	95
24 CADARACHE	LABORATORY FOR RESEARCH AND EXPERIMENTAL FABRICATION OF ADVANCED NUCLEAR FUELS (LEFCA) 13115 Saint-Paul-lez-Durance Cedex	CEA	Fabrication of radioactive substances	123
24 CADARACHE	CHICADE BP 1 - 13108 Saint-Paul-lez-Durance Cedex	CEA	R&D laboratory	156
24 CADARACHE	CEDRA 13115 Saint-Paul-lez-Durance Cedex	CEA	Packaging and interim storage of radioactive substances	164
24 CADARACHE	MAGENTA 13115 Saint-Paul-lez Durance Cedex	CEA	Reception and shipment of nuclear materials	169
24 CADARACHE	EFFLUENT ADVANCED MANAGEMENT AND PROCESSING FACILITY "AGATE" 13115 Saint-Paul-lez Durance Cedex	CEA	Packaging and interim storage of radioactive substances	171
24 CADARACHE	JULES HOROWITZ REACTOR (JHR) 13115 Saint-Paul-lez Durance Cedex	CEA	Reactor	172
24 CADARACHE	ITER 13115 Saint-Paul-lez-Durance Cedex	International àrganisation ITER	Nuclear fusion reaction experiments with tritium and deuterium and deuterium plasmas	174
25 MARCOULE	PHÉNIX NUCLEAR POWER PLANT 30205 Bagnols-sur-Cèze	CEA	Reactor	71
25 MARCOULE	ATALANTE CEN VALRHO Chusclan 30205 Bagnols-sur-Cèze	CEA	R&D laboratory and study of actinides production	148
25 MARCOULE	NUCLEAR FUELS FABRICATION PLANT (MELOX) BP 2 - 30200 Chusclan	AREVA NC	Fabrication of radioactive substances	151
25 MARCOULE	CENTRACO Codolet 30200 Bagnols-sur-Cèze	SOCODEI	Radioactive waste and effluent processing	160
25 MARCOULE	GAMMATEC 30200 Chuslan	Synergy Health Marseille	Ionisation treatment of materials, products and equipment, for industrial purposes and for research and development	170
26 MARSEILLE	GAMMASTER IONISATION PLANT – M.I.N. 712 13323 Marseille Cedex 14	Synergy Health Marseille	Ionisation installation	147
27 NARBONNE	PONDS B1 AND B2 (Malvési) 11100 Narbonne	AREVA NC	Packaging and interim storage of radioactive substances	
LOCATION OF INSTALLATIONS REGULATED BY THE NANTES DIVISION				
28 POUZAUGES	POUZAUGES IONISATION PLANT Z.I. de Monlifant 85700 Pouzauges	IONISOS	Ionisation installation	146
29 SABLÉ-SUR-SARTHE	SABLÉ-SUR-SARTHE IONISATION PLANT Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionisation installation	154
LOCATION OF INSTALLATIONS REGULATED BY THE ORLÉANS DIVISION				
30 SACLAY	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor undergoing decommissioning	18
30 SACLAY	ARTIFICIAL RADIONUCLIDES PRODUCTION FACILITY 91191 Gif-sur-Yvette Cedex	CIS Bio International	Fabrication or transformation of radioactive substances	29
30 SACLAY	LIQUID EFFLUENT MANAGEMENT ZONE 91191 Gif-sur-Yvette Cedex	CEA	Transformation of radioactive substances	35
30 SACLAY	OSIRIS-ISIS 91191 Gif-sur-Yvette Cedex	CEA	Reactors	40
30 SACLAY	HIGH ACTIVITY LABORATORY 91191 Gif-sur-Yvette Cedex	CEA	Utilisation of radioactive substances (decommissioning in progress)	49
30 SACLAY	SPENT FUEL TEST LABORATORY (LECI) 91191 Gif-sur-Yvette Cedex	CEA	Utilisation of radioactive substances	50
30 SACLAY	SOLID RADIOACTIVE WASTE MANAGEMENT ZONE 91191 Gif-sur-Yvette Cedex	CEA	Storage of radioactive substances	72
30 SACLAY	POSEIDON – CAPRI IRRADIATION FACILITIES 91191 Gif-sur-Yvette Cedex	CEA	Utilisation of radioactive substances	77
30 SACLAY	ORPHEE 91191 Gif-sur-Yvette Cedex	CEA	Reactor	101

SITE NAME	NAME AND LOCATION OF THE INSTALLATION	LICENSEE	TYPE OF INSTALLATION	BNI
31 SAINT-LAURENT-DES-EAUX	SAINT-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors A1 and A2) 41220 La Ferté-Saint-Cyr	EDF	Reactors undergoing decommissioning	46
31 SAINT-LAURENT-DES-EAUX	INTERIM STORAGE OF IRRADIATED GRAPHITE SLEEVES 41220 La Ferté-Saint-Cyr	EDF	Storage of radioactive substances	74
31 SAINT-LAURENT-DES-EAUX	SAINT-LAURENT-DES-EAUX NUCLEAR POWER PLANT (reactors B1 and B2) 41220 La Ferté-Saint-Cyr	EDF	Reactors	100
32 DAMPIERRE-EN-BURLY	DAMPIERRE NUCLEAR POWER PLANT (Reactors 1 and 2) 45570 Ouzouer-sur-Loire	EDF	Reactors	84
32 DAMPIERRE-EN-BURLY	DAMPIERRE NUCLEAR POWER PLANT (Reactors 3 and 4) 45570 Ouzouer-sur-Loire	EDF	Reactors	85
33 CHINON	IRRADIATED MATERIALS FACILITY 37420 Avoine	EDF	Utilisation of radioactive substances	94
33 CHINON	CHINON INTER-REGIONAL WAREHOUSE 37420 Avoine	EDF	Storage of new fuel	99
33 CHINON	CHINON NUCLEAR POWER PLANT (reactors B1 and B2) 37420 Avoine	EDF	Reactors	107
33 CHINON	CHINON NUCLEAR POWER PLANT (reactors B3 and B4) 37420 Avoine	EDF	Reactors	132
33 CHINON	CHINON A1D 37420 Avoine	EDF	Reactor undergoing decommissioning	133
33 CHINON	CHINON A2 D 37420 Avoine	EDF	Reactor undergoing decommissioning	153
33 CHINON	CHINON A3 D 37420 Avoine	EDF	Reactor undergoing decommissioning	161
34 ORSAY	LABORATORY FOR THE USE OF ELECTROMAGNETIC RADIATION (LURE) 91405 Orsay Cedex	CNRS	Particle accelerator undergoing decommissioning	106
35 BELLEVILLE-SUR-LOIRE	BELLEVILLE NUCLEAR POWER PLANT(reactor 1) 18240 Léré	EDF	Reactor	127
35 BELLEVILLE-SUR-LOIRE	BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	Reactor	128
36 FONTENAY-AUX-ROSES	PROCEDE 92265 Fontenay-aux-Roses Cedex	CEA	Decommissioning research installation	165
36 FONTENAY-AUX-ROSES	SUPPORT 92265 Fontenay-aux-Roses Cedex	CEA	Installation for treatment of effluents and storage of decommissioning waste	166
LOCATION OF INSTALLATIONS REGULATED BY THE STRASBOURG DIVISION				
37 FESSENHEIM	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 and 2) 68740 Fessenheim	EDF	Reactors	75
38 CATTENOM	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	Reactor	124
38 CATTENOM	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	Reactor	125
38 CATTENOM	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	Reactor	126
38 CATTENOM	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom	EDF	Reactor	137

APPENDIX B

Acronyms and abrevations

ACCIRAD	Guidelines on a risk analysis of ACCIdental and unintended exposures in RADiotherapy
ACN	Aarhus Convention and Nuclear (ANCCLI initiative)
ACO	Orsay Collider Ring (LURE - CNRS - Orsay)
ACRO	Association for the Control of Radioactivity in the West
ADNR	Agreement on the transport of dangerous substances on the river Rhine
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road
ADS	Accelerator Driven System (nuclear reactor driven by a particle accelerator)
AEN	French acronym for the Nuclear Energy Agency (NEA-OECD)
AERB	Atomic Energy Regulatory Board (Indian regulatory body)
AFCEN	French Association for NSSS Equipment Construction Rules
AFCN	Federal Agency for Nuclear Control (Belgium)
AFPPE	French Association of Radiographers
AFSSAPS	French Health Product Safety Agency (replaced by the ANSM as of December 2011)
AGATE	Effluent Advanced Management and Processing Facility (CEA - Cadarache)
AIEA	French acronym for the International Atomic Energy Agency (IAEA)
ALARA	As Low As Reasonably Achievable (radiation protection principle also called "optimisation principle")
ALS	Saclay Linear Accelerator (CEA)
AMI	Irradiated Material Facility (EDF - Chinon)
ANCCLI	National Association of Local Information Commissions and Committees (since 2009)
ANDRA	French National Radioactive Waste Management Agency
ANR	French National Research Agency
ANSES	French National Agency responsible for Health and Safety of Food, the Environment and Work (since July 2010)
ANSM	French National Agency for Drug and Health Product Safety (formerly AFSSAPS)
AP-913	Maintenance doctrine (EDF)
APEC	Fuel Evacuation Facility (EDF - Creys- Malville - Isère *département*)
AP-HP	Public Health Service – Paris Hospitals
AREVA	Industrial group active in the nuclear fuel cycle and construction of nuclear installations
AREVA NC	Fuel cycle licensee (Areva group)
AREVA NP	Designer and builder of nuclear power plants (Areva group)

ARS	Regional Health Agency (since 2010)
ASG	Steam Generator Auxiliary Feedwater system (PWR)
ASIT	Swiss Technical Inspection Association
ASN	*Autorité de Sûreté Nucléaire,* the French nuclear regulatory body, also referred to as the French nuclear safety authority
ASND	Defence Nuclear Safety Authority (structure responsible for regulating nuclear safety and radiation protection with regard to defencerelated nuclear activities and installations. It is placed under the authority of DSND)
ASR	Simple Refuelling Outage (PWR)
ASTRID	Advanced Sodium Technological Reactor for Industrial Demonstration (prototype sodium-cooled fast reactor (SFR) project (CEA))
AT1	Former pilot reprocessing plant for spent fuel from fast neutron reactors (CEA - La Hague)
ATALANTE	Alpha Facility and Laboratory for Transuranian elements Analysis and Reprocessing Studies (CEA - Marcoule)
ATEX	EXplosive ATmospheres (ATEX regulations)
ATMEA	Joint venture between Areva and MHI responsible for the development, commercialisation, certification and sale of ATMEA 1, a new 1,100 MWe reactor
ATPu	Plutonium Technology Facility (Areva NC - Cadarache)
ATUE	Enriched uranium processing facility (CEA - Cadarache)
AZF	Former name of the company operating the fertiliser plant destroyed in the 21st September 2001 accident in Toulouse
BCOT	Tricastin Operational Hot Unit (nuclear maintenance installation - EDF - Bollène)
Bel V	Technical Safety Organisation and subsidiary of FANC (since 2008)
BK	BK Fuel Building
BMU	German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety
BSM	Fissile Materials Storage and Handling Building (MASURCA reactor)
BSS	Basic Safety Standards
CABRI	Research reactor (CEA - Cadarache)
CADA	Administrative Documents Access Commission
CANR	CNRA Committee on Nuclear Regulatory Activities
CARSAT	French retirement and occupational health insurance fund
CASCAD	Cadarache bunker research reactor spent fuel storage facility (CEA)
CCAP	French Central Committee for Pressure Vessels
CCP	Joint consultative commission
CCSN	Canadian Nuclear Safety Commission (CNSC)
CE	European Community - “CE mark” - mandatory and regulatory conformity mark for some products in the European Union to ensure that the product conforms with the “essential requirements” defined by a European directive
CEA	French Atomic Energy Commission (now the Atomic Energy and Alternative Energy Commission)
CEDAI	Internal Authorisations Assessment Committee
CEDRA	Radioactive waste packaging and interim storage unit (CEA - Cadarache)

CEE	European Economic Community
CEIDRE	Construction and Operation Expert Appraisal and Inspection Centre (EDF)
CELIMENE	Former cell for examining the fuel from the EL3 reactor (CEA – Saclay)
CENTRACO	Low-level waste processing and packaging centre (SOCODEI - Marcoule)
CEPN	Nuclear Protection Evaluation Centre
CERCA	Company for the Design and Fabrication of Atomic Fuel
CERN	European Organization for Nuclear Research
CGA	French Armed Forces General Inspectorate
CGEDD	French Departmental Council for the Environment and Sustainable Development (Ministry of Ecology, Sustainable Development and Energy)
CH	Hospital Centre
CHICADE	Chemistry, waste characterization (CEA Cadarache)
CHRU	Regional University Hospital
CHSCT	Committee for Health, Safety and Working Conditions
CHU	University Hospital
CIC	French Inter-ministerial Crisis Committee
CICNR	Inter-ministerial Committee for Nuclear or Radiological Emergencies
CIESCT	Inter-Company Working Conditions and Safety Committee
CIGEO	Industrial GEOlogical Disposal Facility
CIPR	International Commission on Radiological Protection (ICRP)
CIRC	International Agency for Research on Cancer (part of the WHO - Lyon)
CIREA	Interministerial Commission for Artificial Radioelements
CIRES	Industrial centre for collection, storage and disposal (Andra)
CIS bio international	Company specialising in international biomedical technologies, especially radiopharmaceuticals
CISSCT	Inter-firm Health, Safety and Working Conditions Committee (for EDF power plants)
CITMD	French Interministerial Commission for the Carriage of Hazardous Goods
ClF3	Chlorine trifluoride
CLCC	Anti-cancer Centre
CLI	Local Information Committee
CLIGEET	Tricastin Major Energy Facility Local Information Committee (name of the CLI on the Tricastin site since 2008)
CLIO	Accelerator (see PHIL)
CLIS	Local Committee for Information and Follow-up - name of the CLI for underground laboratories
	Local Committee for Information and Monitoring (name of the CLI at the Fessenheim plant since 2009)
CMIR	Mobile Radiological Intervention Unit
CNA	Ardennes NPP (Chooz A reactor - EDF)
CNA-D	Equipment storage facility during decommissioning of the Chooz A reactor (EDF - Chooz)
CNAM	French National Health Insurance Fund
CNAR	French National Funding Commission for Radioactive Matters

CNPE	Nuclear Power Generation Site (NPP) - EDF
CNRA	Committee on Nuclear Regulatory Activities (NEA)
CNRS	French National Centre for Scientific Research
CNSC	Canadian Nuclear Safety Commission
COCT	Working Conditions Guidance Council
COD	Departmental Operations Centre
CODERST	Council for the Environment and for Health and Technological Risks
Codex alimentarius	Collection of food health safety and consumer protection standards produced by a commission set up by the FAO and the WHO
CODIRPA	Steering committee for managing the post-accident phase of a nuclear accident or radiological emergency situation
CODIS-CTA	Departmental Fire and Emergency Operational Centre - Alert Processing Centre
COFRAC	French Accreditation Committee
COFREND	French Non-Destructive Testing Confederation
COFSOH	Social, Organisational and Human Factors Steering Committee
COMURHEX	*Société pour la COnversion de l'URanium en métal et en HEXafluorure* (Company for the conversion of uranium into metal and hexafluoride) (Areva group)
CP0	First series of 900 MWe nuclear reactors (EDF)
CPP	Main Primary (cooling) System (PWR)
CPY	Second series of 900 MWe nuclear reactors (EDF)
CRPPH	Committee on Radiation Protection and Public Health (NEA)
CSA	Aube Waste Repository (Andra) (former name of the CSFMA)
CSD-C	Standard Compacted Waste Package
CSD-V	Standard Vitrified Waste Package
CSIN	French acronym for the CSNI (Committee on the Safety of Nuclear Installations - NEA)
CSM	Manche Waste Repository (Andra)
CSN	*Consejo de Seguridad Nuclear* (Spanish regulatory body)
CSP	Main Secondary Cooling System (PWR)
CSPRT	High Council for the Prevention of Technological Risks (since 2010)
CSS	Commission on Safety Standards (IAEA)
CSTB	Building Industry Scientific and Technical Centre
CSWG	Codes and Standards Working Group (part of the MDEP programme)
CTC	Technical Emergency Centre
CTIF	French metal casting research and development centre
CTP	ASN Social Dialogue Committee
DAC	Authorisation Creation Decree (BNI Procedure)
DCI	Communication and Public Information Department (ASN)
DCN	Nuclear Power Plants Department (ASN)
DEM	Decommissioning
DEP	Nuclear Pressure Equipment Department (ASN)

DEU	Environment and Emergency Department (ASN)
DFCI	French equivalent of Ionisation Chamber Smoke Detector (ICSD)
DFK	*Deutsch-Französische Kommission für Fragen der Sicherheitkerntechnischer Einrichtungen* (Franco-German commission on questions of nuclear installation safety)
DGAC	General Directorate for Civil Aviation (Ministry of Ecology, Sustainable Development and Energy)
DGEC	General Directorate for Energy and Climate (Ministry of Ecology, Sustainable Development and Energy and Ministry of the Economy and Finances)
DGITM	General Directorate for Infrastructure, Transport and the Sea (Ministry of Ecology, Sustainable Development and Energy)
DGOS	General Directorate for Health Care (Ministry of Social Affairs and Health)
DGPR	General Directorate for Risk Prevention (Ministry of Ecology, Sustainable Development and Energy)
DGS	General Directorate for Health (Ministry of Social Affairs and Health)
DGSCGC	General Directorate for Civil Protection and Crisis management (Ministry of the Interior)
DGSNR	General Directorate for Nuclear Safety and Radiation Protection (ASN central structure until the November 2006 reform)
DGT	General Directorate for Labour (Ministry of Labour, Employment, Professional Training and Social Dialogue)
DHOS	Directorate for Hospitalisation and Health Care Organisation (Ministry of Social Affairs and Health)
DIADEM	Irradiating or Alpha Waste from DEcommissioning
DICWG	Digital Instrumentation and Control Working Group (part of the MDEP programme)
DIS	Ionising Radiation and Health Department (ASN)
DIRECCTE	Regional Directorate for Businesses Competition Policy Consumer Affairs Labour and Employment
DOrS	Safety Guidance Document
DOS	Safety Options File (for BNIs)
DOT	Department of Transportation (United States)
DPSN	Nuclear Safety and Protection Division (CEA)
DRC	Nuclear Waste, Research Facilities, and Cycle Department (ASN)
DREAL	Regional Directorate for the Environment, Planning and Housing
DRI	International Relations Department (ASN)
DRIEE	Inter-Department Regional Directorate for Environment and Energy (Ile-de-France region)
DSND	Delegate for Nuclear Safety and Radiation Protection for National Defence Installations and Activities (see ASND)
DSWG	Design Specific Working Group
DTS	Transport and Sources Department (ASN)
DTI	Total Indicative Dose
EAN	European ALARA Network (the aim of which is to promote implementation of the ALARA principle)
EACA	European Association of Competent Authorities on the transport of radioactive material

EAS	Reactor Building Containment Spray System (PWR)
ECRIN	Contained storage of conversion residues
ECS	Stress tests
EDE	Containment annulus ventilation system (PWR)
EDF	*Électricité De France*
EEVSE	Glass Storage Building
EFRS	European Federation of Radiographer Societies
EEVLH	Glass Storage Building Extension on the La Hague site (Areva NC - La Hague)
EFOMP	European Federation of Organisations in Medical Physics
EGRA	Expert Group on Regulatory Authorisation (sub-group of the NEA's CRPPH)
EGRPM	Expert Group on the Radiological Aspects of the Fukushima Accident
EHESP	French School of Public Health
EIL	Inter-Laboratory Tests
EIP	Elements Important for Protection
EIS	Elements Important for Safety
ÉLAN II B	Former sealed source fabrication installation (CEA - La Hague)
EL3	Heavy water reactor No. 3 (former experimental reactor - CEA - Saclay)
EL4	Heavy water reactor No. 4 (former Monts d'Arrée nuclear power plant - EDF - Brennilis)
EL4-D	Equipment interim storage installation for decommissioning of the Monts d'Arrée nuclear power plant
ENEF	European Nuclear Energy Forum
ENSREG	European Nuclear Safety REgulators Group (high-level group set up by the European Commission to deal with nuclear safety and waste management - former HLG)
EOLE	Research reactor (CEA - Cadarache)
EPA	Environmental Protection Agency (United States)
EPI	French acronym for Personal Protective Equipment (PPE)
EPR	Evolutionary Pressurized water Reactor (new type of nuclear reactor developed by Areva NP)
EPRUS	Health Emergency Preparedness and Response Organisation
EPS	Probabilistic Safety Study
EPSF	French Railway Safety Authority
ERPAN	European RadioProtection Authority Network
ERR	European Radiation Research society
ESE	Significant Environmental Event
ESP	Pressure Vessel
ESPIC	Private health establishment of collective interest
ESPN	Nuclear Pressure Vessel
ESR	Significant Radiation Protection Event European Society of Radiology
ESRF	European Synchrotron Radiation Facility (Grenoble)
ESS	Significant Safety Event
ETP	French acronym for Full-Time Equivalent (FTE)

EU	European Union
Euratom	EURopean ATOMic energy community treaty
EURODIF	EUROpean gaseous DIFusion enrichment plant
EVEREST	French acronym for "evolving towards entry without standard suit" (entry into a controlled area in working overalls - initiative implemented by EDF)
FA-MA	Low Level - Intermediate Level wastes
FANR	Federal Authority for Nuclear Regulation (UAE)
FAO	Food and Agriculture Organization of the United Nations
FARN	Nuclear rapid intervention force
FA-VL	Low Level - Long Lived radioactive waste
FBFC	Franco-Belgian Fuel Fabrication Company (Pierrelatte and Romans-sur-Isère)
FMA	Low or Intermediate Level Wastes (LLW/ILW)
FMA-VC	Low or Intermediate Level, Short-Lived Waste (LLW/ILW-SL)
FRAMATOME	French NSSS builder (now known as Areva NP)
FRAMATOME	Framatome - Advanced Nuclear Power (company set up by Areva and Siemens to develop the new EPR reactor type - now known as Areva NP)
FRAREG	FRAmatome REGulators (Association of regulatory bodies in countries operating power plants of French design)
FSOH	French acronym for Social, Organisational and Human Factors (SOHF)
FTE	Full-time Equivalent
GALICE	Nuclear fuel management method (EDF)
GAMMATEC	Ionisation installation (company ISOTRON France in Marcoule)
GANIL	National Large Heavy Ion Accelerator (Caen)
GB II	Georges Besse II plant
Génération IV	International "Forum" of ten countries and the European Union to develop future nuclear reactors, known as 4th generation (GEN IV)
GEOSAF	International Project on Demonstrating the Safety of Geological Disposal (IAEA project on the safety of an operational deep geological disposal repository)
GEP	Pluralistic Expert Group
GFR	Gas-cooled Fast Reactor (see RNR-G)
GIAG	Severe Accident Action Guide
GIE	Economic Interest Grouping
GIF	Generation IV International Forum (see GEN IV)
GPE	Advisory Committee of Experts (reporting to ASN)
GPD	Advisory Committee of Experts for Waste (reporting to ASN)
GPESPN	Advisory Committee of Experts for Nuclear Pressure Equipment (reporting to ASN)
GPMED	Advisory Committee of Experts for Radiation Protection in Medical and Forensic Applications of Ionising Radiation (reporting to ASN)
GPMDR	Advisor Committee of Experts on Radioactive Materials and Waste (ANCCLI)
GPPA	Advisory Committee of Experts on "Post-Accident and regions" (ANCCLI)
GPR	Advisory Committee of Experts for Nuclear Reactors (reporting to ASN)

GPRADE	Advisory Committee of Experts in Radiation protection for industrial and research applications of ionising radiation and in the Environment (reporting to ASN)
GPT	Advisory Committee of Experts for Transport (reporting to ASN)
GPU	Advisory Committee of Experts for Laboratories and Plants (reporting to ASN)
GRS	*Gesellschaft für Anlagen und Reaktorsicherheit* (technical support organisation for the German regulatory body)
GT	French acronym for Working Group (WG)
GV	French acronym for Steam Generator (SG)
G8	Group of the 8 leading industrial nations (Germany, Canada, United States, France, Italy, Japan, United Kingdom and Russia)
HAO	Oxide High Activity facility (Areva NC - La Hague)
HARMONIE	Former fast neutron source reactor (CEA - Cadarache)
HAS	French National Authority for Health - since 2005
HATVP	High Authority for Transparency in Public Life
HA-LL	High-Level, Long-Lived waste
HCFDC	French High Committee for Civil Defense
HCSP	French High Public Health Council
HCTISN	French High Committee for Transparency and Information on Nuclear Security (created by the 13th June 2006 Act)
HDR	High Dose-Rate
HERCA	Heads of the European Radiological protection Competent Authorities
HFD	Defence High Official
HFDS	Defence and Security High Official
HIDRA	Human Intrusion in the context of Disposal of Radioactive Waste (IAEA project on the unintentional impact of human activities on deep geological disposal repositories)
HTR	High Temperature Reactor (thermal neutron high temperature reactor)
HYDROTÉLÉRAY	Network for continuous measurement of radioactivity in major rivers (IRSN)
ICAO	International Civil Aviation Organisation
ICEDA	Activated waste packaging and interim storage installation (EDF interim storage project)
ICPE	Installation Classified on Environmental Protection grounds (owing to its potential impact on the public and the environment, installation subject to the regulations defined in part I of book V of the French Environment Code)
ICRU	International Commission on Radiation Units and measurements
ICSD	Ionisation Chamber Smoke Detector
ICSN	Nuclear Safety Cooperation Instrument (NSCI) (European Union)
IDN	International Decommissioning Network
IEER	Institute for Energy and Environmental Research
IFFO-RME	French Institute of Trainers in Major Risks and Environmental Protection
IFSN	Swiss Federal Nuclear Safety Inspectorate
ILO	International Labour Organisation
ILL	Laue-Langevin Institute - Grenoble
IMDG	International Maritime Dangerous Goods code
IMRT	Intensity Modulated Radiation Therapy

IMS	Integrated Management System
INAPARAD	NAtional Inventory of RADioactive Lightning Arresters
INB	Basic Nuclear Installation (BNI)
INBS	Secret Basic Nuclear Installation
INCa	French National Cancer Institute
INES	International Nuclear and Radiological Event Scale
INRA	International Nuclear Regulators' Association (grouping the German, Canadian, Spanish, US, French, Japanese, UK and Swedish nuclear regulators)
	French National Institute for Agricultural Research
INSAG	International Nuclear Safety Advisory Group (IAEA)
INSTN	French National Institute for Nuclear Science and Technology - CEA
InVS	French Health Monitoring Institute
IONISOS	Company operating ionisation installations
IOTA	Installations, Structures, Works and Activities
IRE	National Radioelements Institute, Fleurus - Belgium
IRCA	CAdarache IRradiator (CEA)
IRM	Magnetic Resonance Imaging (MRI)
IRPA	International Radiation Protection Association
IRRS	Integrated Regulatory Review Service (audit on the organisation of a regulatory body performed by the IAEA)
IRSN	French Institute for Radiation Protection and Nuclear Safety
ISIS	Research reactor (CEA - Saclay)
ISO	International Organisation for Standardisation
ISWG	Issue Specific Working Group (part of the MDEP programme)
ITER	International Thermonuclear Experimental Reactor (nuclear fusion reactor to be installed at Cadarache)
JFR	French Radiology Days (annual conference organised by SFR)
JOUE	French acronym for the Official Journal of the European Union (OJEU)
KINS	Korea Institute of Nuclear Safety (technical support organisation for the South Korean regulatory body)
LAMA	Active Materials Analysis Laboratory (CEA - Grenoble)
LCPu	Plutonium Chemistry Laboratory (CEA - Fontenay-aux-Roses)
LDAC	Fuel Assembly Shearing Laboratory (CEA - Cadarache)
LDR	Low Dose-Rate
LECA	Active Fuel Examination Laboratory (CEA - Cadarache)
LECI	Spent Fuel Testing Laboratory (CEA - Saclay)
LEFCA	Laboratory for Research and Experimental Fabrication of Advanced nuclear Fuels (CEA - Cadarache)
LFR	Lead cooled Fast reactor
LHA	High Activity Laboratory (CEA - Saclay)
LHC	Large Hadron Collider (CERN - Geneva)
LIDEC	Ceidre Integrated Assessments Laboratory (EDF)

LPC	Chemical Purification Laboratory (Areva NC - Cadarache)
LUDD	Laboratories, Plants, Waste and Decommissioning
LURE	Electromagnetic Radiation Laboratory (CNRS - Orsay)
MAD	Final shutdown
MAD-DEM	Final Shutdown and Decommissioning (BNI Procedure)
MAGENTA	Cellular nuclear materials storage facility project (CEA - Cadarache)
man-Sv	Man-sievert: the SI unit for collective dose. For information, the collective dose is the sum of the individual doses received by a given group of persons. To give an example, the collective dose of 10 people having each received 1 mSV equals 10 man-mSv.
MASURCA	Cadarache fast-breeder mockup (research reactor - CEA - Cadarache)
MA-VL	Intermediate Level, Long-Lived Waste (ILWLL)
MCMF	Central Fissile Material Warehouse (CEA - Cadarache)
MDEP	Multinational Design Evaluation Programme (multinational initiative in which secretaryship is ensured by the NEA, and which aims at pooling the knowledge of the safety authorities who will be responsible for the regulatory evaluation of new reactors)
MEA	Management and Appraisal Mission (ASN)
MEDDE	Ministry of Ecology, Sustainable Development and Energy (since November 2012)
MELOX	MOX fuel fabrication plant (Marcoule)
MÉLUSINE	Research reactor (CEA - Grenoble)
MIMAUSA	History and impact of uranium mines: summary and archives - Programme for an inventory of uranium mining sites
MINERVE	Research reactor (CEA - Cadarache)
MIR	Inter-regional Fuel Stores (EDF - Bugey and Chinon)
MOX	Mixed OXide fuel (mix of uranium and plutonium oxides)
MSNR	Nuclear Safety and Radiation Protection Mission (MEDDE/DGPR)
MSR	Molten Salt Reactor
MTMD	Hazardous Materials Transport Mission
NEA	Nuclear Energy Agency (OECD)
NECSA	Nuclear Energy Corporation of South Africa (South-African public entity carrying out R&D in the nuclear power field)
NF	French Standard
NMA	Maximum Permissible Level (MPL) (for radioactive contamination of foodstuffs of livestock feed)
NNR	National Nuclear Regulator (South African regulatory body)
NNSA	National Nuclear Safety Administration (Chinese regulatory body)
NRA	Nuclear Regulation Authority (Japanese regulatory body)
NRBC	Nuclear Radiological Biological Chemical
NRC	Nuclear Regulatory Commission (American regulatory body)
NRD	French acronym for Diagnostic Reference Level (DRL)
NRPA	Norwegian Radiation Protection Authority
NSGC	Nuclear Security Guidance Committee
NSSC	Nuclear Safety and Security Commission (South Korean nuclear regulator)
NUSSC	NUclear Safety Standards Committee (IAEA)

OA	Approved Organisation for supervision
OACI	French acronym for the International Civil Aviation Organization (ICAO)
OCDE	French acronym for the Organisation for Economic Cooperation and Development (OECD)
OECD	Organisation for Economic Cooperation and Development
OEEI	EDF project to "Obtain Installations in Exemplary Condition"
OFSP	Federal Public Health Office (Swiss radiation protection inspection agency)
OIT	French acronym for the International Labour Organisation (ILO)
OJEU	Official Journal of the European Union
OMS	French acronym for the Word Health Organisation (WHO - United Nations)
ONR	Office for Nuclear Regulation (United Kingdom nuclear regulator)
ONU	French acronym for the United Nations Organization (UNO)
OPAL	Tool for raising local stakeholder awareness of post-accident issues
OPECST	Parliamentary Office for the Evaluation of Scientific and Technological Choices
ORAMED	Optimization of Radiation protection for MEDical staff
ORPHEE	Research reactor (CEA - Saclay)
ORSEC	General plan organising the emergency services at departmental, defence zone, or maritime prefecture level, should a disaster be declared by the State
ORSEC-TMR	The ORSEC plan specific to the Transport of Radioactive Materials
OSART	Operational Safety Review Team (mission d'évaluation de la sûreté en exploitation des centrales nucléaires organisée par l'AIEA)
OSIRIS	Research reactor (CEA - Saclay)
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic (signed in 1992 and combining and updating the Oslo 1972 and Paris 1974 conventions)
P4	First series of 1,300 MWe PWRs (EDF)
P'4	Second series of 1,300 MWe PWRs (EDF)
PAA	*Panstwowa Agencja Atomistyki* (Polish National Atomic Energy Agency)
PACA	Provence-Alpes-Côte d'Azur (region)
PC	Command Post
PCC	Command and Control Post (EDF)
PC Com	Communication Command Post (ASN)
PCD	Command and Decision Post
PCL	Local Command Post (installation operation)
PCM	Resources Command Post (logistics)
PCR	Person Competent in Radiation protection
PCRD	Research and Development Framework Programme
PCS	Local Safeguard Plan
PDR	Pulsed Dose-Rate
PEGASE	Spent fuel and radioactive substances interim storage installation (CEA - Cadarache)
PET	Positron Emission Tomography
PHÉBUS	Research reactor (CEA - Cadarache)
PHÉNIX	Fast neutron reactor (CEA - Marcoule)

PHIL	Linear electron accelerator (CNRS - Orsay)
PHISP	Public Health Inspector Pharmacists
PIGD	Industrial Waste Management Programme
PIRATE	Response plans that are integrated in an overall heightened security, prevention, protection and counter-terrorism approach
PLECI	Extension of the LECI (BNI 50)
PLTECV	French Green Growth Energy Transition Bill
PNGMDR	French National Plan for the Management of Radioactive Materials and Waste (instituted by the 28th June 2006 Programme Act on the sustainable management of radioactive materials and waste)
POPM	Organisational Plan in Medical radiation Physics
POSÉIDON	Irradiation facility (CEA - Saclay)
PPE	Personal Protective Equipment
PPI	Off-site Emergency Plan (specific emergency plan drawn up by the State addressing risks associated with the existence and operation of specific installations or structures)
PRISME	Eurodif project for intensive rinsing followed by venting
PROCEDE	Decommissioning research facility (CEA - Fontenay-aux-Roses)
PRSE2	Regional Health Environment Plan
PSP	Multi-year Strategic Plan
PSRPM	Medical Radiation Physicist
PTR	Reactor cavity and spent fuel pit cooling and treatment system (PWR)
PUI	On-site Emergency Plan (crisis management plan drawn up by a BNI licensee)
PV	Report / minutes of a meeting / statement of offence
PWR	Pressurised Water Reactor
QMS	Quality Managment System
RANET	Response Assistance NETwork (network for response to requests for assistance in the case of a radiological emergency - IAEA)
RAPSODIE	Former fast neutron experimental reactor (CEA - Cadarache)
RASSC	Radiation Safety Standards Committee (IAEA)
RCC	Design and Construction Rules
RCC-E	Design and Construction Rules for Electrical equipment
RCC-G	Design and Construction Rules for Civil Engineering
RCC-M	Design and Construction Rules for Mechanical equipment
RCD	Waste Recovery and Packaging
RCF	*Regulatory Cooperation Forum*
RCMI	French acronym for Intensity Modulated Radiation (IMRT)
RCN	RCN Act: Act on Civil Liability in the field of nuclear energy
RCV	Chemical and Volume Control System (PWR)
REA	*Rosenergoatom* (Russian nuclear power plant operator)
REC II	Reception, shipment and monitoring unit for uranium hexafluoride containers (Georges Besse II plant)
REP	French acronym for Pressurised Water Reactor (PWR)

RFS	Basic Safety Rule
RGE	General Operating Rules
RHF	High Flux Reactor (Institut Laue-Langevin - Grenoble)
RIA	Radio Immunology Assay
RIC	Regulatory Information Conference (annual public conference held by the United States regulatory body)
RID	Regulations governing the international carriage of dangerous goods by rail
RIS	Safety Injection System (PWR)
RIV	Targeted internal radiotherapy
RJH	Jules Horowitz Reactor (irradiation reactor: CEA - Cadarache)
RM2	Former RadioMetallurgy laboratory No. 2 (CEA - Fontenay-aux-Roses)
RNM	French national network of environmental radioactivity measurements
RNR	Fast Neutron Reactor
RNR-G	Gas-cooled Fast Neutron Reactor
RNR-Na	Sodium-cooled Fast Neutron Reactor
ROTONDE	Solid waste management installation project (CEA - Cadarache)
RPE	Radiation Protection Expert
RPO	Radiation Protection Officer
RPS	Preliminary Safety Analysis Report (BNI Procedure)
RRA	Residual Heat Removal System (PWR)
RRI	Component Cooling System (PWR)
RSE-M	Rules for In-service Monitoring of Mechanical equipment
RSN	Regulation concerning the Safety of Ships
RTN	*Rostekhnadzor* (Russian nuclear safety authority, attached to the Federal Service of Industrial, Environmental and Nuclear Regulation)
RTGV	Steam Generator Tube Rupture
RTR	Research and Test Reactors (fuel assemblies known as "aluminides" used in research reactors)
RWMC	Radioactive Waste Management Committee (NEA)
R & D	Research and Development
SAMU	French Emergency Medical Service
SAPPRE	Reflex Phase Population Alert System
SATURNE	Former particle accelerator (CEA - Saclay)
SCWR	SuperCritical Water Reactor
SDIS	Departmental Fire and Emergency Service
SEC	Essential Service Water System (ESWS) (PWR)
SEIVA	Valduc Information Exchange Structure (Association created around the CEA centre at Valduc)
SET	*Société d'Enrichissement du Tricastin*
SEVESO	Seveso II directive: name given to Council Directive 96/82/EC of 9th December 1996 on the control of major-accident hazards involving dangerous substances (with reference to the site of a 1976 accident in a chemical plant)
SFMN	French Nuclear Medicine and Molecular Imaging Society
SFPM	French Society of Medical Physics
SFR	French Society of Radiology
SFRO	French Society for Radiation Oncology

SFRP	French Radiation Protection Society
SG	Office of Administration (ASN) Steam Generator
SGDN	French General Secretariat for National Defence (until 2009)
SGDSN	General Secretariat for Defence and National Security (since 2010)
SICN	*Société Industrielle de Combustible Nucléaire* (Industrial Nuclear Fuel Company)
SILOE	Research reactor (CEA - Grenoble)
SILOETTE	Research reactor (CEA - Grenoble)
SISERI	Ionising Radiation Exposure Monitoring Information System
SMI	French acronym for Integrated Management System (IMS)
SMQ	French acronym for Quality Management System (QMS)
SNM	Military Nuclear System (either a weapon system designed or adapted to deploy a nuclear weapon, or a military vessel propelled by nuclear power)
SNRIU	State Nuclear Regulatory Inspectorate of Ukraine (Ukrainian nuclear regulatory body)
SOC	Organised disposal of hulls (Areva NC - La Hague)
SOCATRI	*SOCiété Auxiliaire du TRIcastin* (company operating an Areva owned clean-up and uranium recovery installation at Bollène - Vaucluse *département*)
SOCODEI	*SOciété pour le COnditionnement des Déchets et Effluents Industriels* (Company for industrial effluent and waste treatment - EDF group)
SOHF	Social, Organisational and Human Factors
SOLEIL	LURE Optimised Source of Intermediary Energy Light (synchrotron located in Saint-Aubin, Essonne *département*)
SOMANU	*SOciété de MAintenance NUcléaire* (Nuclear Maintenance Company - Areva group - Maubeuge)
SPECT	Single Photon Emission Computed Tomography
SPIRAL	Radioactive Accelerated Ion Beam Production Source (GANIL - Caen)
SSM	*Strål Säkerhets Myndigheten* (Swedish nuclear safety and radiation protection Authority)
STAR	Treatment, Clean-out and Reconditioning Station (CEA - Cadarache)
STD	Waste Treatment Station
STE	Technical Operating Specifications Effluent Treatment Station
STED	Effluent and Waste Treatment Station
STEDS	Radioactive Effluent and Solid Waste Treatment Station
STE2	Effluent collection and treatment and precipitation sludge storage facility (Areva NC – La Hague)
STE3	Effluent collection and treatment and bituminous package storage facility (Areva NC – La Hague)
STELLA	Active liquid effluent treatment station project (CEA - Saclay)
STUK	*Säteilyturvakeskus* (Radiation and Nuclear Safety Authority - Finnish regulatory body)
SUP	French acronym meaning “active institutional controls”
SUPERPHÉNIX	Fast Breeder Reactor under decommissioning (Creys-Malville - Isère *département*)
SUPPORT	Effluent treatment and waste storage facility undergoing decommissioning (CEA - Fontenay-aux-Roses)

T7	Vitrification facility (Areva NC - La Hague)
TAEK	*Türkiye Atome Enerjisi Kurumu* (Turkish nuclear safety authority)
TAR	Cooling Tower
TCSP	Transport en Commun en Site Propre
TDM	TomoDensitoMeter (Computed Tomography scanner)
TELEHYDRO	Network for continuous monitoring of waste water radioactivity in major cities (IRSN)
TELERAY	Ambient radioactivity measurement network
TEMP	French acronym for Single Photon Emission Computed Tomography (SPECT)
TEMP-TDM	French acronym for Single Photon Emission Computed Tomography coupled with a CT scanner (SPECT-CT)
TEP	French acronym for Positron Emission Tomography (PET)
TEP-TDM	Positron Emission Tomography associated with a Computed Tomography scanner (PET-CT)
TEPCO	Tokyo Electric Power Company (Japanese electric utility)
TFA	French acronym for Very Low Level (VLL waste)
TGAP	General Tax on Polluting Activities
THA	French acronym for Very High Level (VHL waste)
TMD	Transport of Dangerous Goods
TMR	Transport of Radioactive Materials
TN International	International subsidiary of AREVA NC specializing in the packaging, transport and interim storage of nuclear materials
TNA	Sodium (Na) treatment installation (EDF - Creys-Malville - Isère *département*)
TRANSSC	TRANsport Safety Standards Committee (IAEA committee on radioactive materials transport safety standards)
TSN	TSN Act: Act of 13th June 2006 on transparency and security in the nuclear field
TU5	Fuel cycle installation (Areva NC - Pierrelatte)
UCD	Alpha Waste Conditioning Central Unit (Areva NC - La Hague)
UE	French acronym for European Union (EU)
ULYSSE	"Teaching" reactor (CEA - Saclay)
UNE	Enriched Natural Uranium
UNGG	Graphite-moderated gas-cooled reactor (old-generation nuclear reactor process)
UNO	United Nations Organization
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
UP2-400	Spent fuel reprocessing plant (Areva NC - La Hague)
UP2-800	Spent fuel reprocessing plant (Areva NC - La Hague)
UP3-A	Spent fuel reprocessing plant (Areva NC - La Hague)
UPRA	Artificial radionuclide production plant
URE	Enriched Reprocessing Uranium (fuel assemblies)
USIE	Unified System for Information Exchange in Incidents and Emergencies - (IAEA tool proposed to member countries for the notification of nuclear events occurring on their territory)
UTE	*Union Technique de l'Électricité* (French electrical engineering standardising body)
VD	Ten-yearly Outage

VD1	1st Ten-yearly Outage
VD2	2nd Ten-yearly Outage
VD3	3rd Ten-yearly Outage
VD4	4th Ten-yearly Outage
VHTR	Very High Temperature Reactor
VICWG	Vendor Inspection Cooperation Working Group (part of the MDEP programme)
VP	Partial Inspection Outage
VVP	Main Steam System
W	Fuel cycle plant (Areva NC - Pierrelatte)
WANO	World Association of Nuclear Operators
WASSC	Waste Safety Standards Committee (IAEA)
WENRA	Western European Nuclear Regulators' Association (extended in 2003 to all “nuclear” member States of the European Union or negotiating membership at that time)
WG	Working Group
WGIP	Working Group on Inspection Practices (NEA)
WGWD	Working Group on Waste and Decommissioning (WENRA)
WHO	World Health Organization
WNA	World Nuclear Association
WPNEM	Working Party on Nuclear Emergency Matters (within the NEA)
ZGDS	Solid Waste Management Zone (CEA - Saclay)
ZGEL	Liquid Radioactive Waste Management Zone (CEA - Saclay)
ZPP	Population Protection Zone
ZST	Tightened Surveillance Zone

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