

# FRANCE



September  
2014

## Fifth National Report on Compliance with the Joint Convention Obligations

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management provides for each contracting party to present a report describing the way in which it implements the obligations of the Convention at the review meetings (held every three years). The drafting of the French report is coordinated by ASN with contributions from the other regulatory authorities, concerned ministries and the nuclear licensees. This report undergoes a practice Q&A session before being presented to the peers in Vienna.

FIFTH NATIONAL REPORT ON COMPLIANCE WITH  
THE JOINT CONVENTION OBLIGATIONS



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# EXECUTIVE SUMMARY

This report is established by France in accordance with Article 32 of the *Joint Convention* on the implementation of the obligations of this Convention. It presents the latest developments in the management of spent fuel and radioactive waste and in the nuclear installation decommissioning in France in the framework of the fifth review meeting of the *Joint Convention*.

## 1 | THE GENERAL FRAMEWORK

Nuclear activities are governed in France by a range of legislative and regulatory provisions the objectives of which are public health and safety and protection of nature and the environment.

Depending on the level of radioactivity concerned, a difference is made between activities regulated by the Public Health Code (medical activities for example), those covered by the ICPE regulations (Installations Classified on Environmental Protection Grounds) and finally, beyond a certain radioactivity threshold, those covered by the BNI regulations (Basic Nuclear Installations).

The legislative framework applying to Basic Nuclear Installations (BNIs), with regard to their design, operation and decommissioning, is Act 2006-683 of 13 June 2006 on transparency and security in the nuclear field, known as the “TSN Act”.

The management of radioactive substances (materials and waste) is for its part governed by Act 2006-739 of 28 June 2006 on the sustainable management of radioactive materials and waste, known as the “Waste Act”. This Act has also been codified in the Environment Code.

Under the terms of these Acts, France has an independent safety regulator, ASN, and an organisation responsible for the management of radioactive waste, Andra, which is independent of the radioactive waste producers.

These Acts also set the rules regarding information of the public and dialogue.

## 2 | NUCLEAR INSTALLATIONS IN FRANCE

Numerous nuclear installations are in service in France, that is:

- 58 nuclear power reactors;
- nuclear fuel cycle facilities;
- research facilities for the nuclear power generating or other fields, including those carrying out research into the management of radioactive waste;
- radioactive waste processing and packaging facilities;
- radioactive waste storage facilities (interim solution);
- 3 radioactive waste surface disposal centres (final solution); two BNIs for low and intermediate level, short-lived waste (one under surveillance, the other in service) and an ICPE which receives very low level waste;
- a plant producing radiopharmaceuticals and irradiators, and
- facilities undergoing decommissioning.

The nuclear power reactors (EDF) and research reactors (CEA, ILL) use fuels which, after use, become spent fuels. These are stored on-site and then on the La Hague site or in certain CEA facilities pending processing.

All the facilities listed above, as well as those currently undergoing decommissioning or which are part of the fuel cycle, produce and manage radioactive waste.

In addition, facilities dedicated to waste management – processing, packaging, storage, and disposal – are also in service.

Several BNIs are also under construction:

- an EPR reactor on the Flamanville site;
- the Jules Horowitz experimentation reactor on the Cadarache site;
- the ICEDA storage facility (intermediate level, long-lived waste from EDF);
- ITER.

The Georges Besse II plan (enrichment) has been partially commissioned.

Two disposal facility projects are currently being studied:

- a disposal centre in a deep geological formation for intermediate level, long-lived waste and for high-level waste, and
- a sub-surface repository for low level, long-lived waste.

One should also mention the existence of the former uranium mines, which generated mining waste rock, as well as mining processing residues during processing of the ore to extract the uranium.

### 3 | MATRIX OF FRANCE

Type of liability	Long-term management	Funding of liabilities	Current practice / Facilities	Planned facilities
<b>Spent Fuel</b>	Processing	Owner pays for processing	La Hague processing plant (plant authorization to be modified for processing all the SF quantities)	Disposal of NPP SF studied prospectively
<b>Nuclear fuel cycle waste</b>	Repository	Producer pays. Dedicated assets required by 2006 Planning Act for ultimate waste	LIL-SL waste at CSA and VLL waste at CIREs; interim storage for other wastes	New repositories for HL, IL-LL and LL-LL ( <i>under study</i> )
<b>Non-power waste</b>	Routes for some waste to be established	Producer pays	Repositories for VLL and LIL-SL waste. Management by radioactive decay for VSL waste	Project for radium bearing waste and other waste (LL-LL)
<b>Decommissioning liabilities</b>	Immediate dismantling after shutdown	Operator pays. Dedicated assets required by Waste Act	Immediate dismantling after shutdown	
<b>Disused sealed sources</b>	Return to manufacturer. Disposal routes or recycling solutions to be established	Insurance arrangements between users & suppliers	Some sources at CSA repository Interim storage in dedicated facilities	New repositories for HL, ILL and LL-LL ( <i>under study</i> ) Interim storage at CSTFA in commissioning
<b>Disused sealed sources</b>	Stabilize in place and reinforce control	Responsibility of operator (AREVA)	Stabilised mines	N.A

TABLE 1 : MATRIX OF FRANCE

### 4 | THE CHALLENGES FOR FRANCE IDENTIFIED AT THE 4TH REVIEW MEETING

During the 4<sup>th</sup> review meeting of the Joint Convention, the following challenges for France were identified: 1 – The publication, in late 2012, of the National Plan for Radioactive Materials and Waste Management (PNGMDR) for the period 2013 – 2015, including new topics corresponding to the requirements of the directive from the Council of the European Union (notably the cost and financing of radioactive waste management). The new edition of the PNGMDR is detailed in § A.2.2.1 and § B.1.3.

2 – Continued efforts to successfully complete the management of legacy waste. The steps taken for management of this waste, as well as ASN's opinion, are detailed in § F.6 and H.2.

3 – Public acceptance of the siting of disposal facilities. The steps taken are detailed below in the summary, as well as in § A.2.2.2 and B.1.6.

4 – Continuation of the geological disposal programme for high level and intermediate level, long-lived waste, allowing the transition from the R&D stage to the practical phase, along with submission of the creation authorisation application. This subject is developed below in the summary, as well as in § H.3.5 – Follow-up to ASN's requests resulting from the stress tests performed in the wake of the Fukushima Daiichi accident. This subject is developed in § A.3 and G.1.3.

## 5 | THE MAIN CHANGES SINCE THE 4<sup>TH</sup> REPORT

### 5.1. The regulations

The regulations applicable to BNIs and those concerning the management of radioactive waste, the provisions of which were already well-advanced with the publication of the "BNI Procedures" Decree of 2 November 2007 and several other decrees implementing the TSN and Waste Acts, were supplemented by the "BNI" order of 7 February 2012 and several ASN statutory resolutions. A number of additional statutory resolutions are also currently being drafted, mainly pursuant to the above-mentioned "BNI" order.

ASN thus has at its disposal a rigorous and comprehensive working framework that is harmonised with that of its European colleagues, as it includes the "reference levels" from WENRA, the Western European Nuclear Regulators' Association.

In addition, the requirements concerning the safety case to be provided by the licensee, are broadly based on the IAEA standards.

In the more specific field of radioactive materials and waste management, *decree 2013-1304 of 27 December 2013* was published on 31 December 2013, establishing the prescriptions of the National Plan for Radioactive Materials and Waste Management (PNGMDR) for the period 2013-2015. It repeals *decree 2012-542 of 23 April 2012*.

In order to tackle major climate and energy issues, France is currently drafting legislation on energy transition for green growth. Among other things, this Bill proposes measures to reinforce nuclear safety and information of the citizens and local residents, as well as the missions of ASN.

### 5.2. Spent fuel management

#### 5.2.1. The fuel cycle

The fuel cycle comprises the extraction, chemical conversion and enrichment of uranium, then the fabrication of the fuel and, finally, its subsequent processing / recycling after it has been used in the nuclear reactors. Main fuel cycle plants belong to the AREVA group.

The overall consistency of the industrial choices made with respect to fuel management must be checked in terms of safety. A detailed check was carried out by ASN in 2000, another in 2010. ASN then decided to reinforce the oversight of the fuel cycle and its upgrades, by asking EDF for two-yearly update reports, pending a general overhaul of the "fuel cycle file" in about 2016. The occupancy of the spent fuels (AREVA and EDF) underwater storage facilities and anticipation of saturation are points that are being closely monitored by ASN.

#### 5.2.2. Examination of the safety management system within the AREVA group

The AREVA Group's safety management system was reviewed in late 2011, mainly from the viewpoint of relations between the functional divisions and the establishments. Organisational and human factors were also taken into consideration. During this review, AREVA agreed to take steps to supplement the measures already in place. ASN checks their effectiveness by means of inspections.

The safety management review already undertaken should be continued by a review of the steps taken by the licensee to ensure the operational safety of the facilities (detailed exercise of the function of head of facility, first-level "safety" inspection, monitoring of subcontracted services, etc.). These various points should

be reviewed by the Advisory Committee of Experts concerned, by 2016, and will lead to a position statement from ASN.

### **5.2.3. Front-end fuel cycle**

The facilities of the front-end fuel cycle have been extensively renewed. The first part of the COMURHEX II plant was commissioned in 2013 as, gradually, was the GEORGES BESSE II enrichment plant, while in the EUODIF plant, now shut down, AREVA started system rinsing in early 2013, a process scheduled to last 3 years as part of the decommissioning process.

In the field of fuel fabrication, ASN considers that FBFC needs to make significant operating and safety management improvements.

### **5.2.4. Back-end fuel cycle**

With regard to the La Hague plants in service, the most notable point is ASN's ongoing examination of the conclusions of the first periodic safety review of the UP3-A plant at La Hague. This involves work of considerable scope, which will enable ASN to issue a ruling on the conditions for the continued operation of this plant. Identification of the elements important for the protection of the interests defined by the TSN Act and the review of their conformity with the safety requirements will continue in 2014. Similarly, improvements to the general operating rules for the La Hague plants will be considered.

An extension to the vitrified waste package storage facility (EEVLH) was partially commissioned in September 2013.

The recovery and packaging of legacy waste remains a subject of concern (see § 5.4.4).

The final shutdown and decommissioning process for the former facilities in the La Hague plant, in particular the HAO and the UP2-400 plant, was initiated.

With regard to the MELOX plant, a periodic safety review was held in 2013. ASN will ensure that the means chosen to support the changes to the MOX manufactured in this plant do actually correspond to the expected nuclear safety and radiation protection requirements as defined during said review.

## **5.3. Decommissioning of nuclear installations**

### **5.3.1. Principles**

Decommissioning, a phase covering all the activities performed after final shutdown of a nuclear installation, up to its delicensing, currently concerns about thirty nuclear installations, to which can be added 29 installations already decommissioned and delicensed.

In line with IAEA recommendations, ASN advocates the immediate dismantling strategy, with removal of all dangerous substances. This strategy more specifically avoids having future generations bear the technical and financial burden of the decommissioning operations. Any other proposal must be duly justified.

These principles, which have been implemented for several years now, became requirements through the BNL order.

The public is informed of decommissioning operations, notably through the public inquiry which is held when any final shutdown and decommissioning authorisation application is submitted, as well as at meetings of the Local Information Committees (CLI).

### **5.3.2. Ongoing decommissioning work**

The decommissioning work in progress is taking place in conditions of safety that are on the whole satisfactory. Particularly noteworthy is the delicensing of the CEA centre in Grenoble, currently nearing completion. However, the decommissioning of the Brennilis NPP is behind schedule, notably owing to cancellation of the 2006 decommissioning authorisation decree.

The decommissioning of the old gas-cooled reactor (GCR) vessels is a major challenge owing to the problem of the fate of the graphite stacks they contain. The decommissioning strategy proposed by EDF for all of its facilities will be thoroughly and carefully examined by ASN in the next few years: a position statement will in particular need to be issued on the GCR decommissioning time-frame.

As for the decommissioning of the UP2-400 facilities at La Hague, the challenges are mainly the retrieval operations for the legacy waste stored in them, prior to dismantling.

Concerning EURODIF, which is shut down and will soon be the subject of a final shutdown and decommissioning procedure, one important point to be considered is the large quantity of waste liable to be produced by the decommissioning operations. It will be necessary to check that the strategy proposed corresponds to the waste volume and harmfulness reduction targets and to the recommendations of the National Plan for Radioactive Materials and Waste Management.

Generally speaking, the licensees will need to continue devoting the resources necessary for immediate and rapid dismantling and to ensure a final state in which all dangerous substances, including those that are radioactive, have been removed.

## 5.4. Radioactive waste

A long-term management solution now exists for nearly 90% of the volume of radioactive waste. The other waste is stored pending the availability of solutions. Most of it is packaged. Some of the radioactive waste is still in bulk or packaged in such a way as to make it incompatible with acceptance in the disposal routes for which it is intended. This mainly concerns legacy waste, which must be retrieved and packaged.

### 5.4.1. A robust management framework: a law and a management plan revised every three years

The *Environment Code* sets a roadmap for management of all radioactive waste. This roadmap is clarified every three years by the publication of the PNGMDR.

This plan summarises the existing management methods for radioactive materials and waste and then identifies the foreseeable needs in terms of storage and disposal facilities and, with regard to radioactive waste for which there is as yet no final management solution, determines the required objectives. It organises research and studies, by setting deadlines for the definition of new management methods, the creation of new facilities or the improvement of existing facilities.

*The third version of the PNGMDR (2013-2015)* was sent to Parliament in late 2012 and made public in early 2013. It takes account of the bulk of directive 2011/70 from the Council of the European Union. In particular it includes a chapter on the cost and financing of radioactive waste management. The document can be consulted on the ASN website <http://www.asn.fr/>. The *decree of 27 December 2013* specifies the corresponding prescriptions.

The drafting of the PNGMDR is based on the *National inventory of radioactive materials and waste*, the first edition of which dates from 2004 and which is revised every three years. The latest publication was in June 2012. This inventory, which gives details of individual sites as well as total figures, is available on the Andra website <https://www.andra.fr/>.

### 5.4.2. Existing disposal facilities

Operation of the low and intermediate level, short-lived disposal centre (CSA), the very low level waste disposal centre (Cires) and surveillance of the Manche disposal centre (CSM) is taking place normally.

The CSA, which was commissioned in 1992, has a regulation capacity of 1 million m<sup>3</sup>. As at the end of 2013 the volume of waste disposed of in this centre represented 280,000 m<sup>3</sup>. The radiological capacity consumption fraction is below the volume capacity fraction consumed, except for chlorine 36, which is being particularly closely monitored.

The flexibility of the CSA's disposal conditions meant that it could accept large sized waste packages, enabling the waste producers to limit the doses resulting from cutting work. 48 PWR reactor vessel heads were thus disposed of, including 6 in 2013.

The Cires, which was commissioned in 2003, has a regulation capacity of 650,000 m<sup>3</sup>. As at the end of 2003, the volume of waste disposed of in this centre amounted to 252,000 m<sup>3</sup>. As at the CSA, large components are disposed of there. Since the autumn of 2012, the Centre has been hosting two new activities: the grouping and storage of non-NPP waste from hospitals, research facilities, pharmaceutical laboratories or other industrial sectors. This waste can also be old objects in the possession of private individuals.

The future flow of VLL waste will lead to the regulation capacity of the Cires being reached earlier than anticipated. In order to improve the situation, studies have been initiated to improve the density of waste emplaced, to optimise the use of the disposal space available and to evaluate the feasibility of very low level metal waste recycling within the nuclear industry. In the medium term, the resulting measures will not however be sufficient and the creation of a new disposal centre for VLL waste will have to be envisaged.

At the CSM, which officially entered the surveillance phase in 2003, Andra has carried out work to consolidate the embankment slopes around the cover in three sectors. The effectiveness will be evaluated over approximately a decade before moving onto the subsequent modification stages.

Assessments and usability tests were carried out on the CSM “summary records” which – in about 170 pages - describe the history and the main characteristics of the centre. This will lead to modifications, notably to establish a more active link between the “summary records” and the more detailed records which are harder to use, owing to their volume.

### 5.4.3. Two key projects

#### Management of High Level Waste (HLW) and Intermediate Level, Long-lived waste (ILW-LL)

The management of HLW and ILW-LL is studied in three complementary directions, identified in the Act of 30 December 1991 and then incorporated into the Waste Act: reversible disposal in a deep geological layer, long-term packaging and storage, and the separation and transmutation of long-lived radionuclides. Research is also being carried out into the processing and packaging of the waste.

The Waste Act adopts the following guideline “*After storage, ultimate radioactive waste which, for nuclear safety or radiation protection reasons, cannot be stored on the surface or at shallow depth, shall require deep geological disposal*”. The target stipulated by the Act is 2015 for submission of the creation authorisation application for the disposal facility and then, subject to authorisation, 2025 for start-up of the facility. Andra is in charge of this project.

The volumes considered in the disposal centre design studies are 10,000 m<sup>3</sup> for HLW waste (mainly vitrified waste), of which 2,700 m<sup>3</sup> had already been produced as at the end of 2010, and 70,000 m<sup>3</sup> of ILW-LL waste, of which 40,000 m<sup>3</sup> had already been produced as at the end of 2010. As a precautionary measure, the adaptability of the project to the direct disposal of spent fuels, as presented by Andra in 2005, will be updated by the autumn of 2015.

In this project, called Cigéo (industrial centre for geological disposal), the underground facilities of the disposal centre are being envisaged within a layer of clay about 100 m thick, at a depth of about 500 m. The research carried out by Andra in the Meuse / Haute-Marne laboratory is contributing more specifically to the study of the feasibility and safety of such a repository.

ASN is evaluating the reports submitted by Andra as the research progresses (on the surface and in the underground laboratory) and as the disposal project proper proceeds. Through follow-up visits to the underground laboratory, it checks that the experiments are carried out using processes guaranteeing the quality of the results obtained. It sends the Government opinions concerning the evaluations thus made. These opinions can be consulted on its website. The research conducted is also evaluated by the National Review Board (CNE) created by the Act of 30 December 1991 and carried over in the Waste Act, with broader duties (<http://www.cne2.fr/>).

The public debate provided for by law was held in 2013. A certain number of opponents of the Cigéo project prevented public meetings from being held, so the French National Public Debate Commission decided to propose new debating procedures, more specifically by organising nine interactive joint debates on the Internet and organising a citizens conference. The summary and minutes of the public debate presented on 12 February 2014 can be consulted on the CNDP website <http://www.debatpublic.fr/>. One of the important points is that *a vast majority of the individuals and independent experts who took part in the debate, as well as IRSN, agree that the project deployment schedule as specified in the 2006 Act is far too tight and that additional proof of the safety of the project is required. It would appear that the elements important for demonstrating the safety of this facility, which are to be acquired in-situ, will only be obtainable after 2015 and that the time needed to establish these*

*elements would, in the opinion of several experts, be incompatible with the scheduled 2025 commissioning deadline for the facility<sup>1</sup>.*

On 6 May 2014, Andra presented its revised intentions for the Cigéo project following the public debate, unanimously voted by its Board meeting of 5 May. To take account of the opinions and expectations expressed during the debate and in order to conserve the step-based approach initiated by the 1991 Act, Andra has decided to continue with Cigéo, with the adoption of four changes clarifying its proposals concerning reversibility and making undertakings for subsequent operation:

- integration of a pilot industrial phase when the installation starts up;
- implementation of a regularly revised master plan for operation of the disposal facility;
- modifications to the schedule, with the goal, subject to the necessary authorisations, of beginning construction of the repository in 2020 with start-up via a pilot industrial phase in 2025, and
- greater involvement in the project by civil society.

#### Other avenues of research

CEA coordinates research into *separation-transmutation*, together with other research organisations, notably CNRS. The status of the research, the data acquired, the progress achieved and the studies still to be carried out are described in the PNGMDR and in the CNE reports. The *decree of 27 December 2013* states the research topics to be investigated in greater depth in the coming years. However, this avenue of research can only be envisaged for applications in the future and will not concern the waste already produced.

With regard to packaging and long-term storage, ASN's opinion of 1 February 2006<sup>2</sup> *considers that long-term storage cannot be considered a final solution for the management of high level, long-lived radioactive waste*. The main goal of the studies conducted by Andra is to ensure optimum complementarity between storage options and the geological disposal project. High level waste has to be stored for 60 years or more to allow a reduction in the heat it gives off; storage offers a degree of flexibility for the construction and operation of the disposal centre: storage facilities could prove to be useful in the event of recovery of packages from the disposal centre. ASN also considers that the waste producers concerned must adopt the necessary margins to protect against problems with the downstream routes, so that there is sufficient waste storage capacity in good time, prior to disposal in the deep geological formation.

The report produced by Andra in late 2012 details the various principles, criteria and technical options for storage, thus completing a process of several years of studies. The *decree of 27 December 2013* requires that after consultation with the main licensees, Andra will draft recommendations for the design of storage facilities to complement the disposal process.

#### Management of low level, long-lived waste (LLW-LL)

In 2008, the search for a disposal site capable of taking LLW-LL type waste was unsuccessful.

Following the 2010-2011 analysis by the HCTISN (High Committee for Transparency and Information on Nuclear Security) of the feedback from this failure, and according to the recommendations made by the 2010-2012 PNGMDR, Andra submitted proposals to the Government in 2012 for the continuation of the project.

In its report, Andra stated that the disposal of radium-bearing waste was a priority and, for graphite waste, submitted ongoing R&D studies on the essential upstream sorting/processing in order to define disposal methods for the resulting waste. The possibility of disposing of other waste was also studied. In 2013, The Ministry of Ecology, Sustainable Development and Energy asked Andra to continue to search for a disposal site, both on sites already housing nuclear facilities and in locations where communes had expressed their candidacy in 2008. The investigations are in progress.

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<sup>1</sup> Taken from the conclusions and proposals of the Summary of the Cigéo project public debate of 12<sup>th</sup> February 2014 (<http://www.debatpublic-cigeo.org/docs/cr-bilan/bilan-cpdp-cigeo.pdf>)

<sup>2</sup> ASN opinion of 1 February 2006 on research into management of high level, long-lived waste (HLW-LL) carried out pursuant to the 30 December 1991 Act, and links with the PNGDR-MV (<http://www.debatpublic-cigeo.org/docs/docs-complementaires/docs-avis-autorites-controle-evaluations/01-02-06-recherche-gestion-dechets-havl.pdf>)

The *decree of 27 December 2013* following the 2013-2015 PNGMDR prescribes studies to be carried out by Andra during this period, in particular:

- proposed choices of management scenarios for graphite and bituminous waste, notably with the possibility or otherwise of resuming the search for an Intact Cover Disposal site, and
- a feasibility file for a “reworked cover”<sup>3</sup> disposal site project, the scope of the waste to be emplaced in it and the calendar for implementing it.

ASN will then evaluate the Andra report requested for mid-2015 before sending the Government its corresponding opinion.

#### **5.4.4. Legacy waste**

Certain legacy waste is not packaged or has been inadequately packaged (deterioration of the containers for example) and is not compatible with the subsequent management procedures as required by Article 6.7 of the BNI order.

Interim storage of this waste, primarily on the La Hague site, at Cadarache and at Saint-Laurent-des-Eaux is insufficient in terms of safety. Legacy waste retrieval and packaging (RCD) is required so that it can be taken away either to existing disposal centres or to storage facilities with a satisfactory level of safety.

ASN is concerned by the significant delays in the projects, more specifically on AREVA’s La Hague site. It asked the licensees to step up their efforts to comply with the deadlines required for the safe storage of legacy waste and to achieve the 2030 goal set by the Waste Act for the completion of intermediate level, long-lived waste packaging operations.

To regulate the process on the AREVA La Hague site, ASN is preparing a draft resolution which will set the essential requirements to be adhered to by AREVA.

#### **5.4.5. Mining waste**

The steps taken to assess the impact of mining waste disposal sites and, if necessary, reinforce their safety, have made progress in recent years. Studies and further steps are still required, in accordance with the recommendations of the 2013-2015 PNGMDR. They concern mining residue disposal sites, but also the management of mining waste rock. The *decree of 27 December 2013* lists the corresponding study requests for the end of 2014. It in particular asks that Areva identifies where mining waste rock has been reused in the public domain, evaluates the impacts and mitigates these impacts as necessary. Greater information and consultation in the field of mining waste rock is also requested.

#### **5.4.6. Contaminated sites and soils**

ASN issued a number of opinions in 2013 on rehabilitation projects for contaminated sites and soils, based on the principles of its doctrine published in October 2012 and maintained its investment in the operational oversight of Operation Radium Diagnosis. It aims to continue its action within this context in 2014, together with the administrations concerned and the other stakeholders.

#### **5.4.7. Sealed radioactive sources**

The general rules for the management of sealed radioactive sources are given in the Public Health Code. This deals with the license to hold sources, traceability, notification of loss or theft and the procedures for recovery of sources withdrawn from service.

In addition, a bill is currently being drafted, with a view to setting up monitoring in France of the protection of radioactive sources against malicious acts. The Defence and Security High Official (HFDS) at the Ministry of the Environment, Sustainable Development and Energy (MEDDE) and ASN will be tasked with this monitoring.

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<sup>3</sup> Reworked cover disposal is disposal at shallow depth, involving open-cast excavation of a clay or marl layer for access to the disposal level. Once filled, the vaults are covered with a layer of compacted clay and then a planted protective cover recreating the natural level of the site.

### Management of used sealed sources

All users are required to have their suppliers collect the sealed radioactive sources delivered to them, as soon as they are no longer needed and no later than ten years following the date of first registration as it appears in the supply form.

Life extension of certain sources can be envisaged in certain conditions. Similarly, source recycling should be sought whenever possible. For the remainder, the long-term solution envisaged is disposal in the existing or planned facilities.

As stipulated in the PNGMDR, Andra studied the feasibility of disposing of sealed radioactive sources in the existing or planned centres, according to the various characteristics of the sources. In early 2013, it also submitted a report establishing recommendations to optimise scheduling of the recovery and collection of sealed sources considered to be waste, but this document does not give all the elements necessary for creating appropriate disposal routes for these sealed sources.

A working group was thus set up in 2013 with the aim of more clearly defining the management methods for managing used sealed sources, if they are intended for recycling or considered to be waste. The various areas of work were determined by the *decree of 27 February 2013*. The working group should submit a proposed overall optimised scheme for management of used sealed sources, by the end of 2014.

### 5.5. Financing of long-term nuclear costs

The *Environment Code* sets the requirements concerning the financing of long-term nuclear costs that is the cost of managing spent fuels, radioactive waste and decommissioning.

The BNI licensees must make a prudent evaluation of these costs, create the relevant provisions and ring-fence the necessary assets for coverage of these provisions (the part devoted to long-term radioactive waste management and to decommissioning). The law comprises monitoring measures and sanctions. The licensees are required to issue a report every three years.

These operations are checked by the State, via an administrative authority comprising the Ministers responsible for the economy and energy and, at a secondary level, by a commission, the CNEF. ASN is contacted for its opinion by the Ministry for energy concerning the consistency of the decommissioning strategy and the management of spent fuels and radioactive waste, as described in the three-yearly reports issued by the licensees.

The CNEF published its first opinion in July 2012 and it has been made public.

ASN's latest opinion dates from 9 January 2014 and can be consulted on the ASN website.

One of the points to be examined in depth concerns the costs relating to the implementation of long-term management solutions for high level waste and intermediate level, long-lived waste. The cost of geological disposal was calculated in 2005 and needs to be reassessed on the basis of the latest technical design options.

### 5.6. Integration of the experience feedback from the Fukushima accident

Following the nuclear accident in the Fukushima Daiichi nuclear power plant, France considered that stress tests needed to be carried out on French civil nuclear facilities with respect to the type of events which led to this accident.

Following this process, ASN sent its conclusions to the Prime minister in early 2012. It considered that the facilities examined offered a sufficient level of safety such that immediate shutdown was not necessary for any of them, but that their continued operation required an increase in their robustness to extreme situations, beyond existing safety margins, as rapidly as possible.

In its resolutions of 26 June 2012, ASN set additional prescriptions to be followed by the licensees. These resolutions cover all the facilities examined in 2011, referred to as "batch 1" (see Appendix) owing to their priority nature. In particular, the licensees will be required to set up a "hardened safety core" of material and organisational measures to control the fundamental safety functions in extreme situations. Reinforced provisions were requested to reduce the risk of uncovering of the spent fuels in the pools.

For the NPPs, the ASN resolutions of 21 January 2014 gave requirements concerning the hardened safety core.

For the fuel cycle plants, ASN has prepared draft resolutions indicating the requirements concerning the hardened safety core. The licensee and the public will be consulted in 2014.

For the lower-priority facilities, known as “batch 2”, the stress test reports were submitted by the licensees in September 2012. The facilities more specifically concerned include those being decommissioned by EDF, the ITER facility, CIS bio and the CERCA plant in Romans. ASN and its technical support organisation have begun their review of these reports. In 2014, ASN will issue a position statement after a review by the Advisory Committees scheduled for July 2013.

Finally, from among about thirty other facilities of lesser importance, referred to as “batch 3”, ASN in late 2013 instructed CEA to comply with a calendar for submission of the stress test reports, no later than on the occasion of the next ten-yearly safety review, and published a draft resolution for the other licensees.

Implementation of all the measures arising from the stress tests and to be performed in the next few years, will require exceptional mobilisation on the part of the industrial firms concerned.

### 5.7. The next audit mission by the *Integrated Regulatory Review Service (IRRS)* chaired by IAEA

After the November 2006 mission (and the follow-up mission in March-April 2009), ASN is preparing to receive a second IRRS full-scope mission in November 2014.

The reports from the 2006<sup>4</sup> and 2009<sup>5</sup> missions can be consulted in full in English, with a French summary, on the ASN website ASN<sup>6</sup>.

### 5.8. International activities

France continued to be heavily involved in international work, maintaining its active participation in the working groups, more specifically IAEA’s WASSC Committee, which in particular examines draft standards concerning the management of radioactive waste, ENSREG, WENRA and the NEA.

Bilateral relations between ASN and its foreign counterparts are a priority focus for international actions. They are a forum for exchanges on topical subjects and for the implementation of cooperative measures.

During the third review meeting of the Joint Convention, it was decided that thematic international meetings would be held, notably with a view to ensuring continuity, between two plenary meetings of the contracting parties. After organising the first one about national radioactive waste management organisations in 2010, France was involved in the second thematic meeting held in Vienna in October 2013 at the initiative of the United States, on the subject of the back-end fuel cycle. French experts played an active part in this second meeting, in the capacity of panellist or rapporteur.

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<sup>4</sup> <http://www.asn.fr/Media/Files/Final-IRRS-Mission-Report-France-2007-03-12-2>

<sup>5</sup> [http://www.asn.fr/Media/Files/00-Publications/2009\\_IRRS\\_FRANCE\\_FOLLOW-UP\\_MISSION\\_REPORT](http://www.asn.fr/Media/Files/00-Publications/2009_IRRS_FRANCE_FOLLOW-UP_MISSION_REPORT)

<sup>6</sup> [http://www.asn.fr/Media/Files/00-Publications/Synthese\\_rapport\\_IRRS](http://www.asn.fr/Media/Files/00-Publications/Synthese_rapport_IRRS)

# SECTION A | INTRODUCTION

## 1 | GENERAL INTRODUCTION

### 1.1. Purpose of the report

The *Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management*, hereinafter referred to as the “*Joint Convention*”, is the result of international discussions that followed the adoption of the *Convention on Nuclear Safety*, in 1994. France signed the *Joint Convention* at the General Conference of the International Atomic Energy Agency (IAEA) held on 29 September 1997, the very first day the *Joint Convention* was opened for signature. She approved it on 22 February 2000 and filed the corresponding instruments with the IAEA on 27 April 2000. The *Joint Convention* entered into force on 18 June 2001.

For many years, France has been taking an active part in the pursuit of international actions to reinforce nuclear safety and considers the *Joint Convention* to be a key step in that direction. The fields covered by the *Joint Convention* have long been part of the French approach to nuclear safety.

This report is the fifth of its kind. It is published in accordance with Article 32 of the *Joint Convention* and presents the measures taken by France to meet each of her obligations set out in the *Convention*.

### 1.2. Facilities involved

The facilities and radioactive materials covered by the *Joint Convention* are much diversified in nature and are controlled in France by different regulatory authorities (see Section E).

Over and above a specific threshold of radioactive content, a facility is under the “basic nuclear facility” (*installation nucléaire de base – BNI*) scheme and placed under the control of the French Nuclear Safety Authority (*Autorité de sûreté nucléaire – ASN*). Below that threshold, if a nuclear installation is subject to authorisation according to the nomenclature of “classified facility on environmental-protection grounds” (*installation classée pour la protection de l’environnement – ICPE*), this facility is placed under the control of the Ministry for the Environment.

Facilities that contain only small amounts of radioactive materials or do not meet the above-mentioned criteria are not subject to any regulatory control in that respect.

### 1.3. Authors of the report

ASN prepared this report and co-ordinated the contributions not only from the General Directorate for Energy and Climate (*Direction générale de l’énergie et du climat – DGEC*) part of the Ministry of Ecology, Sustainable Development and Energy (*Ministère de l’écologie, du développement durable et de l’énergie – MEDDE*), the Nuclear Safety and Radiation Protection Mission of the MEDDE and Institute for Radiation Protection and Nuclear Safety (*Institut de radioprotection et de sûreté nucléaire – IRSN*) and the French National Radioactive Waste Management Agency – (*l’Agence nationale pour la gestion des déchets radioactifs – Andra*) but also from the major operators of nuclear facilities, including *Électricité de France* (EDF), AREVA, and particularly its subsidiary AREVA NC, the French Atomic Energy and Alternative Energies Commission (*Commissariat à l’énergie atomique et aux énergies alternatives – CEA*), the International Organisation ITER and the Laue-Langevin Institute (ILL). The final draft was completed in September 2014 after consultation with all French parties concerned.

## 1.4. Structure of the report

For her fifth report, France drew from the experience it acquired from its participation in the previous meetings on the *Joint Convention* and the *Nuclear Safety Convention*. It constitutes a self-supporting report based on existing documentation and reflects the viewpoints of the different actors (regulatory authorities and operators). Hence, for each of the sections in which the regulatory authority is not the only party to express its opinion, a three-step structure was adopted, as follows:

- a description by the regulatory authority of the regulations involved;
- a presentation by the operators of the steps taken to comply with those regulations, and
- an analysis by the regulatory authority of the steps taken by the operators.

This report is structured according to the “guidelines regarding national reports” for the *Joint Convention*, i.e., an “article-by-article” format, with each one being addressed in a dedicated section bearing the corresponding text of the relevant article of the *Joint Convention* on a shaded background at the top of the section. After the Introduction (Section A), the various sections deal successively with the following topics:

- Section B Policy and practices under the *Joint Convention* (Article 32-1);
- Section C Scope (Article 3);
- Section D Spent-fuel and radioactive-waste inventories, together with the list of the corresponding facilities (Article 32-2);
- Section E Legislative and regulatory system in force (Articles 18 to 20);
- Section F Other general safety provisions (Articles 21 to 26);
- Section G The safety of spent-fuel management (Articles 4 to 10);
- Section H The safety of radioactive-waste management (Articles 11 to 17);
- Section I Transboundary movements (Article 27);
- Section J Disused sealed sources (Article 28), and
- Section K General Efforts to Improve Safety.

A few annexes complete the report (Section L).

It should be noted that regulatory discussions common to the safety of spent-fuel management facilities and to the safety of radioactive-waste management facilities have been inserted in Section E in order to prevent partial duplications between Sections G and H, as recommended by the guidelines for drafting national reports.

## 1.5. Publication of the report

The *Joint Convention* does not require the report referred to in Article 32 to be communicated to the public. Nevertheless, pursuant to its information mission and in a constant concern to improve the transparency of its activities, ASN has decided to make the report available to any interested party. Consequently, the report is available in both English and French on ASN’s website: [www.asn.fr](http://www.asn.fr).

# 2 | MAJOR DEVELOPMENTS SINCE THE LAST FRENCH REPORT

## 2.1. Evolution of nuclear safety control

### 2.1.1. European legislative framework

Council Directive 2009/71/Euratom 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. As at 22nd July 2011, through its existing system of Acts and Decrees, France was in compliance with its obligations under the directive.

The 2009 text of the directive requires that the Member States submit a first national implementation report to the European Commission no later than 22nd July 2014.

Following the Fukushima Daiichi accident in 2011, the Heads of State and Government asked the Commission to review the legislative and regulatory framework in force in the field of nuclear installation safety and to propose any improvements that would appear necessary. During the period 2013 to 2014, France played an active role in the negotiations on the revision of the text of Directive 2009/71/Euratom. In July 2014, the revised European Union directive on nuclear safety was adopted by the Council.

This directive more specifically applies to processing facilities, spent fuel storage facilities and to certain radioactive waste storage facilities (when on the same site as another nuclear facility).

In addition, another directive establishing a community framework for the responsible and safe management of spent fuel and radioactive waste was adopted on 19 July 2011 (*directive 2011/70/Euratom*) for transposition into national law before August 2013.

Under the terms of the directive, each Member State must submit a report on the implementation of the text by August 2015.

In the case of France, a very large percentage of the provisions of the directive is already incorporated into the national regulations. The provisions which have not yet been transposed will be included in the Energy Transition Act currently under preparation.

That directive deals with two essential aspects of the management of radioactive waste and spent fuel: first, it specifies the obligations relating to safe management by reiterating the basic principles of the IAEA and of the *Joint Convention*, and second, it sets the framework for the national management policies to be developed and implemented by every Member State. Hence, the European Union (UE) now requires every Member State to establish a national management programme for spent fuel and radioactive waste.

The directive reiterates notably the distinction that exist between “spent fuel” and “radioactive waste”, the qualification as “waste” for any spent fuel requiring that no further use be scheduled or envisaged for that spent fuel (especially, no intended processing).

The national programme must comply with the following principles:

- the production of radioactive waste must be kept at the lowest possible level;
- spent fuel and radioactive waste must be managed safely, including over the long term;
- management costs for radioactive waste and spent fuel must be supported by those who produce them and sufficient financial resources must be available when necessary;
- in principle, radioactive waste must be disposed of in the Member State where it was produced (including when it involves a by-product that was separated from exported radioactive waste or spent fuel in a foreign processing plant), with the possibility of storing such items in a third-party country being restricted to certain conditions;
- Member States must establish their own national legislative, regulatory and organisational framework, including notably a licensing system for the facilities and activities involving the management of radioactive waste and spent fuel, together with an appropriate system of control and enforcement dispositions;
- Member States must designate a single competent authority for waste safety. That authority shall be separated from any other organisation involved in the promotion or use of nuclear energy or of radioactive substances. Its task will be notably to develop and manage a licensing system. It must also be allocated the necessary financial and human resources to fulfil its missions;
- irrespective of their involvement, all organisations associated with the management of radioactive waste or spent fuel must implement training or R&D provisions in order to fulfil the implementation requirements of their national programme, and
- the public must have access to all necessary information relating to the management of spent fuel and radioactive waste and must be able to participate effectively in the decision-making process concerning the management of spent fuel and radioactive waste, pursuant to the national legislation and international obligations.

The prime responsibility for the safety of facilities and/or management activities lies with licensees. However, that directive reiterates explicitly the responsibility of Member States in last resort for the management of any spent fuel and radioactive waste that is produced on their territory.

The directive applies to all management steps for spent fuel and radioactive waste, including production, handling, pre-treatment, processing, conditioning and storage, as well as the final elimination of the waste. The directive applies only to radioactive waste resulting from civilian activities (pursuant to EURATOM competencies). It does not apply to extracting industries for which there separate Community regulations already exist.

### 2.1.2. Overhaul of the general technical regulations

Following the publication of the TSN Act and of its enforcement decrees, a thorough consolidation of the general technical regulations for BNIs has been launched. In fact, that approach was consistent with the determination to harmonise nuclear safety throughout Europe by integrating in the new regulatory set the principles ("reference levels") developed by the Western European Nuclear Regulators' Association (WENRA), which has been working for several years at constituting a reference system of common prescriptions. The work conducted by WENRA resulted from a reflection on existing reactors and the experience feedback generated by their operation and control.

The work to overhaul the BNI general technical regulations led to the publication of the BNI order. The majority of the provisions of this order entered into force on 1<sup>st</sup> July 2013.

ASN statutory resolutions will clarify this new regulatory framework. In 2013, ASN thus adopted two resolutions: ASN resolution 2013-DC-0352 of 18 June 2013 concerning public access to the modification project files specified in Article L. 593-15 of the Environment Code and ASN resolution 2013-DC-0360 of 16th July 2013 concerning the management of nuisances and the impact of BNIs on health and the environment.

This is supplemented by ASN guides which, although not legally binding, present ASN doctrine; in 2013, guides No. 7 concerning transport, No. 9 concerning the definition of the perimeter of a BNI, No. 13 concerning consideration of the external flooding risk and No. 19 concerning pressure equipment were published.

## 2.2. Evolution of the radioactive-waste-management policy

### 2.2.1. Publication of the new National Management Plan for Radioactive Materials and Waste (PNGMDR)

The Environment Code requires that the Government draft a National Plan for Radioactive Materials and Waste Management (PNGMDR), every three years. It is transmitted to Parliament, which refers it to the Parliamentary Office for the Evaluation of Scientific and Technical Choices (OPECST) for assessment, and is made public.

Following each edition of the Plan, the Government publishes a decree establishing the prescriptions and ensuring implementation of the PNGMDR. It checks execution thereof and requests opinions, more specifically from ASN, concerning the proposals and studies from the organisations concerned by said prescriptions.



Article L.542-1-2 of the Environment Code defines the PNGMDR's objectives more precisely: it "identifies existing management modes for radioactive materials and waste, inventories the foreseeable need for storage or disposal facilities, clarifies the capacity that will be needed in these facilities and the storage durations and, for radioactive waste for which no final management mode has yet been defined, determines the objectives to be attained". This article also states that "the national plan organises research and studies into the management of radioactive materials and waste, by setting deadlines for the implementation of new management modes, the creation of facilities or the modification of existing facilities [...]", and that "it comprises an appendix summarising achievements and research in other countries".

The Environment Code sets the guidelines for the Plan:

*1° One goal is to reduce the quantity and harmfulness of the waste, in particular by processing spent fuels and processing and packaging radioactive waste;*

*2° Radioactive materials awaiting processing and ultimate radioactive waste pending disposal are stored in specifically designed facilities, and*

*3° 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 require deep geological disposal".<sup>7</sup>*

A decree specifies the main provisions of the PNGMDR.

After the first two editions in 2007 and 2010, a new PNGMDR for the period 2013-2015 was drafted and transmitted to Parliament in late 2012, based on the work of a pluralistic working group (co-chaired by the Director General for Energy and Climate (DGEC) of the MEDDE and ASN). It was made public in early 2013. The *decree of 27 December 2013* specifies the corresponding prescriptions.

France was the first to produce a PNGMDR and played an active role at the European level in the draft directive mentioned above, the aim of which is to require each Member State to produce a radioactive waste management plan.

### 2.2.2. Changes to management solutions under development

For high level and intermediate level long-lived waste, Andra carried out basic studies to define an overall industrial architecture for the Cigéo project.

These studies, entrusted to an industrial lead contractor, are based on a range of requirements established by Andra (safety, reversibility, operation, integration). These requirements consolidated the acquired scientific and technical results as well as the recommendations by the assessors following the investigation of the technical options presented by Andra in 2009. The draft inter-*département* local development scheme drafted by the State jointly with local players and Andra identifies the challenges as related to local integration of the project (need for infrastructures, housing, training, etc.).

The Environment Code requires the organisation of a public debate on the disposal facility project prior to the submission of its creation authorisation application. This debate was organised by the French National Public Debate Commission (CNDP) in 2013. The minutes and report of the public debate were published on 12 February 2014<sup>8</sup>.

On 6 May 2014, Andra presented its *intentions for the Cigéo project following the public debate, unanimously voted by its Board meeting of 5 May. To take account of the opinions and expectations expressed during the debate and in order to conserve the step-based approach initiated by the 1991 Act, Andra has decided to continue with the Cigéo project, although with the adoption of four changes to it, clarifying its proposal concerning reversibility and making undertakings for subsequent operation:*

- *the integration of a pilot industrial phase when the installation starts up, in order to test all disposal facility functionalities in real conditions;* On the basis of an inventory representative of the high level and intermediate level, long-lived waste to be disposed of, this phase will first of all comprise inactive tests, followed by radioactive waste package disposal operations. The transition to routine operations will take place after Andra has produced a report summarising the results of this phase;
- *Implementation of a regularly revised master plan for operation of the disposal facility, produced with the stakeholders;*
- *Modifications to the schedule, with the goal, subject to the necessary authorisations, of beginning construction of the repository in 2020 with start-up by means of a pilot industrial phase in 2025;*
- *Greater involvement in the project by civil society.<sup>9</sup>*

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<sup>7</sup> Waste Act (<http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000240700>)

<sup>8</sup> <http://www.debatpublic-cigeo.org/>

<sup>9</sup> Data communicated by Andra

For low level long-lived waste, Andra presents the various management scenarios studied for this waste, according to its nature, in late 2012. Further to the guidelines issued by the State for the continued search for a site, geological investigations were initiated in 2013 on the territory of the Soulaines local authority, close to the disposal centres operated by Andra for LLW/ILW-SL and VLL waste. As requested by local government officials, a consultation Committee was set up under the aegis of the State, to define the incentives and steps associated with project development, with the existing local information committees being regularly informed of the progress of the project. A geological analysis on the other BNI sites in France is also being carried out together with AREVA, CEA and EDF. The PNGMDR recommends continued work to characterise the waste, R&D on processing and the feasibility of the envisaged management scenarios (see *decree of 27 December 2013*). Evaluation of the studies carried out until 2015 will lead to the definition of guidelines for the subsequent phases of the project, more specifically indicating which scenarios are to be adopted for management of the various types of LLW-LL waste and the various methods to be envisaged subsequently.

### 3 | INTEGRATION OF EXPERIENCE FEEDBACK FROM THE FUKUSHIMA ACCIDENT

Following the nuclear accident at the Fukushima Daiichi nuclear power plant, ASN considered that stress tests needed to be carried out on French civil nuclear facilities with respect to the type of events which led to this accident. The purpose of this approach was notably to respond to the requests made by the Prime Minister on 23 March 2011 and the European Council on 24 and 25 March 2011.

ASN decided that stress tests would be conducted on all facilities liable to present risks in the case of events of the same nature as at Fukushima Daiichi and not only on nuclear power reactors. The exercise first of all concerned the priority facilities (more specifically NPPs, all fuel cycle plants operated by AREVA and some of the CEA facilities). It then concerned lower priority facilities. The list of facilities concerned according to their level of priority is given in appendix L.4.

In September 2011, the licensees of the priority facilities presented ASN with the stress tests of their facilities in extreme situations, accompanied by proposed modifications to be implemented in the short and medium terms. These evaluations and proposals were examined by the Advisory Committees of Experts concerned in November 2011.

Following this process, ASN submitted its conclusions to the Prime Minister in early 2012 (see ASN opinion 2012-AV-0139 of 3 January 2012 and the ASN report available in English on the ASN website). It considered that the facilities examined offered a sufficient level of safety such that immediate shutdown was not necessary for any of them. At the same time, ASN considered that their continued operation requires that their robustness to extreme situations be increased beyond their existing safety margins, as rapidly as possible.

In its resolutions of 26 June 2012, which can be consulted in English on its website, ASN sets prescriptions for the licensees, which include the need to create a “hardened safety core” of robust material and organisational measures designed, in the extreme situations studies by the stress tests:

- to prevent a severe accident or limit its progression;
- to mitigate large-scale releases, and
- to enable the licensee to perform its emergency management duties.

#### 3.1. NPP reactor pools

The pools of NPP reactors were the subject of stress tests (see § G.2.2.3. below). The licensee demonstrated the robustness of its facilities.

On 26 June 2012, these stress tests led ASN to issue a resolution for each of the NPPs, with regard to the creation of a hardened safety core of material and organisational measures concerning the spent fuel



pools, in order to guarantee cooling of the fuel. Furthermore, requests were made for enhanced instrumentation of the pools, including in the event of loss of electrical power, for prevention of their accidental emptying, placing the assemblies being handled in a safe position, evaluating the behaviour of the pool so that local intervention can be carried out if necessary and checking the robustness of these structures to induced hazards, notably by a falling fuel packaging during handling.

In addition, in resolutions dated 21 January 2014, ASN indicated what it expected in terms of the hardened safety core.

### 3.2. The fuel cycle plants

In September 2011, the AREVA group supplied stress test reports for virtually all of the sites and facilities operated (La Hague and Tricastin sites, MELOX plant and FBFC plant at Romans-sur-Isère).

In its resolutions of 26 June 2012, ASN set additional prescriptions for the AREVA Group facilities thus assessed, in the light of the conclusions of the stress tests. These prescriptions require that the following measures be taken:

- proposal by the licensee of a “hardened safety core” of material and organisational measures;
  - implementation of reinforced measures to reduce the risk of the fuel stored in the La Hague pools becoming exposed by emptying of the pool;
  - for the silos at La Hague, feasibility studies with a view to setting up technical arrangements, such as geotechnical containment or equivalent effect, with the aim of protecting the underground and surface water in the event of a severe accident;
- for the Tricastin and Romans-sur-Isère sites, implementation of complementary means for mitigating the consequences of a toxic product leak (gaseous hydrogen fluoride, uranium hexafluoride, chlorine, chlorine trifluoride, etc.), and
- measures relative to emergency management and social, organisational and human factors (SOHF).

The proposals thus made by the AREVA group to define the hardened safety core were reviewed by ASN and its technical support organisation and were presented to the Advisory Committees of Experts in April 2013. ASN consequently drafted resolutions containing requirements for the hardened safety core. AREVA and the public will be consulted in 2014. At the same time, ASN is examining AREVA’s responses to the prescriptions contained in the resolutions of 26 June 2012.

### 3.3. CEA research centres

For CEA’s four priority experimental reactors (OSIRIS, PHENIX, MASURCA and the RJH) as well as for the RHF, the ASN resolutions of 26 June 2012 set additional prescriptions in the light of the conclusions of the stress tests.

ASN requested the definition of a “hardened safety core” of material and organisational measures to control the fundamental safety functions in extreme situations.

With regard to the implementation of this hardened safety core, the Advisory Committees of Experts concerned were consulted in April 2013 regarding the proposals submitted to ASN in June 2012. ASN will issue a position statement on the proposals from the licensees for implementation of the hardened safety core and will issue additional prescriptions in 2014.

The stress tests approach continued for a second group of 22 facilities considered to have “lower priority” (notably CHICADE, LECA, MCMF, CABRI, ORPHEE, ATALANTE). In July 2013, the Advisory Committees of Experts concerned were consulted concerning the proposals submitted to ASN. On the basis of this opinion and the undertakings made by the licensee, ASN will issue a position statement in 2014.

For the Saclay site, CEA submitted its stress tests report on 30 June 2013. It is currently being reviewed by ASN.

Finally, of the thirty or so other facilities of lesser importance, ASN notified CEA of a calendar for submission of the stress test reports, a process which will run until 2020.

### 3.4. The high flux reactor in the Laue-Langevin Institute

The stress tests were carried out in 2011 (see G.1.2.1 below). These lead to implementation of a hardened safety core, verification of the robustness of certain equipment items, proposed modifications to reinforce others and the performance of improvement works (ultimate reflooding system, new emergency control station).

After a review by the Advisory Committees of Experts concerned in April 2013, ASN considers that the hardened safety core proposed by ILL and the associated requirements are satisfactory and prescribes their implementation in a resolution dated 21 November 2013.

ASN issued the prior agreement necessary for certain of the improvements proposed. The ILL was authorised to commission an ultimate reflooding system and adopt new heavy water management.

To conclude, ASN therefore considers that following the nuclear accident at Fukushima, ILL has taken significant steps to reinforce the safety of the reactor.

### 3.5. Facilities undergoing decommissioning

In order to take account of the lessons learned from the Fukushima accident, ASN asked the BNI licensees to carry out stress tests, including on the facilities being decommissioned.

For certain priority facilities, in particular CEA's PHENIX reactor, ASN set additional prescriptions in June 2012 in the light of the conclusions of the stress tests. The proposals concerning the hardened safety core and associated requirements for PHENIX were examined by the Advisory Committees of Experts in April 2013.

For the APEC, the Advisory Committees of Experts recommended that EDF ensure that it be possible to conduct a water level diagnostic and resupply the pool with water. ASN's official position regarding the recommendations of the Advisory Committees of Experts and EDF's proposals regarding the APEC, but also other reactors undergoing decommissioning, will be made known in 2014.

### 3.6. French participation in the European stress tests

Stress tests were carried out to verify the robustness of the European NPPs at the request of the European Council. These stress tests were carried out in 2011 in the 15 member States with nuclear reactors, plus some neighbouring countries.

The national reports were examined by means of European peer review between early January and late April 2012. All aspects concerning the safety of the NPPs were considered during the review, including the safety of spent fuel pools.

Each country drew up an action plan for implementation of the recommendations thus made.

## SECTION B | POLICIES AND PRACTICES

### (ART. 32-§1)

#### Article 32-§1

*In accordance with the provisions of Article 30, each Contracting Party presents a national report at each Contracting Parties review meeting. This report concerns the steps taken to meet each of the obligations specified in the Convention. For each Contracting Party, the report also concerns:*

- *its spent fuel management policy;*
- *its spent fuel management practices;*
- *its radioactive waste management policy;*
- *its radioactive waste management practices;*
- *the criteria it applies to define and classify radioactive waste.*

#### 1 | GENERAL POLICY

The Management Policy for Radioactive Materials and Waste is consistent with the legal framework constituted by two acts and their implementation instruments, as follows: the *Law of 30 December 1991 (1991 Law)* and *Waste Act*.

The policy is described in detail in the PNGMDR, which has been developed notably on the basis of the *National Inventory of Radioactive Waste and Materials (Inventaire national des matières et déchets radioactifs)* (see § A.2.2.1).

The policy relies on the following three principles:

- research and development (R&D);
- transparency and democratic dialogue, and
- adequate funding for radioactive-waste management and decommissioning activities.

##### 1.1. Planning Act of 28 June 2006 Concerning the Sustainable Management of Radioactive Materials and Waste (Waste Act)

The *Waste Act* was published after 15 years of research prescribed by the *1991 Law*. Its scope covers all radioactive materials and waste and prescribes the orientations and objectives of R&D investigations on the management of radioactive waste for which no management solution is yet in service. The law prescribes also the financing modalities for decommissioning and waste-management costs. It reiterates the fact that it is forbidden to dispose of any foreign waste in France.

The law describes also various dialogue tools with the public and the funding principles of research projects and radioactive-waste management. More specifically, that law has amended and completed the *Environment Code* (Articles L. 542-1 to L. 542-14 and L.594-1 to L.594-14).

Decrees		Law Article	Publication Date
<b>National Management Policy for Radioactive Materials and Waste</b>	Prescriptions of the 2013-2015 National Management Plan for Radioactive Materials and Waste	<b>Art. 6</b>	27 December 2013
	Management of foreign waste and processing contracts	<b>Art. 8</b>	3 March 2008
	Appointment of CNE members	<b>Art. 9</b>	5 April 2007
	Nature of information to be transmitted for National inventory and PNGMDR	<b>Art. 22</b>	29 August 2008
<b>Support for research conducted at the Meuse/Haute Marne URL</b>	CLIS	<b>Art. 18</b>	7 May 2007
	GIPs – Generic decree	<b>Art. 13</b>	14 December 2006
	Delineation of the proximity zone-- GIP Meuse and Haute-Marne	<b>Art. 13</b>	5 February 2007
	“Support” tax: fraction paid by GIPs to communes located within the 10-km zone	<b>Art. 21</b>	7 May 2007
	Coefficient of “incentive” and “technological diffusion” taxes	<b>Art. 21</b>	26 December 2007
	Consultation zone for the creation of a repository	<b>Art. 12</b>	To be published
<b>Funding provisions</b>	Coefficient of the additional “research” tax	<b>Art. 21</b>	26 December 2007
	Securisation of long-term nuclear charges	<b>Art. 20</b>	23 February 2007
	Implementation of the CNEF	<b>Art. 20</b>	20 June 2008

TABLE 2 : LIST OF DECREES TAKEN PURSUANT TO THE WASTE ACT ON 31 DECEMBER 2013

## 1.2. An all-encompassing management policy for radioactive substances

### 1.2.1. Definitions

In accordance with the *Environment Code*, the following definitions are used in France:

- a radioactive substance is a substance containing radionuclides, whether natural or man-made, whose activity or concentration justifies a radiation protection control;
- a radioactive material is a radioactive substance for which a subsequent use is planned or envisaged, after processing, if need be;
- nuclear fuel is considered as a spent fuel when, after having been irradiated in the reactor core, it is permanently removed from it;
- radioactive waste consists of radioactive substances for which no subsequent use is planned or envisaged;
- ultimate radioactive waste consists of radioactive waste that are impossible to process under the current technical and economic conditions of the time, notably by extracting their recoverable share or by reducing their polluting or hazardous character;
- the storage of radioactive materials or waste consists in placing temporarily such materials within an especially-fitted surface or shallow facility for that purpose, pending their recovery;
- the disposal of radioactive waste is an operation consisting in placing such substances within an especially-fitted facility with a view to preserving them potentially for ever, and
- the disposal of radioactive waste within a deep geological formation is the disposal of such substances within an especially-fitted facility for that purpose in accordance with the reversibility principle.

### 1.2.2. Radioactive materials

Radioactive materials consist mainly of the depleted uranium generated by enrichment plants, of the spent fuel unloaded from nuclear reactors and of the fissile materials extracted from irradiated fuel (uranium and plutonium) after processing of spent fuel.

Currently speaking, radioactive materials are partly recoverable in certain existing systems, as follows:

- plutonium from spent fuel processing is used to manufacture MOX fuel;
- depleted uranium resulting from the enrichment of natural uranium is not widely used (only in the fabrication of MOX fuel) and is stored;
- part of uranium from spent fuel processing (about one third of the annual production) could be re-enriched abroad and could be consequently used for the fabrication of the fuel types acceptable in the four reactors of the Cruas Nuclear Power Plant (NPP). A more thorough recovery of uranium from spent fuel processing could be envisaged as mentioned in § B.2.

The integration of certain radioactive materials, which are not considered as waste, was discussed initially within the Working Group for the Development of the PNGMDR.

As for the OPECST, it stated in its report of 15 March 2005 that the scope of the Plan should be extended to recoverable materials in order to prevent any shadow zone in the management of radioactive waste. The application of that recommendation helped making the Plan consistent with the scope of the National Inventory of Radioactive Materials and Waste, as established by ANDRA.

The 2013-2015 PNGMDR is not taking any stand on the status of recoverable materials, but takes their existence into account and advocates that the owners study the long-term management solutions in cases where they would not be reused. The future of those materials is reviewed periodically, especially during the update of the PNGMDR.

### 1.2.3. Inventory of Radioactive Materials and Waste

At the government's request, the Chairman of ANDRA advocated in June 2000 that a national reference inventory be drawn on the basis of a broad notion of waste (including spent fuel with no further use) and provide prospective assessments of the "committed waste" in existing facilities. Hence, the purpose was to obtain an accounting and prospective overview that would be better suited to serve as the basis for a reflection on the overall management.

To ensure transparency, a pluralistic Steering Committee has been established by ANDRA to follow the national inventory preparation. Chaired by the Director-general of ANDRA, this Steering Committee includes representatives from various administrations (Ministries, ASN, HCTISN<sup>10</sup>...), waste producers and associations for environment protection. The inventory lists all waste identified as radioactive throughout France, thus providing corresponding balance sheets, as well as an overview of existing radioactive materials. In addition, it includes a prospective section with an estimate of the quantities of radioactive waste and radioactive materials that will be produced until 2020 and 2030, as well as an estimate of the waste to be generated after 2030 according to different scenarios.

The national inventory forms an integral part of the missions entrusted upon ANDRA and is published every three years. The law provides that ANDRA shall benefit from a State subsidy in order to contribute to the funding of the general-interest mission. The first edition of the National Inventory has been published by Andra in 2004, the latest edition in June 2012.

The inventory may be consulted on ANDRA's website ([www.andra.fr](http://www.andra.fr)).



<sup>10</sup> Haut comité à la transparence et à l'information sur la sécurité nucléaire

### 1.3. The National Management Plan for Radioactive Materials and Waste (PNGMDR)

The PNGMDR constitutes a key element for steering the national management policy effective in France.

The first plan was tabled before Parliament in March 2006. It was the result of the work that had been launched by the Minister of Ecology and Sustainable Development on 4 June 2003 and carried out by a pluralistic working group placed under the aegis of ASN and the Directorate-General of Energy and Raw Materials (*Direction générale de l'énergie et des matières premières* – DGEMP) and consisting of representatives from the Administration, radioactive-waste producers from the nuclear and non-nuclear sectors, ANDRA, IRSN, environmental associations, as well as a member from the CNE.

Nurtured by that work, the *Waste Act* then confirmed the principle of the national management plan. It also provided that a decree set forth its requirements; hence, the decree for the first Plan was issued on 16 April 2008, whereas the decree stating the requirements for the current Plan was issued on 27 December 2013.

The PNGMDR is based on the knowledge of the different types of waste, and notably on the national inventory (see §B.1.2.3). The National Plan is drawn and updated every three years by the government and tabled before Parliament, which in turn refers it to the OPECST (see § E.3.4.1). In addition, the CNE (see §E.3.4.2) is responsible for assessing every year the progress made by investigations and studies on the management of radioactive materials and waste.

#### 1.3.1. Legislative framework for the implementation of the PNGMDR

##### 1.3.1.1. DRIVING PRINCIPLES OF THE PNGMDR

The driving principles of the PNGMDR are those of the *Waste Act*:

- seeking to reduce the quantity and toxicity of radioactive waste, notably by processing spent fuel and conditioning radioactive waste;
- storing all radioactive materials pending processing and all radioactive waste pending storage in especially-fitted facilities for that purpose, and
- after storage, disposing in a deep geological repository any ultimate radioactive waste that may be unsuitable for disposal in surface or shallow installations, due to nuclear-safety or radiation-protection concerns.

The PNGMDR is also based on the following principles:

- compliance with protection principles against ionising radiation (justification, optimisation, limitation) and for environmental monitoring (precaution principle, polluter-pays, etc.);
- principle of an integrated approach from production to storage/disposal;
- determination of long-term management systems adapted to the characteristics of the different waste categories, particularly concerning the storage of waste for which no long-term management solution exists so far or the taking-over by the community of “orphan waste” resulting most of the time from historical activities;
- traceability of radioactive waste management, and
- information and active involvement of citizens.

##### 1.3.1.2. OBJECTIVES OF THE PNGMDR

The main objectives of the PNGMDR are recalled in Article 3 of the *decree of 27 December 2013*:

- The radioactive waste management system must be consistent and it must be technically and economically optimised;
- Best use must be made by the various players of the radioactive waste disposal facilities, which are few in number and of limited capacity;
- The radioactive waste management routes take account of the volumes of waste transported and the distances to be covered.

The PNGMDR focuses mainly on the following fields:

- to seek long-term management solutions for every category of radioactive waste being produced;
- to continuously improve and optimise existing routes;
- to analyse the long-term management solutions and their optimisation adopted in the past and to justify an intervention, if improvements are necessary, with a view to achieving a type of management that will always keep improving in clarity, rigour and safety;
- to take over and to condition historical radioactive waste;
- to ensure the consistency of the overall management mechanism for radioactive waste, irrespective of its radioactivity level;
- to ensure the consistency of the entire radioactive waste management system, regardless of the level of radioactivity or the origin;
- to take due account of public concerns and expectations about the future of radioactive waste.



In order to achieve those goals, it is important to organise a global and national reflection from which to draw the main lines of a policy aiming at ensuring a sound management of all radioactive waste, especially by determining long-term management venues and financing means for the management of radioactive-waste categories lacking a final solution.

### 1.3.2. Implementation of the PNGMDR in 2013

#### 1.3.2.1. SCOPE OF THE PNGMDR

The PNGMDR applies to all radioactive waste categories:

- all “waste resulting from nuclear activities” (regulated activities due to the presence of radioactivity involved);
- all “waste resulting from activities involving the handling of radioactive materials, but exempted from regulatory control”, which include significant concentrations of radioactivity or are very important in number, and which require specific measures (e.g., smoke detectors);
- all “waste containing natural radioactivity”, which may be reinforced following a human activity without calling necessarily upon the radioactive properties of the materials, and whose radioactive concentration is too high to be overlooked from a radiation-protection standpoint, and
- all tailings resulting from the processing of uranium ore being disposed of in ICPEs.

In addition, the PNGMDR takes radioactive materials into account (see § B.1.2.2).

#### 1.3.2.2. CONCLUSIONS OF THE 2013-2015 PNGMDR

The 2013-2015 edition of the Plan continues and expands on the steps taken in the previous version. It relies in particular on the National Inventory of Radioactive Materials and Waste, published by Andra in June 2012, which evaluates the waste production prospects for the coming decades, along with the storage capacity requirements.

The 2013-2015 PNGMDR stresses the need to develop overall industrial schemes to manage and develop certain management modes for high-level waste (HLW) and intermediate level, long-lived waste (ILW-LL). It more specifically proposes the following measures:

### Developing new long-term management modes

The 2013-2015 PNGMDR requires that studies and research be continued:

- on high level waste (HLW) and intermediate level, long-lived waste (ILW-LL), more specifically that concerning the planned deep geological disposal facility, Cigéo, which entered a new phase during the period 2013-2015 with the holding of a public debate in 2013 and the preparation of the creation authorisation application, and
- on the packaging of intermediate level, long-lived waste (ILW-LL) more specifically to meet the 2030 goal for the packaging of waste produced before 2015.

With regard to low level, long-lived waste (LLW-LL), the 2013-2015 PNGMDR requires the definition of management scenarios, in particular by continuing studies into sorting, characterisation and processing of graphite waste and bitumen-encapsulated waste, as well as feasibility studies concerning disposal options for waste already produced by Comurhex Malvési.

### Improving existing management modes

The 2013-2015 PNGMDR requires:

- improved monitoring of the volume and radiological capacity of the disposal centres, thus anticipating the need for new capacity;
- the development of reutilisation solutions for very low level (VLL) waste in order to preserve the disposal capacity resource; saturation of the VLL waste disposal centre will be reached more rapidly than anticipated (in about 2025-2030), owing to the large quantities of VLL waste to be generated by the decommissioning and post-operational clean-out operations.
- continued studies into mining processing residues in order to propose concrete improvement measures, whether in terms of identifying the exposure risks for the populations, the long-term resistance of embankments or changes to water treatment techniques, and
- continuation of the approach implemented pursuant to the circular from the Minister for ecology and ASN of 22 July 2009 in order to determine whether the places where mining waste rock is reused are compatible with the uses and to reduce the impact as applicable.

### Take account of significant events during the period 2010-2012

The 2013-2015 PNGMDR also requires:

- the identification of the investments needed to ensure continuity of the management routes for the waste generated by small non-NPP producers and in particular to continue the studies into the processing of liquid and gaseous tritiated waste generated by this sector;
- the continuation of the work started to define a management scheme for used sealed sources, and
- the production of operating experience feedback from the shutdown lasting several months of the Centraco incineration facility and to propose measures to secure the incinerable radioactive waste management solutions.

## 1.4. Formal ban on the disposal of foreign radioactive waste in France

In order to take due account of her industrial activities regarding the processing of spent nuclear fuel or radioactive waste, France adopted the legislative principle to ban the disposal of all foreign radioactive waste on French soil.

The *Environment Code* reaffirmed that principle: hence, no radioactive waste either originating from abroad or resulting from the processing of spent fuel and of radioactive waste abroad shall be authorised in France.

In addition, the *Waste Act* specifies that the introduction of any spent fuel or radioactive waste on French soil for processing purposes shall be conditional upon the conclusion of intergovernmental agreements prescribing a maximum date for the return of the ultimate waste in the country of origin. Furthermore, every inter-governmental agreement shall specify provisional periods for the reception and processing of those substances, and, if need be, any subsequent prospect for using the radioactive materials separated during processing.

Operators who process spent fuel or radioactive waste originating from abroad must implement a waste-attribution mechanism approved by a ministerial order.

The law requires operators to prepare and publish every year a report describing the inventory and streams of foreign radioactive substances, together with a section on future prospects.

Lastly, that legislative mechanism must be completed by a regime of administrative controls and punitive sanctions.

## 1.5. Management policy based on research and development

### 1.5.1. High-level and intermediate-level long-lived waste

For HL-IL/LL waste, three complementary research areas have been identified and described in the *Waste Act* as follows:

On 21 December 2012, CEA submitted a detailed report in response to the objectives of the *Waste Act*. This report presents the research and prospects for new “nuclear systems”: the sustainable management of radioactive materials with different generation IV reactor concepts, the partitioning and transmutation of long-lived radioactive waste, the ASTRID generation IV fast sodium- cooled fast neutron reactor (FNR), the ALLEGRO gas-cooled FNR project and the other FNR technologies.

The feasibility of the partitioning of minor actinides has, for all the options envisaged, been demonstrated in the laboratory. In principle, there is no obstacle to extrapolating these processes to an industrial scale.

The feasibility of the transmutation of americium has been demonstrated. Two concepts remain envisaged<sup>11</sup>. CEA proposes the Astrid<sup>12</sup> technology demonstrator.

For FNR deployment in the French NPP fleet, CEA considers that a gradual approach should be preferred, with scenarios involving initial deployment of a limited number of FNR alongside the water reactors in the fleet (with large-scale deployment then only being considered subsequently). The studies have also demonstrated the interest of not delaying the deployment of this first series, to be envisaged for the 2040 time-frame. Industrial scenario studies will be carried out with EDF and Areva to fine-tune this approach.

This avenue of research can therefore only be envisaged for some time in the future and will not concern the waste already produced.

### Reversible waste disposal within a deep geological formation

This avenue of research corresponds to the following objective set by the *Waste Act*: “after storage, ultimate radioactive waste which, for reasons of nuclear safety or radiation protection, cannot be disposed of on the surface or at shallow depth, shall be disposed of in a deep geological formation”.

The studies and research are carried out in order to produce the file which will back up the creation authorisation application for the centre. The reversibility conditions will be defined in a future act. Andra’s studies and research draw more specifically on the experimental results obtained in the Meuse/Haute-Marne Underground Laboratory. This laboratory is used to study the geological medium in situ and test and develop excavation and closure processes.

The reversibility of repositories, as prescribed by the *Waste Act*, is a noteworthy evolution in relation to the *1991 Law*. The *Waste Act* prescribes that, when time comes to review the corresponding creation-licence application, the safety of the deep geological repository will be assessed with regard to the different phases of its management, including its final closure that only a new act may authorise. A specific law

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<sup>11</sup> The two concepts are as follows: the concept of recycling with dilution in the reactor fuel (“homogeneous” mode, leading to equilibrium at an americium content of about 1% in the fuel) and concept of recycling on the core periphery, in “UO<sub>2</sub> blankets charged with americium” (a row of such blankets containing 10% americium at equilibrium); this latter concept has the advantage of limiting the number of objects charged with actinides and does not affect the working of the reactor core.

<sup>12</sup> The Astrid project (Advanced Sodium Technological Reactor for Industrial Demonstration) is a prototype 600 MWe reactor project which is an essential milestone before possible industrial deployment; its characteristics mean that it is representative of the main industrial aspects and can demonstrate the qualification of innovative concepts. The R&D phase, which is continuing, will allow the choice of particularly advanced options, more specifically in terms of safety and operability.

prescribing the applicable reversibility conditions will also specify a minimum period of at least 100 years during which the reversibility of the repository will be maintained as a precaution.

The reversible waste disposal within a deep geological formation is developed in the report (See § D and § H.3).

### Storage

The studies and the corresponding research are carried out with a view to creating new facilities or modifying existing ones in order to meet the needs identified by the National Plan for Radioactive Materials and Waste Management.

Unlike disposal, storage is a temporary situation, offering an interim solution for keeping waste safely and securely pending the commissioning of the disposal centre. The studies and research explored the various aspects of the complementarity between storage and reversible disposal. Storage is necessary but can never be a final solution for the management of high level waste and intermediate level, long-lived waste.

In 2012, Andra submitted the results of its studies and research on storage, in accordance with the Waste Act. The report supplied by Andra details the various principles, criteria and technical options concerning storage and thus marks the completion of several years of studies. The *decree of 27 December 2013* requires that, further to consultation with the major licensees, Andra produce recommendations for the design of storage facilities to complement disposal.

Investigations on deep geological disposal and on storage are conducted by ANDRA and developed in § F.2.2.1.1. So far, research on partitioning and transmutation are funded by a CEA subsidy.

#### 1.5.2. Low-level long-lived waste

The *Waste Act* set the development of disposal solutions for LL/LL waste, and particularly for radium-bearing and graphite waste. In 2012, ANDRA submitted a report on possible management scenarios for LL/LL waste, according to their nature.

The nature of the long-term management for that waste category relies notably on waste characterisation and on studies concerning their behaviour under disposal situations.

The PNGMDR recommends also an R&D synthesis on processing possibilities for radium-bearing and graphite waste. Several international exchanges, for instance, have taken place in the framework of the European Programme, called “*Carbowaste*”, and of the IAEA co-ordinated research project entitled “*Treatment of Irradiated Graphite to Meet Acceptance Criteria for Waste Disposal*”.

#### 1.5.3. Other waste categories covered by research programmes

A working group was set up within the framework of the 2010-2012 PNGMDR in order to propose solutions for waste, for which no long-term management mode has yet been defined. Within this working group, Andra, AREVA, CEA and EDF submitted a report in late 2011 identifying the waste on which priority efforts needed to be focused: asbestos and asbestos-bearing waste, waste contaminated by mercury, non-incinerable organic oils and liquids. This report also produced an inventory and proposed avenues for the development of processing, to be shared by the producers.

The *decree of 27 December 2013* requires that the work by this working group be continued and lead to an updating of the 2011 report before 31 December 2014, so that the results acquired can be integrated into the following plan.

Asbestos has been used in NPPs not only for its thermal- and electrical-insulation properties, but also as fireproof material. Hence, the dismantling of such facilities generates asbestos-bearing waste, which is intended primarily for the Cires Disposal Facility and to a lesser extent to the CSA (*Centre de stockage de l'Aube*).

The current inventory of asbestos-bearing waste has already reached several thousands of cubic metres m<sup>3</sup> (conditioned equivalent), most of which are unsuitable to be taken over as such in surface disposal facilities, due to the presence of free asbestos.

Under those conditions, an overall approach regarding the take-over of asbestos-bearing waste in disposal facilities was initiated by ANDRA with the following three objectives in mind:

- refining the current and future inventory of asbestos-bearing waste in co-operation with waste producers;
- proposing processing/conditioning solutions, and
- assessing better health hazards over the long term.

On the basis of a safety analysis, Andra was thus able to define the total quantities of asbestos that are acceptable in the Cires disposal vaults. It also clarified the packaging method enabling this waste to be accepted in the repository. It proposed working with the main holder of this waste, EDF, to look for an optimised packaging solution, in terms of both cost and consumption of disposal capacity.

With regard to the other waste for which there is no solution, studied by this working group, the technical feasibility (in the laboratory for some) of at least one processing process per type of waste was confirmed by the end of 2013. A progress report for the various developments will be provided in late 2014.

In parallel with the work by this working group, steps to develop packaging processes for some organic waste are also envisaged in the framework of the Future Investment Programme (*Investissements d'Avenir*).

### 1.6. Management policy based on transparency and democracy principles

The second area of the Management Policy for Radioactive Materials and Waste consists in maintaining a democratic dialogue at all levels, as follows:

- at the local level and on a continuous basis, thanks to the implementation of a CLI for each treatment and disposal facility;
- at the level of the public at large: the PNGMDR, based on ANDRA's National Inventory of Radioactive Materials and Waste, is a key element to ensure transparency. In addition, France may also rely on public national debates. Such a debate, on the radioactive waste management, was organised over a four-month period before the adoption of the Waste Act. Another debate concerning the project for the reversible disposal of radioactive waste in a deep geological formation (Cigéo) was held for 6 months in 2013, in accordance with the Environment Code, before submission of the creation authorisation application for a deep geological formation disposal centre, and
- in Parliament: in the framework of the licensing of a deep geological repository, the Waste Act prescribes two parliamentary deadlines, the first in order to set forth its reversibility conditions, before the authorisation of the disposal facility and the second over a longer term, in order to authorise its future closure. The final decision to issue the creation licence will lie with the government, but no licensing decree will be issued for the disposal facility without holding a parliamentary review beforehand.

Lastly, according to the *Environment Code*, any officer responsible for nuclear activities and any company referred to in Article L. 333-10 of the Public Health Code must establish, update and make available to the administrative authority all required information for the performance of that control. The *Waste Act* includes penalties in case of non-compliance on the part of operators.

The decree No.2008-875 of 29 August 2008 specifies the scope and nature of the information required to prepare the National Inventory of Radioactive Materials and Waste.

### 1.7. Funding the French Management Policy for Radioactive Materials and Waste

With due account of the challenges relating to radioactive-waste management, public authorities are concerned with securing sufficient funds not only for investigations and for management itself, but also for BNi decommissioning

#### 1.7.1. Securing funds for the managing radioactive waste and spent fuels and decommissioning nuclear facilities

The French funding system for decommissioning BNIs and managing the resulting radioactive waste rests on the full financial liability of industrial operators.

BNL operators must establish conservative estimates of the charges for decommissioning their facilities and for managing their spent fuel and radioactive waste; they must also set aside specific provisions in their accounts and constitute specific financial assets to cover the provisions, with the understanding that such assets be entered separately.

The market value of that portfolio of dedicated assets must be at least equal to the value of the provisions (except for the charges associated with the operating cycle, notably with regard to the charges for the management of recoverable spent fuels in a facility either existing or under construction. Even though spent fuel processing costs are not submitted to the constitution of covering assets, management costs for radioactive waste resulting from that processing are. That obligation for covering provisions already exists since the commissioning of the facility. However, a transit period has been initiated starting on the enforcement date of the Waste Act in order for operators to set up their constitution plan of covering assets.

Hence, it is possible to secure the funding of those long-term charges, while preventing that their burden rest on taxpayers or future generations.

In order to prevent and to limit the charges to be borne by future generations, those dedicated assets must have sufficient levels of security, diversification and liquidity. In order to achieve that goal, regulatory provisions must prescribe clear admissibility rules for those assets (notably concerning the asset category and the diversification level of the portfolio).

In addition, all assets allocated to those estimates must be protected by law, including in case of financial hardships on the part of the operator: in case of the operator's bankruptcy, only the State, in the course of its duties, has the right, with regard to those provisions to ensure that operators comply with their obligations relating to decommissioning and to radioactive-waste management.

The law also provides for a State control supported by regulatory and enforcement powers, including the seizure of funds (see § F.2.3.2). That control must be valid notably on the basis of the reports to be submitted every three years by operators in order to describe not only the costs for decommissioning activities and waste management, but also the modalities selected by operators to allocate the assets corresponding to the coverage of the associated financial charges. At the instigation of Parliament, the law also created a second-level control authority, called the National Financial Assessment Committee for Charges Relating to Decommissioning Operations for Basic Nuclear Facilities and the Management of Spent Fuel and Radioactive Waste (*Commission nationale d'évaluation financière des charges de démantèlement des installations nucléotides de base et de gestion des combustibles usés et des déchets radioactifs*), in order to assess the control conducted by the administrative authority.

### 1.7.2. Funding research and development and design studies on deep geological disposal

The R&D and the design studies for the deep geological disposal centre carried out by Andra are financed by taxes levied on the radioactive waste producers. The “research” tax and the “design” special contribution, are described in greater detail in § F.2.2.1.1. They are a means of securing Andra's funding sources.

The amount of this tax and this contribution are calculated as the product of a lump imposition by an adjustment factor. Hence, on the basis of current BNIs, ANDRA receives more than 200 M€ every year.

## 2 | FRENCH SPENT-FUEL-MANAGEMENT POLICY

### 2.1. General processing/recycling policy

With the 58 NPPs operated by EDF, France generates a yearly output in the order of 400 TWh of nuclear power (403,7 TWh in 2013), which, in turn, produce an average of approximately 1,150 t of spent fuel every year.

For that nuclear spent fuel and similarly to other countries, France has selected a processing/recycling strategy for spent fuel that was confirmed by the *Waste Act*, since the PNGMDR is required to comply with the following guideline: “Reducing the quantity and toxicity of radioactive waste must be sought, notably by processing spent fuel and by processing and conditioning radioactive waste”.

The selected strategy for managing the spent fuel generated by research reactors must be developed in relation to the characteristics of the fuel and may involve either processing/recycling or direct disposal. However, only a minor quantity of spent fuel is intended for direct disposal (see § G.7).

## 2.2. Justification of the processing/recycling option

France estimates that this processing/recycling strategy presents a certain number of energy and environmental advantages.

**Recycling nuclear materials forms an integral part of the security of supply.** Not only does recycling allow for re-using current energy resources in the form of the uranium and plutonium that is still present in spent fuel (close to 95%) and that would otherwise be discarded within an open cycle, but new reactors might also reduce the consumption of natural uranium by as much as 25%, if all the nuclear materials were recycled, due to an equal share of MOX fuel and to the re-enrichment of uranium from spent fuel processing. That strategy improves proportionally the security of supply and contributes to the diversification of supplies, which is especially significant for a country such as France, which benefits from little indigenous resources. Lastly, the strategy provides useful energy materials for an eventual wide use of future fast-neutron reactors.

**Processing spent fuel proves interesting with regard to the long-term disposal of radioactive waste.** As a matter of fact, not only is processed waste conditioned in a sustainable fashion, thus facilitating their handling, storage and disposal, but the reduction in volume and thermal load of the waste packages facilitates long-term disposal, since the footprint and the volume of management facilities decrease proportionally, thus lowering disposal costs and limiting the impact of uncertainties on disposal costs. In addition, since conditioning packages of processed waste by vitrification provide a high-quality containment, it represents an environmental benefit compared to the direct disposal of spent fuel, especially within a strategy aiming at recycling materials, and notably plutonium, in fast-neutron reactors where it induces a decrease in the long-term radiotoxicity of ultimate waste.

**From a strictly more political standpoint, that strategy is consistent with the determination to limit the charges to be borne by future generations,** by calling upon the best existing technologies, by making the best possible use of energy resources and by leaving all options open for the future, irrespective of the fact that fast-neutron reactors are involved or not.

**Lastly, using plutonium in MOX fuel in order to consume about only a third of the plutonium needed, not only alters heavily the isotopic composition of the remaining plutonium, but it also ensures that such technology remains non-proliferating.** Moreover, France is adapting the stream of processing/recycling operations to the consumption needs in MOX fuel in order to minimise the inventory of separated plutonium. By using processing/recycling technologies in a few facilities regulated by international safeguards and scattered around the world, it is possible to reduce proliferation risks worldwide: thanks to processing/recycling services, it is possible to prevent the accumulation of spent fuel in a large number of storage facilities around the world, in favour of final waste, since that category is not submitted to IAEA safeguards.

In the framework of that strategy, spent fuel is considered as an energy material intended for future reuse and not as waste. Hence, it leaves open the recycling option for recoverable materials as energy resources in future fuel types and reactor systems. That item is also addressed in the section below.

## 2.3. Policy implementation

In France, the processing/recycling strategy is enforced with the following implementations:

- one fuel-processing plant (La Hague facilities) and one MOX-fuel fabrication plant (MÉLOX facility at Marcoule), and
- a nuclear fleet of 58 reactors, 22 of which are licensed to run with MOX fuel (up to one-third of assemblies), with a further four reactors being licensed to operate exclusively with assemblies made of processed and re-enriched uranium.

With due account of such a reactor fleet running on MOX fuel and of reactors authorised to load uranium from spent fuel processing, France is therefore saving approximately 17% of natural uranium in its fuel consumption.

In order to avoid inventories of useless separated plutonium, the fuel is processed as prospects develop for the extracted plutonium (“flux-adequacy principle”).

All spent fuel pending processing is stored in the ponds of the La Hague Plant after having been stored in the individual NPP cooling ponds.

## 2.4. Prospects

### 2.4.1. Prospects for Generation-IV reactors

In the case of spent MOX fuel, which contains a high concentration of plutonium with a high energy potential, and of uranium oxide (UO<sub>2</sub>), which is manufactured from uranium processed from spent fuel, the current strategy consists in storing them and if so, processing them at a timely moment with a view to using the resulting plutonium in fast-neutron reactors. Hence, the development of new reactor generations at term or not will prove determining in order to specify the storage period for those fuel types, as well as their future and their destination. In addition, experimental MOX processing campaigns (65 t of MOX processed up to date) have already taken place at La Hague and demonstrated the feasibility of that operation.

The development of such Generation-IV fast-neutron reactors would allow for a better optimisation in the use of energy resources. For an equal quantity of natural uranium, the recoverable energy could be up to 100 times higher than with current reactors. That is the reason why France is so deeply involved in research activities on those reactors of the future (ASTRID prototype), which represent a key technology for the sustainable use of nuclear systems.

### 2.4.2. Precautions for the future, (as a complement to that long-term strategy)

The *Environment Code* instituted a securing mechanism for long-term nuclear charges (see § B.1.6.1), from which are excluded all charges relating to the operating cycle. Inversely, any non-recyclable spent fuel present in existing facilities (spent MOX and spent processed and re-enriched uranium) must be allocated accounting provisions on the basis of a direct-disposal scenario and of a financial coverage by the dedicated funds referred to in § B.1.7.

Furthermore; any holder of recoverable materials must, for preservation purposes, carry out all relevant studies on potential management systems in case such materials were to be considered as waste in the future (see § B.1.2.2 and § B.4.1.2).

## 3 | SPENT-FUEL MANAGEMENT PRACTICES

### 3.1. Spent-fuel management by EDF for its nuclear power reactors

EDF is responsible for the future and the processing of its spent fuel and all associated waste.

EDF's current strategy is to process spent fuel, while optimising the energy yield of nuclear fuel.

After cooling in the pools located in the fuel buildings of nuclear reactors, spent-fuel assemblies are transferred to the AREVA plant at La Hague.

After a few years, the spent fuel is dissolved in order to separate the reusable materials from HL waste, which is then vitrified. Reusable materials are recycled into MOX fuel (plutonium) or partly now into fuel containing re-enriched separated uranium during the processing of spent fuel (processed re-enriched uranium) after re-enrichment.

That industrial processing/recycling process has been recently confirmed as follows:

- MOX fuel consumption has been authorised in 2013 in two reactors in addition to the 22 other reactors already running on it, and
- With four reactors authorised to load uranium from spent fuel processing, the resulting saving in natural uranium is estimated at approximately 17%.

That way, EDF, in connection with fuel-cycle industrialists, is keeping an up-to-date version of a file on the compatibility between the evolving characteristics of new and spent fuel and the developments in the cycle facilities, as follows:

- the quantities of stored radioactive materials resulting from past fuel-management activities and especially the storage of vitrified waste in existing facilities;
- current management measures that may require the safety reference system of fuel-cycle facilities to be reviewed, or even modified;
- fuel assemblies whose structural or cladding materials for pencils are different from those that were taken into account in previous studies on the safety of fuel-cycle facilities;
- hypotheses concerning new fuel-management and new products whose implementation is planned over the next few years;
- management hypotheses for unloaded spent fuels, and
- the consequences of those management measures and management hypotheses first until 2017, and then beyond, with regard to by-products and waste categories resulting from the activation and processing of spent fuel (processing possibilities and associated systems, potential storage or disposal).

ASN completed its review of the most recent version of that file in 2010 (See § G.1.3) and EDF is now currently updating it in order to incorporate the developments that occurred in fuel-cycle facilities, notably with regard to storage-pond capacities in NPPs and in processing plants, as well as the management means it applies to the fuel and the products being loaded into reactors.

Finally, the design and the strength of the spent fuel pits located in the NPPs were reviewed during the stress tests carried out following the accident at the Fukushima Daiichi nuclear power plant.

### 3.2. Spent-fuel management by the CEA for research reactors

The CEA's reference strategy is to send, as soon as possible, all non-reusable fuel for processing to facilities dealing with the back-end of the fuel cycle.

Most of the CEA's spent fuel is sent for processing to the La Hague Plant UP2 800 (AREVA NC).

Pending their processing at the La Hague Plant, the CEA stores its spent fuel at two facilities on the Cadarache Site, in accordance with specific safety rules. Those facilities include a dry-storage bunker for spent-fuel elements cooled in pits by natural convection (*casemate d'entreposage à sec d'éléments combustibles usés avec refroidissement des puits par convection naturelle* – CASCAD) in order to store most of the spent fuel from the CEA's activities in the civilian nuclear sector, as well as an underwater storage facility (CARES pool).

Storage facilities still exist at Saclay and Marcoule: the fuel they contain are disposed of progressively. Those that are still laying in the BNI-22 PÉGASE ponds at Cadarache and in the BNI-72 will be disposed of by 2016 and 2017 for araldite-bearing waste.

All planned technological solutions until now include staggered processing at La Hague's Plant UP2 800 or storage in Cadarache's CASCAD or CARES facilities.

### 3.3. Spent-fuel management by AREVA

AREVA provides French operators with all required resources for implementing their spent-fuel management policy.

That range of services is also made available to foreign electricity utilities with a similar policy. In such cases, spent fuel is shipped to La Hague where it is cooled for an appropriate time. Recoverable products are recycled, either immediately or at a later date, depending on market conditions. The waste is packaged and returned to its owners, in accordance with Article L. 542 of the *Environment Code*.

The separation of recoverable materials and the various residues, as well as their specific packaging, are performed at La Hague plants, while the recycling of plutonium into MOX fuel is performed at the MÉLOX plant in Marcoule, where the authorised capacity stands at 195 HMt (heavy metal tonne).

The feasibility of processing/recycling of MOX, FNR and URE fuels was demonstrated in the La Hague plants through specific industrial campaigns covering about a hundred metric tons of fuels in the La Hague, UP2 400, UP2 800 and UP3 A units. At the same time, AREVA stores these fuels in pits (if the fuels are under French ownership), pending their processing, for example with a view to recycling in generation IV fast neutron reactors.

## 4 | APPLICABLE CRITERIA FOR THE DEFINITION AND CLASSIFICATION OF RADIOACTIVE WASTE

### 4.1. Definition of “radioactive waste”

The legal definitions of “radioactive substance”, “radioactive waste” and “radioactive material” are provided in § B.1.2.1.

Two aspects are worth commenting on: when a substance starts to be considered as radioactive? Is this substance be considered as a recoverable substance or a waste?

#### 4.1.1. Radioactive character of substances

This paragraph covers the topics of exclusion, exemption and clearance of radioactive substances, clarifying the notion of radioactive substance in France.

##### 4.1.1.1. EXCLUSION

Most materials are radioactive by nature. Their radioactivity is due mostly to potassium 40 and to the radionuclides of the uranium and thorium families. That radioactivity is generally low and does not require the corresponding radiological risk to be taken into account, entailing no particular precautions (except for radon in the home, but this does not fall within the scope of this report). If not used in a process which leads to this radioactivity being concentrated, these materials are then considered as non-radioactive and managed as this.

##### 4.1.1.2. EXEMPTION

In France, nuclear activities are exempt from the authorisation or notification stipulated by the Public Health Code if they comply with one of the following two conditions (Article R. 1333-18):

- the quantities of radionuclides present at any moment on the location where the practice is carried out do not exceed the exemption thresholds set by the Code, regardless of the activity concentration of the substances concerned, and
- the concentration, per unit mass, of the radionuclides present at any moment on the location where the practice is carried out does not exceed the exemption thresholds set by the Code, provided that the masses of the substances concerned do not exceed one metric ton.

The exemption thresholds appearing in the Code apply to the total stock of radionuclides held at any time by an individual or a company for a specific activity, with any division designed to artificially reduce the stock, or any dilution of a substance aimed at reducing the activity concentration, being prohibited.

The Code also defines rules in the case of mixing of radionuclides.

It is not therefore the substances which are exempted, but rather the processes using them.

##### 4.1.1.3. CLEARANCE

Another important notion is clearance, in other words the removal of a substance from the regulated scope. Some countries, pursuant to *European directive 96/29* and the associated technical recommendations, accept unconditional clearance levels, below which a waste produced by a nuclear activity can be considered conventional waste. France has developed a different approach: any substance which falls within the scope of the regulations applicable to the uses of radioactivity for BNIs or from the small-scale nuclear sector, requires specific management if it has been in contact with radioactive contamination or has been activated by radiation. French regulations make no provision for the clearance of such substances. This entails management of radioactive waste, including processing and/or disposal, in duly authorised facilities.

This is why France has a specific solution for the long-term management of very low level (VLL) waste that is the Cires disposal facility in the Aube *département*.

With regard to the potential for recycling, the materials from a nuclear activity must be recycled in the nuclear industry, whenever they are contaminated or activated by radionuclides or liable to have been so as a result of this activity.

The recycling or reuse of materials, even if very slightly radioactive, is exclusively allowed in the nuclear industry (nuclear facilities, waste containers, biological shielding in waste packages, etc.).

France's position is therefore to be more restrictive than the recommendations made by international organisations with regard to radiation protection on which the policy of several other countries is based when VLL waste is involved.

#### **4.1.2. Prospect analysis for the future use of nuclear materials (implying that they are not considered as waste)**

Among radioactive substances, some are considered for a future use, thus justifying the clearance from the qualification as "radioactive waste". The PNGMDR takes into account those materials and their prospects for future use (see. § B.1.2.2).

Pursuant to the *Decree of 23 April 2012*, all owners of radioactive materials for which recovery processes have never been implemented have submitted to the government in late 2012 a status report on the studies dealing with the recovery processes they are contemplating.

The observations made by the PNGMDR are mentioned in § B.4.1.2.1 to B.4.1.2.4. They are followed by ASN's opinion (§ B.4.1.2.5) and recommendations from the PNGMDR (§ B.4.1.2.6).

##### **4.1.2.1. SPENT FUEL**

Pursuant to the French policy, most spent fuel is considered as recoverable materials. More particularly, in the case of UOX fuel, the recovery of civilian uranium-bearing spent fuel is already applied from an industrial standpoint. In the case of plutonium-bearing MOX fuel, the feasibility of the process has been demonstrated. Similarly, but except for limited quantities of certain types of spent fuel from research reactors, the feasibility of the process for the fuel being unloaded from research reactors or nuclear-driven ships is confirmed.

##### **4.1.2.2. URANIUM AND PLUTONIUM**

Depleted uranium offers a recovery potential, since it may be:

- enriched to the same extent as natural uranium;
- used in MOX fuel, and
- used in future Generation-IV fast-neutron (if France decide to acquire such reactors).

The fact that the first two recovery systems are already available is sufficient to justify on its own that depleted uranium constitutes a radioactive material since its use is already scheduled or contemplated.

With regard to the share of uranium-238 contained in depleted uranium, whether it has been processed from spent fuel or not, it may be recovered over the very long term in Generation-IV fast-neutron reactors.

In cases where Generation-IV fast-neutron reactors may not be developed, those materials would become waste once their content of uranium-235 would stop to be attractive. At that point, they ought to be managed as waste over the very long term. That long-term strategy falls in line with the framework prescribed by the *Environment Code*. With regard to plutonium, EDF feels that the overall quantity of mobilisable plutonium in 2040 should be in the order of 505 to 565 t. According to CEA, that quantity would allow for the commissioning of approximately 25 1,450-MWe Generation-IV fast-neutron reactors similar to the type that is proposed in CEA studies in accordance with a schedule that depends notably on spent-fuel-treatment capabilities. The order of magnitude of the quantity of available plutonium at that time is therefore consistent with a progressive replacement scenario for the fleet of Generation-IV reactors. The recoverable character of the plutonium inventory scheduled in 2040 is therefore confirmed.

#### 4.1.2.3. AIRBORNE MATERIALS

The Rhodia Company holds some radioactive materials that include airborne materials, such as rare-earth oxides and traces of uranium. Rhodia has conducted various technico-economic feasibility studies on the recovery of those airborne materials. It also identified several processing and recovery prospects for the rare earths contained in the airborne materials it holds. Hence, the recoverable character of those materials has been confirmed.

#### 4.1.2.4. THORIUM

AREVA and RHODIA are envisaging several possibilities for reusing thorium-bearing materials, which led to them being classified as radioactive materials. As far as thorium-bearing materials are concerned, no management system is operational so far for the recovery of the quantities held by Areva and Rhodia. There are also large reserves for the short- and medium-term purposes of a recovery system based upon thorium-fuelled reactors. The fine-tuning of the relevant processes and the design of the different types of thorium-fuelled reactors require further and more significant research and development efforts. In addition, the economic aspects of the potential uranium resources of that system still need to be demonstrated.

#### 4.1.2.5. ASN'S OPINION

ASN sent the Ministers concerned opinion 2014-AV-202 of 6 February 2014 on the studies submitted in late 2012 by AREVA, CEA, EDF and Solvay (formerly Rhodia). According to this opinion, experience feedback confirmed the fact that the materials produced by the “uranium” technology (spent fuel, depleted natural uranium and uranium obtained from the processing of spent fuels) could be reused, as could the materials produced by the “plutonium” technology, both in current energy conditions and in fast neutron reactors. However, in its opinion, ASN stressed the need to check the adequacy between the planned uses and the stock of these materials held by their owners, more specifically with regard to depleted uranium. Moreover, in its opinion of 16 May 2013, ASN recommended that with a view to the safety and robustness of future energy choices, Andra continue the studies into the technical design options which would be implemented for the possible direct disposal of spent fuels, so that were creation of the disposal facility to be authorised, it would be technically possible to accept these spent fuels. These different topics are the subject of prescriptions in the *decree of 27 December 2013* (also see Chapter G.7 below).

With regard to materials containing thorium, ASN estimated that there is no certainty they can be reused and that they should therefore be reclassified as radioactive waste.

For safety and robustness reasons the *decree of 23 April 2012* required that the owners of radioactive materials carry out studies on the long-term management routes for these materials in the event of them being in the future reclassified as waste and that they submit these studies to the Ministers responsible for energy, nuclear safety and radiation protection, defence, the environment and research. In June 2012, ASN submitted an opinion on the corresponding studies submitted by the owners of radioactive materials. The opinion underlined the significant level of specific activity of the materials considered and the lengthy half-lives of the corresponding radionuclides. ASN considered that the envisaged depth would make the disposal facilities vulnerable to human intrusion and to natural phenomena liable to occur in the long-term and that there was no guarantee that conditions such as to limit the release of radionuclides could be maintained over the long-term. ASN therefore recommended that, together with Andra, the owners of radioactive materials conduct further studies into the disposal of these materials in the event of them in the future being reclassified as waste, providing assessments of the radiological and chemical impacts resulting from transfers by water, air and the soil, for both normal and altered evolution scenarios. This request is important because it is necessary to anticipate a possible reclassification of radioactive materials as waste, more specifically to guarantee that the design and operation of the disposal facilities intended for them can be adapted accordingly.

#### 4.1.2.6. PNGMDR RECOMMENDATIONS

The *decree of 27 December 2013* formulated the following requests:

- the owners of radioactive materials shall, before the end of 2014, provide information on the recycling/reutilisation processes they envisage, or on the envisaged changes. This information shall include an analysis of the adequacy between the recycling/reuse prospects and the current and future quantities held, and
- the owners of radioactive materials shall in the meantime, carry out studies on the possible management routes in the event of these materials being in the future reclassified as waste.

## 4.2. Classification of radioactive waste

### 4.2.1. Criteria and categories

The usual French classification of radioactive waste is based on two parameters of importance for defining the appropriate management mode: the activity level of the radionuclides it contains and their radioactive half-life.

With regard to the radioactive half-life, a distinction is made between very short-lived waste, for which the half-life is less than 100 days, short-lived waste, for which the radioactivity stems mainly from radionuclides with a half-life of 31 years or less, and long-lived waste, which contains a significant quantity of radionuclides with a half-life of greater than 31 years.

Depending on the radioactive half-life and taking account of the activity level, six main waste categories were defined:

- **high level waste (HLW)** mainly consists of vitrified packages of waste from spent fuels after processing. These waste packages contain the vast majority of the radioactivity contained in all the waste produced in France, whether fission products or minor actinides. The activity level of the vitrified waste is several billion Bq/g. Owing to their high level of radioactivity, this waste gives off heat;
- **intermediate level, long-lived waste (ILW-LL)** comes mainly from spent fuels after processing and from the maintenance and operation of the processing plants. This primarily consists of structural waste from nuclear fuels, that is the hulls (cladding sections) and end-pieces, packaged in cement-encapsulated or compacted waste packages, as well as technological waste (used tools, equipment, etc.), or even waste resulting from the treatment of effluents such as certain sludge. The activity of those residues ranges between 1 million and 1 billion Bq/g. There is either no or negligible heat release;
- **low-level long-lived waste (LL-LL)** mainly consists of graphite and radium-bearing waste. The graphite waste comes mainly from the former gas-cooled reactor (GCR) technology. The graphite waste (graphite sleeves of the fuels stored and the stacks still in place) mainly contains long-lived beta radionuclides such as carbon 14 and chlorine 36. Their activity level is from ten thousand to a hundred thousand Bq per gram. The radium-bearing waste, most of which comes from non-NPP activities (such as the processing of ores containing rare earths), mainly contains long-lived alpha emitter radionuclides, with an activity of between several tens of Bq per gram and several thousand Bq per gram. This waste category also comprises other types of waste such as certain legacy bitumen packages, residues from the uranium conversion processing carried out in the Comurhex plant in Malvesi, etc.;
- **low-level and intermediate-level short-lived waste (LIL-SL)** results mainly from the operation, maintenance and dismantling of NPPs, fuel-cycle facilities and research establishments, as well as, for a slight share, from activities relating to medical studies.;
- **very-low-level waste (VLL)** is mostly due to dismantling of NPPs, fuel-cycle facilities, research establishments and, to a lesser extent, from the operation and maintenance of this type of nuclear installations. The activity level of this waste is generally below one hundred Bq per gram. Its activity level is generally lower than 100 Bq/g, and
- **very-short-lived waste** comes mainly from the medical and non-NPP research sector.

For practical purposes, the following acronyms are often used:

Acronyms	Designation	French acronyms
<b>HL</b>	high level	<b>HA</b>
<b>IL-LL</b>	intermediate level – long-lived	<b>MA-VLL</b>
<b>LL-LL</b>	Low-level long-lived	<b>FA-VLL</b>
<b>LIL-SL</b>	Low-level and intermediate-level short-lived	<b>FA/MA-VC</b>
<b>VLL</b>	very-low-level	<b>TFA</b>

**TABLE 3 : ACRONYMS USED FOR THE DIFFERENT WASTE CATEGORIES**

*Note:* There is currently no acronym for “very-short-lived waste”.

This categorization allows the association of each waste category, one or several corresponding long-term management solutions already implemented or still under study. The following table presents the long-term management solutions.

		Very short-lived waste (i.e. containing radionuclides with a half-life < 100 days)	Short-lived waste in which the radioactivity comes mainly from radionuclides with a half-life ≤ 31 years	Long-lived waste containing a significant quantity of radionuclides with a half-life > 31 years
~ hundreds Bq/g	<b>Very low level (VLL)</b>	Management by radioactive decay	Recycling or dedicated surface disposal (Cires – the industrial grouping, storage and disposal centre in the Aube département)	
~ Millions Bq/g	<b>Low level (LL)</b>		Surface disposal (Aube disposal centre, CSA)	Solutions being studied under Art. 4 of the Waste Act
~ Billions Bq/g	<b>Intermediate level (IL)</b>			Solution planned under Art. 3 of the Waste Act
	<b>High level (HL)</b>	Not applicable <sup>13</sup>		(Planned Cigéo disposal centre)

**TABLE 4 : RADIOACTIVE WASTE CLASSIFICATION PRINCIPLES**

#### 4.2.2. Absence of single and simple classification criterion

There is no single classification criterion for determining the category of a waste. The radioactivity of the various radionuclides present in the waste must be studied to enable it to be classified. However, in the absence of a single criterion, it is possible to give the specific activity range within which each waste category is generally situated. This is shown in the previous section.

A particular waste may appear to correspond to one of the categories defined above in terms of radioactivity but will not be accepted in the corresponding management route because of other characteristics (chemical composition, potential attractiveness). This is notably the case with waste containing significant quantities of tritium, a radionuclide that is hard to contain, or sealed sources, which can be attractive.

Numerous criteria are therefore required to determine the acceptability of a given waste in a given route. The licensees of disposal facilities determine acceptance specifications to define the acceptable waste packages. It is the conformity with these specifications which in the end defines the category of a given waste.

<sup>13</sup> The high level very short-lived waste category does not exist.

## 5 | RADIOACTIVE WASTE MANAGEMENT POLICY

### 5.1. General framework

Radioactive-waste management is part of the general framework for radioactive waste set forth in *Law No. 75-633 of 15 July 1975 Concerning Waste Elimination and Material Recovery* (Article L. 541 of the *Environment Code* and hereinafter referred to as the “1995 Law”) and completed by *Law No. 92-646 of 13 July 1992 Concerning Waste Elimination and ICPEs*, and its implementation decrees.

The management policy for radioactive materials and waste is part of the more precise of the *Waste Act* (see § A.2 and B.1).

### 5.2. Conventional waste, radioactive waste and VLL waste

#### 5.2.1. Conventional and radioactive waste in BNIs

Management of BNI waste is governed by strict regulations, defined by the *BNI Procedures Decree* and the BNI order. In particular, all BNI licensees must, at commissioning, send ASN a “waste study” concerning their facility. This study must comprise:

- an analysis of the waste produced or to be produced, and
- a “waste zoning plan” identifying the areas of possible production of radioactive waste, in other words areas in which the waste produced is contaminated, activated or liable to be so. The zones of the facility not defined as “zones for possible production of radioactive waste” are known as “conventional waste zones”.

The provisions adopted for the management of existing or future waste, more specifically the organisation put into place and the envisaged changes. This includes the steps taken to prevent and reduce the production and harmfulness of waste, the waste management choices made, the list and characteristics of the storage facilities, the consistency of the measures adopted for waste and effluents, and traceability.

Before the end of 2014, ASN will publish a resolution clarifying its requirements with regard to the content of the “waste study” and the study update procedures, the procedures for the production and management of the waste zone plan and with regard to the content and drafting procedures for the “waste summary”.

This regulatory arrangement replaces the old system based on the 31 December 1999 order which already stated the need to produce “waste studies”, themselves based on the definition of “waste zoning”.

Two points are worth highlighting.

First of all, the waste from zones of possible production of radioactive waste must be managed in routes which take into consideration the fact that they are contaminated, activated or liable to be so by radioactive substances, with respect to the interests mentioned in Article L. 542-1 of the *Environment Code*. In the absence of any clearance level, the very low-level waste from these zones is disposed of in the Cires, or incinerated at SOCODEI, or reused in the nuclear industry or, for certain waste, stored pending a final solution (for example if it contains free asbestos).

The system for the traceability of radioactive or hazardous waste is also defined by Articles R. 541-42 and following of the *Environment Code* and its implementing orders. The BNI order requires that the licensee ensure the traceability of the management of the waste produced in its installation. It must keep up-to-date and accurate accounts of the waste produced and stored, specifying the nature, the characteristics, the location, the producer of the waste, the disposal routes identified and the quantities both present and removed.

To conclude, the “waste study” determines the baseline requirements for the management of waste in a BNI. It must be kept up to date according to any changes in the installation. It is also periodically reassessed.

### 5.2.2. Waste with enhanced naturally-occurring radioactivity

#### 5.2.2.1. NATURE OF WASTE

Waste containing enhanced naturally-occurring radioactivity results from the transformation of raw materials containing naturally-occurring radionuclides that are not used for their radioactive properties, fissile or fertile. Their radioactivity is due to the presence of natural radionuclides, such as potassium-40, and radionuclides from both the uranium-238 and thorium-232 families. These radionuclides can be found concentrated in waste due to transformation processes.

There are two types of waste with enhanced naturally-occurring radioactivity, as follows:

- *VLL-LL waste*, such as historical stockpiles of phosphogypsum coming from the fertiliser production and coal-ash coming from coal power plants, and residuals coming from alumina production, foundry sand, refractory waste from zirconium-based refractories used notably in the glass industry, etc. , and
- *LL-LL waste*, such as certain waste resulting from the processing of monazite, the fabrication of zirconium sponges, existing and future residues from the dismantling of industrial facilities originating, for instance, from plants for manufacturing phosphoric acid, for processing titanium dioxide, processing zircon flour and former activities involving the processing of monazite.

#### 5.2.2.2. THE ORDER OF 25 MAY 2005 AND THE CIRCULAR OF 25 JULY 2006

The *order of 25 May 2005* concerning professional activities utilising raw materials naturally containing radionuclides but not used for their radioactive properties requires the licensee of an installation belonging to one of the activity sectors listed in this order:

- to carry out a study to measure exposure to naturally occurring ionising radiation and estimate the doses to which the population is liable to be exposed owing to said installation, and
- to evaluate the doses received by the workers.

The circular of 25 July 2006 concerning classified installations – Acceptance of technologically enhanced or concentrated naturally occurring radioactive materials in waste disposal centres, defines the procedures for acceptance of TENORM waste in “conventional” waste disposal facilities. It specifies that the waste concerned by this circular is that originating in one of the activities mentioned by the order of 25 May 2005.

#### 5.2.2.3. FORMER PRODUCTION AND CURRENT PRODUCTION

It is first of all worth recalling that it is hard to produce an exhaustive list of the industries liable to produce this type of waste. On the basis of the list drawn up by the order of 25 May 2005, the current production of TENORM waste is mainly due to the following activity sectors:

- ore processing and transformation industries;
- refractory ceramics production industries;
- zircon production and utilisation industries;
- industries producing or using compounds comprising thorium;
- water treatment installations;
- spas.

#### 5.2.2.4. MANAGEMENT OF TENORM WASTE

There are several modes for managing TENORM waste:

- disposal in conventional disposal centres duly authorised for this purpose;
- disposal in facilities dedicated to radioactive waste (existing or planned facilities);
- depots on the production sites (legacy waste);
- reutilisation/recycling solutions.

### **TENORM waste disposed of in conventional disposal centres**

In France, for nuclear activities subject to the BNI and secret BNI (BNIS) regime as well as for nuclear activities authorised or notified pursuant to Article L.1333-4 of the Public Health Code, mentioned in Article R.1333-12 of the same Code, any waste that is contaminated, activated, or liable to be so shall, as a precautionary measure, be the subject of specific, reinforced management which more specifically includes the disposal of ultimate waste in a centre dedicated to radioactive waste. The French regulations make no provision for the clearance of very low level waste.

For the other nuclear activities, the justification or otherwise of radiation protection monitoring is assessed in accordance with the provisions of the Public Health Code, taking account of the three fundamental principles of radiation protection: justification, optimisation and limitation of the radiation doses, and of the fact that the sum of the effective doses from nuclear activities received by any member of the public may not exceed 1 mSv per year. Therefore, when an acceptability study concerning the radiological impact associated with acceptance of the waste is able to demonstrate that radiation protecting monitoring is not justified, the waste may, in certain conditions, be accepted in conventional disposal facilities. This is notably the case for certain waste containing technologically enhanced naturally occurring radioactive materials.

There are currently 4 centres in France which have licensed to accept this type of waste. The main two are Villeparisis in the Ile-de-France region and Bellegarde in Languedoc-Roussillon.

### **TENORM radioactive waste disposed of or to be disposed of in disposal facilities dedicated to radioactive waste (existing or planned facilities)**

Very low level TENORM waste which cannot be accepted in conventional waste disposal facilities is disposed of in the industrial grouping, storage and disposal centre (Cires) in Morvilliers. The 2012 edition of the National Inventory identifies 7,800 m<sup>3</sup> of waste in this category as at the end of 2010, excluding waste generated by spas, paper mills and the combustion of biomass.

Low level, long-lived TENORM waste is included in the industrial management schemes for low level, long-lived waste studied by Andra. The 2012 edition of the National Inventory identifies 17,000 m<sup>3</sup> of TENORM waste in this category (excluding waste generated by spas, paper mills and the combustion of biomass). Pending disposal, this waste is stored on certain production sites.

### **Depots of TENORM waste on the production sites (legacy waste)**

The depots of legacy waste are mainly the result of the production of phosphoric acid used to manufacture fertiliser, alumina production and thermal power plants (disposal of coal ash). These sites no longer take any new waste and are under appropriate surveillance. They are identified in the National Inventory of Radioactive Materials and Waste produced by Andra (see § B.1.2.3 above). The volume of this legacy waste is estimated at 40 million metric tons.

### **Recycling solutions**

Recycling solutions only concern certain types of waste. Coal ash can be recycled in the manufacture of high valued added concrete. Over the period 2000-2009, 1.4 million metric tons of ash were produced and 1.8 million metric tons were recycled. The additional volume recycled was taken from spoil heaps.

At present, the Solvay Company is also looking at the possible recycling of the thorium contained in the raw hydroxides of thorium. Thorium recovery could find applications in the medical sector.

#### **5.2.2.5. THE RECOMMENDATIONS OF THE 2013-2015 PNGMDR**

Based on an ASN opinion dated 20 July 2009, the 2013-2015 PNGMDR recommends a number of regulatory changes in order to increase the information available on the waste produced and improve its traceability. The recommendations made are based on the principle that the waste processing routes are determined according to the origin of the waste. Since the *decree of 13 April 2010*, the waste processing routes are in fact determined according to the intrinsic characteristics of the waste itself (harmfulness, inert or not, etc.). There is thus a degree of incompatibility between the recommendations made and the current waste regulations. However, certain recommendations, such as implementing radiological surveillance around waste disposal centres, are in the process of being taken into account.

The regulatory framework concerning the management of waste containing radionuclides of natural origin will be reviewed within the context of the transposition of *Council directive 2013/59/EURATOM* of 5 December 2013, which sets basic standards for health protection against the dangers resulting from exposure to ionising radiation, which should be completed in 2018.

### 5.2.3. Disposal of radioactive waste in conventional disposal facilities

In the past, waste containing radioactive substances consisting mostly of sludge, earth, industrial residues, rubble and scrap metal generated by the historical activities of conventional industries, or even the nuclear civilian or military nuclear industry, had been disposed of in conventional technical burial facilities (*centre d'enfouissement technique* – CET), most of which are now closed or have been rehabilitated.

In general, two types of facilities were involved in the disposal of such waste, as follows:

- disposal facilities for hazardous waste, previously known as “Class-1 burial facilities”, and
- disposal facilities for non-hazardous waste, previously known as “Class-2 disposal facilities”.

The Order of 30 December 2002 concerning the disposal of hazardous waste and the Order of 9 September 1997 concerning the disposal of non-hazardous waste both prohibit the elimination of radioactive waste in such facilities. That ban dates back to the early 1990s. Radiological-detection procedures upon entering disposal facilities must be implemented in order to prevent any radioactive waste from being introduced on site, and if need be, to refer them to the competent approved system.

The national inventory published by ANDRA includes 11 disposal sites having received waste containing radioactive substances in the past.

Those include, for instance, the Vif dump, where the fabrication-process residues from the Cézus Plant, the phosphate-transformation waste that had been disposed of at the Menneville Dump or at the Pontailleur-sur-Saône and Monteux Dumps that accommodated the waste resulting from the sewage sludge from the Valduc Study Centre and from the fabrication of zirconium oxides, respectively.

A dump in Solérieux contains fluorspar originating from the COMURHEX Plant.

Those former disposal sites are submitted to the monitoring measures imposed upon classified facilities (mainly with regard to implementing measures against chemical-pollution, verifying the absence of settlements and implementing public-utility easements, if need be). For all sites listed in ANDRA's inventory, which have recorded the highest radioactivity level, more or less comprehensive monitoring completed in proportion to the site provide for a radiological monitoring of groundwater, as in the case of the Vif, Solérieux or Monteux Dumps.

## 5.3. Sealed sources unlikely to activate materials

The use of sealed sources not likely to activate materials does not generate any other radioactive waste than the source itself. Existing regulatory mechanisms are described in § F.4.1.2.3 and F.4.1.2.4, whereas prospects (disposal, lifetime extension, justification of the use of sealed sources) are mentioned in Section J. The management of disused sealed sources constitutes an integral part of the PNGMDR.

### Unsealed sources and radioactive waste from ICPEs and mining residues

Radioactive waste from ICPEs or sites regulated under the Public Health Code must be disposed of in the same facilities as those defined for BNIs.

Facilities that receive conventional waste must not receive any radioactive waste whatsoever, although some waste with enhanced naturally-occurring radioactivity may be accepted under the conditions specified in § B.5.2.3.

After use, unsealed sources are considered as liquid radioactive waste and are normally entrusted upon ANDRA, which, in turn conveys them to CENTRACO's facility for processing. However, if the half-life is below 100 days, the waste may be managed through its natural decay.

Waste containing radionuclides with a half-life of less than 100 days, may however be managed by radioactive decay.

At present, no mining residues are produced on French territory. Legacy mining residues are disposed of, in situ, on certain former dedicated mining sites.

#### 5.4. Stakeholders' responsibilities

Article L. 542-1 of the *Environment Code* prescribes that “any producer of spent fuel and of radioactive waste shall be liable for those substances, without any prejudice to the liability of their holders as persons responsible for nuclear activities”. However, different stakeholders also intervene in waste handling: transport companies, processing suppliers, managers of storage or disposal facilities, as well as R&D organisations aiming at optimising that management.

The responsibility of the waste producer does not relieve the above-mentioned stakeholders of their own responsibility concerning the safety of their activities. The scope of the waste producer's responsibility encompasses his financial liability. The fact for a producer of radioactive waste to transfer his waste to a storage or disposal facility does not relieve him from his financial responsibility for it (See also § F.1.2.2).

In accordance with PNGMDR orientations, waste producers must continue to minimise the volume and activity of their waste, not only upstream when designing and operating their facilities, but also downstream by managing their waste. Compliance with that objective shall be controlled by ASN in the framework of the approval process of studies on BNI waste and by the cost associated with the take-over of that waste, thus encouraging necessarily the producers to minimise their quantity of waste. The topic of waste reduction is addressed in § B.6.1.1 and H.1.2.3 for LIL-SL waste and in § B.6.1.3.5 for HL/IL-LL waste (AREVA NC): those sections show the advances achieved in the field over the last two decades. The quality of waste conditioning shall also be guaranteed, with due account of long-term radiation-protection and safety goals

Research organisations contribute to the technical optimisation of radioactive-waste management in terms of both the production level and the development of treatment, conditioning and characterisation of the conditioned waste. A sound co-ordination of research programmes is necessary in order to improve the overall safety of that management.

#### 5.5. Role of ANDRA

As a public establishment of an industrial and commercial nature, the French National Agency for Radioactive Waste Management (Andra) is responsible for finding and implementing safe management solutions for all French radioactive waste, in order to protect present and future generations from the risk that this waste represents.

Andra is independent of the radioactive waste producers and placed under the supervision of the Ministers responsible for energy, research and the environment, respectively.

Its role was defined by two successive Acts: the 30 December 1991 Act which created the Agency as a public establishment, notably giving it responsibility for research into the deep geological disposal of high level and intermediate level, long-lived radioactive waste, and the Waste Act, which determines its scope of action and which entrusts it with the following duties:

- Design, scientific research and technological development: study and design of sustainable management solutions for radioactive waste as yet without a disposal solution: high level waste (HLW), intermediate level, long-lived waste (ILW-LL) and low level, long-lived waste (LLW-LL).
- Industrial duties:
  - collect and take charge of all radioactive waste, regardless of its origin;
  - operate and monitor the radioactive waste disposal centres, in order to guarantee their safety for man and the environment.
- Public service and information duties:
  - collect radioactive objects from individuals and from local authorities;
  - clean-out and rehabilitate sites contaminated by radioactivity;
  - produce the National Inventory of Radioactive Materials and Waste in France and publish it every three years;
  - provide clear and verifiable information on the management of radioactive waste;
  - encourage meetings and promote dialogue with all the stakeholders.

- Technology transfer of know-how in France and internationally:
  - develop scientific collaboration at the national, European and international levels;
  - exploit all the Agency's service offerings in France and internationally;
  - disseminate scientific and technical culture as broadly as possible in the field of radioactive waste management.

With regard to the decommissioning operations, which will entail significant volumes of waste, Andra is also focusing on four areas of work:

- acceptance of waste in its industrial facilities, adapting its procedures as applicable with the aim of ensuring overall optimisation, in other words, considering all the phases of waste management, from production to disposal and taking account of criteria such as the radiological exposure of the operators, the consumption of disposal capacity, costs, etc.;
- the search for alternative management solutions to disposal on the sites and provision of services to the licensees for intervention as far upstream as possible in the choice of decommissioning strategies in terms of waste management;
- R&D concerning the characterisation and packaging of the waste;
- assistance for the authorities in defining policy guidelines to be adopted for decommissioning waste management.

## 5.6. ASN policy

Through the codified TSN Act, ASN is tasked on behalf of the State with regulating the safety of basic nuclear installations (BNIs) and radiation protection for all civil nuclear facilities and activities, in order to protect workers, patients, the public and the environment from the risks linked to nuclear activities. Moreover, in accordance with this Act, ASN must contribute to informing the public.

ASN's aim is to ensure efficient, legitimate and credible nuclear oversight, recognised by the population and constituting an international benchmark. To do this, ASN's constant objective is to achieve and maintain high levels of competence, independence, rigorousness and transparency.

ASN's policy is to advance the management of radioactive materials and waste in a manner that is safe, coherent and structured. It considers that the drafting of the PNGMDR and its recommendations is essential for implementing this improvement policy and is therefore closely involved in it. One of the priorities is the existence of safe management solutions for each category of radioactive materials and waste, regardless of their activity, their lifetime, or their origin, preferring final management solutions. This presupposes identifying the foreseeable need for storage and disposal facilities and ensuring compliance with the requirements of the *Environment Code* and the hierarchy of management modes (reduction at source, recycling, reuse, incineration, and disposal).

For ASN, this policy must be accompanied by strict monitoring of all activities concerned by radioactive waste management. It in particular attaches importance to the safety of each step in the management of radioactive waste (production, processing, packaging, storage, transport and disposal).

The aim is to ensure that the BNI licensees and waste producers assume their responsibilities for the management of radioactive waste. To do this, ASN establishes rules and guides, checks the safety examinations and reviews by the BNI licensees involved in the management of radioactive waste, conducts inspections of the licensees, encourages and takes part in project progress meetings to identify any potential difficulties as early as possible. Checks are also carried out on the general organisation set up by Andra for the design and operation of disposal centres and for the acceptance of waste from the producers in the corresponding facilities. Whenever necessary, this oversight work leads to resolutions or opinions, which are made public.

Finally, ASN's policy is to provide the public with impartial information. This information is through the Annual Report it transmits to Parliament every year, and the various publications and information on its website. It should be noted that most draft resolutions, rules or guides are posted for consultation and published on its website.

## 6 | RADIOACTIVE-WASTE MANAGEMENT PRACTICES

### 6.1. NPP radioactive waste

#### 6.1.1. Management by EDF of waste generated by its nuclear power reactors

Most of the waste resulting from the operation of pressurised-water reactors (PWR) consists of VLL, IL or LL-SL waste. It contains beta and gamma emitters and only a few or no alpha emitters. It may be divided into two categories:

- process waste resulting from the purification of circuits and the treatment of liquid or gaseous effluents, in order to reduce their activity level prior to discharge. It comprises ion-exchange resins, water filters, evaporator concentrates, sludge that can be pumped, pre-filters, absolute filters and iodine traps, and
- technological waste arising from maintenance activities. It may be solid (rags, paper, cardboard, plastic sheets or bags, wood or metal pieces, rubble, gloves, protective clothing, etc.) or liquid (oils, solvents, decontamination effluents, including chemical cleaning solutions).

The following tables show the annual distribution of waste arising from the operation of EDF nuclear reactors in 2013. Data are expressed in the volume of conditioned packages that are intended for disposal at the Cires or CSA facility, directly or after processing at Centraco. Those masses or volumes of packages represent the output in 2013; most packages had been shipped, but some of them are still on the sites at the end of the year.

#### VLL waste to be disposed of at the Cires

2013 results (58 PWRs)	Disposal facility	Mass of disposed waste (t)	Activity (TBq)
Process waste	CIRES	450	0.001
Technological waste	CIRES	1,550	0.002
<b>Total</b>		<b>2,000</b>	<b>0.003</b>

**TABLE 5 : MASS AND ACTIVITY OF NUCLEAR OPERATIONAL WASTE PRODUCED BY EDF IN 2013 AND TO BE DISPOSED OF AT THE CIREs**

*Nota: Values given, in t. of VLL waste produced, are different from those given in § B.6.4, expressed in m<sup>3</sup>, corresponding to volumes delivered at the CIREs in 2013.*

#### Disposal of LIL waste to be disposed of at the CSA

2010 results (58 PWRs)	Routes	Gross volume before conditioning (m <sup>3</sup> )	Volume of disposed packages at CSFMA (m <sup>3</sup> )	Activity (TBq)
Process waste	CSFM/CTO*	1,203	3,616	227
Technological waste	CSFMA/CTO	9,111	4,035	9
<b>Total</b>		<b>10,314</b>	<b>7,651</b>	<b>236</b>

*(\*) CTO (Centraco): Processing and Conditioning Plant operated by SOCODEI (EDF subsidiary).*

*Nota: the difference between these values and those presented in § B.6.4 comes from time-lag between production and delivery. In 2013, volume produced are lower than volumes delivered.*

**TABLE 6 : VOLUME AND ACTIVITY OF NUCLEAR OPERATIONAL WASTE PRODUCED BY EDF IN 2013 AND TO BE DISPOSED OF AT THE CSA**

Technological waste represents the main stream with 88% of the total volume of gross waste and is:

- after on-site compacting, either directly shipped, in 200-L metal drums to the CSA press for further compaction and final disposal after concrete encapsulation in 450-L metal drums. Certain non-compactable technological waste is conditioned in 5-m<sup>3</sup> or 10-m<sup>3</sup> metal boxes. Lastly, the most radioactive technological waste is conditioned on site in concrete containers and disposed of directly in the CSA, or

- if the LL waste involved can be cremated, shipped in metal or plastic drums to the CENTRACO Incineration Unit, whereas LL-contaminated scrap is sent to the melting unit of the same plant in 2-, 4- and 8-m<sup>3</sup> metal boxes. The waste resulting from CENTRACO processing includes:
  - ashes, clinkers (incineration residues), which are encapsulated in 450-L metal drums, then disposed of at the CSA, and
  - 200-L ingots (melting residues), which are disposed of at the CSA, or at the Cires, if their activity level warrants it. Similarly, according to their mass activity, ventilation filters for the treatment of gases and smoke, slags and refractories, which are renewed periodically, are disposed of the CSA or at the Cires.

CENTRACO's low-level-waste processing and conditioning plant, located in Codolet, near the Marcoule Site in the Gard département, and operated by SOCODEL, specialises in the treatment of low-level and VLL waste, either by melting metal scrap or incinerating combustible or liquid waste (oil, solvents, evaporation concentrates, chemical-solution effluents, etc.

Thanks to that facility, part of low-level or VLL metal scrap is recycled in the form of biological shielding for packaging other more radioactive waste within concrete containers.

It should be noted that the reduction in the volume of technological waste finally disposed of in the CSA as a result of incineration or melting, was severely affected in 2012 and 2013 by the industrial accident concerning the Centraco melting furnace (September 2011). This led to an increase in the volumes of packages disposed of in the CSA.

Process waste is packaged in concrete containers with a metal liner. Water filters, evaporator concentrates and liquid sludge are encapsulated in a hydraulic binder in fixed facilities, such as the nuclear auxiliary building or the plant's effluent-treatment station.

For the packaging of ion-exchange resins, EDF uses the MERCURE process (encapsulation in an epoxy matrix) with two identical mobile machines.

Packages produced by both machines are intended for the CSA. The steel biological shields inserted into the containers may be manufactured using the low-contaminated steel recycled in the CENTRACO facility.

NPP maintenance may require the replacement of large components, such as reactor-vessel heads, steam generators, racks (fuel-storage modules in pools), etc. Those special residues are either stored on site or in the SOCATRI perimeter at Tricastin, or disposed of at the CSA or the Cires (4 generators from the Chooz NPPP will be disposed of at the Cires, See § D.3.2.2.3).

Over the last 25 years, significant advances have been made on LIL-SL waste quantities coming from the NPP operation. The quantity of that type of waste in relation to the net power output has decreased considerably, with the volume of relevant packages dropping from about 80 m<sup>3</sup>/TWh(e) in 1985 to slightly less than 20 m<sup>3</sup>/TWh(e) today. That latest value (2013) corresponds to an average production of about 132 m<sup>3</sup> of packages intended for the CSA per PWR unit for a net energy output of 404 TWh.

The decisive factors leading to the drop during the 1985-95 decade are chiefly organisational (reduction of potential waste at source, feedback sharing, good practices) and technical (implementation of changes to the re-draining of liquid effluents, denser packaging of certain waste by grouping and/or pre-compacting) Those improvements proved effective for the waste generated directly by reactors or resulting from reactor maintenance.

It is important to stress that the reduction in the production of solid waste was not offset by an increase in liquid discharges. On the contrary, over the same period, the average activity (excluding tritium) of the liquid effluents discharged into the environment by NPPs was divided by a factor of 50.

Improvement actions are carried out particularly with regard to the following issues:

- “waste zoning” (see § B.5.2.1);
- waste production reduction at source (ion-exchange resins, water filters and technological waste), and
- waste sorting before routing to the best management system.

It is worthwhile noting that the results of those actions are enhanced and constitute sound elements to judge of the individual environmental performance of each EDF site in service.

### 6.1.2. CEA management of the waste generated by its nuclear research establishments

The CEA's strategy regarding radioactive waste management may be summed up as follows:

- recycling historical waste as soon as possible, through recovery and characterisation operations, as well as suitable processing and conditioning systems;
- minimising the volume of generated waste;
- producing only waste categories with a predefined management solution;
- sorting waste at the level of the primary producer, in accordance with predefined waste-management systems, especially in order to prevent waste upgrading or subsequent recovery operations;
- directing waste towards existing systems (ANDRA's final disposal facilities or, failing that, the CEA's long-term interim storage facilities), while ensuring a removal rate equal to the production rate, in order to avoid encumbering experimental facilities or waste-treatment and conditioning plants that are not designed for the long-term interim storage of significant waste volumes;
- once Andra has defined the specifications for acceptance of LLW-LL and ILW-LL packages, directly packaging the LLW-LL primary packages and, to a lesser extent, the ILW-LL primary packages in disposal packages, then sending all the LLW-LL and ILW-LL packages to the future disposal centres, and
- implementing those actions under the best possible nuclear-safety, radiation-protection and technico-economic conditions

#### 6.1.2.1. TREATMENT WASTE FROM RADIOACTIVE LIQUID EFFLUENTS

Radioactive aqueous effluents produced by the CEA are treated at Cadarache, Saclay and Marcoule facilities. Treatment stations are designed primarily to decontaminate such effluents, and to discharge them into the environment pursuant to the discharge licence of each site. Their function is often also to package the residues from this treatment.

In Cadarache, a new facility for evaporation treatment of beta-gamma emitting effluents called AGATE has been commissioned in 2014. The concentrates will be transferred to Marcoule for treatment in the liquid effluents treatment station (STEL) with the site's own alpha and beta-gamma emitter effluents. The treatment is based on treated by evaporation and/or precipitation-filtering; resulting sludge are embedded in bitumen matrices to form packages intended either for disposal at the CSA or for storage pending final disposal. Bitumisation will be replaced by cementation in 2015/2016.

In Saclay, a new facility called STELLA, replaces the former facility and is used to treat beta-gamma effluents by evaporation, whereas concentrates are embedded in a cement matrix for disposal purposes at the CSA.

#### 6.1.2.2. SOLID RADIOACTIVE WASTE

Since the end of 2003, all VLL waste produced by the CEA has been sent to the Cires. The CEA has been evacuating approximately 15,000 t of VLL waste every year.

Solid LIL-SL waste is either:

- incinerated at the CENTRACO facility, or
- or compacted at Cadarache, Saclay and Marcoule facilities, or
- or pre-conditioned and then transferred untreated to the CSA for definitive conditioning purposes.

Solid waste that is compacted at the CEA is embedded or immobilised in a cement matrix. Depending on the radioactive level they contain, packages are either sent to the CSA or stored at Cadarache, pending a final solution.

The CEA has more than 20 waste-acceptance certificates for those waste packages at CSA, thus allowing it to dispose currently of about 4,300 m<sup>3</sup> /a.

In the case of non-acceptable types of radioactive waste at the CSFMA, the CEA has storage facilities, whose capacity and design, notably with regard to safety, are consistent with its production forecasts and to the creation details of facilities for permanent disposal that ANDRA is due to implement.

The CEA's LL/LL waste is:

- graphite waste generated by R&D activities regarding gas-cooled reactors (GCR) and heavy-water reactors (HWR) and from operating reactors in the series. Most of the waste, consisting of graphite piles from the reactors, is temporarily stored in shut-down reactors themselves, and
- radium-bearing waste.

It will be accepted as soon as Andra commissions the dedicated disposal facility.

For low and medium radioactivity ILW-LL waste intended for geological disposal, the packaging and storage facility (CEDRA, BNI 164) replaced the existing dedicated disposal facility (BNI 56), which is of an outdated design and reaching saturation. This facility, commissioned in April 2006, will allow storage of this waste until opening of the Cigéo disposal facility.

Furthermore, for highly radioactive waste, CEA intends to commission a storage facility called DIADEM on the Marcoule site in 2018, for which the creation authorisation application is being examined by the Administration.

On the Marcoule site, the storage facility known as the multi-purpose interim storage facility (EIP) can be used to store LLW-LL and ILW-LL bitumen packages resulting from treatment of site effluents in the STEL, in particular those from the operation and then post-operational clean-out of the UP1 plant, which is a secret BNI (BNIS), as is the above-mentioned EIP.

The other categories of waste produced by CEA (specific waste) are also being covered by retrieval studies or measures, with a view to processing and/or packaging.

This mainly concerns:

- tritiated waste;
- sodium-bearing waste generated by R&D activities regarding fast-breeder reactors and the operation of experimental or prototype reactors in that series. The waste will be treated by 2017, by using facilities that already exist or that will be built within the perimeter of the PHÉNIX reactor, which is currently being dismantled. After processing and stabilisation, the waste will be disposed of at ANDRA's CSA or Cires, and
- contaminated metal waste, such as lead and mercury, for which decontamination processes are available and have been used respectively at Marcoule and Saclay and (mercury distillation and lead fusion). Possible options include lead recycling in the nuclear sector and final disposal by ANDRA (after physical and chemical stabilisation in the case of mercury). Continuation of the recycling process is the subject of technical and economic analyses.

Achieving the technical-economic optimum in waste management is a major concern for CEA. Its policy is therefore to use packaging appropriate to storage on its sites and also directly acceptable by Andra. It is with this in mind that CEA plays an active role in the discussions being held around the various Andra projects. This also implies maintaining a coherent range of service, packaging and storage facilities and transport containers in good condition.

### **6.1.3. Management by AREVA of the waste generated by its fuel-cycle facilities**

Most of the waste generated by the operation of AREVA's facilities are currently managed on the basis of direct logistic flows and are shipped directly to ANDRA's disposal facilities. AREVA tends to favour that management mode, which contributes in limiting notably the quantity of stored waste. In 2013, 87% of operating waste having operating disposal or recovery routes were handled.

All pending waste includes residues for which suitable systems are being developed or are not operational so far.

They include especially LL/LL waste that is produced by the Cézus Plant on the Jarrie Site during the fabrication of zirconium sponges. Those residues are stored in a specific facility in order to ensure the

safety and the absence of any impact not only on the operating staff, but also on the public and the environment.

With regard to managing HL or IL/LL waste, which is being examined within the framework of the law, AREVA's share represents a minor part of the national inventory (See § B.6.1.1).

Those residues consist mainly of historical waste from the previous generation of treatment plants that were in operation from the 1960s to the 1980s. It is stored at Marcoule and at La Hague. Almost all HL historical waste in the history of the French nuclear industry is packaged today in standard vitrified-waste containers (*conteneur standard de déchets vitrifiés* – CSD-V) (See § H.2.2.3).

Among the legacy high level waste stored at La Hague, the molybdenum solutions of fission products resulting from the processing of "UMo" spent fuels (consisting of Uranium/Molybdenum alloy) used in the gas cooled reactors (GCR) required the development of a technologically innovative process known as the "cold crucible". "UMo" fission product solutions retrieval and "cold crucible" vitrification in the R7 facility began in January 2013.

On the other hand, the majority of intermediate level legacy waste is still to be retrieved and/or packaged (see § H.2.2.3 below). Large-scale programmes are devoted to legacy waste retrieval and packaging (RCD), owing to the major safety and radiation protection implications, and this is one of AREVA's major commitments. IL-LL dismantling waste must also be considered, since it will represent a few thousands of cubic metres after packaging.

All waste resulting from the spent fuel after treatment owned by foreign customers shall be returned to them as soon as technical conditions allow it in accordance with the *Environment Code*. Hence, most of the activity of the waste conditioned under the UP3Service Agreement contracts – which is the main reason for the construction and initial operation of the modern La Hague Plant – has been shipped back to the customer's country of origin.

With regard to the sizing of planned disposal facilities, AREVA's relative share is estimated on the basis of current inventories and thanks to the forecasts submitted by its French customers. Those forecasts serve as the basis for their financing conditions.

Lastly, it is worth noting that AREVA's waste volume and relatively low share in the national yield vary only slightly. AREVA's HL waste consists mainly of historical waste, whose volume is definitely standing still. The volume of IL-LL waste packages from AREVA, the CEA and EDF is well known and the forecasts have proven to be robust enough. Among the prospective factors that are taken into account to set volumes, the evolution in packaging methods for waste yet to be packaged, the operation pattern at La Hague, future commercial agreements and the volumes of decommissioning waste are among the factors used in drawing such forecasts.

#### 6.1.3.1. FISSION PRODUCTS

HL solutions of fission products are concentrated by evaporation before being stored in stainless-steel tanks, equipped with permanent cooling and mixing systems, as well as a uniflow scavenging system for the hydrogen generated by radiolysis. After a period of deactivation, solutions are first calcined, then vitrified via a process developed by the CEA. The resulting molten glass into which the fission products are incorporated is then poured into stainless-steel containers. Once the glass has solidified, the containers are transferred to an interim-storage facility where they are air-cooled.

#### 6.1.3.2. STRUCTURAL WASTE

Since the end of 2001, the hull-compaction workshop (*Atelier de compactage des coques* – ACC) at La Hague has been processing IL-LL structural (hulls and end-pieces from spent fuel) and has led to the fabrication of standard packages of compacted waste (CSD-C) that replace with a significant gain in volume compared to the cemented packages in the past. That process is also designed to condition certain categories of technological waste.

#### 6.1.3.3. WASTE RESULTING FROM THE TREATMENT OF RADIOACTIVE EFFLUENTS

##### La Hague

Since most of the activity and volume of liquid effluents generated by AREVA originate from its plant at La Hague, the company is therefore seeking to enhance effluent management on that site.

Initially, the La Hague site had two radioactive effluent-treatment plants (STE2 and STE3). Effluents were treated by co-precipitation and resulting sludge were encapsulated in bitumen and poured into stainless-steel drums in the most recent of the facilities (STE3). Those drums are stored on site. The yield of both plants has been virtually zero over the last decade, because most of acid effluents are now evaporated in the various spent fuel-processing workshops, whereas concentrates are vitrified (§ F.4.2.3.2).

Retrieval and packaging operations regarding “historical” sludge, especially those from the seven STE2 silos now require to be launched. Conditioning modalities are currently under study.

The shipment of waste to AREVA’s foreign customers under contracts predating the Waste Act takes place in the form of effluent packages vitrified using the cold crucible method.

At La Hague, AREVA also has a workshop for mineralising organic effluents by pyrolysis in the MDSB Workshop, which produces suitable cemented packages for surface-storage purposes.

Lastly, the water in the fuel-unloading and storage pools is purified on a continuous basis by ion-exchange resins. Once out of use, those resins constitute process residues that are encapsulated in cement in the Resin Packaging Workshop (*Atelier de conditionnement des résines* – ACR) before being transferred to CSA.

##### SOCATRI, AREVA NC Pierrelatte

Those sites also have management modalities and facilities designed to reduce the quantity of radioactive materials and chemical compounds they contain in order to reduce their impact on the environment. The facilities on the Tricastin Site have been mutualised and used by all operators (EURODIF - *European Gaseous Diffusion Uranium Enrichment*, SET - *Société d’enrichissement du Tricastin*, COMURHEX, AREVA NC Pierrelatte and SOCATRI) of the platform.

At SOCATRI, the New Treatment Station for Uranium-bearing Effluents (*Station de traitement des effluents uranifères nouvelle* – STEUN) was commissioned in 2008.

##### SOMANU and AREVA NC Cadarache (decommissioning)

Both sites rely on the facilities of other operators (CEA at Saclay and AREVA NC at La Hague for SOMANU; CEA at Cadarache for AREVA NC and Cadarache) for the treatment and management of their liquid effluents.

#### 6.1.3.4. SOLID TECHNOLOGICAL AND STRUCTURAL WASTE

##### La Hague

Solid technological waste is sorted out, compacted and encapsulated or immobilised in cement in the AD2 Workshop and then sent to CSA. If they do not meet ANDRA’s technical specifications for surface disposal, packages are stored, pending a final disposal solution.

##### FBFC Romans, AREVA NC Pierrelatte, EURODIF, SET, COMURHEX, SOCATRI

The waste produced by all industrialists is treated and conditioned at the STD and SOCATRI facilities. The objective of the TRIDENT Project is to implement a mutualised facility on the SOCATRI Site by 2016. Most of the waste includes VLL residues (80%), whereas the rest consists of low-level residues.

##### COMURHEX Malvési

Compactable waste is first conditioned in situ before is shipped to the Cires or Pierrelatte facility and managed the same way as those resulting from the Pierrelatte platform. Packaging waste (drums) and packages used for the transfer of raw materials towards the site are processed internally, and the processes involved refer to volume reduction and incineration.

The overall waste being processed by the AREVA group’s facilities are subject to specific checks and sorted at source and to an assessment of its radiological activity during management.

#### 6.1.3.5. RECENT ACHIEVEMENTS AND VOLUME REDUCTIONS CONCERNING HL/IL-LL WASTE

With regard to waste-management in general, significant results were achieved in the following areas:

- progress in packaging the past waste streams: historical waste, shutdown of old facilities, etc.;
- optimisation of spent-fuel treatment prior to packaging (recycling, etc.), and
- progress in packaging (including volume reduction).

In the field of HL/IL-LL waste, those actions as a whole have particularly ensured that the waste resulting directly from the spent fuel treated at La Hague is currently packaged:

- in CSD-V containers for vitrified fission products and minor actinides, and
- in CSD-C containers for compacted metal structures.

Thanks to the experience acquired, bitumised waste was eliminated from the latest generation of plants, by recycling effluents and vitrifying residual streams. Compacting has also reduced the volume of structural waste by a factor of 4. Lastly, actions to improve waste management (workshop zoning, sorting at source, recycling, measurement performance, etc.) have contributed significantly to reducing the volumes of technological waste. The annual volume of HL/IL-LL waste, for instance, dropped by a factor of more than 6 in relation to the treatment plant's design parameters, down from an expected volume of about 3 m<sup>3</sup>/t of fuel processed, to less than 0.5 m<sup>3</sup> at present.

### 6.2. Radioactive waste resulting from industrial, research or medical activities

This chapter concerns the nuclear activities defined by Article R. 1333-12 of the Public Health Code, that is:

- all nuclear activities intended for medicine, human biology or biomedical research;
- all other nuclear activities, with the exception of those carried out<sup>14</sup>:
  - in BNIs,
  - in defence-related nuclear facilities and activities,
  - in installations classified on environmental protection grounds subject to authorisation, pursuant to Articles L. 511-1 to L. 517-2 of the *Environment Code*,
  - in installations subject to authorisation pursuant to the *Mining Code* (Articles L.162-1 and following of the new *Mining Code*).

These activities are regulated and authorised by ASN

Radionuclides are used by a large number of public and private institutions, including:

- medical domain;
- establishments for biological and medical research;
- physics laboratories;
- academic research establishments; and
- non-nuclear power industry.

These fields of activity produce small quantities of radioactive waste in comparison to those produced by the nuclear power industry. However, the waste is much diversified and some, notably in the field of biological research, may have specific characteristics (putrescible waste, chemical risks, biological risks).

*The medical sector* includes all public or private establishments using radionuclides for analysis or treatment in the field of medicine. It mainly covers three fields:

- biological analyses, carried out in vitro on biological samples for diagnostic purposes;
- medical imaging techniques used for diagnostic purposes;
- therapeutic applications, in vitro or in vivo.

These establishments use unsealed sources, in other words radionuclides (mainly very short lived) contained in liquid solutions. They also use sealed sources for radiotherapy, brachytherapy and instrument calibration.

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<sup>14</sup> For the installations excluded from Article R1333-12, the rules are set by the particular regulations applicable to them.

Liquid waste is managed in two different ways, depending on the lifetime of the radionuclides it contains (decay processing or treatment at Centraco then disposal of incineration residues in the disposal facilities operated by Andra, see § B.6.2.2.2 below).

Apart from sources, solid waste is managed by decay or disposed of as defined in § B.6.2.2.1 below.

In the field of *medical and biological research*, the most frequently used radionuclides are VSL, SL (tritium and Cobalt 57) or long-lived (carbon-14). They often appear in the form of unsealed sources (small volumes of liquid samples).

Some research laboratories are located within hospitals and the residues they produce are managed directly by the hospital services themselves along with those resulting from therapeutic activities.

Physics laboratories come in different sizes and include various equipment, including particle accelerators. Waste categories may involve any given radioelement (including activation products). On the other hand, no waste poses both a radiological hazard and a significant biological or chemical hazard. The management of waste, radioactive materials and sealed sources is paid by the relevant laboratories. Most of the generated waste consists of LIL-SL and VLL residues.

In the field of *academic research*, there is no national overview on the status of radioactive-waste management. That sector encompasses strong specificities (labour turnover, different spread-out practices within establishments, limited means, etc.). The residues generated by universities are quite similar to those produced by biological and medical research. They may involve biological or chemical hazards.



*Waste resulting from industrial activities* outside the nuclear field come from:

- past or present use of radioactive sources (sealed or unsealed). There are no longer any manufacturers of sealed sources in France, with the exception of CERCA, which manufactures sealed calibration sources. There are however many users. They are to be found in the nuclear and non-nuclear industries (measurements, inspections, molecule detection, and industrial irradiation). The management of sealed sources which are no longer used is covered in section J of this report;
- non-nuclear industries concerning chemistry, metallurgy or energy production, which handle mineral raw materials with natural radioactivity, even though they are not intending to use this radioactivity (this subject is covered in Chapter B.5.2.2 above).

### 6.2.1. Provisions applicable to nuclear activities defined by Article R. 1333-12 of the Public Health Code

The regulatory part of the Public Health Code (Article R. 1333-12), states that for the activities concerned: “the effluents and waste contaminated by radionuclides or liable to be so contaminated owing to a nuclear activity, of whatsoever nature, must be collected, treated or disposed of, taking account of the characteristics and quantities of these radionuclides, the corresponding risk of exposure and the disposal routes chosen. An ASN resolution, approved by the Ministers responsible for health and the environment, sets the technical rules with which the disposal of effluents and waste shall comply”.

In this case, ASN resolution 2008-DC-0095 approved by the order of 23 July 2008 defines the requirements for the management of contaminated waste and effluents for these nuclear activities mentioned in Article R. 1333-12 of the Public Health Code. In addition, ASN has published a guide defining best practices in the management of effluents and waste (guide No. 18 available in French on [www.asn.fr](http://www.asn.fr)).

All the contaminated solid and liquid waste management procedures for an establishment must be described in a contaminated waste and effluents management plan (§ B.6.2.3 below).

## **6.2.2. Management of solid and liquid radioactive waste produced by nuclear activities defined by Article R.1333-12 of the Public Health Code (in particular biomedical research and nuclear medicine activities)**

### **6.2.2.1. SOLID WASTE MANAGEMENT**

#### **Solid waste containing radionuclides with shorter half-lives than 100 days**

Waste containing only radionuclides with a half-life of less than 100 days (called very short-lived waste) may be managed by in-situ decay, before disposal in conventional waste routes.

They result from waste sorting according to its half-life radioactivity level, conditioned as early upstream as possible in specific garbage bins and placed in storage room pending their elimination after decay.

In order to verify the non-contamination of waste intended for the management systems for non-radioactive waste, detection devices such as warning beacons or portals are installed at the exit of all establishments equipped with a nuclear-medicine service.

#### **Solid waste containing radionuclides with longer half-lives than 100 days**

Waste containing radionuclides with a half-life of longer than 100 days must be disposed of in radioactive waste management routes. This waste is then collected and managed by Andra. The management routes are more specifically incineration in Centraco, with the residues produced by this operation being disposed of in Andra's disposal facilities. Certain solid waste can be disposed of in the Cires if its characteristics are compatible with the acceptance specifications issued by Andra (VLL).

With regard to solid waste containing tritium, the *decree of 27 December 2013* indicates that this waste generated by the small producers will be stored in storage facilities planned for the tritiated waste to be produced by ITER and for which the creation authorisation application is to be submitted by CEA (see § B.6.2.4). In the meantime, this decree orders that Andra study the possibility of accepting tritiated waste from defaulting producers in its facilities.

### **6.2.2.2. MANAGEMENT OF CONTAMINATED LIQUID**

#### **Liquid effluents containing radionuclides with shorter half-lives than 100 days**

Liquid effluents containing radionuclides with a half-life of less than 100 days can be managed by decay and then, following inspection, can be discharged into the environment in conditions identical to non-radioactive liquid effluents.

In order to ensure their radioactive decay, those effluents are directed either towards a storage tank, a container system or a mechanism that prevents any direct discharge in the drainage system. In practice, certain establishments equipped with a nuclear-medicine service encounter technical problems when installing such devices, with due account of the large volumes of effluents to handle.

#### **Liquid effluents containing radionuclides with longer half-lives than 100 days**

A licence for discharging effluents containing radionuclides with longer half-lives than 100 days in the drainage water system may be granted by ASN under certain conditions (Cf. § F.4.1.4.3). In this case, discharge limits are set.

Liquid effluents containing radionuclides with a half-life of longer than 100 days are collected by Andra and mostly incinerated in the Centraco facility.

With regard to liquid tritiated effluents produced in this sector, the above-mentioned *decree of 27 December 2013* requires that Andra continue with the preliminary studies into their treatment. The corresponding volume is about 0.2 m<sup>3</sup>.

## **6.2.3. Management plan for contaminated waste and effluents**

As mentioned above, each establishment concerned must describe all the contaminated solid and liquid waste management procedures in a contaminated waste and effluents management plan.

This plan, the content of which is defined in the above-mentioned ASN resolution and clarified in guide No. 18 shall in particular present the procedures for sorting, packaging, storage, monitoring and disposal of the solid and liquid waste produced by the establishment.

That plan is established either at the level of the nuclear-medicine service or of the establishment when several units producing contaminated waste or effluents and using common resources are involved.

#### 6.2.4. ITER activities

##### Construction phase

The current management of waste on ITER meets the needs of the construction phase currently ongoing on this BNI. This waste is conventional (paper, cardboard, metal waste, packaging, rubble, etc.) from non-nuclear waste zones. It is collected and sorted before being sent to an appropriate disposal route, in accordance with the order of the Prefect concerning installations classified on environmental protection grounds and with the BNI Order.

##### Radioactive waste

Radioactive waste will be produced on ITER as of its commissioning in around 2027, when the BNI will use tritium, which is part of its fuel, participating in the Deuterium-Tritium fusion reactions. Baking and tritium removal processes will be implemented to recover the part of the tritium which is not used in the fusion reaction. The neutrons produced during the fusion reactions will activate the materials within the tokamak. Replacement of the tokamak's internal components will generate operating waste. The process generates waste activated and/or contaminated by tritium. ITER will produce no high level, long-lived waste. The estimated waste quantities were presented in the Preliminary Safety Assessment Report. It is VLL waste, LLW/ILW-SL waste, purely tritiated waste and tritiated ILW-LL waste produced during the operating phase (1200 metric tons) and during the final shutdown and decommissioning phase (34,000 metric tons).

##### Waste management

The ITER agreement states that responsibility for the facilities will be transferred to France as the host country and that it is also responsible for final decommissioning of the facility. For each category of waste, specific treatment is planned before being accepted for disposal by the host country.

The solutions chosen for storage of the ITER operating waste make provision for its storage on Intermed, the decay storage facility built by the host country. This waste comprises very low level (VLL) tritiated solid waste and low and intermediate level, short-lived (LLW/ILW-SL) tritiated waste. The purely tritiated and ILW-LL waste will be stored in the ITER hot cells until decommissioning. Concerning the waste resulting from decommissioning, the preferred solution is storage on the ITER site. The storage solutions must be authorised by the ITER final shutdown and decommissioning decree, after about 20 years of operation.

On behalf of the host country, CEA is responsible for providing a service to ITER Organization for management and storage of radioactive waste resulting from ITER operations and the Decommissioning phase. Coordination of these measures between CEA and ITER was set up through a decision-making committee which determines the overall strategy and the working groups which deal with technical aspects of the waste, decommissioning and the design reviews.

The undertaking made by ITER Organization during the Advisory Committee's review of the creation authorisation application, is to *"take the necessary steps, for the duration of the operation of the facility, so that at the end of operations, the change in nuclear licensee takes place in the best possible conditions with regard to safety"*.

#### 6.3. Mine-tailing management

The management of former uranium mines is the subject of continuous attention from French public authorities since those mines were closed. Once the sites were secured, their management continued by restoration, rehabilitation and monitoring measures. The rehabilitation of the residue disposal sites consisted in putting in place a solid cover over the residues to act as a geo-mechanical and radiological protective barrier designed to minimise the risks of intrusion, erosion, dispersion of the products emplaced and the risks

linked to external and internal (radon) exposure of the surrounding populations. Public access to these sites is nonetheless prohibited.

In order to reinforce of AREVA, responsible for managing those sites and of public authorities, the Minister of Ecology, Sustainable Development and Energy, together with ASN Chairman, have decided, in accordance with the 22 July 2009 Circular to implement an action plan resting on the following four principles:

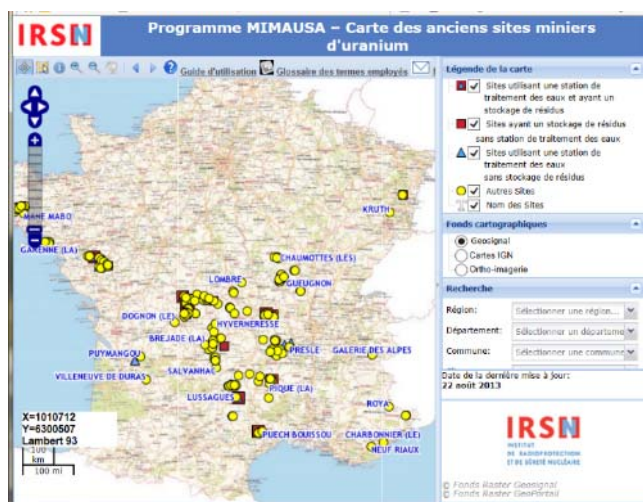
- control of the actions taken by AREVA NC on former mining sites to be conducted by the Regional Directorates for the Environment, Land Planning and Housing (*Direction régionale de l'environnement, de l'aménagement et du logement* – DREAL), in co-operation with ASN; reinforcement of preventive measures against intrusions on such sites and corresponding improvement proposals;
- knowledge improvement on environmental and health impacts of former uranium mines, and on their monitoring, and better environmental description of those sites;
- management of mine tailings through better knowledge on their uses and, if necessary, by reducing their environmental and health impact, and
- improvement of information and consultation practices (notably at the local level).

All these actions are currently ongoing. AREVA has sent the authorities 19 of the expected 26 environmental reports. The studies submitted by AREVA in compliance with the 2010-2012 PNGMDR enabled progress to be made on the questions of evaluating the long-term health and environmental impacts of the disposal of mining treatment residues (physical-chemical characterisation of the residues, geo-mechanical strength of the embankments and long-term radiological impact of the disposal sites) as well as of the former uranium mining sites (management of diffuse discharges and water treatment, long-term impact of mining waste rock).

Local information and consultation was reinforced, in particular by transforming the CLIS into site monitoring commissions set up to create a forum for exchanges and information about the action taken by the licensees and to promote information of the public.

An additional specific programme on the Memory and Impact of Uranium Mines – Synthesis and Archives (*Mémoire et impact de mines d'uranium: Synthèse et archives* – MIMAUSA), carried out by the IRSN in connection with the General Directorate for Risk Control (*Direction générale de la prévention des risques* – DGPR) and ASN, was launched in 2003 in order to collect historical data on all uranium-mining sites in France and on the environmental-monitoring devices that have been installed. It constitutes a working tool for the State services in charge of determining rehabilitation and monitoring programmes and a tool for the information of the public. Since the end of 2008, the database is accessible on the following website: <http://mimausa.irsn.fr>, (latest update of August 2013). MIMAUSA thus allows access to the environmental reports submitted by AREVA, as well as to the second-level checks performed by IRSN on these reports. It will eventually be supplemented by an inventory of mining waste rock).

Furthermore, a pluralistic expert group (*groupe d'expertise pluraliste* – GEP) on uranium mines in the Limousin area (around Limoges in central western France) was implemented in November 2005 at the initiative of the Ministers in charge of the environment, industry and health. The missions entrusted upon the GEP were not only to assess the current impacts of the operation of ancient uranium mines on a few sites, but also to cast a critical judgement on the monitoring of former mining sites in the Limousin area in order to enlighten the Administration and the operators about management prospects over the more or less long term.



On 15 September 2010, the Limousin GEP submitted to both the Minister of Ecology and Sustainable Development and ASN's Chairman its final report and recommendations for the management of old uranium-mining sites in France. ASN and the Ministry responsible for the environment are engaged in an action plan dedicated to implementing these recommendations and entrusted the GEP Chairman with the duties of presenting its conclusions and recommendations to the local and national consultation bodies and of evaluating the effective implementation of its recommendations.

In November 2013, the GEP sent ASN and the DGPR of the Ministry responsible for the environment its report presenting the conclusions of this latter mission. The GEP reached positive conclusions concerning its involvement and noted that its recommendations remain fully pertinent. In order to retain the pluralistic approach the GEP brings to the question of the former uranium mining sites, ASN and the DGPR proposed creating a network of site monitoring commission experts, to whom the task of appraising issues of local and national scope so warranted by the social component would be entrusted.

In addition, the action undertaken by public authorities since the 1990s concerning the long-term of disposal facilities for uranium-mine tailings is reflected in the provisions of the PNGMDR. The studies provided by AREVA NC at the end of 2012 in that framework constitute a significant improvement for the guaranteed safety of those disposal facilities. In October 2012, ASN issued an opinion on those studies and formulated recommendations in several fields (long-term evolution and modelling of the physico-chemical characteristics of tailings resulting from ore processing, dyke behaviour, needs dealing with cover reinforcement of tailing-disposal facilities, impact assessment of mine dumps, including the radon, water treatment, impact of discharges, etc.). The actions to be performed were largely repeated in the 2013-15 PNGMDR, and in the *decree of 27 December 2013*.

#### 6.4. Waste management by ANDRA

Andra operates three industrial facilities. Two are dedicated to low and intermediate level, short-lived waste (LLW/ILW-SL):

- The CSM, which is a disposal facility currently in the surveillance phase (see § D.3.2.2.1),
- The CSA, which is an operating disposal facility and which also comprises waste packaging installations (drum compacting, injection of metal containers) and disposal installations.

The Cires (Industrial grouping, storage and disposal centre) comprises:

- Treatment and packaging facilities for very low level (VLL) waste.
- A VLL waste disposal facility,
- A grouping building for transit before transfer to treatment facilities for the waste collected by Andra, especially waste from the medical sector and from institutional research,
- Storage facilities for waste collected by Andra and for which there is no operational disposal route.
- The grouping building and storage facilities were commissioned in 2012.

	Deliveries to CSA (m <sup>3</sup> )	Deliveries to CIRES (m <sup>3</sup> )
EDF	9 800	4 700
AREVA NC	1 900	7 800
CEA	2 600	13 700
Miscellaneous	70	560

TABLE 7 : WASTE DELIVERIES AT THE CSA AND CIRES IN 2013 (INCLUDING DECOMMISSIONING WASTE)

#### The disposal facilities

The basic principle of those disposal facilities operated by ANDRA is to protect residues against any aggression (water circulation, human intrusions) until the radioactivity they contain has decayed down to a level such that any significant radiological risk may be discarded, even if those disposal facilities fell into oblivion. Table 8 gives the deliveries of LLW/ILW-SL and LLW waste packages which, possibly after additional treatment, are disposed of in the CSA or in Cires.

### **Waste collected by Andra**

ANDRA is also involved in the collection of the waste generated by small and medium-size industries, research laboratories (except those from the CEA), universities, hospitals, etc. A removal guide was prepared to describe the take-over protocol of the waste for which ANDRA has processing routes enabling their elimination or disposal. Concerning waste for which the disposal routes are not yet available, the producers send their requests for collection to Andra, which examines them on a case by case basis.

This activity concerns 850 Andra customers, 200 of whom submit collection requests every year, in accordance with the collection guide. 2,200 packages were thus collected in 2013.

Since 2012, the grouping and storage activities are no longer subcontracted but are performed by Andra itself on the Cires. After grouping in the Cires, the waste for which there is no disposal route remains stored in the Cires; the other waste is transferred to the Socatri Company for sorting and repackaging prior to shipment to the Centraco plant for incineration and then disposal in the CSA.

The processing capacity limitations of the Socatri company and experience feedback from the Centraco accident in 2011 showed that this sector was vulnerable. In order to make it more robust, Andra decided to create a waste sorting and treatment unit on the Cires, which should enter service in 2016.

The Cires will more specifically store sealed sources, radioactive lightning conductors and radium-bearing waste from the rehabilitation of sites with legacy contamination (radium industry).



## SECTION C | SCOPE (ART. 3)

1. *This Convention shall apply to the safety of spent fuel management when the spent fuel results from the operation of civilian nuclear reactors. Spent fuel held at processing facilities as part of a processing activity is not covered in the scope of this Convention unless the Contracting Party declares processing to be part of spent fuel management.*
2. *This Convention shall also apply to the safety of radioactive waste management when the radioactive results from civilian applications. However, this Convention shall not apply to waste that contains only naturally occurring radioactive materials and that does not originate from the nuclear fuel cycle, unless it constitutes a disused sealed source or it is declared as radioactive waste for the purposes of this Convention by the Contracting Party.*
3. *This Convention shall not apply to the safety of management of spent fuel or radioactive waste within military or defence programmes, unless declared as spent fuel or radioactive waste for the purposes of this Convention by the Contracting Party. However, this Convention shall apply to the safety of the management of spent fuel and radioactive waste from military or defence programmes if and when such materials are transferred permanently to and managed within exclusively civilian programmes.*
4. *This Convention shall also apply to discharges as provided in Articles 4. 7. 11. 14. 24 and 26.*

### 1 | STATUS OF SPENT-FUEL PROCESSING IN SPENT-FUEL MANAGEMENT

At the Diplomatic Conference held on 1-5 September 1997 at IAEA Headquarters to adopt the *Joint Convention*, France, Japan and the United Kingdom made the following declaration (Final Proceedings § 12 – Analytical Report of the Fourth Plenary Session § 93-95 – GC(41)/INF 12/Ann. 2):

*“The United Kingdom, Japan and France regret that no consensus could be reached on the inclusion of processing in the scope of the Convention.*

*They declare that they shall report, within the context of the Convention, on processing as part of spent fuel management.*

*The United Kingdom, Japan and France invite all other countries that undertake processing to do the same.”*

In accordance with her commitments and through this document, France reports on the measures taken to ensure the safety of spent-fuel processing facilities, which she considers as spent-fuel management facilities for the purposes of the *Joint Convention*, that is, corresponding to the definition of spent-fuel management facilities appearing in Article 2 of the *Joint Convention*.

### 2 | RADIOACTIVE WASTE

This report deals with all radioactive waste resulting from civilian uses, and notably the residues generated by the nuclear fuel cycle and by various activities especially in medicine, industry and research.

### 3 | OTHER SPENT FUEL AND RADIOACTIVE WASTE TREATED WITHIN CIVILIAN PROGRAMMES

Spent fuel and radioactive waste produced by military or defence programmes, when transferred to civilian programmes, are included in the inventories and treated in the facilities presented in this report.

All disposal facilities are civilian in nature. Hence, ANDRA is completely free to determine the quality of the waste packages intended for its facilities, even if the waste originates from military or facilities concerning Defence. ASN also double-checks their quality after ANDRA in order to verify notably that the implemented procedures at waste producers' premises and in disposal facilities actually guarantee the quality of the received packages and, hence, the safety of the disposal facilities. Inspections are conducted by ASN and,

if need be, in conjunction with the French Authority for Defence Nuclear Safety (Delegate for the Nuclear Safety of National Defence Activities and Facilities – (*Autorité de Sûreté Nucléaire Défense* – ASND).

Any transfer of nuclear materials or radioactive waste between civilian and military facilities must be duly approved by both authorities in order to ensure transparency in that field and to verify their acceptability in the receiving facility.

## 4 | EFFLUENT DISCHARGES

Effluent discharges are addressed in § F.4.

## SECTION D | INVENTORIES AND LISTS (ART. 32-§2)

### Article 32-§2

*This report shall also include:*

- i) a list of spent fuel management facilities subject to this Convention, their location, main purpose and essential features;*
- ii) an inventory of spent fuel that is subject to this Convention and that is being held in storage and of that which has been disposed of. This inventory shall contain a description of the material and, if available, give information on its mass and its total activity;*
- iii) a list of the radioactive waste management facilities subject to this Convention, their location, main purpose and essential features;*
- iv) an inventory of radioactive waste that is subject to this Convention that:*
  - a) is being held in storage at radioactive waste management and nuclear fuel cycle facilities;*
  - b) has been disposed of, or*
  - c) has resulted from past practices.*

*This inventory shall contain a description of the material and other appropriate information available, such as volume or mass, activity and specific radionuclides, and*
- v) a list of nuclear facilities in the process of being decommissioned and the status of decommissioning activities at those facilities.*

The major facilities involved are shown on the map located in Annex (§ L).

## 1 | SPENT-FUEL MANAGEMENT FACILITIES

### 1.1. Spent-fuel generating facilities

In France, most spent fuel is produced by 58 PWRs ranging from 900 to 1,500 MWe. Commissioned between 1977 and 1999, they are distributed over 19 EDF sites. The fuel they used is either based on uranium oxide that is slightly enriched with uranium 235, or a mixture of depleted uranium oxide and separated plutonium originating from spent-fuel processing (MOX).

The other spent-fuel categories originate from nine active research reactors of different types, with a thermal power varying between 100 kW and 350 MW, and commissioned between 1964 and 1978. Eight of them are located in CEA facilities at Cadarache, Marcoule and Saclay, and the last, at the Laue-Langevin Institute (*Institut Laue-Langevin – ILL*), located near the CEA facility in Grenoble.

The inventory of each facility is shown in § L.1.1.

### 1.2. Spent-fuel storage or processing facilities

Some BNIs are involved in spent-fuel management. They include experimental laboratories, storage facilities and treatment plants, all dealing with spent fuel, and are managed by EDF, the CEA or AREVA. The inventory of those facilities is shown in § L.1.2.

#### 1.2.1. AREVA facilities

##### 1.2.1.1. BACKGROUND

All of AREVA spent-fuel management facilities currently in service are located at La Hague, in a complex located on the northwest tip of the Cotentin Peninsula, at 20 km west of Cherbourg.

Pursuant to the three *Decrees of 12 May 1981*, AREVA was licensed to build the UP3-A and the UP2-800 treatment facilities with the same capacity to treat spent fuel from light-water reactors (LWR) and an STE3 facility designed to purify effluents from both units before discharge into the sea.

The different buildings of the UP3-A, UP2-800 and STE3 facilities were commissioned between 1986 (spent-fuel reception and storage) and 1992 (R7 Vitrification Workshop), with most treatment buildings coming on line in 1989-90. The last facilities to be commissioned include the ACC (hull-and-end-piece compacting) and the R4 Workshops (end of the plutonium line in unit UP2-800) buildings in 2001.

The backbone of those units includes facilities for the receipt and interim storage of spent fuel, shearing and dissolution, chemical separation of fission products, final purification of uranium and plutonium, as well as treatment of effluents.

*Decree No. 2003-31 of 10 January 2003 Authorising COGEMA to Modify the Perimeters of La Hague BNIs* increased the treatment capacity of both facilities to 1,000 t/a, although the total capacity of the complex remains limited administratively to 1,700 t.

The recycling of materials resulting from spent fuel processing with the current generation of nuclear reactors represents raw material savings of up to 25% of the uranium that would otherwise be needed and preserves this material for far more efficient use in the generation IV reactors.

The total quantity of plutonium recovered during processing operations is today recycled in the form of MOX fuels in light water reactors belonging to AREVA's customers.

Historically, the Belgian, Dutch, Swiss and French (EDF) customers of AREVA recycled the uranium resulting from the processing of spent fuels; up to two-thirds for EDF and all of it for Belgium, the Netherlands and Switzerland.

In recent years, the price of natural uranium has suffered from the slow-down in nuclear programmes around the world, owing to the Fukushima accident. This price did not give the strong economic incentive previously expected, which would have enabled AREVA to commission new recycling facilities for the uranium resulting from the processing of spent fuels.

#### 1.2.1.2. SPENT-FUEL STORAGE FACILITIES

Spent fuel awaiting treatment is stored in two stages: first in pools adjacent to the reactor building in NPPs and later in pools at La Hague, until they are treated.

The capacity authorised by the *decree of 10 January 2003* for the La Hague plant corresponds to a total of 17,600 metric tons, broken down as follows:

- Pool C: 4800 t
- Pool D: 4600 t
- Pool E: 6200 t
- Pool NPH 2000 t.

#### 1.2.2. Other storage facilities

The SUPERPHÉNIX fast-breeder reactor, the sodium-cooled industrial prototype reactor with a 3,000 MW thermal-power output, was shut down permanently in 1998. For fuel-disposal purposes, a dedicated workshop (*Atelier pour l'évacuation du combustible* – APEC) consisting mainly of a storage pool, located on the EDF Creys-Malville Site, was commissioned on 25 July 2000. Irradiated fuel assemblies were removed from the reactor between 1999 and 2002, and washed, before being stored in the facility's pool.

Pending a permanent solution (processing and disposal), all non-reusable fuel from the CEA's civilian programmes is stored either in dry-storage pits at the CASCAD Facility or under water (pool storage) at the PÉGASE Facility in Cadarache. The destocking of that facility started in 2006 by sending OSIRIS-type fuel towards the CARES storage facility (BNIS) and is continuing. Spent fuel from the CEA is also stored at Saclay's BNI-72 pending disposal.

## 2 | INVENTORY OF SPENT FUEL HELD IN STORAGE FACILITIES

Most spent fuel stored in France originates primarily from PWRs and boiling-water reactors (BWR), thus containing either uranium oxide or MOX, and secondarily, from research reactors. It is stored at the various facilities mentioned in the preceding paragraphs.

Locations	Mass of French spent fuel in storage (t)
La Hague	9 790
EDF NPP sites	4172
CEA centres	120

TABLE 8 : MASS OF FRENCH SPENT FUEL STORED IN FRANCE AT THE END OF 2012

Origin	Australia	Belgium	Netherlands	France	Italy	Switzerland
	102 kg	128 kg	6,7 t	9,790 t	2,1 t	148 kg

TABLE 9 : ORIGIN OF THE SPENT FUEL STORED ON THE LA HAGUE SITE AND CORRESPONDING QUANTITIES AT THE END OF 2012

## 3 | RADIOACTIVE-WASTE MANAGEMENT FACILITIES

### 3.1. Installations producing radioactive waste

#### 3.1.1. Basic Nuclear Installations (BNI) in operation

The BNIs in operation produce radioactive waste. They are listed in appendices L.1 (for spent fuel management facilities) and L.2 (for facilities managing radioactive waste other than those managing spent fuel).

#### 3.1.2. BNIs undergoing decommissioning

Radioactive waste is also produced in BNIs being dismantled (shut-down reactors, laboratories and plants), the list of which appears in § L.3 (it should be noted that the list in appendix 3 includes delicensed facilities no longer producing radioactive waste).

#### 3.1.3. Classified facilities on environmental-protection grounds (ICPE)

France has licensed about 800 ICPEs due to the radioactive substances they hold and use. Most of these facilities hold sealed sources and do not therefore generate radioactive waste. They are scattered throughout the country and consist notably of analytical and research laboratories, industrial facilities (manufacturers of sealed radioactive sources, plants using naturally radioactive ores, irradiators).

#### 3.1.4. Polluted sites

Certain sites have been polluted by radioactivity, such as those that hosted radium-related activities (extraction) in the past or using radium-bearing or tritium-bearing materials (paints). For end-of-life ICPEs, Articles R.512-39-1 and following of the *Environment Code* set site rehabilitation obligations.

Rehabilitating such sites may generate radioactive waste resulting from decontamination and excavation.

Waste from rehabilitation work has a low specific activity. Some radionuclides are long-lived and radium-bearing waste involves a danger due to radon emanations. Since management systems for the latter are not available so far, the waste must be stored pending the availability of a disposal facility for LL-LL waste likely to accommodate them.

ANDRA keeps an up-to-date inventory of all those sites in its *National Inventory of Radioactive Waste and Recoverable Materials*, the latest edition of which was published in 2012 (available on ANDRA's website: [www.andra.fr](http://www.andra.fr)). It was developed on the basis of various information sources, including the Database of French Former Industrial Sites and Service Activities likely to have initiated a pollution (*Base de données des anciens sites industriels et activités de service* – BASIAS) ([basias.brgm.fr](http://basias.brgm.fr)) and the Database of French Sites

Polluted or Potentially Polluted by Chemicals and Requiring an Action by Public Authorities (*Base de données des sites pollués (ou potentiellement pollués) par des produits chimiques et appelant une action des pouvoirs publics* – BASOL): <http://www.basol.environnement.gouv.fr>.

### 3.2. Radioactive waste management facilities

In addition to the facilities which produce and carry out the first steps in the management of radioactive waste, the treatment and/or storage facilities and the disposal facilities given in Appendix L.2.2 are shown on the following map. Most of these facilities are BNIs. However the very low level (VLL) waste disposal facility, Cires, is an ICPE.

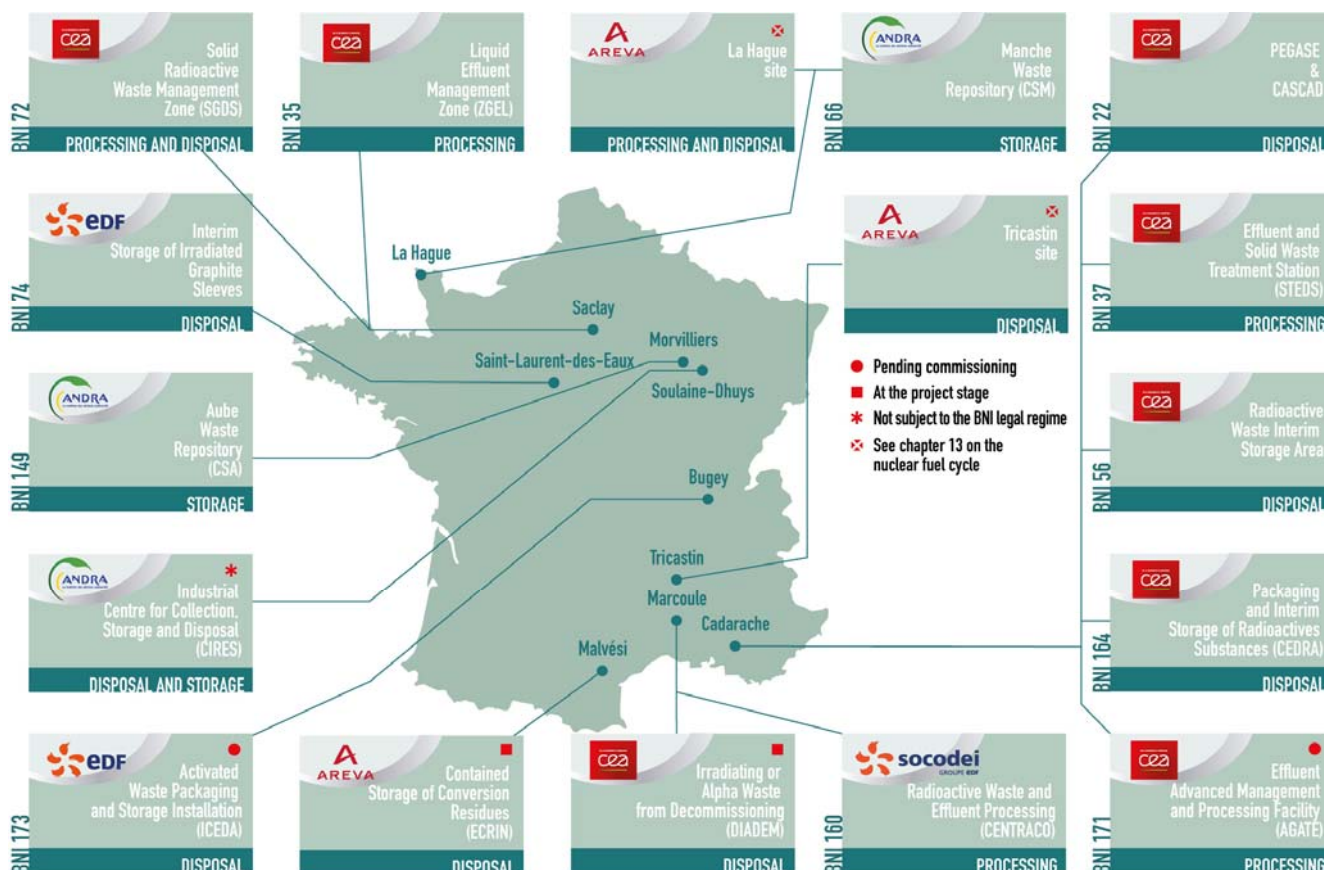


FIGURE 1 : RADIOACTIVE WASTE MANAGEMENT FACILITIES (EXCLUDING NATIONAL DEFENCE INSTALLATIONS)

#### 3.2.1. Radioactive-waste treatment facilities

##### 3.2.1.1. STORAGE OF HL WASTE AT LA HAGUE

CSD-V packages are stored in three facilities: both the R7 and T7 production workshops, which are equipped with appropriate halls, and the E-EV-SE facility, which has an extension since September 2013.

The storage capacity is as follows:

- BNI 116 (UP3-A): Storage T7: 3,600 packages;
- BNI 116 (UP3-A): Storage EEVSE 4,320 packages;
- BNI 116 (UP3-A): Storage EEVLH in activity since September 2013 with capacity of 4,199 packages;
- BNI 117 (UP2-800): Storage R7 4,500 packages.

AREVA is developing an additional extension project (EEVLH2) in BNI 116 with a capacity of 12,636 containers, for which commissioning is scheduled for about 2018.

All of the extensions will represent a vitrified fission products storage capacity corresponding to about 40,000 metric tons of spent fuels.

Current capacities		
Total capacities	8,100	R7/T7
(number of CSD-V)	+ 4,320	E-EV-SE
	+ 4,199	EEVLH
<b>Total</b>	<b>= 16,619</b>	
Available spaces	16,619	
(9047 CSD-V stored by end 2007)	- 11,665	
<b>Total</b>	<b>= 4,954</b>	

TABLE 10 : STORAGE CAPACITIES FOR HL WASTE ON THE LA HAGUE SITE ON 31 DECEMBER 2012

Hence 4954 spaces are currently free. A total of 5171 CSD-V packages have been returned to foreign customers, from 1 January 1995 till 31 December 2012, thus representing a return rate exceeding 94%.

### 3.2.1.2. IL-LL WASTE

In the IL-LL waste category, most currently-produced packages result from compacted metal structures of processed assemblies called “CSD-C”. However, most of the existing output, which has already been stored, originates from the operation of plants of older generations that were in service from the 1960s to the 1980s. Those residues, which are currently being stored in pools and silos, have led to the creation of a retrieval and conditioning programmes. Most selected conditioning modes involve compacting, bitumisation and cementation.

#### Standard containers of compacted waste (CSD-C)

The capacity of the Storage Workshop for Hulls and End-pieces (*Atelier d'entreposage des coques et embouts compactés* – ECC) currently stands at 20,000 places and allows for the storage of the packages to be generated over the next 12 years, with due account of the plant's programme. It is also possible to add on six additional cells.

#### Drums of bitumised waste

The current production of bitumen drums at La Hague is almost nil, following the implementation of the new effluent-management system (*nouvelle gestion des effluents* – NGE), which ensures the concentration and vitrification of radioactive effluents (see § B.6.1.3.2).

Current capacities are sufficient to store all bitumen drums that already exist.

#### Packages of cemented waste

Asbestos-cement containers (*conteneur amiante ciment* – CAC) are no longer produced since 1994. They reached a total number of 753 packages, but only 306 constitute IL-LL waste. The other packages are intended for disposal at the CSA.

The production of fibrous-concrete packages (CBFC'2) started to replace CACs in 1994. Most of that production will slow down significantly as the stream of technological waste is gradually incorporated in the Compacting Workshop (*Atelier de compactage* – ACC), which was commissioned in 2002.

### 3.2.1.3. OTHER STORAGE FACILITIES

There are a certain number of disposal facilities apart from the AREVA NC listed below, including:

#### EDF's storage facilities

EDF stores graphite waste (LL-LL waste) originating from the old GGR system, especially in the silos of the Saint-Laurent A NPP.

EDF also stores IL-LL waste on the sites of its NPPs, including control clusters and poison clusters. Those residues are grouped together in the Conditioning and Storage Facility for Activated Waste (*Installation de conditionnement et d'entreposage de déchets activés* – ICEDA) under construction.

Some ILW-LL waste from decommissioning of sites being dismantled will be produced as of 2015-2016 and will also be stored in the ICEDA facility.

### **CEA's storage facilities for CEA-generated waste**

In its facilities, the CEA stores IL-LL waste and some HL waste. At Cadarache, the old trenches and ditches of BNI-56 are used to store waste that is intended for retrieval for storage purposes in more recent amenities. A new facility (Unit 1 of CEDRA) has been commissioned. At the BNI-72, BNI-73 and BNI-79 facilities, located respectively at Saclay, Fontenay-aux-Roses and Grenoble, historical residues are also stored, but plans call for destocking and for re-storage in more recent facilities.

### **Storage facilities for waste enhanced with naturally-occurring radioactivity**

Waste enhanced with naturally-occurring radioactivity includes notably the LL-LL radium-bearing waste (FA-VL) stored at La Rochelle (resulting from rare-earth industry) and at Jarrie (resulting from the fabrication of zirconium sponges).

### **Storage facilities for non-CEA generated waste on CEA sites**

For historical reasons and due to their skills, CEA facilities, mostly those at Saclay and at Cadarache, host various waste categories that it did not generate itself. Those residues are intended disposal in facilities that are only at the project stage for the time being (radium-bearing waste and disused sealed sources).

### **ANDRA's storage facilities**

In 2012, Andra commissioned a storage facility in its industrial grouping, storage and disposal centre, primarily intended for low level, long-lived waste, in particular that resulting from the Agency's public service duties (see § B.6.4).

## **3.2.2. Waste-disposal facilities**

### **3.2.2.1. THE CENTRE DE LA MANCHE DISPOSAL FACILITY (CSM)**

The *Centre de la Manche* Disposal Facility (*Centre de stockage de la Manche* – CSM), which is managed by ANDRA, was commissioned in 1969. Located in Digulleville, Cotentin Peninsula (Normandy), it is very close to the La Hague Spent-fuel Processing Plant (AREVA) and accommodated approximately 527,000 m<sup>3</sup> of waste packages prior to its shutdown on 30 June 1994.

The general design principle was to dispose of waste packages on or in structures, as well as to collect and control separately all remaining rainwaters from the waters likely to have been in contact with packages. The structures consisted of concrete slabs on which the packages were either stacked directly or stored in concrete bunkers built on those slabs. The structures were loaded in open air, whereas rainwaters were collected peripherally from the structure and directed to the nearby AREVA NC Plant by a pipe network through underground drifts. The decision to dispose of packages by stacking them directly or by disposing of them in a concrete box depended on the radiological activity of the packages and/or the sustainability criterion of the packaging.

The repository occupies a site of about 15 ha and was covered in 1997 with a bitumen membrane within an assembly of draining or impermeable layers designed to prevent water seepages. The cover layer was planted with grass in order to favour the evaporation of rainwaters and to prevent the erosion of the top layer of the cover.

In January 2003, the CSM entered officially into its post-closure monitoring phase, although supervision operations had already started in 1997. The transition from the operational to the monitoring phase was the subject of a type of process similar to the creation of a nuclear facility, including a public inquiry. Since 1997, the active monitoring phase covers the following tasks:

- checking the sound operation of the disposal facility, including:
  - the stability of the cover;
  - the impermeability of the cover, and
  - an estimate of water seepages in the cover and at the base of the structures;

- detecting any abnormal or altered-evolution situation:
  - the radiological and chemical monitoring of the water table;
  - irradiation checks under shutdown conditions/inside the fence, and
  - atmospheric-contamination checks, and
- following up the radiological and physico-chemical impact of the facility.

The impact assessment of the CSM is the subject of public annual reports, which may be consulted on ANDRA's website ([www.andra.fr](http://www.andra.fr)).

The periodic safety reassessments are carried out every ten years. The latest safety assessment of the centre was carried out by ASN in December 2009. ASN notified its conclusions concerning the files in a letter sent out on 15 February 2010. In accordance with the strategy it proposed, concerning the evolution of the cover, Andra performed work to consolidate the embankments around the edge of the cover on three sectors. The aim is to assess the effectiveness over a period of about ten years, before moving onto the subsequent redevelopment stages. In the meantime, Andra should submit an additional file to ASN in early 2015 to clarify the various aspects concerning the long-term evolution of the CSM that is a description of the development of the CSM and the associated conditions (drainage, embankment, cover, surveillance).

Technical requirements relating to the CSM's monitoring phase provide a list of all required information to be archived over the long term. Documents must be archived safely under suitable conservation conditions and in two copies deposited in two separate locations. The documentation designed to maintain the memory of the disposal facility was assembled and a copy was deposited in the French National Archives.

This documentation includes a "summary record" which in 170 pages describes the history and main characteristics of the facility and a "detailed record" containing technical documents about the construction, operation and closure of the CSM, and those concerning its safety.

The CSM's Local Information Committee assessed the CSM "summary record" in 2011 and 2012. Moreover, 3 information search exercises were carried out in 2012 on the entire memory records system: 2 Andra internal assessments and one international assessment, involving the Local Information Committee. These exercises will lead to changes to the documents conserved, notably to create a more operational link between the "summary record" and the "detailed record", which is hard to utilise owing to its volume.

#### 3.2.2.2. LIL WASTE DISPOSAL FACILITY (CSA)

Located at Soulaire-Dhuys, Aube *département*, in Eastern France, the CSA for LIL-SL waste was commissioned in January 1992 and is managed by ANDRA.

The CSA, which benefits from operating experience feedback from the CSM, is authorised to hold a volume of 1 million cubic metres of waste packages. The site covers an area of 95 hectares, of which 30 are for actual disposal.

Besides disposal operations, the facility is also involved in waste-conditioning activities, consisting either in injecting cement mortar in 5- or 10-m<sup>3</sup> metal boxes or in compacting 200-L drums and immobilising them with mortar into 450-L drums.

Disposal structures consist of cells, in which packages are emplaced. Waste-loading operations are protected against rainwaters. Packages with a metal cover are concreted in the structure, whereas packages with a sustainable-concrete cover are stabilised with fine gravel in the structure. Once the structure is full and the packages have been immobilised, a closing slab is poured over the top and covered by a temporary impermeable layer, pending the installation of the final cover with its impermeable clay layer. The apron of the structures is made of reinforced concrete and covered with an impermeable polymer; it also includes a perforation in order to recover any potential seepage waters.

On 31 December 2013:

- the total volume of disposed waste amounted to approximately to 280,000 m<sup>3</sup>, and
- 123 structures had been closed down on a planned total of approximately 400.

Given an annual delivery of around 15,000 m<sup>3</sup> and the fact that the disposal facility was designed originally for an annual input of 30,000 m<sup>3</sup>, the facility will probably remain in operation for more than fifty years. The figures of the National Inventory show that it should be capable of absorbing the low and intermediate level, short-lived waste produced by the operation and decommissioning of the nuclear facilities currently authorised.

With regard to radiological protection, the *Public Health Code* (Book III, Title III, Chapter III) states that the total impact of all nuclear activities (except medical uses) on the public shall not exceed an annual dose of 1 mSv. As for ANDRA, it allows a maximum dose of 0.25 mSv/a under normal conditions during both the operating and post-closure monitoring phases. For all other altered-scenario situations, the annual value of 0.25 mSv remains a reference, but may be exceeded. The criteria to be used for assessing whether the calculated impact is acceptable include mainly the exposure mode and time, as well as the conservative calculation hypotheses being selected (See § H.5.1).

Radionuclides	Tritium	Cobalt 60	Strontium 90	Caesium 137	Nickel 63	Alpha Emitters
Radiological capacities (TBq)	4 000	400 000	40 000	200 000	40 000	750

**TABLE 11 : MAXIMUM RADIOLOGICAL CAPACITIES SPECIFIED FOR A CERTAIN NUMBER OF RADIONUCLIDES IN TONNES  
(CREATION-LICENCE DECREE OF 4 SEPTEMBER 1989)**

The centre's package acceptance criteria are derived from the long-term operational safety studies.

Radiological capacity levels were defined for a certain number of radionuclides in the *creation authorisation decree of 4 September 1989*.

Other limits were set forth in the facility's technical specifications. For instance, the 1999 revised technical prescriptions have been consolidated in the General Operating Rules and impose relevant radiological capacities for chlorine-36, niobium-94, technetium-99, silver-108m and iodine-129.

For all radioelements, except for chlorine-36, the consumption fraction of the radiological capacity lies below the fraction of the consumed volume capacity. The capacity in chlorine 36 was set by ASN after examining the long-term safety conditions of the disposal facility in order to take into account the take-over of some graphite waste that used to cause radiation-protection problems on their storage site. In the case of that specific radioelement, the share of consumed capacity is close to 90%, compared to 28% in volume-capacity consumption. Hence, the specific activity of the chlorine-36 concentration in the acceptable waste contained in the disposal facility is very low (5 Bq/g) is carefully monitored.

Over and above radiological hazards, other risks relate to toxic chemicals (Pb, Ni, Cr VI, Cr III, As, Cd, Hg, Be, U, B, Sb) and are divided into two different classes depending on their pathway to human beings: ingestion or inhalation. The method being used is similar to that for preparing ICPE impact statements.

The creation authorisation decree for the CSA was modified on 10 August 2006 in order to include an explicit reference to facility discharges and to formalise the corresponding limits in the Ministerial Order of 21 August 2006.

The discharge order also provides for a quarterly assessment of gaseous discharges from disposal structures.

The flexibility in the CSA's disposal conditions facilitated the take-over of bulky waste packages, thus allowing waste producers to limit the doses being received during shearing operations. Hence, 48 PWR covers have already been disposed of, including six in 2013, and that disposal operation was reviewed and licensed by ASN.

ANDRA has been licensed by ASN to dispose of sealed sources provided that their half-life was shorter than that of caesium-137. The licence prescribes the relevant admissible activity limits for the radionuclides involved per source.

### 3.2.2.3. VLL WASTE DISPOSAL FACILITY (CIRES)

The Cires disposal facility for VLL waste, commissioned in 2003, has a capacity of 650,000 m<sup>3</sup> and is located in Morvilliers, Aube *département*, a few kilometres away from the CSA. It covers an area of 45 ha. At the end of 2013, slightly 252,000 m<sup>3</sup> of waste had already been disposed of there. Given the total radiological activity it will contain in the future, the facility is not subject to BNI regulations, but to ICPE regulations.

The design of the facility follows the same principles applicable to disposal facilities for hazardous waste.

Waste must be solid and inert. With due account of the activity level of the waste involved, the only purpose of conditioning is to prevent any dispersal of radioactive materials during transport and disposal operations. Protected against rain under a mobile roof, the waste is placed in cells hollowed out in the clay formation. A bottom membrane reinforces the impermeability of the system. Once full, each cell is backfilled with sand and covered with another membrane and a layer of clay. An inspection shaft is used to check the cell and especially to detect any potential water infiltrations into the cell.

As in the case of the CSA, ANDRA allows a maximum impact value of 0.25 mSv/a for the Cires in normal conditions, either during operation or after shutdown. For instance, the impact of the Cires on members of the public is estimated at  $3 \cdot 10^{-5}$  mSv/a under normal conditions after 200 years. For all other post-monitoring scenarios, such as road construction or a children's playground, dose estimates range between 0.02 and 0.05 mSv/a.

As for the CSA, all risks associated with toxic chemicals have been taken into account.

The Cires was designed before any experience feedback was available on the enforcement of the French regulations regarding waste management in BNIs (implementation of waste zoning, no clearance threshold). The needs regarding waste take-over from the operators who produced the waste appeared more significant than forecasts had led to believe at the design stage. Hence, ANDRA has adapted its means for being able to absorb a higher flow than the flow initially considered at design stage (24,000 up to 35,000 m<sup>3</sup> of waste per year).

However, the waste stream may generate an earlier saturation than expected of the Cires' regulatory capacity, whose initial operating lifetime was expected to last about 30 years. Hence, some studies were launched in order to improve the density of the waste intended for disposal, to optimise the use of disposal space and to assess the feasibility of a recycling system for VLL metal waste. Those activities are monitored in the framework of the PNGMDR. In particular, thanks to optimisation of the use of disposal space, the technical capacity of Cires would now appear to be about 40% higher than its regulation capacity, *which, provided regulatory modifications are made, would postpone its saturation. Andra is also tasked, under the PNGMDR, with proposing an overall industrial scheme by June 2015, meeting the need for new very low level radioactive waste disposal capacity.*

As for the CSA, the search for overall optimisation of waste led to the development of solutions for the acceptance of large components, without having to cut them up for packaging in standard packages. These solutions should be deployed taking account of the various issues, in particular safety, technical, economic, calendar, of all the waste management phases. In this way, 4 steam generators from the Chooz NPP will be disposed of in Cires after extensive decontamination on the NPP site, enabling them to be downgraded from LLW/ILW-SL status to VLL status (two are already in the disposal facility). This solution cannot necessarily be extended to all the steam generators of the NPPs in service. However the inventory of outsized waste led Andra to design a disposal vault dedicated to this type of package, which should enter service in 2016.

### 3.2.3. Mine-tailing disposal facilities

In line with economic criteria, the poorest ore underwent static processing and the rest, dynamic processing. Depending on the nature of the ore, the processing method called upon either an acid or basic medium. On most French sites, uranium was leached with sulphuric acid, while sodium chlorate acts as oxidiser, if necessary.

Those processes left virtually all ore components intact once uranium was placed in solution. Any residual uranium amounted to about 0.1 kg/t and could not be extracted owing to its low solubility or its inaccessibility to the acid. However, all highly insoluble radium remained in the solid residue.

The uranium mining industry, which is today no longer active in France, generated 50 million metric tons of mining residues. These residues are currently spread over 17 disposal sites in former mine works (see table § D.4.2). These disposal sites are installations classified on environmental protection grounds and subject to the authorisation system in accordance with section n° 1735.

The rehabilitation of the residue disposal sites consisted in installing a solid cover over the residues to create a geo-mechanical and radiological protective barrier. The licensees also set up installations to treat the water overflowing from the hydraulic ponds created by the mine workings or galleries. These stations reduce the uranium and radium concentrations in the water before it is discharged into the environment.

After rehabilitation of the sites, it may be necessary, on some of them, to maintain installations for treatment of the mine drainage water and/or excess water removed from the residues. Studies are being carried out concerning the long-term fate of these sites, more specifically with respect to the PNGMDR and the decree establishing its prescriptions (see § B.6.3 above).

## 4 | BURE LABORATORY

Following the decision taken in 1998 by the government to select the Meuse/Haute-Marne Site to host an underground research laboratory (URL), the first stope-preparation activities were undertaken in 2000, whereas the access shafts were sunk in 2001.

Since 2005, ANDRA has been conducting at a depth of 500 m within the Meuse/Haute-Marne URL a series of experiments designed to assess *in situ* the thermal, hydraulic, mechanical and chemical properties of the clay rock, to understand its reactivity to various mechanical, thermal or chemical solicitations and to reproduce the expected interactions between the materials that are likely to be used in the repository and in the geological environment. In parallel, ANDRA is testing *in situ* and, via technological demonstrators, various architectural components for disposal purposes (drifts, cells, seals), as well as suitable techniques to carry them out (excavation, lining and support).

More than 1,400 m of drifts have currently been excavated and made available for the experimental and demonstration programme. Nearly 10,000 measurement points are installed in the underground laboratory and transmit information about the behaviour of the rock and the structures built.

The following R&D orientations will be followed, following priority focus on them during the period 2011 - 2014:

Research concerning the Thermo-Hydro-Mechanical and Chemical (THMC) effects in the rock and the evolution of the properties of the excavation damaged zone (EDZ) around the structures:

- Thermal effects (THM properties, superposition of thermal loads and full-scale heating vault),
- Impact of EDZ compression and its hydration (self-sealing) with regard to the transfer properties,
- Hydraulic performance of sealing of a drift (5m long by 5m in diameter),
- Effects of ventilation (de-saturation/re-saturation),
- Continued migration of gases in the undisturbed rock, evaluation of the time to re-saturate clay sealed structures (pellets, bricks of bentonite), gas fracturing in 2014,
- Evolution of forces on the supports and coatings for various construction methods (compressible shims, thick shotcrete, poured concrete, liner segments),
- Characterisation of the EDZ for different construction methods (flexible and rigid linings, liner segments),
- Evolution of deformation of the HLW vault liners with and without filling of the annulus,
- Effects of oxidising disturbance and bacteriological contamination,
- Long-term reactions at the interfaces with the materials added to build the repository (steel, glass, concrete).

Preparation for implementation of demonstration tests and development of:

- The method for excavating vaults intended to take high level waste;
- Excavation of large diameter drifts;
- Installation of liner segments with a tunnelling machine, and
- Installation of a seal core.

All of the work done in the underground laboratory should contribute to the production of scientific and technical data to support the preparation of the creation authorisation application file for the deep geological disposal facility (see § H.3.2.1 below).

## 5 | RADIOACTIVE WASTE INVENTORY

### 5.1. Annual production of radioactive waste

The average annual waste production and its origin in 2012 is summarised in Table 13, according to the classification described in § B.4.2.

Type of waste	Volume (m <sup>3</sup> )	Fuel cycle and electricity production (%)	Nuclear research (%)	Miscellaneous (%)
VLL waste	31 000	68	28	4
LIL-SL waste	13 000	~80	~20	low
LL-LL waste	240	25	0	75
IL-LL waste	200	80	20	0
HL waste	150	100	0	0

TABLE 12 : ANNUAL PRODUCTION OF RADIOACTIVE WASTE IN 2012

The shares of IL-LL and HL waste shown in Table 13 include all waste conditioned through the processing of the spent fuel produced in France.

Percentages were calculated on the basis of the waste conditioned into packages. Spent fuel held in storage facilities is also ignored when calculating percentages. The “Miscellaneous” category comprises only waste resulting from polluted site clean-out (LL-LL) and the non-nuclear industry and medical sectors (VLL, LIL-SL waste).

### 5.2. Existing waste in storage facilities

#### 5.2.1. Waste volume resulting from spent-fuel processing (French share)

All ultimate waste contained in the spent fuel processed in the La Hague facilities belong to two categories: fission products and structural waste.

Fission products and structural waste are conditioned into CSD-V and CSD-C packages, respectively. As shown in Table 14, the large majority of CSD-V packages among the total number of existing or upcoming packages on 31 December 2012, belonged to France, with due account of the fact that most of the activity (79 %) of processed foreign spent fuel has been shipped back.

In the case of CSD-C packages, the share of remaining packages on 31 December 2012 was higher than for vitrified packages, since the priority was given by AREVA to activity over mass.

	Total number of stored packages on 31.12.12	Estimated share of processed spent fuel belonging to French owners before 31.12.12 (%)
CSD-V	11,665	97,8
CSD-C	11,941	57,4

TABLE 13 : QUANTITIES OF CURRENTLY-STORED ON 31 DECEMBER 2012

### 5.2.2. Waste volume resulting from spent-fuel processing (foreign share)

In accordance with the Order of 2 October 2008, all foreign CSD-V and CSD-C packages are shipped back to their countries of origin according to the activity levels and the mass of the imported spent fuel, respectively.

	Estimated share of every foreign State with regard to processed spent fuel before 31 December 2012 (%)							
	Australia	Belgium	Germany	Italy	Japan	Netherlands	Spain	Switzerland
CSD-V	<0.1	0	0	0.6	0	< 0.1	0.5	1.1
CSD-C	0	0.6	26.5	1.4	11.9	0.4	0.4	1.4

**TABLE 14 : ESTIMATED FRENCH AND INDIVIDUAL FOREIGN SHARES OF EXISTING AND UPCOMING CSD-V AND CSD-C PACKAGES, IN RELATION TO THE TOTAL AMOUNT OF EXISTING OR UPCOMING PACKAGES FROM THE STORED WASTE ON 31 DECEMBER 2012**

### 5.2.3. Other stored waste (end of 2012)

- IL-LL waste different from those coming from spent fuel treatment : 40 200 m<sup>3</sup>
- LL-LL waste: 87 600 m<sup>3</sup>
- LIL waste not already stored at CSA: 71 000 m<sup>3</sup>
- VLL waste not already stored at CIRES: 197 000 m<sup>3</sup>
- Tritiated waste: 5 500 m<sup>3</sup>
- for certain VLL and low-level waste categories, which have been lacking a disposal system for a long time (oils, resins, scrap metal, etc.), EDF has created some dedicated and regulated areas (VLL-waste areas) in which those residues are stored pending their evacuation.
- Disused radioactive sources: 1 700 000.
- Mine tailings, constituting a specific VLL-waste category, which is managed separately (see table below).

Region	Storage facility	%	Quantity (thousands of tonnes)
Alsace	Teufelsloch	0,01 %	4
Auvergne	Rophin	0,06 %	30
	Saint-Pierre	1,2 %	605
Bourgogne	Bauzot	0,03 %	16
	Gueugnon	0,4 %	220
Languedoc	Le Cellier	12,0 %	5 940
	Le Bosc (Lodève)	10,0 %	4 960
Limousin	Bellezane	3,1 %	1 552
	Le Bernardan (Jouac)	3,7 %	1 810
	Brugeaud	25,3 %	12 530
	Lavaugrassse	15,1 %	7 480
	Montmassacrot	1,5 %	740
	La Ribière	0,4 %	197
Midi-Pyrénées	Bertholène	0,9 %	470
Pays-de-Loire	La Commanderie	0,5 %	250
	L'Ecarpière	22,9 %	11 340
Rhône-Alpes	Bois-Noirs Limouzat	2,6 %	1 300
		100 %	49 416

**TABLE 15 : INVENTORY OF URANIUM MINE WORKS AND OF MINE TAILINGS (IN MILLIONS OF TONNES)**

### 5.3. Waste intended for final disposal

At the end of 2013, the total volume of disposed VLL, LL and IL-SL waste amounted to about 1 070 000 m<sup>3</sup> as broken down in the following Table.

	Volume (m <sup>3</sup> )
Immersion of 14,300 t (1967 and 1969)	9 900
Centre de la Manche	527 000
CSA	280 000
CIRES	252 000

TABLE 16 : STORED VOLUMES OF TFA, FA, MA SL AND LIL-SL WASTE ON 31 DECEMBER 2013

At the end of 2013, no IL-LL or HL waste had ever been disposed of permanently in France.

## 6 | NUCLEAR FACILITIES BEING DECOMMISSIONED

Nuclear facilities under dismantling are identified in the following figure.

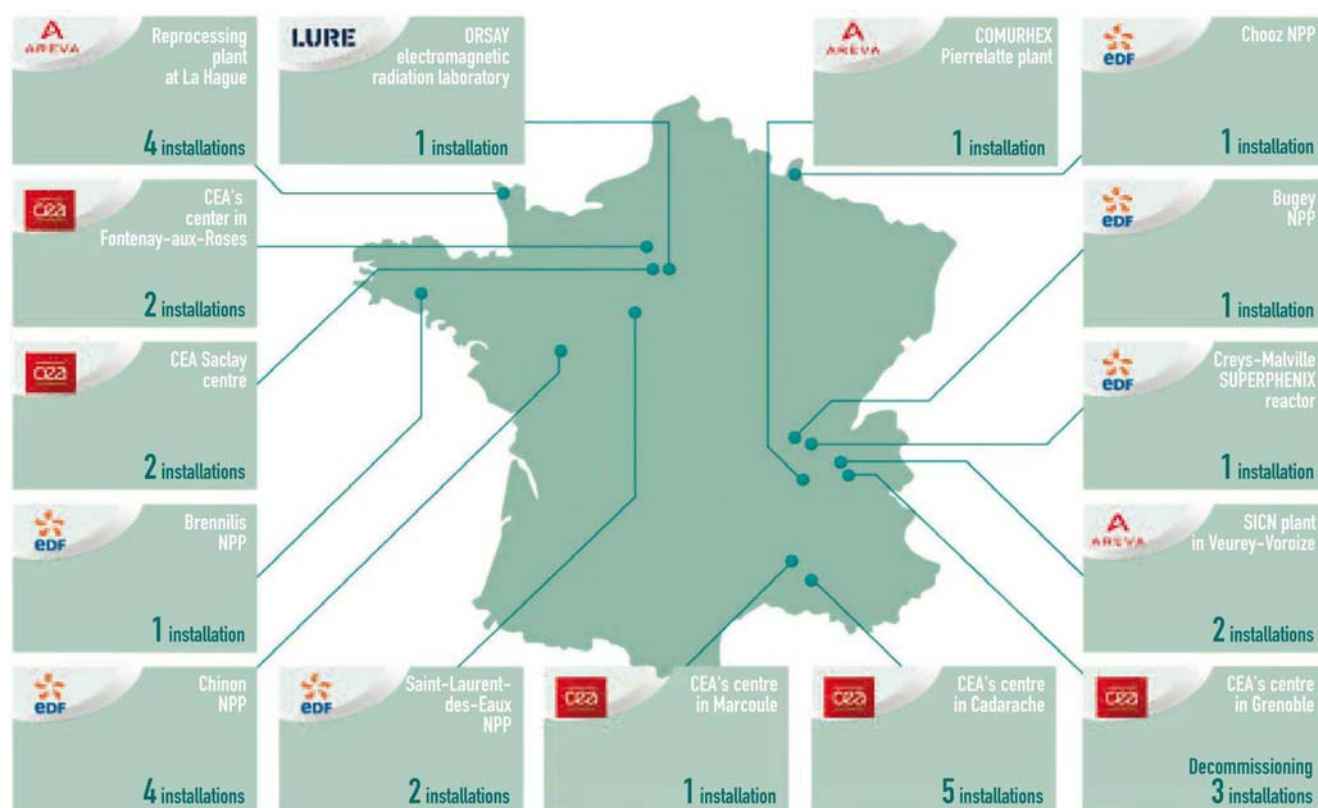


FIGURE 2 : NUCLEAR FACILITIES BEING DECOMMISSIONED ON 31 DECEMBER 2013

At the end of 2013, more than 30 facilities were being dismantled as follow:

- 9 former nuclear-power reactors (EDF) ;
- 13 CEA facilities ;
- 7 AREVA facilities including 4 at La Hague site.



## SECTION E | LEGISLATIVE AND REGULATORY SYSTEM (ART. 18 TO 20)

### 1 | GENERAL FRAMEWORK (ARTICLE 18)

*Each Contracting Party shall take, within the framework of its national law, regulatory and administrative measures and other steps necessary for implementing its obligations under this Convention.*

#### 1.1. General legal framework for nuclear activities

Guaranteeing the safe management of nuclear activities involves two closely-related aspects: radiation protection and nuclear safety.

With respect to radiation protection, there is only one set of regulations in France.

With regard to nuclear safety, however, the facilities and radioactive substances subject to the *Joint Convention* are much diversified in nature and are controlled by various regulatory structures.

Over and above a specific threshold set by *Decree No. 2007-830 of 11 May 2007 Concerning the BNI Nomenclature*, all nuclear facilities are called BNIs and are placed under ASN's control.

To that category belong especially all facilities producing, storing or processing spent fuel from reactors, spent fuel processing plants, storage facilities, etc., as well as facilities whose "main purpose is to manage radioactive waste" as defined in the *Joint Convention* (except for the Cires, which constitutes an ICPE) and a large number of facilities containing radioactive waste, although waste management is not their primary purpose: all in all, BNIs amount to a total of 118 (facilities under construction or in project are not included).

Below the above-mentioned threshold, any facility containing radioactive substances may constitute an ICPE and be placed under the control of the Ministry for the Environment, among approximately 800 other similar facilities.

It should be noted that national-defence facilities follow the same activity-classification system. Specific competent authorities are supervised by the Minister for Industry and/or National Defence. However, since all radioactive waste generated by those facilities are eliminated in civilian waste-elimination facilities, the long-term management of those residues forms an integral part of ASN's control mission.

Lastly, radioactive sources are the subject of specific regulations and are placed under ASN's control, since April 2002. Sealed sources are regulated as soon as they exceed an exemption threshold for every radionuclide as prescribed by *Decree No. 2002-460 of 4 April 2002 Relating to the General Protection of Persons Against Ionising Radiation Hazards* (modified by *Decree No. 2007-1582 of 7 November 2007 Relating to the General Protection of Persons Against Ionising Radiation Hazards and Modifying the Regulatory Provisions of the Public Health Code*). That threshold has been set very low.

It should be noted also that the consistency of safety control is ensured by a constant interaction between regulatory authorities whose high officials meet frequently. General regulations applicable to several types of facilities are being developed by joint working groups. Although informal, those contacts are very effective.

The French structure for nuclear safety and radiation protection relies notably on the primary and full liability of operators, according to which the responsibility of a hazardous activity lies essentially with the

person who carries it out or practises it (BNi operators, such as the CEA, AREVA and EDF; radioactive-material conveyors, radioactive-source users, etc.) and not with public authorities or other parties. On this account the regulations applicable to the BNIs are based chiefly on the *Environment Code* and the implementation decrees of the *TSN Act*, in particular the *BNi Procedures Decree* and the *BNi Order*.

Several legislative and regulatory provisions relative to the BNIs stem from or take up international conventions and standards, notably those of the IAEA.

Several European community texts apply to BNIs. The most important are the Euratom Treaty and the two directives establishing a community framework for the safety of nuclear facilities and for the responsible and safe management of spent fuel and radioactive waste.

## 1.2. National texts

The legal system applicable to the BNIs was revised in depth by the TSN Act and its application decrees, in particular the “*BNi Procedures*” Decree. Since 6 January 2012, the provisions of the three main Acts that specifically concern BNIs, namely the TSN Act, the Waste Act, and Act 68-943 of 30 October 1968 relative to civil responsibility in the field of nuclear energy (called the “RCN” Act) – have been codified in the *Environment Code*.

### 1.2.1. 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 n°2007-830 of 11 May 2007 concerning the list of BNIs and *BNi Procedures decree* as amended, concerning BNIs and the regulation of the nuclear safety of the transport of radioactive substances. 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.

#### 1.2.1.1. TSN ACT

The legislative base governing the safety of BNIs in France is the TSN Act, which has profoundly overhauled the legal framework applicable to nuclear activities and their oversight. It gives a reminder that the environmental protection principles apply to nuclear activities, particularly the polluter-pays principle and the principle of public participation. It also reasserts the three major principles governing radiation protection, namely justification, optimisation and limitation. It sets out the fundamental principle of the prime responsibility of the licensee as regards the safety of its installation. This TSN Act, which also created ASN - an independent administrative authority, contains advances in terms of transparency. It takes into account, for example, the lessons drawn from the examination of foreign legislation.

Lastly, it reinforces the right of the general public to be informed in the nuclear field and it moreover obliges the BNi licensees to draw up an annual report that sets out:

- all steps taken with regard to nuclear safety and radiation protection;
- all incidents and accidents declared to ASN;
- the nature and results of measurements of radioactive and non-radioactive discharges from the facility;
- the nature and quantity of radioactive waste stored on the site, and
- all steps taken in order to limit the volume and impact of that waste on health and the environment.

By granting a legal status to CLIs consisting of State representatives, elected officials and association members, this Act reinforces their status. It recognises the involvement of territorial communities, notably of general councils (elected assemblies managing the French *départements*), in their operation. It grants them the possibility to constitute themselves into associations and ensures their continuous funding. It allows for a

CLI Federation to ensure a sound basis for the National Association of Local Information Committees (*Association nationale des comités et commissions locales d'information*).

#### 1.2.1.2. WASTE ACT

Waste Act dispositions are detailed in § B.1.1.

#### 1.2.2. Decree No. 2007-1557 of 2 November 2007 (BNI Procedures)

*BNI procedure decree* 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 creation authorisation decree to commissioning, to final shutdown and decommissioning or, for a disposal facility, the surveillance phase following closure).

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.

As for radiation protection issues, ASN is the responsible authority in accordance with the *TSN Act*, as well as the *Public Health Code* and the *Labour Code*, both of which were amended at the end of 2007.

#### 1.2.3. “BNI” Order of 7 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.

In addition to the general principles taken from the former Order of 31 December 1999 and the WENRA reference levels (responsibilities, management principles, traceability, etc.), the title 6 of this order contains some new requirements concerning packaging:

- application of the acceptance specifications of the disposal facilities for which the packages are destined;
- for waste for which the disposal route is still being studied: packaging subject to ASN approval;
- or legacy waste: re-packaging as rapidly as possible so that the waste can be placed in a disposal facility.

These requirements are supplemented by title 8 which contains the provisions applicable to facilities for the storage of radioactive substances including waste and spent fuel (defining acceptability criteria, a storage duration, possibility of retrieving the substances at any time, etc.) and to radioactive waste disposal facilities.

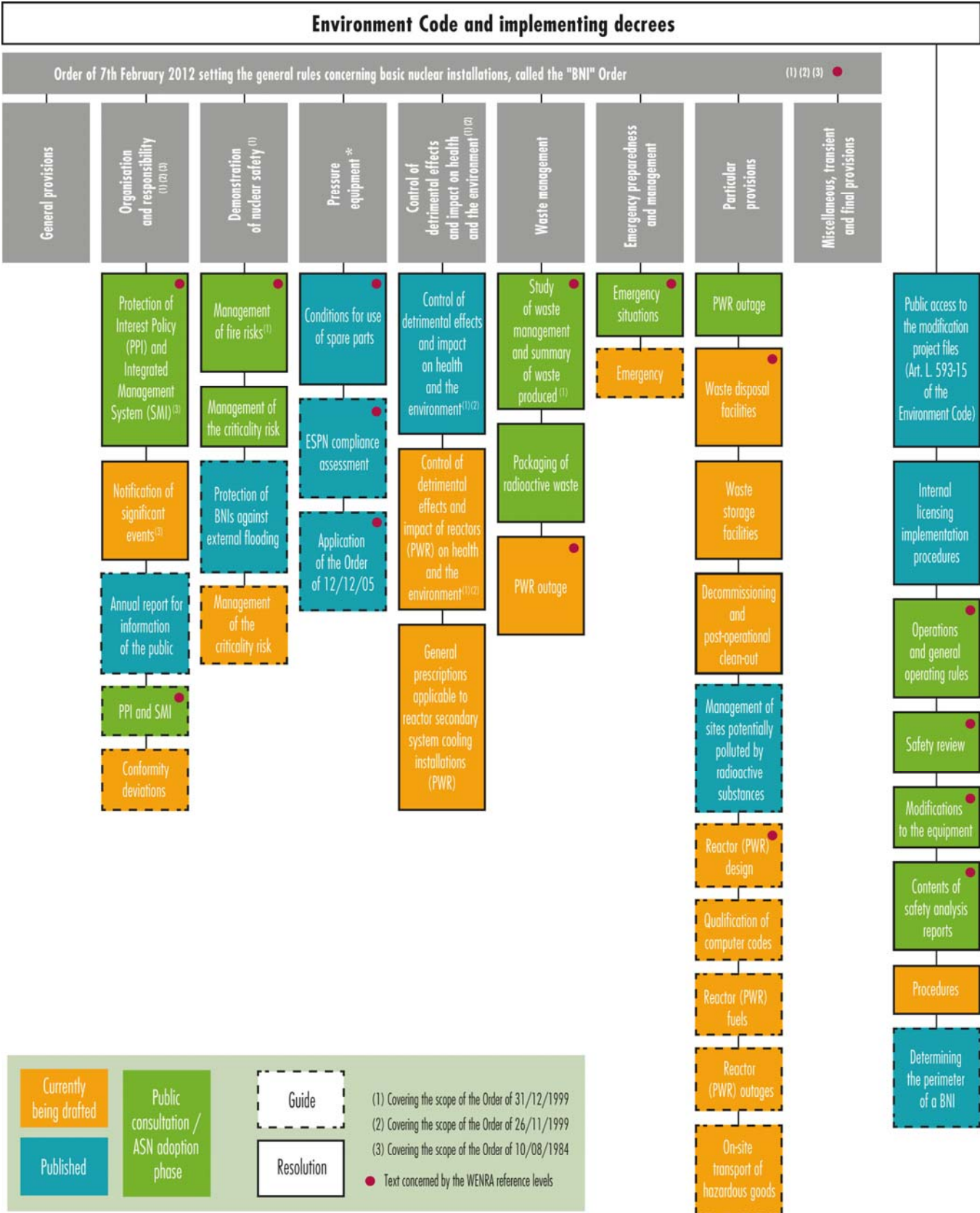


FIGURE 3 : STATUS OF PROGRESS OF THE OVERHAUL OF THE GENERAL TECHNICAL REGULATIONS APPLICABLE TO BNIS, AS AT 28 FEBRUARY 2014

### 1.3. Legal frameworks for ICPEs and mines

The legal framework of the ICPEs is set by the *Environment Code* and its Book V in particular. This legislation succeeded from an act dated 1917 which in turn succeeded from a decree dated 1810.

In France, the State regulates the control of pollution, as well as industrial and agricultural risks. In that capacity, it formulates a policy for controlling industrial risks and nuisances. Those legal instruments provide in general terms the criteria for deciding whether a facility may be hazardous or inconvenient either for the comfort of the neighbourhood, or for public health, security and hygiene, or else for agriculture, for the protection of nature and the environment, or for the conservation of sites and monuments.

The ICPE legislation introduces a very simple system. The industrial activities that come under this legislation are inventoried in a list that subjects them to a system of either licensing, registration or declaration, depending on the activity in question and the quantity of hazardous products involved.

The polluter-pays principle is a basic principle of the environmental policy. It consists in making the polluter pay for any damage caused to the environment due to his activity and, in particular, to the impact of discharged liquid and gaseous effluents, or even waste.

The *Mining code* was created via the *decree of 16 August 1956*, by taking up the fundamental law on mines of 21 April 1810. In France, common law states that "ownership of the ground includes ownership of what is above and below it" (Article 552 of the *Environment Code*). The *Mining code* however nuances this rule by specifying that the substances of the "mines" can be conceded by the State. They are thus outside the law of ownership and the State attributes the use and sets the conditions of mine operation.

In mining law, one must clearly distinguish the difference between:

- the right to the substance granted by a mining title: an exclusive research permit for exploration, an operating license (until the end of 1994 except in geothermal applications or overseas) or a concession for operating the mine. The mining title (concession in perpetuity or limited concession, depending on its date of institution, operating license or exclusive research license) is delivered by the Minister responsible for mines.
- the license to start research or mining work: granted by prefectural decision on account of the mining policing authority exercised by the prefect without necessarily obtaining the agreement of the owner of the land. This license relates to the valorisation of the substance (substantial research work and mining work) and sets the conditions for operating the mine in compliance with the various interests set by the *Mining code*.

### 1.4. Public Health Code

The *Public Health Code* (*Code de santé publique* – CSP) describes the overall nature of "nuclear activities", that is, all activities involving a personal exposure risk due to the ionising radiation emitted by either an artificial source, whether substances or devices are involved, or a natural source when natural radionuclides are or were processed because of their radioactive, fissile or fertile properties. It also covers all "interventions" designed to prevent or to reduce any radiological risk following an accident associated with environmental contamination.

The *CSP* describes also the general international radiation-protection principles (justification, optimisation, limitation) adopted by the International Radiological Protection Commission (ICRP) and integrated in IAEA requirements and in *Euratom Directive No. 96/29*. Those principles orient all regulatory actions for which ASN is responsible.

The *CSP* also instituted the Radiation Protection Inspectorate, which is in charge of controlling the application of its radiation-protection prescriptions.

Lastly, it describes the applicable system of administrative and legal penalties.

## 2 | LEGISLATIVE AND REGULATORY FRAMEWORK (ARTICLE 19)

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of spent fuel and radioactive waste management.

2. This legislative and regulatory framework shall provide for:

- i) the establishment of applicable national safety requirements and regulations for radiation safety;
- ii) a system of licensing of spent fuel and radioactive waste management activities ;
- iii) a system of prohibition of the operation of a spent fuel or radioactive waste management facility without a licence; ;
- iv) a system of appropriate institutional control, regulatory inspection and documentation and reporting ;
- v) the enforcement of applicable regulations and of the terms of the licences, and ;
- vi) a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and radioactive waste management.

3. When considering whether to regulate radioactive materials as radioactive waste. Contracting Parties shall take due account of the objectives of the Convention.

This section deals successively with radiation-protection regulations and the relevant regulations for the three categories of nuclear activities mentioned in § E.1.1: BNIs; ICPEs and the special case of mines and sealed sources.

### 2.1. General regulatory framework for radiation protection

The regulatory framework for radiation protection was updated during the harmonisation with *EURATOM Directives 96/29 and 97/43*, and is presented with the matching regulations in § F.4.

### 2.2. Regulatory framework for BNI safety

Besides general regulations, such as those relating to labour law and the protection of nature, BNIs are subject to two types of specific regulations: licensing procedures and technical rules.

The purpose of ASN's control is to verify that the operator of a nuclear facility assumes fully his responsibilities and obligations with regard to safety. That external control does not relieve the operator from his responsibility to organise and to monitor his own activities, especially those contributing to safety.

#### 2.2.1. Framework of BNI licensing procedures

The French legislation and regulations prohibit the operation of a nuclear facility without the relevant licence. In that framework, BNIs are regulated by the *Environment Code* and by *BNI procedures Decree*, which provide for a creation- licence procedure and a series of further licences during the major steps in the lifetime of those facilities: commissioning, changes to the facility, final shutdown and decommissioning (or, in the case of a disposal facility, the post-closure monitoring phase). Any operator who runs a nuclear facility without the required licences or does not comply with their conditions is liable to the administrative and criminal penalties referred to mainly in Chapters III and IV of the *Environment Code*. The enforcement of the different licensing procedures runs from the siting and design phases to the final delicensing phase.

#### 2.2.2. BNI siting procedures

Well before applying for a licence to create any BNI, the applicant must inform the administration of the future site or sites on which he intends to build his facility.

On the basis of that information, ASN requires that the socio-economic and safety aspects of the project be reviewed. ASN also analyses the safety-related characteristics of the site(s), such as seismicity, hydrogeology, industrial environment, cold-water sources, etc.

Furthermore, pursuant to Articles L. 121-1 of the *Environment Code*, the creation of any BNI is subject to a public-debate procedure, national procedure which must not be confused with the more local public inquiry procedure):

- statutorily, in the case of any new site for the production of nuclear power or any new site not intended for the production of nuclear power, but involving a cost exceeding 300 million euros, and
- eventually, in the case of any new site not intended for the production of nuclear power, but involving a cost ranging between 150 and 300 million euros.

The construction of a BNI is subject to the issuance of a building permit by the prefect in accordance with the procedures specified in Articles R. 421-1 and following, and Article R. 422-2 of the Town Planning Code.

Lastly, the French government has to inform all neighbouring countries in accordance with treaties in force, especially the *EURATOM Treaty*.

### **2.2.3. BNI design, construction and safety assessment procedures**

#### **2.2.3.1. SAFETY ASSESSMENT**

##### **Safety options**

Any person who intends to run a BNI may, before submitting a licence application, seek ASN's advice on all or part of the selected options in order to ensure the safety of the proposed facility. ASN's opinion must be duly notified to the applicant and must contain all complementary studies and justifications to be included in the creation-licence application, if submitted.

In general, ASN requests the competent Expert Advisory Group (*Groupe permanent d'experts – GPE*) to examine the project.

ASN informs the potential applicant of its opinion in order for him to be aware of the questions for which he will have to provide answers in his creation-licence application.

Safety options must then be presented in the licence application through the preliminary safety report.

The purpose of the preliminary procedure is not to replace any subsequent regulatory reviews, but rather to facilitate them.

##### **Safety review and assessment of BNI creation-licence applications**

All documents to be submitted in any application to create a BNI are listed in the *BNI Procedure Decree*. The applicant must provide, for instance, an environmental impact study, as defined in the *Environment Code*, and a preliminary safety report. No application may be submitted before the siting process and the preliminary studies are sufficiently advanced. The modalities for the safety review and assessment of the facility are described in § E.2.2.3.2.

##### **Prerequisite safety review and assessment for BNI commissioning**

In any licence application to commission a BNI, the applicant must provide a safety report containing an update of the preliminary safety report. Modalities for the safety review and assessment of the facility are described in § E.2.2.4.

##### **Safety reviews and re-assessments**

In accordance with the Environment Code (Article L. 593-18), operators must review periodically the safety of their facility by referring to the best international practices. The purpose of such review is to assess the state of the facility by comparing it with applicable rules and to update the assessment of the risks or inconveniences raised by the facility with regard to security, health and the environment, by taking into account the state of the facility, the acquired experience feedback, the evolution of knowledge and applicable rules for similar facilities. All operators concerned must submit to ASN and the Minister in charge of nuclear safety a report containing the conclusions of such review and, if need be, the proposed steps to be taken in order to correct any detected anomaly or to improve the safety of their facility.

After analysing the report, ASN may impose new technical requirements. ASN must also submit its analysis of the report to the Minister in charge of nuclear safety.

Safety re-assessments must be held every 10 years. However, the licensing decree may provide for a different frequency, if the particularities of the facility deem it necessary.

#### 2.2.3.2. CREATION LICENCES

##### **Submission of creation-licence applications**

License application to create a BNI is submitted to the Minister responsible for nuclear safety by the company which intends to operate the facility, which then acquires the status of licensee. The application is accompanied by a file comprising a number of items, including the detailed plan of the facility, the impact assessment, the preliminary safety analysis report, the risk management study and the decommissioning plan.

The coordination of the licensing procedure is led by the competent services under the authority of the Minister responsible for nuclear safety. The said services task ASN with the technical examination of the application file and submit the impact analysis to the opinion of the Environmental Authority within the General Council for the Environment and Sustainable Development.

##### **Consultation of the public and the local authorities**

The authorisation can only be granted after holding a public inquiry. The publication of *decree 2011-2018 of 29 December 2011* reforming the public inquiry process for operations liable to affect the environment led to harmonisation of the public inquiry regime, which meant that the procedure applicable to BNIs was no longer an exception but was incorporated into the general regime. The purpose of this inquiry is to inform the public and obtain public assessments, suggestions and counter-proposals, in order to provide the competent authority with all the information it needs prior to any decision.

The inquiry is conducted according to the provisions of the Environment Code. The Prefect opens the public inquiry in every commune which has any part of its territory located within a 5 km radius of the installation perimeter. This inquiry shall last at least one month and no more than two months. The file submitted by the licensee to support its authorisation application is made available. However, as the safety analysis report is a bulky document (containing the inventory of the risks the installation can present, the analysis of the measures taken to prevent these risks and a description of the measures designed to limit the probability of accidents and their effects) and is difficult for non-specialists to understand, it is supplemented by a risk control study. The opinion of the Environmental Authority is appended to the public inquiry file.

Furthermore, the procedures concerning BNIs subject to an inquiry are concerned by *decree n°2011-2021 of 29 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 understand the projects, in particular the persons who do not live where the inquiry is being held. Making the information available in this manner and providing the possibility of addressing observations by electronic means, as provided for by Article R. 123-9 of the *Environment Code*, since the publication of *decree n°2011-2018 of 29 December 2011* reforming the public inquiry process for operations liable to affect the environment, should make it considerably easier for, and encourage the public to, express their opinions. These provisions came into effect on 1st June 2012.

##### **Consultation of technical organisations**

For the technical examination of the application, in particular of the preliminary safety report supporting the creation-licence application, ASN is technically supported by IRSN and the Advisory Committees of Experts (GPE).

Once the application examined and the conclusions of the consultation are known, ASN must submit to the Minister in charge of nuclear safety a proposal designed to serve as the basis for the decree licensing or rejecting the creation of the facility.

### **The creation authorisation decree (DAC)**

If all the conditions are met, the minister responsible for nuclear safety sends the licensee a preliminary draft decree granting creation authorisation (DAC). The licensee has a period of two months in which to present its comments. The minister then obtains the opinion of ASN. ASN Resolution 2010-DC-0179 of 13 April 2010, which came into effect in July 2010, gives the licensees and the CLIs the possibility of being heard by the ASN Commission before it issues its opinion.

Any BNI-creation licence must be issued through a decree signed by the Prime Minister and countersigned by the Minister in charge of nuclear safety.

The decree sets forth the perimeter and characteristics of the facility.

It must also specify the term of the license if any, and the commissioning delay of the facility. It must also impose the availability of essential means for protecting public security, health, hygiene, nature and the environment.

### **ASN requirements for the enforcement of the licensing decree**

For the enforcement of the licensing decree, ASN may establish any design, construction and operating requirements it deems necessary for nuclear security.

ASN must also define any requirement relating to activities involving water intakes by BNIs and discharges resulting from nuclear facilities. Specific requirements prescribing BNI discharge limits must be validated by the Minister in charge of nuclear safety. Pursuant to article L. 593-15 of the *Environment Code*, BNI modification projects that could cause a significant increase in water intakes or effluent discharges to the environment are now disclosed to the public. This arrangement entered into force on 1st June 2012, but ASN had nevertheless been asking nuclear licensees to apply this practice since 2008, and it had been implemented on several occasions.

ASN resolution 2013-DC-0352 of 18th June 2013 relative to the public disclosure of files for modification projects provided for in Article L. 593-15 of the *Environment Code* specifies the conditions for implementing this procedure.

## **2.2.4. BNI operating procedures**

### **2.2.4.1. COMMISSIONING LICENCES**

Commissioning corresponds to the first loading of radioactive substances in the facility or the initial operation of a particle beam.

Prior to commissioning, the operator must submit an application containing an update of the preliminary safety report, the general operating rules, a waste-management study, the on-site emergency plan and, except for disposal facilities, an update of the decommissioning plan, if need be.

Once checked that the facility complies the objectives and rules defined in the *Environment Code* and its accruing instruments, ASN may license the facility to be commissioned.

The licence resolution must be mentioned in the *Bulletin officiel de l'ASN*. ASN must also notify the operator as well as inform the Minister in charge of nuclear safety and the Prefect concerned. It also informs the CLI.

Before the evolution or completion of the commissioning-licensing procedure, ASN may issue a partial-commissioning licence for a limited time period and in certain specific cases, notably if special operating tests need to be performed requiring the introduction of radioactive substances in the facility, and provided that the resolution is published in its *Bulletin officiel*.

### **2.2.4.2. END OF COMMISSIONING OF THE FACILITY**

ASN's resolution to authorise commissioning must prescribe the time period within which the operator must submit a report on the end of the commissioning phase, including a summary report on the commissioning tests to be performed in the facility, a status report on experience feedback and an update of the documents filed for the commissioning-licensing application.

#### 2.2.4.3. MODIFICATIONS INVOLVING BNI PERIMETER, SIGNIFICANT CHANGES TO THE FACILITY OR CHANGES OF OPERATORS

Subsequently, the operator must notify ASN of any modification to his facility, which requires general operating rules or the on-site emergency plan to be updated.

Whenever an operator is replaced, the site perimeter is modified or any significant change is made to the facility, a new licence, duly reviewed according to the above-mentioned standard procedure for the creation-licence application, is required.

Any change is deemed “significant” in any of the following cases specified in the *BNI Procedures Decree*:

- it modifies the nature of the facility or increases its maximum capacity, or
- it modifies essential components of the facility for the protection of the interests referred in the *Environment Code*, as mentioned in the licensing decree, or
- it adds up, within the facility site, a new BNI the operation of which is associated with the concerned facility.

#### 2.2.4.4. INCIDENT FOLLOW-UP

According to the *Environment Code*, all nuclear or non-nuclear incidents or accidents having an actual or potential significant impact on the safety of the facility or the transport of radioactive materials, or causing actual or potential harm to persons, goods or the environment, due to high exposures to ionising radiation, must be reported by the relevant BNI operator or transport officer to ASN, to the State representative of the *département* where the incidents or accidents occurred, and, if need be, to the State representative at sea.

Experience feedback includes events that occur in France and abroad, as long as it appears worthy to take them into account in order to reinforce safety or radiation protection. All experience feedback on French events deal mostly with what is commonly called “significant” events. ASN defines the declaration criteria for such events to be declared by operators to ASN in order to be inputted in a special database. The declarer must assess the emergency of the declaration in relation to the actual or potential severity of the event and of the required reactivity to prevent any aggravation of the event. The declaration delay of two working days, as tolerated in the declaration guides distributed by ASN to the officers responsible for nuclear activities, does not apply if the consequences of the event require the intervention of public authorities. ASN must classify all events according to the International Nuclear and Radiological Event Scale (INES). A similar system must be set in place for events involving radiation protection and the environment.

If criteria are not met, events are considered as anomalies or discrepancies and must be recorded by the operator in anticipation of any future corrective action. That information must remain accessible to ASN during inspections, for instance.

#### 2.2.4.5. FINAL SHUTDOWN AND DECOMMISSIONING LICENCES

##### **Legislative and regulatory framework for final shutdown and decommissioning**

Any technical measures applicable to facilities that an operator intends to shut down definitively and dismantle must be consistent with general safety and radiation-protection regulations. Those measures concern notably external and internal occupational exposures to ionising radiation, criticality, radioactive-waste production, effluent discharges in the environment, as well as steps to reduce accident risks and to limit their effects.

However, decommissioning operations have specificities that must be taken into account (evolution of the nature of risks, quick changes in the state of the facilities, timescale of the operations, etc.). Hence, any operator having decided to shut down permanently his facility for decommissioning purposes, is released from the regulatory framework set by the creation-licence decree and is not allowed to refer to the safety reference system associated with the operating phase. In accordance with the provisions of the *Environment Code*, the final shutdown and decommissioning of any BNI are subject to the delivery of a relevant licence prior to such operations. Once ASN has provided its opinion, a new licensing decree for final shutdown and decommissioning would be required to replace the creation-licence decree of the relevant BNI.

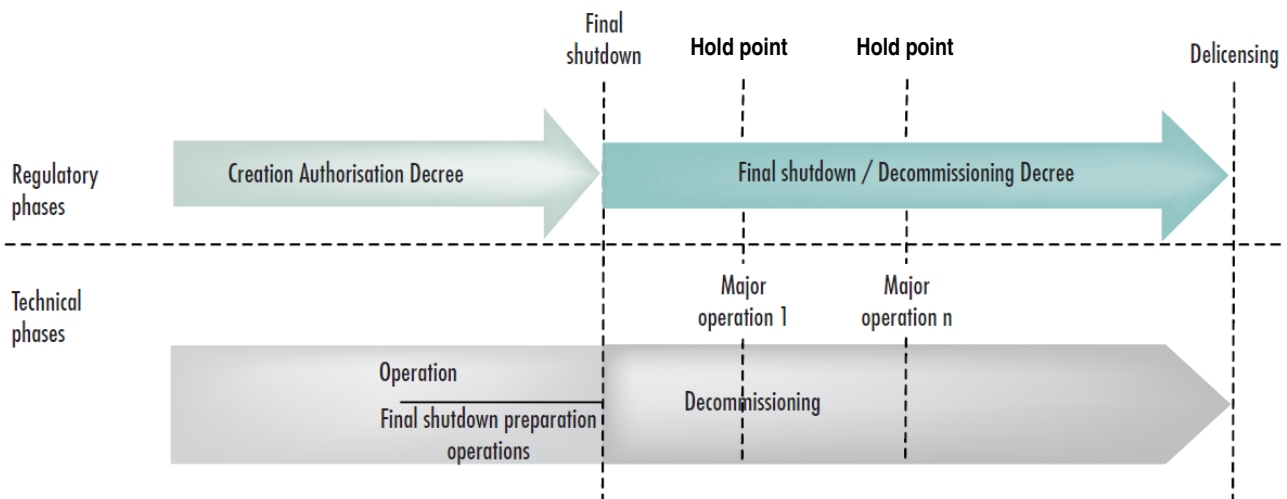


FIGURE 4 : PHASES IN THE LIFE OF A BNI

The *BNI Procedures Decree* prescribes the content of the documents to be filed by the operator in support of his application for the final shutdown and decommissioning of his facility; it also describes the procedure for dealing with such application, including in all cases, a mandatory consultation with the CLI and the public through a public inquiry.

#### Licensing procedure for final shutdown and decommissioning

Any application to obtain a final-shutdown and decommissioning licence must be submitted to the Minister in charge of nuclear safety at least one year before the expected final shutdown by the operator of the relevant facility.

The operator must send ASN a copy of his application together with the relevant supporting documents for its review.

The application to license for final shutdown and decommissioning is subject to the same consultation and inquiry modalities as for licence applications for the creation of BNIs.

However, two licensing systems co-exist, whether a general case or a radioactive-waste disposal facility is involved.

#### General case

- The licence application must contain all relevant provisions relating to final-shutdown, decommissioning and waste-management modalities, as well as to subsequent monitoring and maintenance of the facility's implementation site, and
- the licence must be issued in the form of a decree, once ASN has issued its opinion setting forth the decommissioning characteristics, the actual decommissioning deadline and the types of operations for which the operator remains responsible after decommissioning.

#### Radioactive-waste disposal facilities

- The licence application must contain all relevant provisions relating to the final shutdown, as well as to the maintenance and monitoring of the site;
- the licence is delivered by decree once ASN has issued its opinion setting forth the types of operations for which the operator remains responsible after dismantle; and
- specific provisions for the shutdown of a deep geological repository are mentioned in the *Environment Code*, including the fact that the shutdown of that repository may only be licensed through an act.

### Implementation of final shutdown and decommissioning operations

For other facilities than radioactive-waste disposal facilities, final-shutdown and decommissioning operations are divided into two successive work phases, as follows:

- final-shutdown operations consist mainly in tearing down any installations outside the nuclear island, which are not required for maintaining its monitoring and safety, the maintenance or the reinforcement of containment barriers or the preparation of the status report of radioactivity, and
- decommissioning operations involving the actual nuclear section itself may be undertaken once final shutdown operations are completed or postponed (with the understanding that the immediate-dismantling objective should be prioritised, see § F.6.1).

In certain cases, such operations as the unloading and evacuation of nuclear substances, the elimination of fluids or any decontamination and clean-up action may be carried out in accordance with the creation-licensing decree, provided that they do not lead to any non-conformity with the former rules and that they are conducted in full compliance with the safety report and the general operating rules in force, except for some occasional changes, if need be. In all other cases, those operations are regulated by the licensing decree for final shutdown and decommissioning.

### Decommissioning of facilities and implementation of public easements

Any decommissioning application must include especially a description of the state of the site after decommissioning and clean-out, including an analysis of the state of the soil and a description of potential remaining constructions of the initial facility and of their state.

If all decommissioning operations reach the final expected state as approved by ASN, the facility may be decommissioned and removed from the list of BNIs (delicensed) in accordance with the procedure referred to in the licensing decree for the final shutdown and decommissioning of the facility.

The decommissioning application must contain especially a statement on the expected state of the site after decommissioning, including an analysis of the soil and a description and state of the likely facility constructions to remain.

In order to preserve the past memory of a BNI on a given site and to forecast, if need be, the future use of the facility, public easements relating to soil use on and around the actual footprint of the facility may, in accordance with the *Environment Code*, be instituted after the decommissioning or disappearance of the facility.

Public easements relating to soil use and the conduct of work subject to an administrative statement or licence may also be undertaken on existing facilities, including those in service, in accordance with the *Environment Code*.

#### 2.2.5. BNI technical rules

Technical rules and practices relating to nuclear safety are set in a multi-tier series of texts, as summarised in § L.5.1 and L.5.2, in ascending order of detail. The first of those texts are statutory, but relatively general in nature; their scope is broad and, most of the time, does not involve technical details. The latter ones, however, detail specific subjects, and their legal format is more flexible.

As mentioned in section A, a comprehensive revamping of the general technical regulations applicable to BNIs has started once the TSN published and has progressed substantially.

##### 2.2.5.1. GENERAL TECHNICAL REGULATIONS

General technical regulations deal currently with three major topics: pressurised equipment (not relevant to facilities within the scope of the *Joint Convention*), quality organisation (see § F.3), external nuisances and risks resulting from BNI operation (see § E.2.2.6.2).

In accordance with Article L.592-19 of the *Environment Code*, ASN also takes decisions in order to complete the implementation modalities prescribed by the decrees and orders relating to nuclear safety and radiation protection, except for those relating to occupational medicine.

All ASN resolutions pertaining to nuclear safety and radiation protection are subject to the validation of the relevant Minister in charge of nuclear safety or radiation protection, as the case may be.

Those resolutions, together with the mandatory opinions ASN provides on decree drafts, are published in its *Bulletin officiel*, which may be consulted on ASN's website ([www.asn.fr](http://www.asn.fr)).

#### 2.2.5.2. BASIC SAFETY RULES

On various technical subjects concerning both power reactors and other BNIs, ASN issues *Basic Safety Rules* (*Règles fondamentales de sûreté* – RFS). Those documents consist of recommendations that define safety objectives and describe practices that ASN deems satisfactory to ensure compliance.

They are not statutory in nature. An operator may choose not to follow the provisions of any RFS, as long as he is able to prove that the alternate method he proposes ensures that the prescribed safety objectives are met.

Through its flexibility, that type of text allows for technical requirements to be updated according to technical advances and new knowledge.

In the framework of the general technical regulatory reform, RFSes will be replaced by “ASN Guides”.

All RFSes and guides referring more particularly to facilities within the scope of the *Joint Convention* are listed in § L.5.

#### 2.2.6. Scope of BNI control

ASN's supervision constitutes a statutory mission designed to check that any nuclear operator assume his full responsibilities and comply with all regulatory provisions relating to radiation protection and nuclear safety. Those supervisory activities help ASN ascertain its opinion on the performance or the challenges of a specific operator or nuclear activity.

##### 2.2.6.1. NUCLEAR SAFETY CONTROL

As part of its supervisory activities, ASN takes a keen interest in the physical equipment of the facilities, in the workers responsible for their operation, as well as in working methods and organisational arrangements from the initial design stages to final decommissioning. ASN examines the steps taken with regard to safety, control, the limitation of occupational doses received in facilities, as well as specific modalities for managing waste, controlling effluent discharges and ensuring environmental protection.

ASN's central services co-ordinate and lead regional interventions of other ASN divisions in those fields, deal with significant national issues, as well as draft and enforce the national nuclear-safety policy.

##### 2.2.6.2. ENVIRONMENTAL PROTECTION

The prevention and mitigation of nuisances and risks arising from the operation of BNIs are regulated by Title IX of Book V of the *Environment Code* (integrated system) and its implementing decrees, as well as by the BNI Order.

Generally speaking, ASN's policy in terms of environmental protection tends to be similar to that applied to conventional industrial activities. For example, the BNI Order requires the implementation of the best available techniques at an economically acceptable cost, taking account of the particular characteristics of the environment of the site.

This approach entails the definition of limits applicable to the discharges of chemical substances and to the reduction of the authorised limits for discharges of radioactive and chemical substances. The previous regulatory framework made provision for discharge permits of limited duration. As these permits expire, they are renewed in accordance with the above provisions. This renewal is an opportunity to examine whether it is possible to reduce the discharges from the installations and improve their monitoring conditions.

##### 2.2.6.3. WORKING CONDITIONS IN BNIS

Generally speaking, controlling compliance with labour regulations (especially in the case of labour agreements, working hours, staff representatives, health and safety, conciliation procedures during labour disputes, advice and information of employers, employees and staff representatives about their rights and obligations) is the responsibility of labour inspectors.

In the case of NPPs, the legislator entrusted the functions of labour inspectors upon ASN-designated engineers or technicians among the agents placed under its authority.

In other BNIs where ASN is not responsible for labour inspections, exchanges with other labour inspectors constitute a valuable source of information on the state of labour relationships in the framework of an overview of nuclear safety and radiation protection that grants a larger significance to people and to organisations.

## 2.2.7. Control modalities for BNIs

There are many ASN supervisory procedures, consisting mainly of the following:

- on-site inspections or in services associated with operators, worksite inspections during maintenance outages, and on-site technical meetings with BNI operators or the manufacturers of equipment used in facilities, and
- the review of applications and supporting documents submitted by operators.

### 2.2.7.1. INSPECTIONS

In order to take into account health and environmental issues, the operator's performance in terms of nuclear safety and radiation protection, as well as the number of activities falling under its jurisdiction, ASN designates on a periodical basis which activities and topics represent the strongest challenges and on which it will concentrate its inspections and apply a direct control at a given frequency. Waste and effluent management is one of the priority topics.

In order to ensure a sound distribution of inspection means in relation to the nuclear-safety, radiation-protection and environmental-protection goals of the different facilities and activities involved, ASN draws up a provisional annual inspection programme, which identifies the facilities, activities and topics to be inspected. The programme is not communicated to the persons in charge of nuclear activities.

To achieve its goals, ASN has a team of inspectors that are selected according to their professional experience and their legal and technical knowledge. Nuclear-safety inspectors are ASN engineers designated as such by ASN. They perform their control mission under the authority of the Director-General of ASN; they must take an oath and are bound by professional secrecy.

Every year, ASN carries out about 800 inspections in BNIs and on shipments of radioactive substances.

In 2013, 764 inspections were carried out in BNIs and on pressure equipment, and more than 24% of the inspections were unannounced. These inspections can be broken down into 86 inspections of PE (pressure equipment), 309 inspections in LUDDs (laboratories and plants) and 369 in the NPPs (nuclear power plants). Among these inspections, 131 examined the transport of radioactive substances (TRS).

Graph 2 shows the distribution of the inspections by theme. The themes relating to nuclear safety and social, organisational and human factors represent more than 50% of the BNI inspections. 12% of the inspections, i.e. a total of 93 inspections, are devoted to themes associated with environmental monitoring, waste and effluents in the BNIs (see graph below).

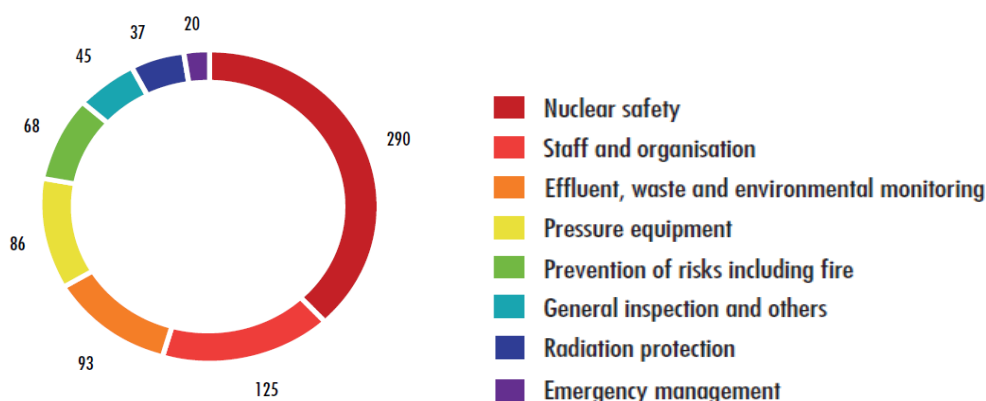


FIGURE 5 : BREAKDOWN OF BNI INSPECTIONS IN 2013 BY THEME

#### 2.2.7.2. TECHNICAL REVIEW OF DOCUMENTS PROVIDED BY OPERATORS

The operator is required to provide ASN with relevant information in order to ensure the efficiency of its control. The content and quality of that information is designed to demonstrate that the objectives of the general technical regulations, along with the operator's own objectives, are met. ASN is responsible for checking the thoroughness of the case and the quality of the demonstration.

The review of those cases may lead ASN to accept or not the operator's proposals, to require further information or studies, or even backfitting activities. ASN must formulate its requirements in the form of resolutions.

The review of the supporting documentation submitted by the operators and the matching technical meetings organised with them constitutes one of the control means used by ASN.

#### Significant incidents

Any "significant event" (see § E.2.2.4.4) relating to the safety of a BNI, to the radiation protection of workers, members of the public and the environment, or to the transport of radioactive materials, must be promptly declared to ASN.

ASN ensures that the operator has conducted a sound analysis of the event and taken all appropriate corrective steps to correct the situation and to prevent its recurrence, and has also disseminated the relevant experience feedback.

The analysis of a significant event deals with the compliance of current regulations regarding the detection and declaration of significant events, the immediate steps to be taken by the operator in order to maintain or to restore the facility under safe conditions, and finally, the relevancy of reports on significant events to be submitted by the operator.

Together with the IRSN's technical support, ASN carries out a deferred review of the experience feedback from events. All information provided by territorial divisions and the analysis of all significant-event reports and periodical status reports submitted by operators constitute the organisational base for ASN's experience feedback. That experience feedback may lead to requests to improve not only the operator's facilities or organisational structure, but also the regulations themselves.

The figure below shows information relative to significant events having occurred in the laboratories, plants, installations undergoing decommissioning, and waste processing, storage or disposal facilities.

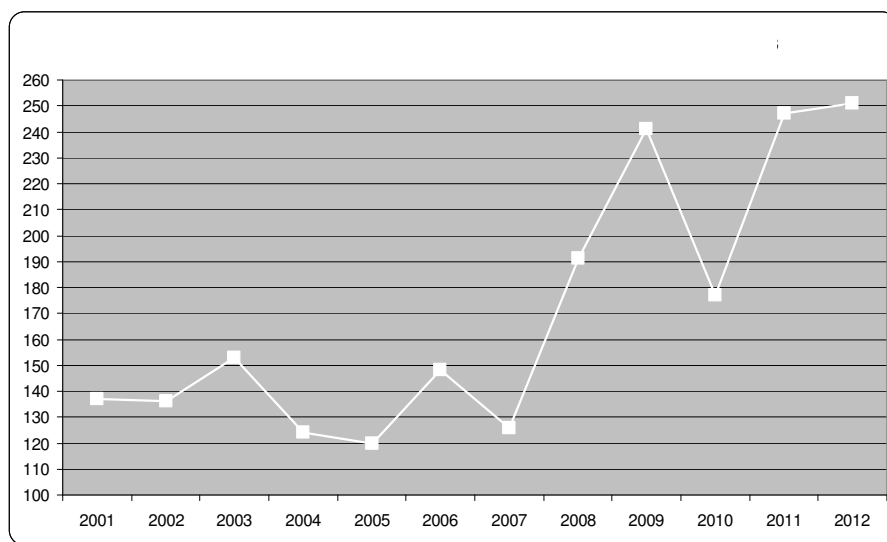


FIGURE 6 : TREND FOR TOTAL NUMBERS OF SIGNIFICANT EVENTS NOTIFIED FOR LUDD FACILITIES (2001-2012)

The total number of significant events has increased overall but stabilised in 2012, even if the number is still high.

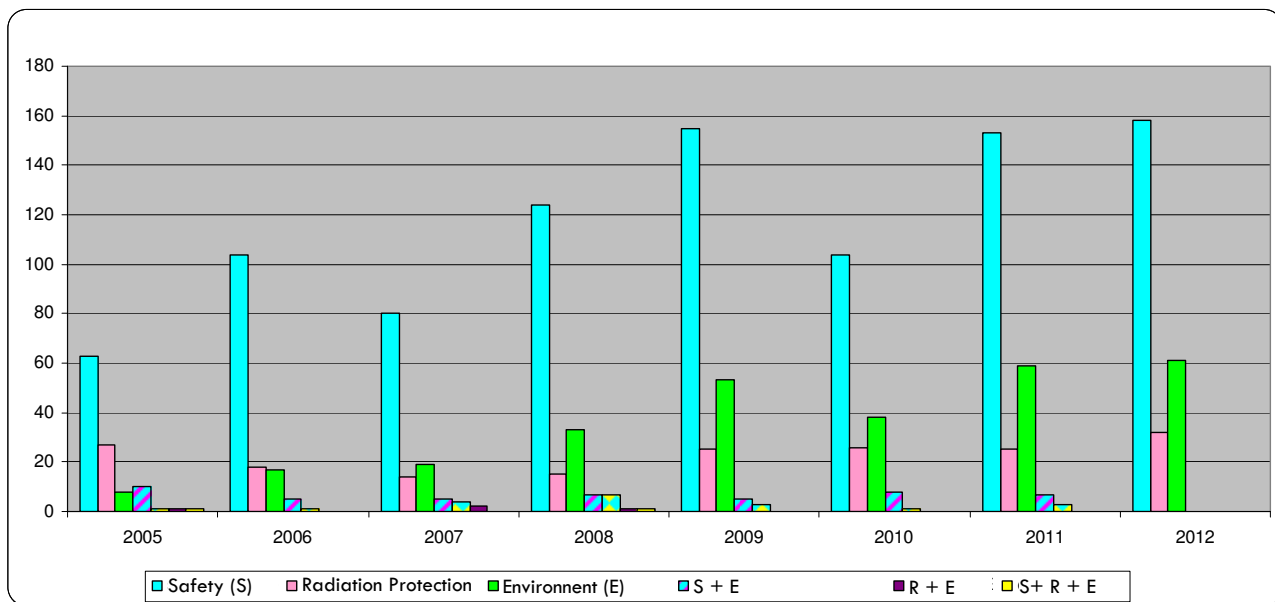


FIGURE 7 : NOTIFICATION AREAS USED FOR THE NOTIFICATION OF SIGNIFICANT EVENTS (2005-2012)

The number of significant radiation protection events has never stopped increasing since the notification system was introduced. An analysis is in progress to assess whether this is due to better detection by the licensees or to a true increase in deviations in the area of radiation protection.

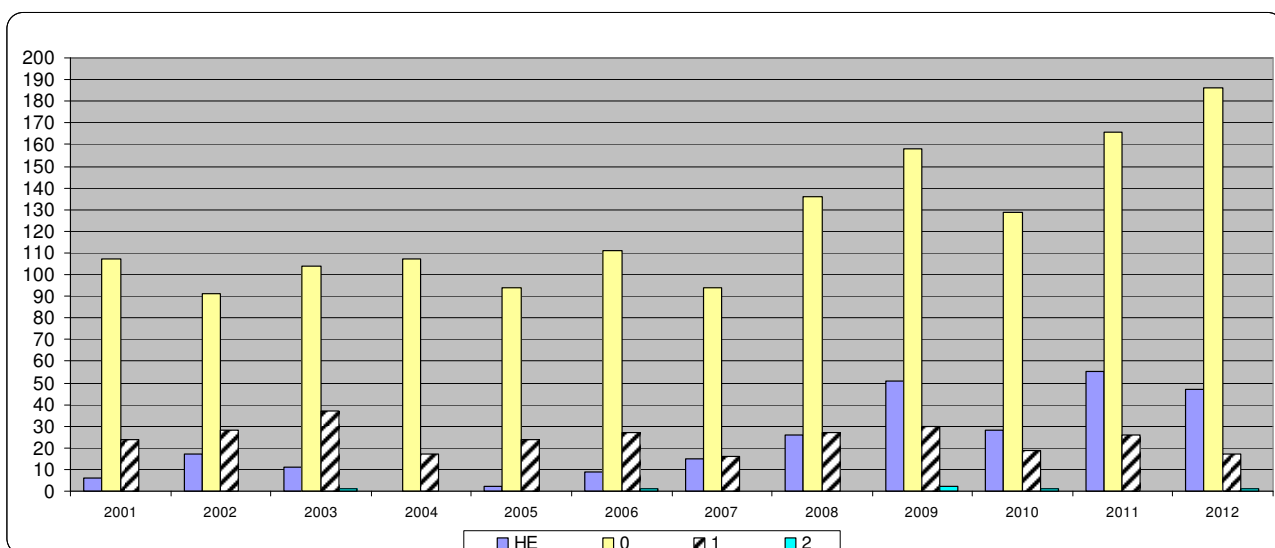


FIGURE 8 : INES CLASSIFICATION USED FOR SIGNIFICANT EVENTS RELATIVE TO LUDD FACILITIES (2001-2012)

#### Other information presented by operators

On a periodical basis, operators must submit activity reports and status reports on liquid and gaseous effluents they discharge and the waste they generate.

Similarly, operators provide a wealth of information on specific topics; such as the seismic resistance of the facilities, fire protection, supplier relations, etc.

#### Review of submitted information

The purpose of much of the information submitted by BNI operators is to demonstrate their compliance with the objectives of the general technical regulations or of the operators themselves. The role of ASN is to check the thoroughness of the case and the quality of the demonstration.

Whenever it deems it necessary, ASN may call upon its technical support organisations, primarily the IRSN, for advice. Safety assessment implies the mobilisation of many specialists and effective co-ordination in order to identify key aspects relating to safety- and radiation protection. The IRSN's assessment relies on

studies and R&D programmes focusing on risk control and knowledge improvement on accidents. It is also based on comprehensive technical exchanges with operating teams who design and run the facilities.

For several years now, ASN has been seeking to diversify its technical support organisations by calling upon both French and foreign organisations.

For major issues, ASN requests the opinion of the competent GPE before which ASN itself or its technical support organisation tables the results of its assessments; for the majority of other matters, safety analyses are the subject of an opinion to be sent directly to ASN by the IRSN.

## 2.3. The regulatory frameworks of the ICPEs and mines

### 2.3.1. The regulatory framework of the ICPEs

The regulations governing the ICPEs are applied by the department Prefects under the coordination of the DGPR. For each heading of the ICPE nomenclature, the inspectorate develops formal prescriptions for the licensees through prefectural orders. The latter take into consideration the particularities of the installations and their environment.

General regulations are drafted by the Ministry for the Environment in full compliance with European directives and French international commitments. The DGPR co-ordinates inspections and is responsible for supervising the technical, methodological, legal and regulatory framework at the national level.

ICPE Regulations are based on an integrated approach, which means that:

- a single environmental-protection licence is issued per industrial site (rather than several licences, including one for liquid discharges, one for gaseous discharges, one for risks, etc.). The integrated approach enables all environmental impacts to be taken into account (air, water, soil, noise, vibrations) along with the industrial risk, and
- a single authority is competent to apply the legislation. In France, only the State is competent with regard to the ICPE legislation. It acts via the Prefect (State representative in each *département*) assisted by the relevant ICPE Inspectorate in France, the State is the only body competent to legislate on the ICPEs. The State intervenes through the Prefect (State representative in each *département*) assisted by the ICPE inspectorate.

Facilities with a low environmental impact are subject to a simple declaration procedure.

Between the declaration and registration thresholds, a declaration must be made to the Prefect of the *département*, general prescriptions must be adhered to and the installation may be inspected. Between the registration and licensing threshold, prior authorisation from the Prefect of the *département* is necessary. Beyond the licensing threshold, the license is issued after a public and administrative inquiry, subject to the report by the ICPE inspectors and the opinion of CODERST (Departmental Council for the Environment and for Health and Technological Risks).

The licensing process concerns the most polluting or hazardous activities. The licensing procedure begins with a licence application containing an impact statement and a risk study. It is subject to various consultations, notably with local communities, and a public inquiry. The procedure ends with the issue (or denial) of the licence in the form of a *prefectoral* order containing requirements.

While the requirements for facilities subject to declaration and registration are standardised, requirements imposed on licensed facilities are set on a case-by-case basis, depending on the characteristics of the facility. Certain categories of facilities, however, are the subject of ministerial orders with a view to setting forth the minimum requirements to be included in licensing orders.

### 2.3.2. Regulatory framework for mines

The regulations governing mines is different to that for the ICPEs, mainly for historical reasons, and also because the working of mines - apart from the strategic aspects - poses particular technical problems. The Prefect of the *département*, the local government representative, is the oversight Authority. However, the mining titles (concessions or operating permits) and the subsequent operating licenses are issued at national level after obtaining the opinion of the CGELET (General Council for the Economy, Industry, Energy and Technologies).

The regulations governing mines covers the actual mining works and the legal dependencies of the mines; the majority of the ore processing and residue disposal facilities are currently classified as ICPEs (see § E.2.3.2.1).

For mining operations, the discharge of radioactive substances into the environment is regulated by *Decree No. 90-222 of 9 March 1990 Completing the General Regulations of Mining Industries* and its implementing *Circular of 9 March 1990*. The Decree forms the second part of the “Ionising Radiation” Section of the *General Regulations of Mining Industries* instituted by *Decree No. 80-331 of 7 May 1980* in accordance with Article L. 162-5 of the *Mining Code*.

Those regulations apply to the actual mining works, as well as to legal outbuildings, including associated surface and other essential installations, notably for the mechanical preparation of the ore before chemical treatment, which is not subject to the *Mining Code*, but to the *Environment Code*.

The end of all or part of mining operations, must be declared by the operator and must indicate which steps he intends in order to take to protect the interests referred to in Article 161-1 of the *Mining Code*. The Prefect either acknowledges the declaration or specifies additional measures. The mining work stoppage procedure concerns all the work and all the structures and facilities vital for operation, and which have never been duly declared abandoned or completely stopped with respect to the applicable regulations in effect at the time of industrial stoppage of the works. This procedure is governed in particular by the *Mining code*, by Decree 2006-649 of 2 June 2006 and specified in the circular of 27 May 2008. Stoppage of the works is the subject of a prior declaration to the competent authority.

The ministerial *Order of 8 September 2004* details the composition of the file for declaring final stoppage of the mining work and use of the mining facilities.

It is important to note that if the mining regulations become applicable as of the start of mine research or operation work, the procedure for stopping the mining work is not applicable if the mining title has given rise to no research or operating work necessitating a start of works procedure.

Pursuant to the *Law of 30 March 1999*, hereinafter called the “1999 Law”, when major risks are likely to compromise the safety of property or persons, the operator must install and operate the necessary equipment for monitoring and preventing such risks. Once the claim expires, the responsibility for risk monitoring is transferred unto the State.

The State drafts and implements mining-risk prevention plans in accordance with *Decree No. 2000-547 of 16 June 2000 Regarding the Enforcement of Articles L174-5 to L174-11 of the Mining Code*, subject to the completion of the work stoppage procedure.

### 3 | REGULATORY BODIES (ARTICLE 20)

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1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 19, and provided with adequate authority, competence and final and human resources to fulfil its assigned responsibilities.

2. Each Contracting, in accordance with its legislative and regulatory framework, shall take the appropriate steps to ensure the effective independence of the regulatory functions from other functions where organisations are involved in both spent fuel and radioactive waste.

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Several Ministries are involved in defining, implementing and overseeing radioactive materials and waste management policy. Within the Ministry for Ecology, Sustainable Development and Energy (MEDDE), the General Directorate for Energy and Climate (DGEC) draws up policy and implements Government decisions concerning the civil nuclear sector, while the Nuclear Safety and Radiation Protection Delegation (MSNR), under the joint authority of the MEDDE and the Minister responsible for health, drafts, coordinates and implements the Government’s roles concerning civil nuclear safety and radiation protection.

#### 3.1. The French Nuclear Safety Authority (ASN)

The TSN Act created ASN (*Autorité de sûreté nucléaire*), an independent administrative authority tasked with the oversight of nuclear safety and radiation protection for all civil nuclear activities.

ASN contributes to the informing of the public. It also contributes to operational management of radiological emergencies.

On technical matters, ASN relies on the expertise provided primarily by IRSN and by the Advisory Committees of Experts (GPE).

### 3.1.1. ASN independence, regulatory body

#### The commission

ASN is run by a Commission consisting of five commissioners appointed by decree on account of their competence in the fields of nuclear safety and radiation protection. Three of the commissioners, including the Chairman, are appointed by the French President. The other two commissioners are appointed by the president of the National Assembly (lower house of the French Parliament) and by the president of the Senate (upper house), respectively.

The ASN commissioners exercise their functions on a full-time basis.

Once they are appointed, the commissioners draw up a declaration of the interests they hold or which they have held during the previous five years in the areas within the competence of the authority. During the course of his or her mandate, no member may hold any interest such as to affect his or her independence or impartiality. For the duration of their functions, the commissioners will express no personal views in public on subjects coming under the competence of the authority.

The duration of the mandate of the members is six years. It is non-renewable. A member's functions may only be terminated in the event of incapacity or resignation as recorded by a majority vote of the Commission. The President of the French Republic may also terminate the term of any commissioner in the event of severe dereliction of duty.

The Commission defines ASN's strategy. In this respect, it draws up a multi-year strategic plan and develops general policies in the form of ASN doctrines and action principles for its essential missions, which include regulation, control, transparency, the management of emergency situations, international relations, etc.



#### ASN opinions

The TSN Act gives ASN competence to issue regulatory resolutions to clarify the decrees and orders relating to nuclear safety and radiation protection, which are subject to approval by the Minister in charge of nuclear safety or radiation protection. It also gives ASN authority to impose prescriptions on the licensee throughout the lifetime of the facility, including during decommissioning, for example to request correction of an anomaly or prevent a particular risk.

Pursuant to the TSN Act, the Commission submits ASN opinions to the Government and issues ASN's main resolutions. They are posted on the ASN website [www.asn.fr](http://www.asn.fr). The members of the Commission act with complete impartiality, receiving no instructions from either the Government or any other person or institution.

#### The OPECST

ASN regularly reports on its activity, notably by submitting its annual activity report to Parliament, to the Government and to the President of the Republic. For Parliament, it is before the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST) that ASN each year presents its annual report on the situation of nuclear safety and radiation protection in France;

Created in July 1983, the OPECST is tasked with informing Parliament of the consequences of scientific and technological choices so that it can take informed decisions. The OPECST is assisted by a scientific council made up of members who reflect the diversity of the scientific and technical disciplines. The role of the OPECST members is to study the organisation of nuclear safety and radiation protection within the

administration and with the licensees, to compare their characteristics with those of other countries and to verify that the authorities have the means to carry out their mission. The Office's reports are drafted before voting a law in order to prepare the legislative decision, or afterwards for follow-up of implementation of the text passed. The members of the OPECST also played an important part in the development of the TSN Act.

### 3.1.2. Organisation

ASN is led by a five-member Commission and constituted by central services, territorial representatives and territorial divisions, which are placed under the authority of the Director-General, who is in turn supported by three assistants, an advisor and a principal private secretary.

The *TSN Act* lists the different categories of either regulatory or individual resolutions to be taken by ASN, such as the following:

- technical regulatory resolutions for the enforcement of decrees or orders relating to nuclear safety and radiation protection;
- commissioning licences of BNIs, and
- licences or certifications relating to the transport of radioactive substances or to medical establishments or equipment using ionising radiation.

Some of those resolutions are subject to validation by the Minister in charge of nuclear safety or radiation protection.

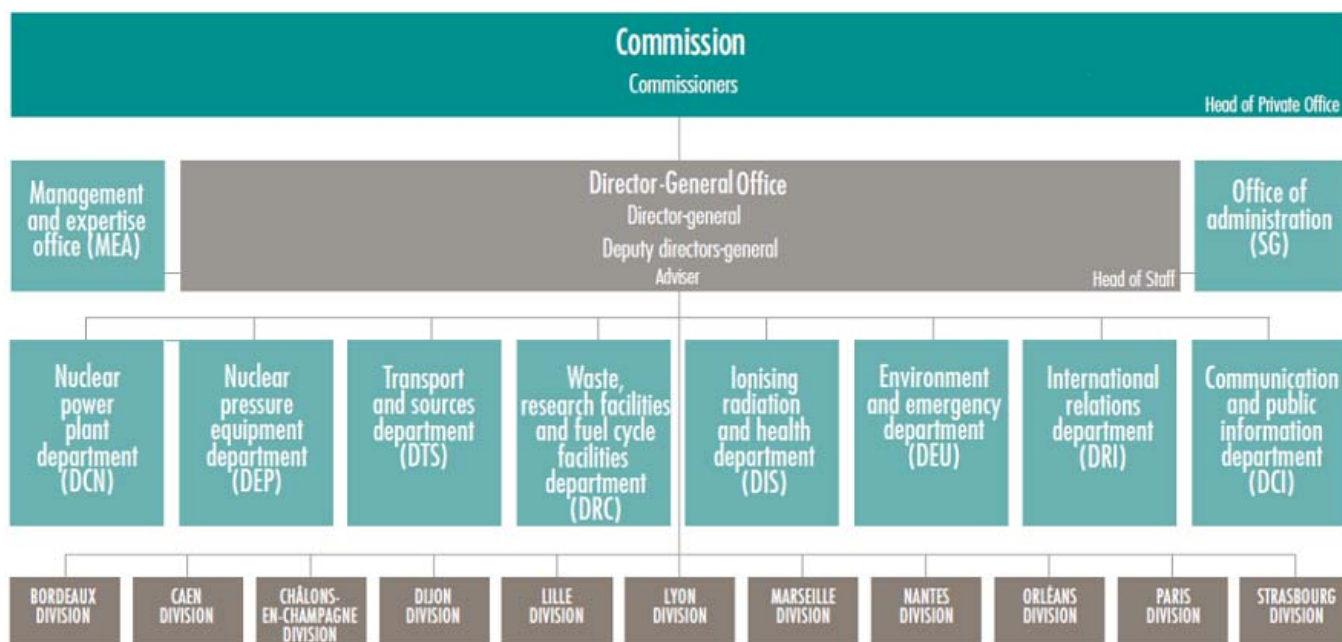


FIGURE 9 : ASN'S ORGANISATION CHART

#### 3.1.2.1. ASN COMMISSION

The commission and its operation are detailed in § E.3.1.1.

ASN has its own *Rules of Procedure*, which govern its organisation and operation, as well as its own *Ethical Code*. The former describes the relevant conditions and limits within which any Commissioner may delegate part of his/her powers to its President and the President may delegate his/her signing authority to agents within ASN services.

#### 3.1.2.2. ASN CENTRAL SERVICES

ASN's central services comprise the Secretariat-General, which is also in charge of communication, the Section of Legal and Corporate Affairs and eight directorates.

Directorates are responsible for managing national matters pertaining to their jurisdictions. They participate in the drafting of general regulations and co-ordinate the overall action of ASN divisions.

### 3.1.2.3. ASN TERRITORIAL REPRESENTATIVES AND DIVISIONS

ASN's territorial divisions carry out their activities under the authority of territorial representatives designated by ASN President. The Director of the relevant regional DREAL assumes the responsibility of representative. He is put at the disposal of ASN and does not report to the Prefect about his mission regarding nuclear safety and radiation protection. A delegation of signing authority by the Director-General confers authority to territorial representatives for local decisions.

Divisions perform most of the direct control of BNIs, transport of radioactive materials and activities relating to the small-scale nuclear sector. They also review most of the licence applications submitted to ASN by the officers responsible for nuclear activities in their jurisdiction.

In emergency situations, divisions assist the Prefect, who is responsible for public protection, and ensure that all *in-situ* operations to secure the facility are monitored, if the site is accessible or does not represent a hazard. For emergency-preparedness purposes, ASN's divisions also take part in the development of emergency plans drawn up by the Prefects and in periodical crisis drills.

Divisions contribute to ASN's public-information mission. Moreover, they take part in CLI meetings, and maintain also regular contacts with local media, elected officials, environmental associations, operators and local administrative partners, such as prefects, regional hospitalisation agencies (*Agence régionale d'hospitalisation* – ARH), Regional Directorates for Health and Social Affairs (*Direction régionale des affaires sociales et de la santé* – DRASS), etc..

### 3.1.3. Human resources and their management at ASN

#### 3.1.3.1. RESOURCES

##### Human resources

On 31 December 2013, ASN's effective amounted 478 employees, divided as follow:

- 374 permanent or contract agents, and
- 85 seconded agents from public corporations, including Social Welfare – Paris Hospitals (*Assistance publique – Hôpitaux de Paris*), the CEA and the IRSN.

At the same date, the average age of ASN employees was 43 years.

That balanced age pyramid helps ASN ensure a dynamic control of nuclear safety and radiation protection, thus preventing the hazards induced by habit and routine, while promoting a “companionship” culture among the youngest and the transmission of knowledge.

Central services and divisions were distributed as shown in the following Table.

Central services	Territorial divisions	Total
257	218	478 (including 3 seconded abroad)

TABLE 17 : DISTRIBUTION OF ASN STAFF ON 31 DECEMBER 2013

##### Financial resources

Since 2000, all staff and operating resources for the fulfilment of ASN's mandate have been drawn from the general State budget.

In 2013, the State budget dedicated to the control of nuclear safety and of radiation protection in France stood at 173,8 M€ and was distributed as follows:

- 39.78 M€ of payroll appropriations (payment of staff)
- 39.27 M€ of administrative appropriations for the central services and the eleven regional divisions of ASN

- 84 M€ of appropriations devoted to the IRSN technical support to ASN and €10.6 M for other IRSN missions.
- 0.15 M€ for operation of the HCTISN (High Committee for Transparency and Information on Nuclear Security – HCTISN).

### BNI Tax

Article 16 of the *TSN Act* also specifies that the President of ASN is in charge of payment invoices and settlements, on the State's behalf, of the BNI tax instituted by Article 43 of the *2000 Finance Act* (*Law No. 99-1172 of 30 December 1999*). The outcome of the tax for 2010 amounted to 584.6 million euros and is deposited in the State's general budget.

### Additional taxes on radioactive waste

With regard to nuclear reactors and spent-fuel treatment plants, the *Waste Act* also instituted three additional BNI taxes, called "research", "economic-incentive" and "technological diffusion" taxes, respectively, and allocated them to the financing of economic-development actions as well as of ANDRA's research activities on waste storage and deep geological disposal facilities.

In 2013, those taxes generated 154,94 M€. Lastly, the Act 2009-1673 of 30 December 2009 instituted an additional tax on the disposal facilities that is paid over to the municipalities and public establishments of intercommunal cooperation situated around the disposal facilities. The returns from this tax represented 3.3 M€ in 2013.

Amount in 2010 (in millions of euros)		
Operators	BNI Tax	Additional taxes
EDF	543,6	121,72
AREVA	16,3	7,87
CEA	6,5	23,4
Andra	5,4	3,3
AUTRES	7,6	1,95
<b>TOTAL</b>	<b>579,4</b>	<b>158,24</b>

TABLE 18 : DISTRIBUTION OF CONTRIBUTIONS FROM OPERATORS

### 3.1.3.2. HUMAN-RESOURCE MANAGEMENT

#### Training of agents

##### Skill management

Companionship" arrangements, as well as initial training and continuing education, whether general in nature or relating to nuclear techniques, constitute key elements of ASN's professionalism.

Managing staff skills is based notably on a formalised curriculum of technical training courses for each agent in accordance with a detailed and regularly updated training reference system. For instance, an inspector must follow a series of predefined training sessions involving technical, legal and communication techniques, before being certified to carry out inspections. In 2013, ASN agents spent 4 100 days in technical training spread over 233 sessions within 126 different courses. The financial cost of those training sessions provided the other organisations than ASN amounted 520 k€ in 2013.

The percentage of training costs with respect to the payroll also includes the payroll costs of the 4,219.5 "trainee days" (national and local training plans), the 184 internal instructor days and the payroll for the personnel responsible for training. In 2013 training costs totalled 2.2 M€, that is to say 7.4% of the ASN payroll.

##### Inspector qualification

Since 1997, ASN has been involved in developing an inspector-qualification system relying on the recognition of their technical skills. A certification Committee was created in 1997 in order to advise the Director-General on an overall qualification mechanism. The Committee reviews notably suitable training

curricula and qualification reference systems for each ASN service and holds hearings with inspectors as part of the confirmation process.

Half the Certification Committee includes confirmed senior ASN inspectors, while the other half is composed of competent persons in the fields of nuclear-safety control, know-how and education, as well as ICPE control, its jurisdiction will be extended to radiation protection.

The Committee met twice in 2013 and proposed to certify 18 BNI inspectors. On 31 December 2013, 56 ASN nuclear-safety inspectors are certified inspectors and represent approximately 20% of all nuclear-safety inspectors.

### Internal quality management

In order to guarantee and to enhance the rigour, transparency and efficiency of its actions, ASN keeps developing and implementing a quality-management system based on the following:

- an organisational manual gathering organisation notes and procedures specifying the rules to carry out by each mission;
- internal and external audits in order to ensure the strict enforcement of the system's regulations,
- listening to stakeholders;
- performance indicators to monitor the efficiency of the action, and
- a periodical review of the system in an effort of continuous improvement.

The first international audit mission - the "Integrated Regulatory Review Service" (IRRS) - of ASN's organisation and activities was held from 5 to 17 November 2006<sup>15</sup>.

The auditors examined ASN's practices in terms of regulations, oversight and informing the public. They met the ASN teams in Paris and in its regional offices, and assessed ASN's oversight actions on the ground, notably by attending some ten inspection operations. The auditors also examined the follow-ups to the "TranSAS" audit devoted to the transport of radioactive material, carried out in 2004.

This mission was followed by a follow-up mission in 2009.

In November 2014, ASN will host a new IRRS audit addressing all activities under ASN oversight.

Furthermore, ASN endeavours to take part in the IRRS audit missions in foreign countries. In 2013, ASN representatives thus took part in the IRRS mission in Belgium, Poland, Czech Republic and the United Kingdom.

### 3.1.4. ASN's technical supports

In preparing its resolutions, ASN benefits from the skills of its technical-support organisations, with the IRSN providing the most extensive contribution. In addition, ASN has been striving for several years to diversify its suppliers among national and international organisations.

#### 3.1.4.1. INSTITUTE FOR RADIATION PROTECTION AND NUCLEAR SAFETY (IRSN)

The IRSN was created by *Law No. 2001-398 of 9 May 2001* and constituted by *Decree No. 2002-254 of 22 February 2002*. The Decree separated the former Nuclear Protection and Safety Institute (*Institut de protection et de sûreté nucléaire – IPSN*) from the CEA and merged it partially with the Office for the Protection Against Ionising Radiation (*Office de protection contre les rayonnements ionisants – OPRI*) in order to form the IRSN as a larger and single body to be responsible for research and assessment in the fields of nuclear safety and radiation protection.

BNIs safety assessments, including radioactive-waste storage and disposal facilities, are conducted on the basis of operators' proposals in order to provide ASN with relevant assessments to carry out its control activities. For larger tasks, such as the review of safety reports, major changes to facilities, waste-discharge licences, transversal issues such as safety and radiation protection management by operators) ASN relies on the opinion of a relevant GPE on the basis of operator data and of their critical analysis by the IRSN. For

<sup>15</sup> Lien vers les rapports de la mission IRRS et de la mission de suivi : <http://www.asn.fr/L-ASN/International/Les-relations-multilaterales-hors-Europe/L-Agence-internationale-de-l-energie-atomique-AIEA/Les-audits-de-l-AIEA-en-France>

other projects (minor modifications to installations, steps taken after minor incidents, package specifications), safety analyses are the subject of assessments sent directly to ASN by the IRSN.

ASN also calls upon the IRSN's help to review the steps chosen by the operator to guarantee the safe transport of radioactive or fissile materials.

Hence, in 2013, with regard to "civilian" BNIs, other than nuclear reactors in service, the IRSN provided ASN with approximately:

- 109 positions concerning minor modifications to facilities or incidents and waste package specifications, and
- seven positions for the GPE and 17 positions on major changes or new facilities,

The IRSN also provided ASN with 52 positions concerning the safe transport of radioactive materials.

About 200 experts and specialists were involved in the preparation of those positions.

The IRSN also carries on research on radiation protection, radiation ecology and the safety of facilities. Those investigations relate to the main risks encountered in the facilities subject to the *Joint Convention* (criticality, fire, dispersion and mechanical strength of structures) and disposal facility safety after closure. These works involve more and more co-operation with French and international bodies.

#### 3.1.4.2. OTHER TECHNICAL SUPPORTS

In order to diversify its skills and to benefit from other specific competencies, ASN also has its own budget.

A significant part of that budget is dedicated to topics associated with radon exposures to populations in homes and to the activities of the Steering Committee for the management of post-accidental phase (*Comité directeur pour la gestion de la phase post-accidentelle* – CODIRPA).

Since 2012, ASN has continued or initiated collaborations with, for example:

- the Building Industry Scientific and Technical Centre (CSTB): subjects associated with the exposure of populations to radon in the home (action spanning 2012-2014)
- the National Institute of the Environment and Risks (INERIS): on the theme of the environment, chemical pollution in particular, and the theme of social, organisational and human factors applied to the transport of radioactive substances;
- the Nuclear Protection Evaluation Centre (CEPN): support for post-accident work - study aiming at improving the system for training in patient radiation protection - assistance with the coordination, implementation and functioning of networks of radiation protection officers (RPOs).

ASN wishes to give impetus to the use of diversified expertise, and to that end it set up a European framework agreement with expert appraisal organisations in 2013.

#### 3.1.5. Advisory Expert Groups (GPE)

In order to prepare its most important resolutions, ASN also relies on the opinions and recommendations from seven GPEs, which are competent respectively in the fields of waste (GPD), pressurised nuclear equipment (GPESPN), radiation protection in the medical sector (GPMED), radiation protection outside the medical sector (GPRADE), reactors (GPR), as well as transport, laboratories and plants (GPU).

More particularly, they review the preliminary, temporary and final safety reports of every BNI. They may also be consulted on various evolutions with regard to regulations or doctrine.

For each of the topics they deal with, the GPEs base their opinion on the reports prepared by the IRSN, a special working group or by one of ASN's directorates. In every case, they issue an opinion, accompanied by recommendations, if need be.

The GPEs consist of appointed experts for their skills. They originate not only from universities and associations, but also from operators who are interested in the topics being addressed. Every GPE may call upon any recognised person for his/her specific skills. The participation of foreign experts diversifies the approach methodology to issues and benefits from international experience.

In its transparency approach with regard to nuclear safety and radiation protection, ASN has been publishing since 2009 the documents relating to the meetings of those GPEs.

The mandate of the members of the Advisory Committees of Experts (GPE) in nuclear safety reach term on 31 May 2104. In order to increase the independence of this expertise and to foster the transparency of its work, ASN has defined new procedures for the selection and nomination of the GPE members, notably by opening them to experts from the "civil society".

The modifications in the composition of the GPEs in the area of nuclear safety will provide additional guarantees of independence of their opinions with respect to the nuclear licensees, transparency in the selection of the Committee members and technical quality of the opinions.

### 3.2. Nuclear-safety and radiation-protection mission (MSNR)

The Nuclear Safety and Radiation Protection Mission (*Mission de sûreté nucléaire et de radioprotection – MSNR*) is the ministerial service placed under the authority of the Minister of Ecology and Sustainable Development in order to deal on their behalves with the issues pertaining to the government's jurisdiction in the field of nuclear safety and radiation protection. Its missions are defined in Article 8.1.3 of the *Order of 9 July 2008*. The MSNR thus:

- coordinates and follows the files coming under the competence of the Minister responsible for nuclear safety and radiation protection (coordination of BNI procedures, preparation of regulations in collaboration with ASN, etc.);
- participates in the development of the national emergency organisation (accidents affecting nuclear installations or radioactive material consignments, radiological emergency situations, acts of terrorism, etc.) in collaboration with the services of the ministry responsible for civil protection;
- contributes to the preparation of the French positions in international and European Community discussions;
- coordinates the action of the DREALs with respect to the uranium mines and the ICPEs containing radioactive substances;
- coordinates and monitors the management of sites and soils other than BNIs polluted by radioactive contamination (in relation with the Bureau of Soils and Sub-Soils);
- proposes the State's intervention priorities in terms of rehabilitation of orphan contaminated radioactive sites (CNAR - National Commission for Assistance in the Radioactive Field) in relation with Andra and the DGEC;
- provides secretariat services to the High Committee for Transparency and Information on Nuclear Security (*Haut Comité pour la transparence et l'information sur la sécurité nucléaire*) (see § E.3.4.3.4).

### 3.3. ICPE Inspectorate and Mine Inspectorate

The ICPE inspectorate checks compliance with the technical prescriptions imposed on the licensees. This means that its work focuses equally well on the equipment of the installations and the persons responsible for operating it, as on the working methods and the organisation. It also intervenes in the event of complaints, accidents or incidents. If the inspectorate observes that the prescriptions are not appropriate, it can propose that the Prefect imposes additional prescriptions through an order. If the licensee does not comply with the compulsory measures, it is liable to administrative penalties (compliance notice, deposition of sums, automatic enforcement, daily penalty payment, administrative fine, suspension of license, closure) and criminal penalties. The law provides for severe penalties in the event of breach of these provisions.

With respect to mines, prospecting and operation are subject to the supervision by the administrative authority represented by the relevant prefect and the DREALs. Inspections are performed by DREAL engineers specialising in mining industries.

As the old uranium mines are no more operated, the supervision implemented concerns the site rehabilitation, security and environment impact monitoring.

### 3.4. Other actors involved in safety and radiation-protection control

#### 3.4.1. Parliamentary Office for the Assessment of Scientific and Technological Options (OPECST)

Created by *Law 83-609 of 8 July 1983*, the OPECST is a parliamentary delegation comprising eight members of the National Assembly and eight senators (and their substitutes), whose mission is to inform Parliament about the impact of scientific and technological choices, particularly with a view to ensuring that decisions are taken with the full knowledge of the facts.

The OPECST is assisted by a Scientific Council consisting of 24 members from various scientific and technical disciplines.

From its outset, the OPECST strictly limited the work scoping of its rapporteur's whose duties are to examine the organisation of safety and radiation protection, both within the Administration and on operators' premises, to compare its characteristics with those of other countries and to check that authorities have sufficient resources to perform their mission. Supervision concerns both the operation of administrative structures and the review of technical cases, such as the future of radioactive waste or shipments of radioactive materials, as well as socio-political matters, such as the conditions under which information about nuclear topics is disseminated and perceived.

Hearings are open to the press and have become a well-established tradition at the OPECST. They allow all interested parties to express their views, to put across their arguments and to debate publicly any given topic under the guidance of the OPECST Rapporteur. The full minutes of the hearings are appended to the rapporteur's reports and represent therefore a substantial contribution to the information of Parliament and the public, and to the transparency of decisions.

It is before the OPECST that ASN tables every year its report on the status of nuclear safety and radiation protection in France.

#### 3.4.2. The advisory bodies

##### 3.4.2.1. THE NATIONAL REVIEW BOARD (*COMMISSION NATIONALE D'ÉVALUATION* – CNE)

The National Review Board (*Commission nationale d'évaluation* – CNE) consists of scientific personalities and was created in 1991 in order to assess investigation results on the management of HL-LL radioactive waste; more particularly, it is also responsible for preparing an annual report of its assessment activities and to follow international investigations on radioactive-waste management. The *Environment Code* formalised activities of the CNE in the sense that the Committee continues to prepare an annual assessment report, which now concerns investigations on all radioactive materials and waste in relation to the PNGMDR objectives.

In addition, the membership of the Committee specified by the law (renewable mandate once, turnover of half the members every three years). Ethical rules were also adopted in order to ensure full impartial assessments. The powers of the Committee have been strengthened in the sense that the law now prescribes that all assessed research establishments must provide the CNE with any required document to establish its annual report.

##### 3.4.2.2. HIGHER COUNCIL FOR THE CONTROL OF TECHNOLOGICAL RISKS (CSPRT)

The BNI Advisory Committee (*Commission consultative des INB* – CCINB), created by the *BNI Procedures Decree* had to be consulted by the Minister in charge of nuclear safety not only concerning licence applications to create, to modify or to shut down definitely BNIs, but also the general regulations applicable to each of those facilities.

The *BNI procedure Decree* was modified in 2010 in order to cancel the CCINB.

From now on, the general regulatory texts concerning BNIs that used to be sent to the CCINB must be submitted to the Higher Council for the Control of Technological Risks (*Conseil supérieur de la prévention des risques technologiques* – CSPRT), whose membership includes all stakeholders and whose scope covers texts relating both to BNIs and ICPEs. As regard texts involving individual measures for such or such BNI

(licensing decree for creation or final shutdown and decommissioning, for instance), they are now subject to a hearing of the operator and the CLI by ASN, as enacted by ASN's resolution on 13 April 2010.

#### 3.4.2.3. HIGH COUNCIL FOR PUBLIC HEALTH (HCSP)

The Higher Council for Public Health (*Haut Conseil de la santé publique* – HCSP), created by *Act No. 2004-806 of 9 August 2004 Concerning the Public Health Policy* forms a scientific and technical advisory entity placed under the Minister in charge of Health.

The Council contributes to the determination of multi-annual objectives regarding public health, assesses the achievement of national public-health objectives and contributes to their annual follow-up. In connection with health agencies, it provides public authorities with the required assessment for the sound management of health hazards, as well as for the design and assessment of policies and strategies regarding health control and security. Lastly, it provides prospective reflections and advice on public-health issues.

#### 3.4.2.4. HIGH COMMITTEE FOR TRANSPARENCY AND INFORMATION ON NUCLEAR SECURITY

The *TSN Act* provided for the creation of a High Committee for Transparency and Information on Nuclear Security (*Haut Comité pour la transparence et l'information sur la sécurité nucléaire*), as an information, consultation and debate structure on the hazards induced by nuclear activities and their impact on human health, the environment and nuclear security.

The High Committee is empowered to issue opinions on any issue within its jurisdiction, as well as on all associated controls and information. It may also address any topic relating to access to information regarding nuclear security and to propose any step aiming at ensuring or at improving transparency in nuclear matters.

The Minister in charge of nuclear safety, the presidents of the competent committees of the National Assembly and of the Senate, the President of the OPECST, the presidents of the CLIs or BNI operators may also call upon the advice of the High Committee on any information issue relating to nuclear security and its control.

The High Committee groups 40 members appointed for a six-year term; they include parliamentarians, representatives from CLIs, environment protection associations (as mentioned in the *Public Health Code*), managers of nuclear activities, labour unions, IRSN, ASN and State services concerned as well as selected personalities for their skills.

The High Committee met for the first time on 18 June 2008 and has been holding four plenary meetings every year since then. It also issues two three reports or opinions on current or fundamental issues. For instance, it has submitted on 12 July 2010 to the Minister of Ecology and Sustainable Development a report on information and transparency with regard to the management of nuclear materials and radioactive waste generated at all stages throughout the fuel cycle and a report dated 28 March 2013 prior to the public debate on the Cigéo project for deep geological disposal of radioactive waste.

#### 3.4.2.5. ACCREDITATION COMMISSION OF LABORATORIES OF RADIOLOGICAL MEASUREMENTS IN THE ENVIRONMENT

Radiological measurements in the environment are made public. According to French regulations (Article R. 1333-11 of the *Public Health Code*), they must be collected within a single network. Called the National Measurement Network of Environmental Radioactivity (*Réseau national de mesure de la radioactivité de l'environnement*), the guidelines are set by ASN and the IRSN ensures its management. In particular, the network collates all the environmental analysis results, analyses that are imposed by the regulation and on operators and those generated by various State services and corporations. In order to ensure that published results are based on satisfactory measurements, a laboratory-accreditation process was set up.

ASN Resolution 2008-DC-0099 of 29 April 2008 details the organisation of the national network and sets the provisions for the approval of environmental radioactivity measurement laboratories.

The approval procedure includes the presentation of an application file by the laboratory concerned after taking part in an inter-laboratory test (ILT), its examination by ASN and a review of the application files by a pluralistic approval commission.

The task of the approval commission is therefore to ascertain that the measurement laboratories have the organisational and technical skills to provide the network with high-quality measurement results. It is this commission that is responsible for proposing to ASN the granting, refusal, withdrawal or suspension of approval. It makes its proposal on the basis of the application file presented by the candidate laboratory and on its results in the inter-laboratory tests organised by IRSN.

Chaired by ASN, the commission comprises qualified persons and representatives from government departments, laboratories, standardisation bodies and IRSN. ASN Resolution 2013-CODEP-DEU-2013-061297 of 12 November 2013 appointing the members of the approval commission for environmental radioactivity measurement laboratories.

The laboratories are approved by ASN resolution published in its Official Bulletin.

ASN has initiated a process to modify the abovementioned Resolution 2008-DC-009, for which a first modification draft has been presented to the RNM Steering Committee and to the laboratory approval commission. It has also been the subject of a public consultation. The main modifications envisaged consist in:

- Changing the composition of the Steering Committee to have increased representation of environmental protection associations in particular;
- Creating a new type of approval for the sanitary control of foodstuffs;
- Making the COFRAC accreditation compulsory for certain approval categories.

### 3.4.3. Health and safety agencies

#### 3.4.3.1. FRENCH HEALTH WATCH INSTITUTE (INVS)

The Health Monitoring Institute (*Institut de veille sanitaire* – InVS), which reports to the Minister for Health, is responsible for the following tasks:

- monitoring and observing public health on an ongoing basis, collecting health-risk data and detecting any event likely to alter public health, and
- alerting public authorities, and especially the three health and safety agencies presented below in case of any threat to public health or of any emergency situation, and recommending appropriate steps.

#### 3.4.3.2. FRENCH NATIONAL AGENCY FOR MEDICINES AND HEALTH PRODUCT SAFETY (ANSM)

The ANSM (National Agency for the Medicines and Health Product Safety) was created on the 1 May 2012. It is a public institution reporting to the Ministry of Health and has taken over the functions of the AFSSAPS (French Health Product Safety Agency) along with other new responsibilities. Its key role is to guarantee the safety of health products throughout their life cycle, from initial testing through to monitoring after receiving authorisation to put them on the market.

#### 3.4.3.3. NATIONAL HEALTH SECURITY AGENCY FOR FOODSTUFFS, THE ENVIRONMENT AND THE WORKSPACE (ANSES)

The National Health Security Agency for Foodstuffs, the Environment and the Workspace (*Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail* – ANSES) is a public administrative establishment placed under the supervision of the Ministries for Health, Agriculture, the Environment, Labour and Consumer Affairs (*ministères chargés de la santé, de l'agriculture, de l'environnement, du travail et de la consommation*). It was created on 1 July 2010 by the amalgamation of two French health agencies: the French Food Safety Agency (*Agence française de sécurité sanitaire des aliments* – AFSSA) and the French Environmental and Occupational Health and Safety Agency (*Agence française de sécurité sanitaire de l'environnement et du travail* – AFSSET).

It fulfils watch, assessment, research and reference missions on a broad scope encompassing, human health, animal health and welfare, as well as plant health. It provides a transverse reading of health issues and,

hence, is able to grasp as a whole the exposures to which human beings may be submitted through their life and consumption patterns, or the characteristics of their environment, including their professional one.

Within the Agency's jurisdiction, its mission is to assess risks, to provide relevant authorities all useful information on those risks, together with the skills and scientific as well as technical support for drafting legislative and regulatory provisions and for implementing risk-management measures.

## SECTION F | OTHER GENERAL SAFETY PROVISIONS (ART. 21 TO 26)

### 1 | RESPONSIBILITY OF THE LICENCE HOLDER (ARTICLE 21)

*1. Each Contracting Party shall ensure that prime responsibility for the safety of spent fuel or radioactive waste management rests with the holder of the relevant license and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.*

*2. If there is no such licence holder or other responsible party, the responsibility rests with the Contracting Party, which has jurisdiction over the spent fuel or over the radioactive waste.*

#### 1.1. Spent-fuel management

Civil spent fuel is produced and stored in BNIs. The fundamental principle of the overall specific organisation and regulatory system for BNI nuclear safety, which has been integrated in the law and in regulatory instruments for many years, is the prime responsibility of the operator. It was reiterated in the *Environment Code*.

The BNI order sets the essential requirements with which BNI licensees must comply. It takes up and supplements the requirements set by the Quality Order of 1984.

In the name of the State, ASN ensures that such responsibility is assumed. The respective roles of ASN and of the operator are divided up as follows:

- ASN sets forth general safety objectives;
- the operator proposes and justifies the technical procedures to achieve them;
- ASN ensures that those propositions are appropriate to meet the set objectives;
- the operator implements the approved procedures, and
- during inspections, ASN checks the sound implementation of those procedures and draws corresponding conclusions.

Furthermore, any BNI licensee assumes civil liability pursuant to the Convention on third-party liability in the field of nuclear energy (Paris Convention).

#### 1.2. Radioactive-waste management

The respective responsibilities and roles of the different parties involved in radioactive-waste management are described in § B.5.4 and § B.5 and summarised below.

##### 1.2.1. ASN and BNI operator with regard to radioactive-waste management

The respective roles and responsibilities of ASN and of the operator of any BNI are similar to those described in § F.1.1 with regard to the spent-fuel management.

### 1.2.2. Operator producing radioactive waste and operator of radioactive-waste-management facilities (waste-treatment company, storage keeper, ANDRA)

A producer of radioactive waste remains responsible for the management of its waste. Even if the producer sends the waste to a facility operated by another company for processing or storage, it remains responsible for it, without prejudice to the responsibilities of that other company as a nuclear installation licensee. Thus, the licensee of the facility in which the waste is stored and/or processed is responsible for the safety and radiation protection of its facility during its operation or its decommissioning. Likewise, for the disposal facilities, Andra is responsible for the safety and radiation protection of the facilities it operates.

The producer of radioactive waste remains responsible for its waste, even once the waste is stored or disposed of: the waste ownership is not transferred to ANDRA. However, as specified above, this principle does not exclude ANDRA's responsibility as BNl operator and in relation to the *Paris Convention*.

The responsibility of the waste producer lies mainly with financial aspects. In that respect, the practice in France, as applied in ANDRA's contracts, but not formalised into regulations, is based on the unlimited possibility in time to turn back to producers, if need be (notably in the case of potential consolidation work or additional provisions resulting from new legal obligations).

There are a few exceptions to that rule, but they only involve a very small share of radioactive waste, such as those originating from "small producers", like biological research laboratories and medical items (radium needles, etc.) or radium-bearing products (salts, compasses, etc.) that were used in the past or result from the clean-up of polluted sites, as part of ANDRA's public-interest mission.

In addition, In case of defaulting responsible entities (e.g., company bankruptcy, actual or alleged insolvency of the responsible officer or officers, etc.), the State may supersede them in order to control risks on the concerned sites. That is notably the case of a certain number of sites contaminated with radioactive substances used in the radium or clock-making industries (radium-based paint) in the early 20<sup>th</sup> century. In accordance with *Environment Code*, ANDRA is not only in charge of collecting, transporting, taking over radioactive waste and rehabilitating sites contaminated with radioactivity upon the request and at the expense of the responsible entities or upon public request when the responsible entities for that waste or those sites are defaulting.

The *Environment Code* provides that ANDRA must benefit from a State subsidy in support of the Agency's public-interest missions. In order to issue an opinion on the use of that subsidy, the National Assistance Commission on Radioactive Issues (*Commission nationale des aides dans le domaine radioactif* – CNAR) was created within ANDRA. Whenever possible, the State is also in charge of suing liable entities in order for any incurred expenses to be reimbursed.

With regard to radioactive sources, the respective responsibilities of users, suppliers and manufacturers, as well as ASN's role, are described in § F.2.5 and in Section J.

## 2 | HUMAN AND FINANCIAL RESOURCES (ARTICLE 22)

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*Each Contracting Party shall take the appropriate steps to ensure that:*

- i) qualified staff is available as needed for safety-related activities during the operating lifetime of a spent fuel and a radioactive waste management facility;*
  - ii) adequate financial resources are available to support the safety of facilities for spent fuel and radioactive waste management during their operating lifetime and for decommissioning, and*
  - iii) financial provision is made which will enable the appropriate institutional controls and monitoring arrangements to be continued for the period deemed necessary following the closure of a disposal facility.*
- 

### 2.1. Regulatory framework for BNIs

The *Environment Code* provides that "the creation licence of any BNI shall take into account the technical and financial capabilities of its operator". Those capabilities must allow him to carry out his project while complying with the interests mentioned in I of Article 28 of the Act, "particularly with regard to covering expenses incurred by the facility's decommissioning and rehabilitation, the monitoring and maintenance of its implementation site, or in the case of radioactive-waste disposal facilities, to covering final-shutdown, maintenance and monitoring expenses".

The BNI order indicates a number of requirements regarding the licensee's technical capabilities and its obligations in terms of outside contractor monitoring.

With regard to the provisions for charges relating to decommissioning and the management of radioactive waste and of spent fuel, the *Environment Code* specifies the associated obligations imposed upon BNI operators and describes the methodology to be used in order to enforce those obligations (see § B.1.6. and § F.2.3.2).

## 2.2. Presentation of safety-allocated resources by BNI operators

### 2.2.1. ANDRA's human and financial resources

#### 2.2.1.1. FINANCIAL RESOURCES

Created in 1979 within the CEA structure, ANDRA was transformed into a public industrial and commercial establishment (*établissement public à caractère industriel et commercial* – EPIC) by the *1991 Law* and the *Waste Act*. That status ensures the independence of the Agency.

ANDRA's structure was clarified in *Decree No. 92-1391 of 30 December 1992* and consolidated in Articles R. 542-1 of the *Environment Code*, and modified again by *Decree No. 2110-47 of 13 January 2010*, thus providing the Agency with the following components:

- a Board of Directors, consisting of a member of the National Assembly or of a senator, six State representatives, seven qualified personalities representing economic activities with an interest for the Agency's operations, three qualified personalities and eight staff representatives;
- a chief executive officer appointed by decree;
- a government commissioner, who is the Director-General of Energy at the Ministry in charge of Energy;
- a finance Committee;
- an advisory market Committee;
- a CNAR, and
- a scientific board.

ANDRA's internal structure is described in § L.6.1.

Since 1 January 2007, ANDRA is financed by the following sources:

- commercial contracts for ANDRA's industrial activities<sup>16</sup> (operation and monitoring of radioactive-waste disposal facilities, specific studies, take-over of waste or rehabilitation of sites). EDF, AREVA and the CEA constitute the major waste producers with whom the Agency has signed contracts, and
- a subsidy for the preparation of the *National Inventory*, the collect and take-over of "small-scale" radioactive waste owned by individuals or local communities and the rehabilitation of sites contaminated with radioactive substances in cases of default of the liable entity. Indeed, in accordance with the *Environment Code*, "the Agency must receive a State subsidy in order to contribute to the financing of the public-interest missions entrusted upon the Agency pursuant to conditions described in Subsections 1 to 6 of Article L. 542-12".
- an assigned tax. Pursuant to Article L.542-12-1 of the *Environment Code*, Andra manages an internal "Research fund" intended for financing research and studies on the storage and deep geological disposal of high-level and intermediate-level long-lived radioactive waste. The Research fund is financed by a tax that is additional to the "Research" tax that already exists for BNIs. This additional tax has been instituted in place of the commercial contract that bound Andra to the main producers in order to "guarantee the funding of research and the management of radioactive waste over the long term". The tax is collected from the waste producers by ASN in accordance with the "polluter pays" principle, on the basis of flat-rate sums set by the *Environment Code* and multiplying factors set by decree. The flat-rate sums vary according to the facilities (nuclear power plant, fuel processing plant, etc.).

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3. Due to their nature, commercial contracts are subject to conventional commercial risks and may therefore generate benefits or involve intrinsic risk.

Moreover, since 1 January 2014, the Cigéo project design studies and any preliminary work are financed by a "design" fund internal to the Agency (Article L.542-12-3 of the *Environment Code*), which is financed by contributions paid by the waste producers.

Lastly, the waste Act provides for a new financial measure for the future (2015/2019) by prescribing that funds for the construction, operation, final shutdown, maintenance and monitoring of HL-IL/LL waste-storage or disposal facilities built or operated by the Agency will be guaranteed through an internal fund created within ANDRA's accounting system and supplied by the resources drawn from the contributions of BNI operators, as designated by agreements.

As mentioned in § B.1.6, BNI operators must set aside sufficient funds corresponding to the management charges for their waste and spent fuel (and to decommissioning activities) and allocate sufficient assets for the coverage of those requirements, thus representing a certain level of guarantee for the funding of ANDRA's activities over the medium and long terms.

ANDRA's financial statements and annual reports are downloadable from its website ([www.andra.fr](http://www.andra.fr)).

#### 2.2.1.2. HUMAN RESOURCES

At the beginning of 2014, ANDRA's staff amounted to approximately 610 agents, 67% of which were engineers and managers. Some 115 employees were assigned to general management or transverse support functions, such as human resources, purchasing, management, accounting, legal services, information systems, communications and international affairs.

About one hundred and fifty people contribute directly to the operational industrial activities (particularly operation or monitoring of above-ground disposal facilities) and providing services, particularly with the aim of optimising the management of radioactive waste in France. They include agents in charge of checking that delivered packages comply with the facility's safety rules. In that regard, the Agency intends to develop and to maintain a strong safety culture through training and daily operating procedures (notably in line with its quality and environmental-protection approach).

The formalisation of safety principles, assistance to operators in their implementation process and control of their sound implementation, the development of safety-analysis methods and experience feedback from the operation of disposal facilities pertain to the Risk Control Division, capitalising on knowledge of the packages and inventories, the inspection of packages, consisting of 65 agents whose duties involve also quality and environmental-management activities.

With a staff of about 100 employees, the Research and Development Division supports ANDRA's overall activities in various fields such as geology, hydrogeology, materials, the biosphere and modelling. In that context, this division participates in safety studies for both operational and planned disposal facilities.

With an effective of about 75 employees, the Programme, Engineering and Cigéo Project Division leads design studies for future waste-management solutions by integrating safety and security concerns very strongly at all stages, in conjunction with the Risk Control Division.

The Underground Research Laboratory Division has a team of about 100 employees, whose task is to ensure the operation and maintenance of the laboratory, to conduct experiments, to survey the future disposal site and to perform communication-related activities in order to facilitate the acceptance of the future disposal facility to be located nearby.

### 2.2.2. CEA human and financial resources

#### 2.2.2.1. FINANCIAL RESOURCES

The day-to-day functioning of CEA's operations concerning the management of spent fuel and radioactive waste is financed by the State subsidy paid to the organisation. For the operations concerning the retrieval and packaging of waste resulting from the clean-out and decommissioning of "legacy" installations, including the waste produced and stored on the sites during the operation of these installations, the financing comes from dedicated funds, towards which matching State contributions were ratified in 2010 by a meeting of the Nuclear Policy Council. By virtue of their nature, these funds present guarantees of

availability to ensure the safety of the spent fuel and radioactive waste management facilities throughout their working life.

Furthermore, for these facilities, like all the nuclear installations it exploits, CEA makes the necessary provisions for their decommissioning in accordance with the regulations in effect.

#### 2.2.2.2. HUMAN RESOURCES

The CEA is a government-funded research organisation set up in October 1945 in order for France to gain access to atomic energy and to develop its applications in the energy, health-care and national-defence sectors. The CEA's organisation chart is shown in Annex (See § L.6.2).

As at 31 December 2012, CEA counted 16,245 permanent employees (9,659 managerial and 6,586 non-managerial employees). Female employees represented 30.8% of the staff. In addition, CEA hosted 1,547 doctoral students and 276 post-doctoral researchers. The employees assigned to the CEA's civil programmes are divided among 5 centres situated in Saclay, Cadarache, Marcoule, Fontenay-aux-Roses and Grenoble.

The CEA's needs for personnel who contribute to the safety of its installations results from its safety policy and the associated organisation.

Human resources dedicated to safety, except for employees assigned to radiation protection and security, include some 300 agents (engineers), such as facility-safety engineers, engineers and experts in support units and safety-skill centres, and engineers in safety-control units. The designation of persons for these functions is dependent on examination - at the appropriate level - of the ability of these persons to fulfil the functions, particularly with regard to their training and experience. Key staff members such as the installation heads or inspection unit heads can only be designated if the Risk Control Pole has approved their designation.

In 2009, the CEA installed more safety-management-specific indicators (monitoring of the staff associated with safety, case-quality compliance with deadlines). Those indicators are monitored by the Centre's units and the overall reporting is handled by the Risk Control Pole. They provide a means of ensuring that on the whole the human resources allocated for safety are sufficient in quantity and quality.

### 2.2.3. AREVA's human and financial resources

#### 2.2.3.1. ORGANISATION OF AREVA

AREVA's major shareholders at the end of 2012, are shown in the following table:

Shareholder	Share in %
<b>CEA</b>	68.88
<b>State</b>	14.33
<b>KUWAIT Investment Authority (KIA)</b>	4.82
<b>Public</b>	4.04
<b>Caisse des dépôts et consignations</b> (Deposits and Consignments Fund)	3.32
<b>EDF</b>	2.24
<b>AREVA</b>	1.20
<b>Total</b>	0.95
<b>Framépargne</b>	0.23

**TABLE 19 : DISTRIBUTION OF AREVA SHAREHOLDERS**

In 2012, the turnover of the AREVA' Group amounted to 9 342 M€ and the net income of the Group reached 99 M€.

At the end of 2012, the Group had a staff of 46513 employees, 87 % of which work for nuclear energy.

Unit managers have the responsibility to decide about the allocation of competent staff members for the execution of the required tasks and, consequently, to assess their skills. In order to achieve that goal, that responsibility refers to the initial training and experience; it also identifies the need for additional training, qualification or certification for specific tasks. It benefits from the support of the competent services of the

Human Resources Division and of its functional extensions in the establishments themselves where they are responsible for providing and recording training sessions.

## FINANCIAL ASPECTS

Although AREVA provides waste-treatment services, electricity utilities retain ownership of their own waste and in fact AREVA holds little waste of its own.

The provisions set up by AREVA for waste-management liabilities are based on the overall volume of all waste categories yet to be disposed of. Those provisions take into account all waste to be managed, including waste from past practices and decommissioning operations. For thoroughness' sake, it should be mentioned that packaging and disposal costs are included, as well as removal and conditioning costs for historical waste. Provisions set up by AREVA on 31 December 2012 totalled 5,835 million euros at present value and covered the liabilities of the 21 BNIs owned by the group and referred to the *Environment Code*. Provisions concern the following subsidiaries and facilities: AREVA NC at La Hague. Marcoule, Pierrelatte, Cadarache, Obligations/SICN; COMURHEX at Pierrelatte/Malvézi; MÉLOX SA at Marcoule; EURODIF and SOCATRI; SOMANU at Maubeuge, and CERCA and FBFC at Romans.

The liabilities concerned include: facility decommissioning, waste-recovery and conditioning programmes and existing waste with no management solutions.

At the end of 2012 the pre-discounting provisions for the group as a whole, on the perimeter of the *Environment Code*, amounted to 11.3 G€, including the cost of transport and disposal of ultimate waste for 1.7 G€. On 31 December 2012, the realisable value of that liability coverage was estimated at 5,8 G€. At that date, the group had already completed a robust and conservative assessment of its liabilities and had constituted and secured financial assets that would be sufficient overall to provide a coverage rate above 98,5% (within the scope defined by law). Moreover, as early as 2002, the group instituted a suitable governance programme by creating the Monitoring Committee on End-of-Life-Cycle Obligations in order to follow up the coverage of clean-out and decommissioning expenses.

AREVA also constituted and secured assets to cover expenses relating to its end-of-life-cycle obligations for ICPEs located in France, as well as for nuclear facilities in foreign countries. On 31 December 2012, corresponding provisions totalled 496 million euros at present value.

### 2.2.4. EDF's human and financial resources

#### 2.2.4.1. HUMAN RESOURCES

At the end of 2012, the workforce of EDF's Nuclear Operations Division (DPN), responsible for operating the nuclear reactors, stood at about 21,000 distributed among the 19 NPPs in operation and the 2 national engineering units. Engineers and managers represented 35% of the workforce (7400 staff), supervisors 62% (13,100 staff) and operatives 3% (700 staff).

To these 21,000 staff must be added EDF's human resources devoted to design, to new constructions, to engineering of the NPPs in service and support functions, and to decommissioning of nuclear reactors:

- about 4,500 engineers and technicians from the nuclear engineering division (DIN) divided between management (75%) and supervisors (25%);
- nearly 170 engineers and technicians from the nuclear fuel division (DCN);
- more than 600 engineers and technicians from EDF's research and development division (EDF R&D).

For the development of a safety culture, the accountability policy implemented within the company means that a vast majority of the personnel devotes a significant percentage of their time and activities to nuclear safety and radiation protection.

If one considers only those whose role and duties exclusively concern nuclear safety, more than 450 persons are involved.

About 950 people are devoted to security and radiation protection activities.

Since 2006, EDF has been devoting considerable efforts to guaranteeing the skill levels and the careers of the staff by adopting a forward-looking jobs and skills management approach, based on uniform principles

for all the NPPs built up from actual feedback from the field. These aspects are the subject of monitoring, coordination and specific oversight.

The staffing levels are currently rising, to deal with the skills renewal process currently under way and with the projects for the NPPs in service and to reinforce skills with regard to severe accident management (for example with the creation of the FARN – the nuclear rapid intervention force). Recruitment numbers have been very high in these last years: in 5 years, nearly 5,500 new employees have joined the DPN (25% of the workforce).

Staff training volumes have also risen greatly in the last 5 years, with a twofold increase from 1.2 million hours in 2007 to 2.7 million in 2012. The initial training curricula have been added to and adapted to this new context, with the creation of "Nuclear joint know-how academies", along with programmes that have been revised for each specific professional sector. Reactive training programmes are also deployed on the sites, based on experience feedback from other international licensees.

Similarly, with regard to engineering, the nuclear engineering division (DIN) has since 2006 been running a "key nuclear engineering skills development plan" (PDCC), involving the units of the DIN and other divisions of the DPI (Engineering Production Division) and R&D. This approach aims to develop the skills of the engineering sectors and, through a cross-cutting, forward-looking approach, helps the other units prepare their choices for forward-looking management of jobs and skills.

New entrants at the DIN follow a 5-week training course on the fundamental know-how of the "design" engineer (operation, safety and quality culture, security and radiation protection, etc.).

#### 2.2.4.2. FINANCIAL RESOURCES

With a net installed power of 140.4 GWe worldwide as at 31 December 2013 for a worldwide production of 653.9 TWh, the EDF Group has, among the world's major energy producers, the largest electrical power production fleet with the lowest CO<sub>2</sub> emissions per kwh produced thanks to the share of nuclear power, hydroelectricity and other renewable energies in its production mix.

In 2013, the Group achieved consolidated sales of 75.6 billion euros, a gross operating surplus of 16.8 billion euros and a net income of 4.1 billion euros.

In France, the net production of electricity by EDF in 2013 was 462 TWh, of which 403.7 TWh was from nuclear sources (installed power 63.13 GWe), 42.6 TWh from hydroelectricity (20 GWe) and 15.6 TWh from fossil fuel (15 GWe), out of a total of 550.9 TWh from all the producers taken together.

In 2011 and 2012, nuclear power production was 421.1 and 404.9 TWh respectively (installed power 63.13 GWe).

The provisions created by EDF (in present values in accordance with international standards) at the end of 2013 amounted to about 17 321 G€. for the back-end of the nuclear fuel cycle (spent fuel management and radioactive waste long term management) and to about 15 337 million euros for the deconstruction of NPPs and the last cores.

Those provisions were created on the basis of estimated waste-processing and disposal costs, at a gradual rate determined by burn up in the reactor with due account of future expense schedules.

With regard to the decommissioning of nuclear reactors and to the treatment of the resulting waste, in particular, EDF sets aside accounting reserves proportional to investment costs throughout the operating period of those reactors, in order to cover expenses at term. Provisions consist of the sum of assets being set aside every year for decommissioning EDF's 58 power reactors currently in operation, plus the assets for decommissioning nine EDF reactors permanently shut down, for which dismantling has begun.

In addition, in order to secure the funding of its long-term nuclear commitments, EDF has set in place over the past years a portfolio of assets dedicated exclusively to the coverage of the provisions associated with NPP deconstruction and to the back-end of the fuel cycle.

The *Environment Code* and the implementing provisions of the waste act have defined the provisions that are not part of the operating cycle and which must therefore be covered by dedicated assets (decommissioning of nuclear power plants, long-term management of radioactive waste). As at 31 December 2013 these dedicated assets represented a realisable value of 21.7 billion euros, compared

with 21 billion euros of net present cost for the long-term nuclear obligations (share of the provisions that must be covered by dedicated assets), which enables the coverage target to be achieved by the portfolio of assets dedicated to the totality of the long-term nuclear commitments in application of the *Waste Act* (in advance with respect to June 2016).

EDF considers that it has enough financial resources to meet the safety needs of each nuclear facility throughout its entire lifetime, including spent-fuel management, waste treatment and facility deconstruction.

### 2.2.5. Human and financial resources of ILL

The ILL is a research institute founded in 1967 by France and the Federal Republic of Germany; it was joined by the United Kingdom in 1973. Its high-flux reactor (HFR), with an output of 58.3 MW, was commissioned in 1971 and provides access for the scientific community to the most intense neutron source, primarily for basic-research purposes.

The ILL is managed by three associate countries: France (CEA and CNRS), Germany and the United Kingdom. Ten other scientific partners partake also in its funding. In 2013, its budget amounted to 93 million euros.

At the end of 2013, the ILL had 480 employees with 24 different nationalities (36% managerial and 64% non-managerial), 28 of which were assigned to safety. The ILL also relies on external competences and expertise.

## 2.3. State Control

### 2.3.1. Control of the administrative authority for securing the funding of long-term nuclear charges

As for funding the decommissioning and the management of radioactive waste, the *Environment Code* describes the control modalities for financial securisation, whereas the obligations to be borne by operators are described in § B.1.7.1.

The administrative authority consists jointly of the Ministers in charge of Economy and Energy. The DGEC, with the French Treasury general directorate (*Direction générale du trésor*), assumes that mission by delegation from the relevant Ministers. Pursuant to Article 20 of the *Waste Act*, operators must submit every three years to the DGEC a report describing an assessment of their long-term charges, the methods they apply to calculate accruing provisions to those charges and the choices they made regarding the composition and management of the assets dedicated to the coverage of those provisions. Every year, they must also provide the DGEC with an update note of that report and inform it without delay of any event likely to modify its content.

In accordance with Article 12 of *23 February 2007 Decree*, the administrative authority must submit the above-mentioned report to ASN in order to review the consistency of the strategy for decommissioning and for the management of spent fuel and radioactive waste submitted by the operator with regard to nuclear security. ASN must convey its opinion to the administrative authority within four months (See § F.2.3.2).

The administrative authority disposes of prescriptive and enforcement powers. In case any insufficiency or inappropriateness is detected, it may, after having collected the operator's observations, prescribe the necessary measures for it to pass from a *de facto* to a *de jure* situation by establishing the delays within which it must implement them. Those delays, which take due account of existing economic conditions and the current situation of the financial markets, must not exceed three years.

If any of those prescriptions are met within the set deadline, the administrative authority may order, with a daily penalty, that the necessary assets be constituted and that any measure be taken with regard to their management.

Any operator who fails to meet his obligations is liable to a financial penalty to be imposed upon him by the administrative authority. In the case of any non-compliance with the assessment of charges and the constitution of assets, the amount of the penalty must not exceed 5% of the difference between the amount of the operator's constituted assets and the amount prescribed by the administrative authority. In case of violation of any information obligations described above, the penalty must not exceed 150,000 €.

In addition, if the administrative authority notes that the application of the provisions of the *Environment Code* is likely to be obstructed, it may impose, with a daily penalty if need be, upon the operator to pay to the fund the required amounts to cover his long-term charges.

Lastly, it should be noted that the Waste Act has also created a second-level control entity, called the National Assessment Committee for the Financing of the Decommissioning Charges of Basic Nuclear Facilities and of Management Facilities for Spent Fuel and Radioactive Waste (*Commission nationale d'évaluation du financement des charges de démantèlement des installations nucléaires de base et de gestion des combustibles usés et des déchets radioactifs*), in order to assess the forms of control implemented by the administrative authority.

The administrative authority may also order that audits be conducted at the expense of operators in order to control their assessments of their charges and the method they use to manage their assets.

### **2.3.2. ASN support to the administrative authority with regard to the oversight of long-term nuclear expenses**

ASN has no competence in the financial aspects relative to the oversight of long-term nuclear expenses, but it analyses and compares the submitted reports in order to give an opinion on the coherence of the strategy for installation decommissioning and the management of spent fuel and radioactive waste.

Pursuant to Article 12, paragraph 4 of the *Decree of 23 February 2007*, the DGEC asks ASN for its opinion on the coherence of the strategy for installation decommissioning and the management of spent fuel and radioactive waste as described in the three-yearly reports produced by the licensees on the subject of long-term nuclear expenses. The DGEC can moreover call upon ASN's expertise pursuant to Article 15 of paragraph 2 of the same decree. The DGEC can in particular refer matters to ASN after receiving the annual update notes.

ASN has thus published opinions on the three-yearly reports submitted by the licensees to meet the requirements of the *Environment Code*, first in 2007, then in 2010 and lastly in early 2014.

Opinion 2013-AV-198 of 9 January 2014 made observations and recommendations concerning:

- the evaluation methodology (harmonising the content of the reports between licensees; complying with the nomenclature appended to the Order of 21 March 2007 relative to the ring-fencing of the financing of nuclear expenses);
- the need to take into account the costs of remediation of contaminated ground of BNIs, favouring the complete clean-out of sites;
- taking into account of the impact of non-availability of waste management facilities, and certain repositories in particular;
- the impact of the modifications resulting from the stress tests on the evaluation of decommissioning expenses, and
- the need to reassess the costs relative to implementation of management of high-level and intermediate level, long-lived waste.

This opinion of 9 January 2014 also included a number of particular observations and recommendations (EDF, CEA, AREVA, SOCODEI, IONISOS, and CISBIO).

ASN reiterated the importance of ensuring the robustness of the composition of the assets dedicated to covering the decommissioning costs and an adequate level of liquidity of these assets. It considers that the measures taken by the licensees to guarantee the effective availability of the funds fall within the scope of the organisational measures to prevent or mitigate the effects of accidents that could be caused by basic nuclear installations. In June 2013 ASN gave a favourable opinion to the new draft amendment of the abovementioned decree aiming to base the system for ring-fencing the financial expenses of decommissioning on the rules applicable in insurance in order to improve its clarity and stability. The corresponding decree was published on 24 July 2013 (*Decree n°2013-678*).

## 2.4. Specific case of ICPEs

The ICPE legislation requires that financial guarantees be constituted for open pits, waste-storage facilities and the most dangerous ICPEs, which are subject to a licence with a public-utility easement.

When the Prefect calls upon those financial guarantees, the State takes over the role of the operator and becomes the client responsible for site remediation.

Depending on the nature of the hazards or inconveniences of each facility category, the purpose of those guarantees is to ensure that the site is monitored and maintained under safe conditions, and that relevant interventions are made in case of accident before or after closure, in order to cover the operator's potential insolvency or legal extinction. However, it does not cover any compensation due by the operator to any third party who may suffer prejudice owing to pollution or an accident induced by the facility.

Those steps apply especially to ICPEs used for radioactive-waste disposal; but, in practice, only disposal facilities for uranium-mine tailings and the CSTFA are currently concerned in France. The operator is responsible for his facility throughout its operating lifetime and at least 30 years after closure, after which the State decides whether to assume responsibility for the site or not. In the case of ANDRA's CSTFA, the Agency will probably retain responsibility for monitoring the facility indefinitely.

In the case of ICPEs that use radioactive substances, but are not designed for waste disposal, there are no general provisions for guaranteeing the availability of resources to ensure the safety of those facilities during operation and decommissioning. The ICPE Inspectorate simply checks that the operator is taking all relevant steps to ensure that safety. In the event of a defaulting operator, special mechanisms supported by public funds exist for resolving hazardous situations for the public or the environment. However, within the framework of the energy transition programming bill, it is planned to impose on classified installations using radioactive substances or waste, a system to make provisions for long term expenses similar to that implemented in the basic nuclear installations.

For mines, Article L.162-2 of the *Mining Code* obliges the setting up of financial guarantees to ensure, depending on the nature of the hazards or inconveniences of each installation category, the monitoring of the site and the safety of the installation, any interventions in the event of an accident before or after closure, and restoring to initial condition after closure. Existing sites are required to ensure this guarantee as of 1st May 2014. Furthermore, the relinquishing of mining concessions at the end of operation was already subject to the condition of taking the measures prescribed by the prefect to preserve the health and safety of the general public and the environment. However, waiving any mining claim at the end of its operating life was already subject to the implementation of measures prescribed by the Prefect with a view to protecting public and environmental health and safety.

## 2.5. Specific case of radioactive sources

Given the provisions of Articles L. 1333-7, R. 1333-52 and 53 of the *Public Health Code*, all users of sealed radioactive sources are required to have those sources collected by their supplier as soon as they become out of use and, in any case, no later than 10 years after purchase.

The supplier is required to take back the sources upon the simple request of the user. He must also constitute a financial guarantee in order to cover any impact resulting from the potential deficiency of the sources. Lastly, in accordance with Article R1333-52, he must declare any sealed source that was not turned back to him within the prescribed deadline at the same time.

The collecting organisation must deliver a removal certificate to the user, thus allowing the latter to be released from his liability with regard to the use of the source. On the basis of that document, the source is withdrawn from the user's inventory in the *National Source Inventory* managed by the IRSN, but its traceability is preserved in IRSN archives. The existence of that old computerised inventory, which undergoes regular technical improvements, ensure the sound management of thousands of sealed sources, while tracing back their history.

Pursuant to the *Law of 1 July 1901 on Association Contracts*, source suppliers formed in 1996 a non-profit association, called *Ressources*, with a view to constituting a mutualised guarantee fund to reimburse ANDRA or any other certified organisation the costs associated with the removal of sources from users, either in the

case of default of the supplier normally responsible for removing them or in the absence of any supplier likely to do so when orphan sources are involved.

### 3 | QUALITY ASSURANCE (ARTICLE 23)

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*Each Contracting Party shall take the necessary steps to ensure that appropriate quality assurance programmes concerning the safety of spent fuel and radioactive waste management are established and implemented.*

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#### 3.1. ASN requirements concerning BNIs

The BNI Order repealed the *1984 Quality Order* relating to design, construction and operation quality.

This order provides a general framework for the steps any BNI operator is required to take in order to design, to achieve and to maintain a satisfactory quality level for his facility and its operating conditions, with a view to ensuring its safety.

The BNI Order also requires that:

- detected discrepancies and incidents be corrected with rigour and that preventive actions be taken;
- appropriate documents provide proof of the results achieved, and
- the operator supervises his suppliers and checks the sound operation of the organisation hired to ensure quality.

Concerning more particularly the control of external suppliers, the Order further specifies that:

- The licensee notifies the outside contractors of the necessary provisions for application of this order.
- The licensee itself monitors or has others monitor the outside contractors to ensure that they apply the notified provisions. More specifically, the licensee ensures that the goods or services provided are subject to inspection to verify their conformity with the specified requirements.
- The licensee presents the methods used to monitor the outside contractors. It specifies more particularly the principles and organisation of this monitoring and the resources assigned to it.

ASN must control that all operators comply with the BNI Order during inspections. Inspectors must especially examine the steps taken by the operator and his suppliers (operator's obligations to suppliers, supplier documentation, results of operator's controls over suppliers, etc.). Visits or inspections may take place on suppliers' premises, and inspectors have the right to interview any employee on relevant issues. Any observation made during an inspection must be forwarded for action to the operator who remains responsible for his facility, including for the tasks performed by his suppliers. The efficiency of internal verifications performed by operators is also assessed by ASN through inspections.

Lastly, experience feedback from incidents and accidents occurring in BNIs, the analysis of malfunctions, together with inspection findings, all enable ASN to assess the compliance of every BNI operator with the BNI Order.

#### 3.2. Steps taken by BNI operators

##### 3.2.1. ANDRA's Quality, Security and Environment Policy

ANDRA benefits from a solid legislative and regulatory framework that describes its role and the matching expectations. More particularly, the Waste Act specifies that the Agency is responsible for the long-term management of radioactive waste and contributes to the national radioactive-waste management policy. Its missions are detailed further in § B.5.5.

ANDRA has resolutely adopted a sustainable-development approach for quality, health-security and the environment, which are consistent with the provisions of Standard ISO-9001 (quality) OHSAS-18001 (health-security) and ISO-14001 (environment), and the prescriptions of the BNI Order for BNIs. In 2010 and 2013 ANDRA had the triple certification by the French Standardisation Agency (*Agence française de normalisation* – AFNOR), which covers all ANDRA's activities throughout its sites.

### 3.2.2. CEA's and ILL's Quality Assurance Policy and Programme

The CEA is committed to a continuous-improvement approach relative to its management system. This approach is applied across the board to the CEA programmes and all related support activities. Protecting the environment and developing a security, safety and quality culture are priorities in the implementation of the Medium- to Long-term Plan (*Plan à moyen et long termes* – PMLT) and the CEA's multi-annual objective and performance contract with the State.

The main quality measures undertaken at central CEA level concern the implementation of project-based management, identification of the processes, control of their interfaces and the production of a generic internal reference baseline defining the applicable rules, the associated organisation and the appropriate training. This management system is adapted for application in the various CEA departments, some of which have obtained certification (ISO 9001, 14001 and OHSAS 18001) or laboratory accreditation (ISO 17025, good laboratory practices) of their thus-adapted system.

The DEN (Nuclear Energy Division) and its three Operational Departments (in the Cadarache and Marcoule centres and the department delegated to nuclear activities in the Saclay centre), which are more specifically responsible for CEA's fuel and waste processing and storage facilities, have obtained the triple certification of ISO 9001 (quality), ISO 14001 (environment) and OHSAS 18001 (health and safety at work) for all their activities.

In this context, the DEN - which operates all CEA's BNIs - has included in its integrated management system provisions enabling it to ensure compliance with the requirements of the BNI order, particularly in terms of quality, for the activities important for the protection of the interests mentioned in Article L. 593-1 of the *Environment Code* (security, public health and safety, protection of nature and the environment).

In the area dealing with BNI design, building, operation and decommissioning, the CEA has a methodological baseline guide on project management with special instructions on “managing facility projects” and “clean-out and decommissioning projects”, which highlight the specification in relation with waste management, particularly to regulatory obligations.

Good practices are identified, enhanced and made available to all concerned units. Comments and non-conformities may be noticed thanks to audits and internal inspections, thus generating corrective and preventive actions.

### 3.2.3. Quality Assurance Policy and Programme of AREVA

AREVA is committed to a sustainable-development approach since 2001.

AREVA adopted a charter of values in which the priority is given to a very high safety.

A Nuclear Safety Charter (accessible on AREVA's website: [www.aveva.com](http://www.aveva.com)) details commitments in the field of nuclear safety and radiation protection, as follows:

- organisational principles – Primary responsibility of the operator; power delegations with regard to safety; competent supports with regard to safety in every establishment; independent internal control; organisation of crisis management; body of independent safety inspectors of the organisations;
- action principles – implementation of facility safety throughout the lifetime cycle of the facility; collection, analysis and diffusion of experience feedback; participation of every collaborator in the implementation of the preventive measures; voluntary approach with regard to radiation protection; similar treatment for collaborators and subcontractors; maintenance of skills and training activities, notably with the professions involving nuclear safety and radiation protection;
- transparency and reporting – declaration process for nuclear events; annual report of the General Inspectorate, presented to the Monitoring Council (Conseil de surveillance) and made public; status report on the operational security of nuclear facilities to be distributed to the Local Information and Consultation Committees (*Commission locale d'information et de concertation*).

The Health-Security policy (accessible on AREVA's website: [www.aveva.com](http://www.aveva.com)) aims at zero impact of the activities on the health and security of employees, subcontractors and nearby populations of the industrial sites.

The environmental policy (accessible on AREVA's website: [www.areva.com](http://www.areva.com)) rests on six commitments regarding environmental management.

ACTION 2016, AREVA's strategic plan of action, places Quality and Performance at the core of its priorities via two of its five pillars, namely "Customers and Operations" and "Economic Competitiveness". One of the Group's major challenges consists in guaranteeing that its Customers receive products that are safe, that meet the Group's commitments and are delivered on time, while ensuring the performance necessary to achieve this goal at fair cost.

Management systems, since 1978, were completed over the years by the environmental and health-security aspects before developing into the ISO-9001, ISO-14001 and OHSAS-18001 integrated management systems, which were certified for all establishments concerned, notably by processing-recycling at AREVA NC Sites in La Hague and Pierrelatte, MÉLOX. That certification is subject to periodic re-assessments to be carried out by a third-party organisation.

Pursuant to the Order AREVA monitors its service providers and subcontractors and, before selecting them, assesses their ability to meet safety requirements. They are also required to commit themselves to sustainable development – which includes a Health, Security and Nuclear Safety Section. Furthermore, an Acceptance Commission for Radioactive Clean-out Companies (*Commission d'acceptation des entreprises d'assainissement radioactif*) monitors the service providers concerned and grants the necessary "certificate" in order to apply for radioactive-clean-out markets (accessible from [www.areva.com](http://www.areva.com)).

Furthermore, the environmental, medical and dosimetric analysis laboratories are approved by ASN in their domains under the order of 8 July 2008; these COFRAC accreditations are linked to radioactivity measurements, the presence of radionuclides in the environment and the protection of workers.

Among other specific actions within the sustainable-development approach should be mentioned the reporting of overall indicators with regard to continuous-improvement management, the environment, social as well as societal issues – *Sustainable Tool for Advanced Reporting (STAR)*.

#### 3.2.4. EDF's Quality Assurance Policy and Programme

The steps taken by EDF with regard to the quality of spent-fuel and waste management, as well as of the decommissioning of its activities, are part of its general quality and safety organisation.

Within the context of its industrial vocation and its public-service mandate to produce electricity, it is up to EDF to ensure that the design, construction and operation of its nuclear reactor fleet are safe and efficient, both technically and economically. Management via a quality policy contributes to the achievement of that goal and may provide the proof needed to generate confidence and trust, which are prerequisites for nuclear power to be accepted by the community.

- Promoting EDF's quality system on the basis of past achievements. The need to ensure safety in NPPs has led EDF to develop a quality system based on personnel skills; work planning, and formalisation and homogenisation of methods.
- Promoting EDF's quality system as an efficient tool for professionals. The fundamental responsibility for the quality of an activity lies with the persons conducting it. Their competence, experience and culture are vital to attain the expected quality level. The *Quality Manual* emphasises not only the quality requirements applicable to all activities and operational processes in BNIs, but also the key role of every actor (involvement of line management, staff, partners and contractors).
- Tailoring EDF's quality-assurance requirements to the significance of the activities. Important safety-related activities have already been identified. Each activity is analysed beforehand with regard to its inherent problems and consequences (especially, safety) resulting from potential failures, thus highlighting the essential quality characteristics of the activity, and particularly, the required quality level. The resulting quality-assurance measures, especially in terms of specific methods and procedures to be applied, incorporate various lines of defence against potential failures.
- Giving EDF the required organisation and resources. Attaining quality targets requires that activities be clearly assigned and that roles, responsibilities and co-ordination among the various players be defined at all levels within the company. Control processes, such as self-controls, controls by another

qualified person, verification actions, guarantee that quality. All those elements participate in the overall defence-in-depth. The achievement of quality is confirmed by the preparation of documents throughout the activity, from the preliminary analysis to the final report. The preservation of those documents ensures the traceability of the operations, especially in the field of safety.

- Relations with service providers. In order to ensure the quality of contracted services, EDF monitors the activities it entrusts upon its service providers. That form of monitoring does not release the provider from his contractual responsibilities and notably from those relating to the application of quality requirements and the guarantee of valid results.
- Anticipating, preventing and progressing at EDF. In order to prevent defects and to improve results, EDF uses an experience-feedback approach based on collecting detected deviations, analysing them, searching for their deep causes, validating good practices and promoting their widespread use. The know-how of EDF's fleet is enhanced by incorporating the experience of other operators. The efficiency in collecting deviations is reinforced by applying progressively a "low-noise signal" approach.
- Monitoring implementation at EDF. More particularly, EDF monitors not only the transport chain by conducting audits and spot checks at conveyor premises, but also spent-fuel processing operations at AREVA, in La Hague.
- Quality assurance of computerised databases. EDF's quality-assurance requirements for the operation and maintenance of the spent-fuel and radioactive-waste database are taken from EDF's *Quality Manual* in the same way as for safety-related activities.

For radioactive waste, site inventories and computer databases (a computer application called "DRA") ensure the traceability of output, interim-storage facilities and shipments of radioactive waste packages to disposal facilities, directly or after processing (incineration, fusion).

### 3.2.5. The ILL's quality assurance policy and programme

The ILL for its part continues its commitment to protect the interests defined by the *Environment Code* through simple procedures that guarantee the availability of the personnel on the ground and for the joint analyses prior to work operations.

The ILL has continued its efforts in project-based management, process identification and control of their interfaces.

The ILL aims to implement an integrated management system to meet the requirements of the BNI order. With the aim of ensuring efficiency, particularly in the protection of interests, this approach implies upstream prioritisation in order to favour investment in the most necessary actions.

The ILL thus endeavours to identify the good practices, add to them and make them available to all the units. Nonconformities can be evidenced by all personnel categories and by audit procedures. They result in corrective and preventive measures.

### 3.3. ASN control and its analysis

Inspection reports and experience feedback from incidents occurring in BNIs help ASN verify and analyse compliance with the provisions of the *BNI Order*. Any observed malfunction is the subject of a corrective-action request sent to the operators.

Furthermore, an overall review of the operators' Quality and Safety Programme is conducted on a regular basis.

ASN observes that the major nuclear licensees generally comply with the organisational and accountability requirements in the management of their activities for the protection of the interests mentioned in Article L. 593-1 of the *Environment Code* (public health and safety, protection of nature and the environment).

Operators subcontract the large majority of their BNI-maintenance operations to outside companies. While that industrial policy remains the strategic choice of the operators concerned, ASN verifies their compliance with the regulatory with regard to the safety of their facilities by setting in place a quality process, especially when it comes to supervising subcontractors. In that respect, subcontractor supervision has become one of ASN's recurring inspection topics.

### 3.4. Specific case of ICPEs

The French waste-management legislation entrusts the responsibility for waste elimination upon the producer or holder of the waste. It structures the control process for elimination networks by requiring certain waste producers, conveyors and eliminators generating nuisances to submit relevant declarations.

The headings of the ICPE nomenclature relating to waste processing were modified by three successive decrees between end of 2009 and mid-2010. The purpose of that change was to stop classifying waste-treatment activities in relation to the origin of the waste, but in relation to their nature and their dangerousness in line with the significance of hazards and inconveniences generated by the processing modes of such waste.

As in the case of all special industrial waste, all radioactive waste produced by ICPEs must be subject to specific precautions collection time and throughout storage (appropriate packaging and labelling), shipment (compliance with the *Regulations for the Transport of Dangerous Goods*) and treatment (exclusively in a licensed ICPE). For all those operations, the Administration must be kept informed.

Any producer of special industrial waste who entrusts upon a third party to transport more than 100 kg of waste must issue a follow-up checklist for hazardous waste. The form must accompany the waste up to the recipient facility, which may be a disposal facility, a consolidation centre or a pre-treatment facility. The final treatment centre must return the last sheet to the producer within one month in order to guarantee that the waste has been taken over. The producer must send a waste sample to the operator of the recipient facility in order to obtain his approval prior to shipment.

A chronological register of all shipment operations must be kept by the producers of dangerous industrial waste and contain all relevant information contained on the slips. Operators of facilities receiving waste (whether dangerous or not) must keep two registers in order to show incoming and outgoing waste shipments. All registers must remain at the disposal of the ICPE Inspectorate.

Any person producing more than 10 t of dangerous waste per year must submit to the Administration an annual declaration summarising the types of waste being produced, the corresponding quantities and the elimination systems. All facilities receiving waste, whether dangerous or not, must also declare the quantities of waste they accepted during the previous year and the type of treatment they performed (elimination or recovery).

### 3.5. Specific case of radioactive sources

Specific licensing conditions for the fabrication, possession, distribution and use of sealed radionuclide sources, which are derived from the current general regulations, include suitable steps to trace back every movement of those sources.

The monitoring of every movement (acquisition, transfer, import, and export) lies with the IRSN, which must keep up to date the source national inventory and notify ASN in case of anomaly.

In addition, the *Public Health Code* requires all source holders to be able to know their exact source inventory at all times. ASN verifies systematically that requirements are met and how sealed sources are evolving, when reviewing renewal applications, in cases of termination of activity and during spot-checks or inspections. This inventory must also be sent by owners to IRSN on an annual basis.

## 4 | RADIATION PROTECTION DURING OPERATING LIFETIME (ARTICLE 24)

1. Each Contracting Party shall take the appropriate steps to ensure that during the operating lifetime of a spent fuel or radioactive waste management facility.

- i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;
- ii) no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection, and
- iii) measures are taken to prevent unplanned and uncontrolled releases of radioactive materials into the environment.

2. Each Contracting Party shall take appropriate steps to ensure that discharges shall be limited:

- i) to keep exposure to radiation as low as reasonably achievable, economic and social factors being taken into account, and
- ii) so that no individual shall be exposed, in normal situations, to radiation doses which exceed national prescriptions for dose limitation which have due regard to internationally endorsed standards on radiation protection.

3. Each Contracting Party shall take appropriate steps to ensure that during the operating lifetime of a regulated nuclear facility, in the event that an unplanned or uncontrolled release of radioactive materials into the environment occurs, appropriate corrective measures are implemented to control the release and mitigate its effects.

### 4.1. General framework of radiation protection

#### 4.1.1. Legislative bases of radiation protection

The legislative and regulatory sections of the *Public Health Code* and of the *Labour Code* were amended in 2001 and 2006 in order to integrate EURATOM directives concerning radiation protection, including *EURATOM directive No. 96/29 of 13 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*. The new regulations were practically completed in 2006 with the publication of the last orders taken in application of both Codes. In parallel, ASN has undertaken to update the regulatory part of both Codes in order to integrate *EURATOM directive No. 2003/122 of 22 December 2003 on the Control of High-activity Sealed Radioactive Sources and Orphan Sources*, to include ASN's new prerogatives and to provide further clarifications and simplifications to the experience-feedback base on controls.

Updating of the existing Euratom directives - which began in 2008 - is now finished, with publication in the Official Journal of the European Union of the new *directive 2013/59/ Euratom of 5 December 2013, setting the basic standards for protecting health against the dangers arising from exposure to ionising radiation*. Counting from 17 January 2014, France has 4 years to transpose this new directive into national law, and the national regulations written into the Health, Labour and Environment Codes and described below shall be adjusted accordingly with the international and European standards.

In accordance with the Environment Code, it is ASN's responsibility to license the commissioning of any BNI and to set relevant design, implementation and operation requirements pursuant to the related decrees. It is in that context that ASN specifies special prescriptions for water intake as well as for liquid and gaseous discharges by nuclear and non-nuclear facilities.

##### 4.1.1.1. PUBLIC HEALTH CODE

#### Radiation-protection principles

Chapter V.I, entitled "Ionising Radiation" of Part L (legislative) of the *Public Health Code* encompasses all "nuclear activities", that is, all activities involving an exposure hazard for persons to ionising radiation emitted either by an artificial source (substances or devices) or by a natural source when natural radionuclides are processed or were processed due to their radioactive, fissile or fertile properties. It also includes "interventions" designed to prevent or limit any radiological hazard resulting from an accident involving environmental contamination.

The general international radiation-protection principles (justification, optimisation, limitation), established by the International Commission on Radiological Protection (ICRP) and included in *EURATOM directive 96/29*, are integrated into the *Public Health Code* (Article L1333-1). They constitute the guidelines for regulatory activities within ASN's jurisdiction.

### Justification principle

“A nuclear activity or intervention may not be undertaken or performed unless justified by its health, social, economic or scientific benefits, when compared with the hazards inherent to ionising radiation to which the persons are likely to be exposed.”

Assessment of the expected benefit of a nuclear activity and the associated health detriment may cause an activity to be prohibited, if the benefit does not appear to outweigh the hazard.

### Optimisation principle

“Exposure of persons to ionising radiation resulting from a nuclear activity or intervention must be kept as low as reasonably achievable, with current technology, economic and social factors being taken into account, and, as applicable, the medical purpose.”

For instance, that principle, referred to as ALARA, explains why discharge licences reduce the admissible amount of radionuclides present in radioactive effluents from nuclear facilities and requires that exposures be monitored at workstations in order to reduce them to the strict minimum.

In the context of the implementation of the principles of justification and optimisation, the 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. In this case, either prohibition is declared generically (for example: prohibition of the intentional incorporation of radioactive substances in consumer goods), or the license required on account of radiation protection will not be renewed.

On account of the prohibition to intentionally incorporate radionuclides into consumer goods and construction materials (Articles R. 1333-2 and 3 of the Public Health Code), the sale of irradiated precious stones, of accessories such as key-rings, of hunting equipment (sighting devices), of navigation equipment (bearing compasses), of river fishing equipment (strike detectors) equipped with sealed sources of tritium, of lightning arresters, is prohibited.

For the existing activities, the justification is reassessed if the state of knowledge and techniques so justifies. This is the case with smoke detection and various other activities that are tending to disappear on account of technical advances in particular.

In the case of smoke detection, where several types of radionuclides have been used (americium 241, plutonium 238, nickel 63, krypton 85), although this technique was justified a few years ago due to the resulting advantages for human safety, this is no longer the case given that new detection techniques using optical technology have been developed and meet the regulatory and normative fire detection requirements. Pursuant to Article R. L1333-1 of the Public Health Code, this change makes it obligatory to organise the withdrawal of smoke detectors containing radionuclides. In 2010 ASN thus proposed to the government a draft order setting a regulatory framework for the gradual withdrawal of ionic smoke detectors from service, with the aim of having no more in use in 10 years' time. The widespread use of this type of object makes it necessary, ultimately, to have disposal facilities in order to dispose of them. Suggestions were made in this respect in the preparation of the PNGMDR.

### Limitation principle

“Exposure of a person to ionising radiation resulting from a nuclear activity may not raise the sum of doses received beyond regulatory limits, except when that person is subject to exposure for medical or biomedical research purposes.”

All personal or occupational exposures induced by nuclear activities are subject to strict limitations. For a member of the public, for instance, the annual effective dose limit from any nuclear activity must not exceed 1 mSv in accordance with Article R. 1333-8 of the *Public Health Code*, while equivalent dose limits for crystalline lenses and the skin are set at 15 and 50 mSv/a (average value for any skin area of 1 cm<sup>2</sup>), respectively. Any dose in excess of those limits is deemed unacceptable and is liable to administrative or criminal penalties.

#### 4.1.1.2. LABOUR CODE

Article L.4121 of the *Labour Code* have introduced a specific legislative basis to protect workers, whether paid employees or not, with a view to integrating *EURATOM directives No. 90/641 and 96/29*.

The *Labour Code* is establishing a link with the three radiation-protection principles referred to in the *Public Health Code*.

#### **4.1.2. Regulatory aspects concerning human protection against ionising-radiation hazards due to nuclear activities**

##### **4.1.2.1. GENERAL PROTECTION OF WORKERS**

Articles R. 4451-1 to 144 of the *Labour Code* created a single radiation-protection regime for all workers (whether paid employees or not) likely to be exposed to ionising radiation during their professional duties. Those provisions include the following:

- the application of the optimisation principle to equipment, processes and work organisation (Articles 4451-10 and 11) in order to clarify procedures for the exercise of responsibilities and the circulation of information between the head of the establishment, the employer – especially if he is not the head of the establishment – and the competent radiation-protection officer;
- dose limits (Article R. 4451-12) are 20 mSv over 12 consecutive months, except if a waiver is granted, in order to take into account any exceptional exposure that has been justified beforehand or any emergency occupational exposure, and
- the dose limit for pregnant women (Article D. 4152-5) or more precisely for the child to be born (1 mSv during the period between the declaration of pregnancy and birth).

The publication of implementing orders provides further details for enforcing those new provisions.

##### **Radiation-protection zoning**

Requirements concerning the delineation of monitored, controlled and regulated areas (especially controlled areas) have been enacted by the *Order of 15 May 2006*, irrespective of the sector involved. In addition, the Order prescribes specific health, safety and maintenance rules in those areas. Since then, the boundaries of regulated areas have taken into account the three following protection levels:

- the efficient dose of external exposures and, if need be, of internal exposures for whole-body exposures;
- equivalent doses for external exposures of extremities, and
- whole-body dose rates, if required.

Hence, the Order sets reference values that the head of the establishment must compare with the actual external and internal exposure levels recorded at workstations, when delineating the areas.

##### **4.1.2.2. GENERAL PROTECTION OF THE POPULATION**

Besides the specific radiation-protection steps prescribed by individual licences concerning nuclear activities for the benefit of the population in general and of workers, several general steps of the *Public Health Code* contribute to protecting the public against the hazards of ionising radiation.

It involves the decision to prohibit any intentional addition of natural or artificial radionuclides in the list of consumer goods and construction products (see § B.4.1.1.2). However, the Ministry for Health may grant a waiver, after consultation with the HCSP, except with respect to foodstuffs and materials placed in contact with them, cosmetic products, toys and jewellery. The new prohibition system does not concern naturally-occurring radionuclides present in the initial components or in the additives used to prepare foodstuffs (e.g., potassium-40 in milk) or for the fabrication of materials used in the production of consumer goods or construction products.

Furthermore, the use, outside BNIs, of all materials or waste resulting from a nuclear activity is also prohibited, if they are contaminated or likely to have been contaminated with radionuclides as a result of that activity.

It also involves the annual efficient dose limit received by a member of the public due to the performance of nuclear activities (see § F.4.1.1.1).

A national network for collecting radioactivity measurements in the environment was constituted in 2009 (Article R. 1333-11 of the *Public Health Code*) in order to collect data to be used for estimating the doses received by the population. The network collates different results from the environmental surveys imposed by



the regulations and performed by different State services and its public corporations, or by territorial communities and associations upon request. Results are accessible to the public since 1 January 2010 ([www.mesure-radioactivite.fr](http://www.mesure-radioactivite.fr)). The management of the network has been entrusted upon the IRSN, while its orientations have been set by ASN in accordance with the *Order of 27 June 2005 Concerning the Institution of a National Network for Collecting Radioactivity Measurements in the Environment and Setting the Laboratory Certification Procedures*.

In order to ensure the sound quality of the measurements, all network laboratories must comply with certain certification criteria, which include notably intercomparison tests. The list of certified organisations may be consulted on ASN's website ([www.asn.fr](http://www.asn.fr)).

The management of waste and effluents generated by BNIs and ICPEs is subject to the provisions of specific regulatory systems concerning those facilities, whereas the management of waste and effluents originating from other establishments, including hospitals, where the use or possession of radioactive materials is authorised by the *Public Health Code* (Article R. 1333-12 of the *Public Health Code*), is described in § B.6.2.3.

Although *EURATOM directive 96/29* authorises clearance thresholds (i.e., the generic radioactivity level below which any effluent and waste from a nuclear activity may be disposed of without monitoring), French regulations do not include that notion (See § B.4.1.1.3). In practice, waste and effluent elimination is monitored on a case-by-case basis when the activities generating them are subject to licensing, which is the case for BNIs and ICPEs. Otherwise, discharges are subject to technical specifications. The notion of “trivial dose”, which refers to a dose below which no radiation-protection action is deemed necessary, is not included either. However, that notion appears in *EURATOM directive 96/29* (10 µSv/a).

#### 4.1.2.3. LICENSING AND DECLARATION PROCEDURES FOR IONISING-RADIATION SOURCES

The licensing or declaration system, which covers all ionising-radiation sources, is described in full in Section 3 of Chapter III of Title III of the *Public Health Code*.

Licences are issued by ASN and declarations are submitted to ASN's territorial divisions.

All medical, industrial and research applications are concerned by those provisions, as long as they are not exempt. More specifically, they pertain to the fabrication, holding, distribution, including import and export, as well as the use of radionuclides or products or devices containing some or electric devices emitting ionising radiation, including import and export.

That provision is consistent with *EURATOM directive 96/29*, which includes import and export explicitly. From a health and safety standpoint, that obligation is imposed in order to follow up source movements as closely as possible and to prevent any accident due to orphan sources.

It should be noted that, in accordance with Article 1333-4 of the *Public Health Code*, licences concerning industries covered by the *Mining Code*. BNIs and ICPEs also act as radiation-protection licences.

Procedures for submitting licence applications or declarations, are specified in ASN resolutions validated by Orders (resolutions ASN 2008-DC-108 and 109, ASN 2009-DC-148 and ASN-DC-2010-192).

#### 4.1.2.4. RADIOACTIVE-SOURCE MANAGEMENT RULES

General rules relating to the management of radioactive sources are detailed in Section 4 of Chapter 3 of Title III of Book III of the *Public Health Code*.

Those general rules include the following:

- it is forbidden to acquire or alienate any source without any authorisation;
- any acquisition, distribution, import and export of radionuclides in the form of sealed or unsealed sources, or of products or devices containing radionuclides, must be declared to the IRSN beforehand, since that the recording of such a declaration is necessary to organise the follow-up of the sources and any further control by customs services;
- a traceable account of radionuclides contained in sealed or unsealed sources and of products or devices containing radionuclides, must be available in every establishment, and a quarterly record of deliveries must be sent to the IRSN by suppliers;
- the loss or theft of radioactive sources must be the subject of a declaration, and
- relevant formalities for the import and export of radioactive sources, products or devices containing radionuclides, as set by the Interministerial Commission for Artificial Radioelements (*Commission interministérielle des radioéléments artificiels* – CIREA) and customs services, are renewed.

The elimination or recovery system for obsolete or disused sources includes the following requirements:

- any user of sealed sources is required to have his obsolete, deteriorated or disused sources removed at his own expense, once they are out of use, and
- the supplier is required to collect unconditionally and upon the simple request of the user, any of the latter's disused or obsolete sources.

The operating instructions for gammagraphy devices were updated by the *Order of 12 March 2004*, thus abrogating the CIREA's specific conditions.

Plans call for both the national schedule for the financial guarantees to be supported by source suppliers and the matching implementation and payment procedures to be specified by an Order of the Ministers in charge of Health and Finance (Articles R. 1333.53 and 54-2 of the *Public Health Code*). Pending the publication of the Order, the specific licensing conditions established since 1990 are reiterated as prescriptions in every licence being delivered.

#### 4.1.3. Radiation protection in BNIs

"Nuclear activities" include those performed in BNIs, which are the subject of specific attention, due to the significant risks of exposure to ionising radiation.

In the framework of the procedures referred to in the Environment Code and the *BNI Procedures Decree*, all BNI operators must demonstrate how they comply with radiation principles (see § .4.1.1.1) as early as the design stage and at every further stage in the lifetime of their facility for which ASN delivers a licence, that is, its creation, its commissioning and its decommissioning.

BNIs are the subject of further safety reviews, during which the operator must demonstrate that he is constantly improving safety and radiation-protection levels.

In addition, radiation protection in BNIs is the subject of controls whenever the facilities are undergoing changes that have an impact on the radiological protection of workers.

Lastly, inspections are also conducted throughout the term of the licence.

#### 4.1.4. BNI discharge licences

##### 4.1.4.1. BNI DISCHARGE LICENCES

By nature, nuclear facilities generate radioactive effluents. In general, their operation also involves water intakes and discharges of non-radioactive liquid and gaseous effluents into the environment. The licence covers all water intakes and effluent discharges, whether liquid or gaseous, radioactive or not.

The legal system of the BNIs was extensively overhauled by the TSN Act and its implementation decrees, particularly the *BNI procedures decree*.

The purpose of the change is to integrate better environmental considerations with nuclear-safety and radiation-protection issues through the creation- or decommissioning -licence application. Consequently, the operator is now required to submit a single application covering all aspects in the form of a creation- or decommissioning-licence application. The content of the application and the matching procedure are detailed in the *BNI Procedures Decree*. If approved, the application is followed by a licensing decree. ASN then sets out in a resolution the relevant technical considerations relating to discharges (limit values, monitoring of discharges in the environment, information, etc.) through technical prescriptions. With regard to specific discharge limits, ASN's resolution is subject to the validation of the Minister in charge of nuclear safety.

The first discharge limits were prescribed on the basis of a lower impact than current health-effect thresholds. Optimisation efforts encouraged by authorities and implemented by operators have generated a considerable reduction of those emissions.

Moreover, following publication of the TSN, ASN engaged the overhauling of the general regulations applicable to BNIs.

Entry into effect on 1 July 2013 of the BNI Order represents a major step in the revising of the regulations relative to BNIs, and in particular its Title 4 – Control of nuisance effects and the impact on health and the environment.

This title governs water intakes and effluent discharges, the monitoring of said intakes and discharges and of the environment, the prevention of pollution and nuisance effects, and the conditions in which the authorities are informed. The main new provisions are:

- the use of the best techniques available within the meaning of the ICPE regulation);
- limiting discharges and noise emissions to the level of the thresholds in the general regulations applicable to ICPEs;
- a ban on the discharge of certain hazardous substances and discharge into the water table;
- setting up monitoring of emissions and of the environment;
- the general application to the equipment necessary for operation of BNIs, of a number of ministerial orders applicable to identical installations governed by the ICPE regulations;
- the production of an annual discharge forecast and an annual impact report by the licensee: this forecast - which is necessarily below the upper regulatory limit - is intended to bring them to adopt forward-looking discharge management that is as precise as is technically possible.

The BNI order was supplemented by ASN Resolution 2013-DC-0360 of 16 July 2013 on the control of nuisance effects and the impact of basic nuclear installations on health and the environment.

Moreover, in accordance with Article 37 of the *EURATOM Treaty*, France provides the EC with general data on all planned discharges of radioactive effluents.

#### 4.1.4.2. ICPE AND MINE DISCHARGE LICENCES

In the case of ICPEs, regulations require that a risk approach be integrated. Discharge licences and conditions are set in the general facility licence (see § E.1.2). The general principles for setting discharge conditions and limits are identical to those for BNIs, because they stem from the same laws (in particular *Law No. 92-3 of 3 January 1992 Concerning Water part of the Environment Code, Second Book*).

Mine discharges are regulated by the second part of Title “Ionising radiation” of the *General Mining Industry Regulations*. The commissioning licences issued by prefectural orders specified those conditions. However, it should be noted that all facilities associated with mines and the discharges of which are likely to have the most significant impact (ore-processing plants, etc.) are generally classified as ICPEs and their discharges are regulated consequently in that framework.

#### 4.1.4.3. DISCHARGE LICENCES FOR OTHER ACTIVITIES SUBJECT TO THE *PUBLIC HEALTH CODE*

The general provisions for the management of waste and effluents contaminated by the nuclear activities referred to in Article R. 1333-12 of the *Public Health Code*<sup>17</sup> are prescribed by the 23 July 2008 Order validating ASN's Resolution No. 08-DC-0095 (see § B.6.2.1).

The management procedure for contaminated effluents must be described in a framework document called the Management Plan for Contaminated Waste and Effluents (MPCWE).

According to the *Public Health Code*, ASN may deliver a licence for the discharge in the cleanup-water network of effluents containing radionuclides with a radioactive half-life exceeding 100 days. In preparation for such a licence, the MPCWE must justify not only those discharges, with due account of the technical and economic restraints, but also the efficiency of the implemented provisions to limit the discharged activity, an impact study describing the effects of the discharges on works, the population and the environment, as well as the procedures set in place to control discharges and suspend them, if certain criteria are not met.

In addition, it is worthwhile noting that “any discharge of wastewater, other than domestic, in the public network must be authorised in advance by the manager of the network”. Those effluents must be subject to a licence, thus specifying, for instance, the monitoring characteristics to be borne by wastewaters before discharge, together with the discharge-monitoring conditions”; that licence must be delivered pursuant to the *Public Health Code*.

## 4.2. Radiation-protection steps taken by BNL operators

### 4.2.1. Radiation protection and effluent limitation at ANDRA

Radiation protection and effluent minimisation of are key areas in ANDRA's environmental policy.

#### 4.2.1.1. RADIATION-PROTECTION OBJECTIVES

For the public, ANDRA considers that the dosimetric impact of disposal facilities running under normal operation must be at as low a level as reasonably achievable and must not exceed a fraction of the regulatory limit of 1 mSv/a set by the *Public Health Code* (Book III, Title III, Chapter III). As mentioned in § D.3.2.2.2 and D.3.2.2.3, ANDRA sets a threshold of 0.25 mSv/a for itself. That guideline is consistent with the recommendations of the IAEA, the ICRP or the French RFSes applicable to the design of HL-LL waste-disposal facilities.

With regard to workers, ANDRA has decided to be stricter than *EURATOM directive 96-29* (consolidated into the *Public Health Code*) and to set a more ambitious target for itself. Given the growing importance of the optimisation principle and the experience feedback from the CSA, ANDRA set itself the operational protection goal of not exceeding an annual dose of 5 mSv/a as early as the design stage. That objective must be reached for all ANDRA and contractors' employees working in ANDRA facilities.

#### 4.2.1.2. MONITORING BY ANDRA AT ITS OPERATING DISPOSAL FACILITIES

Monitoring the impact of ANDRA's disposal facilities involves the application of a monitoring plan proposed by ANDRA and approved by ASN. Monitoring goals concern three topics:

- verifying the absence of impact;
- checking compliance with technical requirements set by the administrative authority (ASN for the CSA and by the Prefect for the Cires), and
- detecting any anomaly as early as possible.

Radioactivity is measured in air, surface waters (rivers, run-offs), groundwater, rainwaters, river sediments, flora and the food chain (e.g., milk). Facility personnel are submitted to individual dosimetric monitoring.

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<sup>17</sup> All authorised or declared nuclear activities are concerned, except for those that are performed in the following facilities:

Monitoring results are forwarded periodically to ASN. Both the CSM and the CSFMA publish them in quarterly brochures that are distributed to the public and to the press. They are also presented officially to the CLIs of the relevant facilities.

At the CSM, which has already entered into its monitoring phase, the dose received by any intervening agent is inferior to the detection threshold of individual passive dosimeters in use ( $< 0,05$  mSv). In 2013, the maximum recorded doses at the CSA and the Cires were 1.20 and 0.35 mSv, respectively (active dosimetry); for the Cires, the dose includes the dose from grouping activities.

In addition, ANDRA completes the radiological monitoring of the disposal facilities by checking the physico-chemical quality of the water and by conducting an ecological monitoring of the environment.

#### 4.2.1.3. EFFLUENT DISCHARGES AND RELEASES FROM ANDRA FACILITIES

In order for the CSM to move into its monitoring phase, disposal structures were protected from rainwaters by alternating layers of permeable and impermeable materials, including notably a bitumen membrane. It resulted in a drastic reduction in the volume of collected waters at the base of the disposal structures.

Furthermore, since the regulatory process for the transition into the monitoring phase is conducted in the same way as for the creation of a BNI, ANDRA submitted in 2000 a licence application for radioactive and chemical discharges. The application covered surface waters (collected rainwaters over the bituminous membrane) and their discharge in rivers, as well as the collected water at the base of the structures and transferred to the AREVA Plant in La Hague before being discharged into the sea. The discharge *Orders of 11 January 2003* constitute the CSM's regulatory reference system.

For hypothetical reference groups, the impact of the CSM is estimated in 2013 at less than  $2 \cdot 10^{-5}$   $\mu$ Sv for discharges into the sea and at 0.30  $\mu$ Sv for discharges into the closest stream.

With regard to the CSA, discharge conditions are regulated by the discharge *Decree No. 2006-1006 of 10 August 2006* and *Order of 21 August 2006*.

Radioelements	Gaseous discharges (GBq/a) (conditioning workshop)	Liquid discharges (GBq/a)
Tritium	50	5
Carbon 14	5	0,12
Iodines	$2 \cdot 10^{-2}$	-
Other beta-gamma emitters	$2 \cdot 10^{-4}$	0,1
Alpha emitters	$2 \cdot 10^{-5}$	$4 \cdot 10^{-4}$

TABLE 20 : DISCHARGE LIMITS PRESCRIBED FOR THE CSA IN THE 21 AUGUST 2006 ORDER

The volumes of effluents produced by disposal facilities are very small as a result of the steps taken to shelter the operation by installing mobile roofs over the structures, following the experience feedback from the CSM.

In 2013, the discharges at the CSA resulted into a low impact, as calculated for a hypothetical reference group in the order of  $5 \cdot 10^{-4}$   $\mu$ Sv/a for liquid discharges and  $4 \cdot 10^{-4}$   $\mu$ Sv/a for gaseous discharges.

### 4.2.2. Radiation protection and effluent limitation at the CEA

#### 4.2.2.1. OCCUPATIONAL RADIATION PROTECTION

The management programme for occupational external and internal exposures of CEA workers is applied when the designing work starts on a facility and continues throughout its operation and decommissioning.

Any operation entailing radiation exposures is conducted according to the ALARA optimisation principle, which applies to both the layout and equipment of the premises. The layout is designed to facilitate tasks, to limit the intervention time and to avoid passing or stopping in the vicinity of any radiation source. It integrates operating needs as well as inspection, maintenance and waste-removal requirements.

The optimisation process is also combined with workplace organisation that covers the classification and monitoring of work premises, as well as the classification, protection and monitoring of workers, as follows:

- workplace classification with due account of potential radiological risks, which is often integrated as early as the design stage, is checked and updated throughout the operating life of the facility on the basis of the results of radiological monitoring at the workstation;
- worker classification depends on the likely occupational exposure level to be received. In order to minimise such exposures, protection measures are implemented: biological protection systems, dynamic containment, together with static systems establishing a negative pressure cascade that allows air to circulate from the least contaminated to the most contaminated areas, and
- worker monitoring by using collective real-time measuring systems for external and internal exposures, plus individual dosimetric monitoring and medical check-ups commensurate with the likely radiological risk to be encountered.

In 2012, 6,862 CEA employees were subject to dosimetric monitoring. The measured dose for 87% of the employees was zero, while for the remainder the annual average individual dose was 0.28 mSv/year. The maximum measured dose was 4.25 mSv.

#### 4.2.2.2. PUBLIC EXPOSURE

The design of biological-protection systems at facilities located near accessible areas to company employees who do not normally work in controlled areas or to members of the public is assessed on the basis of an ALARA exposure level below the regulatory threshold of 1 mSv/a.

The same applies, all the more so, to the general public outside the fences of the different CEA sites. The exposure level is monitored within the site and at the fences using a large number of delayed-readout dosimeters that are checked regularly. In addition to those measurements, dose rates are measured in real-time and on a continuous basis using detectors located at measuring stations positioned around CEA sites. Recordings show values that are equivalent to natural-background radioactivity.

#### 4.2.2.3. REDUCING DISCHARGES

The discharge of radioactive effluents from CEA sites into the environment are subject to the general and specific regulations of each site (inter-ministerial order), in which are defined the licensed discharge limits (annual and monthly limits, maximum concentration discharged into the environment), the waste-discharge conditions and the required environmental monitoring procedures. Even before the first discharge licences were issued in 1979, the CEA had always been committed to controlling all discharges of radioactive effluents into the environment by ensuring their control and by monitoring their impact, whilst ensuring that it has been kept to the lowest possible level.

Orders authorising discharges and water intakes on CEA sites have been revised gradually with due account of the recent evolution in the regulatory framework, which is reflected by a reduction in licensed facility discharges, and for new facilities, by the publication of an individual licence order per facility.

Control of liquid discharges includes the activity of alpha-emitting radionuclides, beta- and gamma-emitting radionuclides and tritium. For at least the last 15 years or so, discharges of radioactive effluents on all sites have consistently been lower than the limits prescribed by ministerial orders.

Research activities being conducted at the CEA call upon radioactive substances, whether chemical or biological in nature. Facility effluents are processed and controlled before discharge and maintained at the lowest level possible. Those controls guarantee that the impact of activities remains negligible for nearby populations and their environment. Every facility implements a detailed environmental monitoring, which is not only adapted to the activities being performed on site and to local characteristics, but also meets common objectives, including the control of the low level of added radioactivity, the knowledge of the environmental status and the role of alerts in case of abnormal increase. The current structure is able to detect very low levels of artificial radioactivity in the environment.

In 2012, the CEA laboratories - which have held Cofrac accreditation for many years - held 170 approvals issued by ASN for taking environmental radioactivity measurements. In 2012, some 22,000 samples were analysed for the purpose of environmental radiological monitoring.

The levels of radioactivity measured in the environment are very low and often below the quantification limits of the most sophisticated measuring instruments. The measurement results are published annually with complete transparency, accessible to all on the website of the French National Network of Environmental Radioactivity Monitoring (RNM). CEA has been a major participant since this network was set up, transmitting 36,000 results in 2012 and accounting for almost 20% of the data available on the website.

The continuous improvement in the performance of the processes and facilities allows gaseous and liquid discharges into the environment to be minimised, and the levels are always below the authorised limits for each centre.

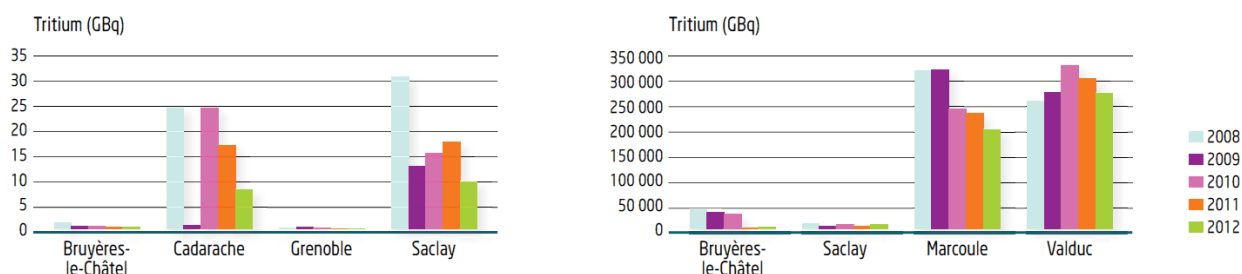


FIGURE 10: REPORT OF LIQUID EFFLUENT DISCHARGES FROM MAJOR CEA FACILITIES BETWEEN 2008 AND 2012

The main liquid discharges at the Marcoule centre which do not figure in the above histogram correspond to the operation of the centre's secret basic nuclear installation, that is to say 10,200 GBq in 2012.

The very low discharge levels have a negligible dosimetric impact on the populations and environment. Although based on pessimistic hypotheses, the impact calculated from actual discharges from the facilities of the centres is extremely low, at about 0.002 mSv/year at the most, far below the annual regulatory dose limit for the general public (1 mSv/year).

#### 4.2.2.4. ENVIRONMENTAL MONITORING

Environmental monitoring involves the constant monitoring of gas and liquid discharges not only at their outlets into the environment, but also at monitoring stations equipped with recording beacons to monitor radioactivity in water and air as well as gamma-emitting background radiation on an ongoing basis. In addition to that alert function that detects any abnormal operation of a facility in real-time, deferred measurements are also made in the laboratory, all of which constitute the provisions for controlling and monitoring the impact of discharges from CEA sites.

Radioactivity measurements are taken in air (aerosols), water (from the surface drainage network, as well as upstream and downstream from the site), groundwater (directly below and around the site), and on vegetation, milk and major crops. They are taken from representative samples, at selected points according to meteorological, hydrological and socio-economic criteria and with due account of feedback. Monitoring those different environments on a monthly basis entails an overall accounting of alpha and beta emissions, as well as specific measurements by liquid scintillation (hydrogen-3, carbon-14, etc.), gamma spectrometry (traces of fission or activation products) or counting after selective separation (strontium-90).

Regulatory monitoring is combined with annual monitoring campaigns covering various sections of the environment, such as sediments or aquatic flora and fauna, during which more sensitive analyses than operational monitoring are performed, or analyses of other physical or chemical parameters.

The analysis of radioecological-inspection results confirms the absence of any significant impact of current discharges from the CEA's civilian nuclear sites on the surrounding environment, except mainly for tritium. That tritium was partly generated by former activities and may be detected in the groundwater flowing immediately below certain sites and in the adjacent area, or in the receiving environment just downstream from the discharge points of liquid effluents, at concentrations that have considerably decreased during the last few years and are generally below 100 Bq/L. Tritium contained in emissions into the air is detected occasionally in vegetation, depending on the prevailing winds, but only very rarely is it detected in milk.

In the aquatic and land environment, and with the exception of sediments where traces of artificial radionuclides may be detected, no artificial radionuclide, other than tritium, has been detected with an activity higher than 1 Bq/L or 1 Bq/kg of matter.

Since 2010, the ILL has been ensuring the regulatory joint environmental monitoring of the CEA Grenoble and the ILL sites in place of CEA Grenoble. The results from this monitoring are identical to those indicated above for the CEA sites.

#### 4.2.2.5. INFORMATION AND SKILLS

The overall results are sent to supervisory authorities and are issued in monthly and annual publications, which are available on line: see ASN website ([www.asn.fr](http://www.asn.fr)). Annual reports on the CEA facilities (named ASN reports) are published by CEA and are available on CEA website ([www.cea.fr](http://www.cea.fr)). All CEA sites maintain regular contacts with their local authorities and with the relevant CLI.

The accreditation by the French Accreditation Committee (*Comité français d'accréditation* - COFRAC) of the CEA's environmental-monitoring laboratories represents an additional token of credibility for the measurements carried out by those laboratories, which participate in the different intercomparison exercises conducted by ASN or other national or even international organisations. Laboratories also benefit from the agreements signed by the Ministers for Health and the Environment in the framework of the National Network of Radiological Measurements in the Environment (*Réseau national de mesures de la radioactivité de l'environnement*).

### 4.2.3. Radiation protection and limitation of effluent discharges at AREVA

#### 4.2.3.1. RADIATION PROTECTION AND EMISSIONS

##### Occupational exposure

Controlling occupational radiation exposures has always been one of AREVA's major concerns. When the facilities currently in service at La Hague were designed in the early 1980s, the occupational design limit was set at 5 mSv/a (i.e., 25% of the limit applied throughout Europe 15 years later). It was clear at the time that such dose was due only to external exposures as work was only carried out in zones with no permanent contamination.

The average occupational individual exposure at La Hague in 2012 remains low: the average exposure was 0.12 mSv, while the collective dose amounted to 0.779 man.Sv.

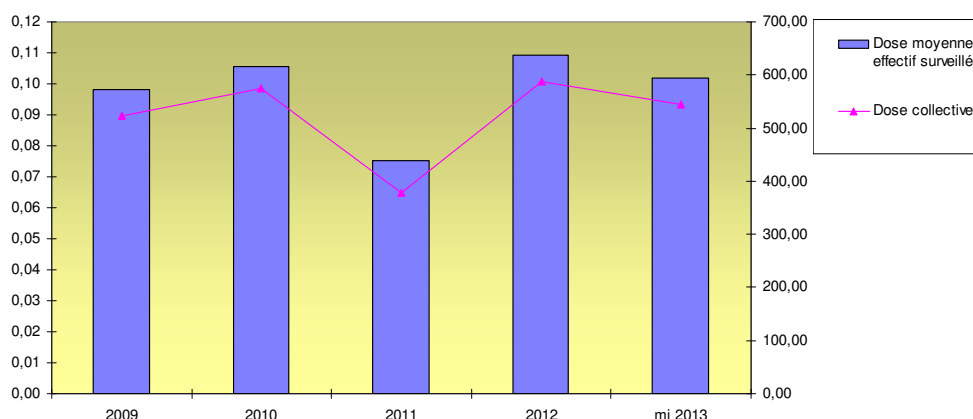


FIGURE 11 : OCCUPATIONAL EXPOSURE FOR AREVA EMPLOYEES AND SUB-CONTRACTORS (2009-MID 2013)

Those results were achieved by:

- designing efficient and reliable process equipment at the front end, thanks to extensive R&D programmes;
- generalising the use of remote operations;
- adapting the conventional installation of biological shielding to all likely operating and maintenance situations;

- ensuring the strict containment of the facilities by providing at least two full physical barriers between the radioactive materials and the environment. Chemistry equipment is completely welded and enclosed in leak-proof cells, while mechanical equipment is fitted with dynamic containment systems (pressure drop, air curtains) and placed in closed cells in which the mechanical penetrations to the working zones were studied very closely. Dynamic containment supplements static arrangements by establishing a series of pressure drops ensuring that air circulates from the least contaminated to the most contaminated zones. Ventilation is provided by several self-sufficient and separate systems based on the contamination level of the ventilated premises in order to prevent any contamination backflow in case of ventilation malfunction. More particularly, a fully separate network ventilates the process equipment, including an air-discharge outlet. All those means ensure that the premises are kept operational under safe conditions in order to prevent internal exposures, and
- taking into account all maintenance operations, as early as the design stage, a decision which has resulted in the equipment being specifically designed on the basis on those operations in order for consumables (pumps, valves, measurement sensors, etc.) to be replaced by remote means, without any breach in containment and with full biological protection (use of mobile equipment-removal enclosures).

### Public exposure

Current provisions limit exposures around the buildings to values that are practically indistinguishable from natural background radiation. Consequently, visitors moving on the site should not receive higher doses than the limits recommended by national authorities.

That is the case, even more so, for the public outside the site fence.

The radiation level is monitored inside the La Hague Site and at the fence perimeter by many dosimeters, which are read every month (11 locations along the fence: exposure range between 60 and 80 nGy/h), supplemented by eight stations along the fence that monitor dose rates on a continuous basis. Lastly, continuous measurements are taken in five neighbouring villages. All continuous measurements are transmitted to the Environmental Control Station of the site.

Radioactive discharges have decreased sharply over the last 30 years. The radiological impact of the La Hague Site dropped by a factor of 5 and the impact on the reference group, which stood at about 70  $\mu\text{Sv/a}$  in 1985 has stabilised at around 10  $\mu\text{Sv/a}$ . Thanks to those efforts, it is now possible to anticipate the strengthening of regulatory standards within the European Union (as transposed into French law) that currently sets at 1 mSv/a the maximum limit for the added effective dose per year for the public, compared to the average natural exposure in France (2.4 mSv/a) and its variants throughout the world (between 1 and 10 mSv/a). AREVA, however, is continuing its studies on the feasibility of reducing further the radioactive discharges of the La Hague Plant, notably in the framework of the Order for plant discharges.

### Impact of discharges

Reducing discharges and their impact has always been one of the prime concerns of the CEA and later of AREVA, in consultation with authorities. Site selection, in particular, has always been guided by that concern.

Discharge licences have always been issued based on practical dose constraints that are far lower than regulatory limits. Furthermore, processing facilities may only be licensed if they are shown to be sufficiently reliable in ensuring that any risk of uncontrolled discharges is kept to a strict minimum. Nevertheless, very unlikely events must be considered as part of a beyond-design-basis approach, whenever their consequences are potentially high, and measures must be taken to limit them. Under those conditions, the risk of exposing an individual to doses exceeding the national regulatory limits due to a discharge may be considered as extremely low.

The following principles were adopted:

- the use of a rigorous containment system to prevent losses, as mentioned above;
- the optimisation of the destination of by-products resulting from effluent processing, with the main priority being focused on recycling those products to the maximum extent possible of the process, and the second priority being centred on sending non-recyclable products for treatment as solid waste (preferably by vitrification, or failing that, by compacting and/or cementing). The remainder is discharged after processing either into the atmosphere or into the sea, depending on what is technically

feasible, preferably in a place where the impact on the environment and reference groups is minimal, and

- the due consideration of worker exposures, as well as to public and occupational risks in the assessment of the various options.

In application of those principles, the effluents are collected, treated to the maximum extent possible in order to recover all reagents, purified, and, if necessary, converted for recycling purposes in the process, with the rest being concentrated and sent with any contained radionuclides for solid-waste disposal, mostly by vitrification, which is the most compact and effective means of packaging radionuclides. Some parts of the process producing unsuitable effluents for vitrification or concentration (such as certain laboratory analyses) were modified in order to eliminate active effluents.

For instance, all aqueous solutions being used to rinse the structural elements of fuel assemblies (top and bottom end-pieces and cladding debris) are recycled in a dissolution solution prepared with highly concentrated nitric acid, which has been recycled, concentrated and purified by evaporation after extraction of other products (fission products, uranium and plutonium) during the process. The same applies to solvents and thinners, which are purged of their radioactivity and of the decay products they contain by vacuum distillation within a special evaporator. In that case, the residue is impossible to vitrify and is packaged as solid waste by embedding it in cement, after calcination in a dedicated unit. That method is a primary and extremely important means for reducing the volume and activity of effluents.

As for non-recyclable solutions, HL effluents are vitrified. Based on their acidity, LL effluents are collected and sorted into acid and alkali effluents. Instead of being sent to the effluent-treatment station for sorting according to their radioactivity level, they are concentrated in dedicated evaporators, which have been installed in such a way that operation never stops. Most of the products fed into the acid and base evaporators come out in the form of distillates, which are virtually free of contamination, then directed towards “V” effluents and discharged as such. The residual concentrate contains all existing radioactivity and, thus, becomes an HL effluent (but of far smaller volume than the initial effluent), and is sent for vitrification with other HL effluents. That method is a second and very important means of reducing the activity and volume of effluents, as well as of solid waste.

It was impossible to use that type of arrangement in old plants that called upon less efficient processes and process equipment.

Effluents from the analytical laboratory constitute a special case. The most significant steps taken to reduce the radioactivity of that type of effluents were to develop new on-line analysis techniques that no longer require that samples be collected from the process, thereby eliminating one source of effluent, and also to develop plasma-torch chromatography, which requires only very small samples and uses no unusual reagent, thus eliminating another fraction of the effluent stream.

Some analyses of residual plutonium solutions have caused the high alpha radioactivity of the analytical laboratory’s effluents. The installation of a special plutonium recovery unit on that stream led to a significant reduction in the alpha energy discharged by the laboratory.

The implementation of the principles described above has led to significant discharge reductions concurrent with a reduction in the volume of solid waste, because, instead of being embedded in bitumen or cement, radionuclides are sent for vitrification, a process that is compatible with far higher activity levels. Hence, reducing discharges was not achieved to the detriment of an increased volume of solid waste, but rather simultaneously with improved compaction.

The result of the steps being taken is particularly visible for discharges into the sea, which had risen appreciably during the period in which LWR fuels were being treated in the old facilities.

AREVA is implementing significant means to control its discharges and to keep regulatory registers, which are transmitted every month to ASN. The measurements of those discharges are also the subject of unscheduled controls by ASN.

The impact of those discharges is currently very low, well below that required by international regulations or recommendations and by health considerations. In any case, the impact corresponding to gaseous and liquid discharges has never exceeded the current dose limits for member of the public (and therefore

certainly never the applicable limits at the time). However, applying the best-available technology (BAT) principle means that the reduction process must be continued, taking into account the progress made in similar processes or operations, advances in scientific and technological knowledge, the economic feasibility of new techniques and the implementation time required, as well as the nature and volume of the relevant discharges.

Radioactive discharges have greatly decreased over the last 30 years. The radiological impact of La Hague has been reduced by a factor of 5: the impact on the reference group has stabilized at around 10  $\mu\text{Sv}$  compared with a level of about 70  $\mu\text{Sv}$  in 1985. These efforts have anticipated the reinforcing of the regulatory standards in the European Union, transposed into French law, which currently sets the maximum cumulative effective dose per year on the general public at 1 mSv, in comparison with the average natural exposure in France which stands at 2.4 mSv/year, and natural exposure levels across the world which vary from 1 to 10 mSv/year. AREVA is nevertheless continuing its studies on the feasibility of a further reduction in radioactive discharges from the La Hague plant, particularly within the framework of the discharge order for the plant.

The calculated impact values were confirmed by a particularly exhaustive study conducted by some 60 experts of the *Groupe Nord-Cotentin Radioécologie* which, at the government's request, examined all discharge values, plus more than 50,000 analysis reports of environmental samples taken by various bodies and through the Nord-Cotentin exercise in 2000, which revealed that environmental markings from the plant discharges were insignificant when compared to natural radioactivity and the fallouts from the Chernobyl accident and atmospheric testing of nuclear weapons, all levels which were already very low.

#### 4.2.3.2. ENVIRONMENTAL MONITORING

Upstream from the controls conducted by competent authorities and by the EC (Article 35 of the *EURATOM Treaty*), AREVA is implementing significant environmental-monitoring means.

Around AREVA's nuclear sites, specialised staff members collect regular intakes and measurements in the different receiving media (air, water, soil, fauna and flora). In France, statistics about radiological monitoring in the environment are in the order of 100,000 measurements and 1,000 intake points. Those data are sent every month to ASN and to the National Network of Radiological Measurements in the Environment (*Réseau national de mesures de la radioactivité de l'environnement* – RNME) which is now accessible on line since February 2010, and all publics are therefore able to consult them on the following website: [www.mesure-radioactivite.fr](http://www.mesure-radioactivite.fr). The overall measurements made by operators in the framework of the regulatory monitoring carried out around their sites. In that framework, the six laboratories involved (AREVA NC La Hague, AREVA NC Pierrelatte, EURODIF Production, FBFC Romans, SEPA Bessines and COMURHEX Malvézi) were all granted by ASN the relevant certifications for the analyses they performed.

#### 4.2.3.3. PUBLIC INFORMATION

AREVA reports on its undertakings through a policy of information transparency by making the discharge values and environmental monitoring results available to the public regularly via the website [www.aveva.com](http://www.aveva.com) as well as via the French national network of environmental radioactivity monitoring [www.mesure-radioactivite.fr](http://www.mesure-radioactivite.fr).

In addition, every BNI of the AREVA Group issues every year:

- pursuant to its discharge-licence order, a public annual report presenting notably the status of annual water intakes and the status report of the control of intake media, the status of annual discharges, the estimated doses received by the population due to the activity conducted during the past year. This report is issued before 30th June of the following year to ASN, to the national and local government administrations concerned and to the Local Information Committee (CLI).
- in accordance with Article 21 of the *2006 TSN Act*, a report describing notably the measures taken with regard to nuclear safety and radiation protection, incidents and accidents, the nature and the measurement results of radioactive and non-radioactive discharges, the nature and quantity of radioactive waste being stored on the site of the facility, as well as all measurements being taken in order to limit the waste volume and impact on human health and the environment, especially soils and waters. This report must be issued before the 30th June of the following year. It is presented to the

CHSCT (Committee for Health, Safety and Working Conditions) of the site concerned, and addressed to the HCTISN (French High Committee for Transparency and Information on Nuclear Security), to the ASN and CLI representatives, and to a wide audience of external and internal stakeholders (elected officials, journalists, suppliers, etc.). It is also posted on line on the AREVA website, ([www.areva.com](http://www.areva.com)).

Each year the AREVA group also publishes the reference document, the annual report and the report on the safety of the nuclear installations. All these documents are available on its website.

In France the Local Information Committees foster direct interchange between the principal local stakeholders (elected officials, associations, experts, etc.), mainly through regular meetings. These meetings, to which the press is also invited, provide the opportunity to present the current news of the AREVA sites and to assess the actions taken with respect to the environment, security and nuclear safety.

#### **4.2.4. Radiation protection and effluent limitation at EDF**

##### **Radiation protection of workers**

Any action taken to reduce occupational doses starts with a thorough knowledge of collective and individual doses induced by internal contamination or external radiation exposures. Thanks to EDF's "radiological cleanliness" policy and the systematic use of respiratory equipment in case of suspected risk of internal contamination, cases are rare or not serious.

Since most doses are due to external exposures, EDF is focusing its efforts on reducing them. That policy and its results form a whole and it is impossible to isolate what is strictly associated with spent-fuel management or waste management. Consequently, the following paragraphs will address the overall operation of nuclear-power reactors.

In order to optimise and to reduce further the doses of exposed individuals, EDF launched the ALARA-1 policy as early as 1992, thus leading to significant improvements in terms of personal dosimetry. To continue making progress, EDF launched a new ALARA initiative in 2000, integrated into a more comprehensive development applying the optimisation principle as a whole and aiming to reduce the collective dosimetry. This initiative is based on three lines of progress:

- reduced contamination in systems (zinc injection, decontamination work, filtration optimisation, etc.);
- dose optimisation in work planning (dose forecasts, optimisation analysis in relation to dose targets, real-time monitoring of collective and individual doses, analysis of deviations, etc.), and
- experience feedback, analysis of deviations and good practices.

Between 2003 and 2013, these efforts reduced the number of workers with an annual individual dose of between 14 and 20 mSv from 322 down to 8, and the average individual dose from 1.93 to 1.04 mSv. Likewise, the collective dosimetry per plant unit continued to drop and reached 0.79 man.Sv/unit in 2013. It is noteworthy that a slight increase was observed in 2013 due to an increase in the volume of maintenance work.

In addition, EDF has undertaken actions to ensure better control of the risk situations represented by radiographic exposures, prohibited areas (red) and limited stay areas (orange) by:

- reducing the repeat exposure situations and drawing the lessons from events involving jammed sources,
- by continuing the proactive procedure for identifying, counting, protecting and reducing the hot points and by reinforcing the preparation and inspection of activities, particularly when they can lead to exposure levels exceeding 2 mSv/h, in close collaboration with the industrial gamma radiography service providers.

The dose-analysis process, which ranges from initial assessment to final optimisation and ends with the integration of experience feedback, is carried out using a computer application, PREVAIR, which is shared by all nuclear sites and corporate engineering groups, and is now being provided to contractors.

During an intervention, PREVAIR allows for the automated collection and tracking of doses per intervention. In addition, since the system is coupled with new dosimeters equipped with alarms, it reinforces the protection of individual workers by adapting the alarm thresholds of their dosimeters to the dose forecast for their intervention.

Once the intervention is over PREVAIR allows experience feedback to be built up by archiving the doses per intervention. The operational-dosimetry process is designed to monitor occupational doses in real-time during interventions and to display deviations to set objectives.

#### **Use and dissemination of experience feedback**

In order to limit occupational doses, EDF took proactive steps to reduce the annual exposure limit to 20 mSv as early as 2000. In addition, alarm thresholds have been implemented in the management of operational doses used on all EDF nuclear sites, with thresholds of 16 and 18 mSv as a first step, and then replaced by a unique threshold of 14 mSv since spring 2012. Monitoring of occupational doses upon entry into a controlled area takes into account not only their doses over the past 12 months, but also their dose forecast. If this value is reached, special consultations involving workers, doctors and radiation-protection experts are held in order not only to assess and to refine the optimisation of subsequent doses, but also to improve monitoring practices and prevent any violation of statutory limits. Crafts identified as receiving the highest exposure levels (insulation fitters, welders, mechanical-maintenance technicians and logisticians) are subject to specific monitoring procedures that have proven effective, since individual doses, although still high, have decreased considerably over the past 10 years, as mentioned earlier in the report.

#### **Implementation of an ALARA approach to shipments**

In order to optimise doses associated with shipments of radioactive materials, EDF applies the ALARA principle. Especially in the case of spent-fuel shipments, all available data are used not only by operators in charge of removal operations, but also by designers to define appropriate tools for new packages.

##### **4.2.4.1. EFFLUENT DISCHARGES**

Discharges of radioactive effluents are subject to a general regulation which provides:

- the relevant procedures for obtaining discharge licences;
- discharge standards and conditions, and
- the role and responsibilities of nuclear-site managers.

In addition to orders for each site include specific requirements regarding:

- limits not to be exceeded (for instance, in the form of regulatory annual limits, or of additional or total maximum concentrations of the receiving environment);
- discharge conditions, and
- the modalities for discharge control and of the environmental-monitoring programme.

Concentration limits are associated with annual total-activity limits set for sound-management purposes.

That regulatory framework also involves the implementation of the optimisation principle, the aim of which is to reduce the impact of radioactive discharges to a level that is compatible with the ALARA principle. It was integrated into the facility design through the use of effluent-treatment capabilities, etc., and has resulted in a rigorous management of effluents during operation.

This procedure was integrated into the facility design (installation of effluent treatment capabilities, etc.) and has resulted in the setting up of rigorous effluent management during operation with the aim of mitigating the environmental and dosimetric impacts. Efforts are therefore being made to limit discharges by improving the effluent collection and treatment channels and by reducing their production at source.

Those measures have led to a drastic reduction in liquid effluent discharges, except for tritium and carbon-14 (proportionate to electricity production), which, in fact, were originally the prevailing contributor to environmental and health impacts (dose).

The substantial reduction in liquid discharges (except for tritium and carbon-14), which has been observed for a number of years (100 times less since 1984), means that the current dose impact of discharges from an NPP is governed chiefly by tritium and carbon-14 discharges.

However, the dose impact of radioactive discharges remains extremely low, in the order of one or a few microsieverts per year, as calculated for the reference group living close to an NPP. That value is well below

the natural exposure level in France (2,400  $\mu\text{Sv/a}$ ) and the exposure limit for the members of the public (1,000  $\mu\text{Sv/a}$ ), excluding exposure to natural radiation and excluding medical practices).

### Environmental monitoring

In order to check on compliance with the regulatory provisions, EDF implements a programme for monitoring effluent discharges and the environment. This programme, established in agreement with ASN, is conducted under the licensee's responsibility.

In addition to the monitoring and measurements carried out on the effluent discharges, EDF deploys substantial resources to measure the radioactivity in the periphery of the BNIs to detect any abnormal change in environmental radioactivity levels near the NPPs. These surveillance measures cover the various external and internal human exposure pathways (inhalation, ingestion):

- atmospheric radioactivity measurements (dust and gas) and the ambient gamma dose rate,
- measurements on environmental matrices taken from terrestrial and aquatic environments and on consumer products.

EDF's monitoring of the environment around the NPPs fulfils three separate but complementary functions:

- an alert function, through a network of radiation meters set up in the vicinity of the installation. By forwarding the alert to the control room, any abnormal change in the ambient radioactivity level near the site is detected in real time.
- A routine surveillance function that concerns the daily to monthly analyses (essentially overall beta and tritium activity measurements) performed on atmospheric dust, rainwater, groundwater, plants, milk, etc.,
- a scientific monitoring and studies function which corresponds to the radioecological measurement campaigns, usually carried out between April and October. It aims at making a highly precise evaluation of radionuclide activities in the terrestrial and aquatic ecosystems and any spatial and temporal changes thereto.

In addition to those technical functions, the communication function encompasses contacts with the authorities and the general public. The keeping of regulatory records (effluents and environment) is entrusted upon a single and independent unit from the services responsible for requesting discharges licences or conducting discharges.

Following the creation by the French authorities within the National Network of Measurements (*Réseau national de mesures* – RNM), all environmental laboratories at EDF's NPPs embarked on a process of gaining approval for the network, via accreditation to the ISO-17025 standard.

Furthermore, a decennial review, similar to the baseline measurements, must also be performed when commissioning the first unit at a site. All sites have now conducted their first decennial review. Third decennial reviews began with Fessenheim in 2009 and are scheduled according to a planning, which is established with the laboratory in charge of that study and site involved.

Each year EDF thus takes more than 40,000 regulatory samples to which it voluntarily adds hundreds of annual analyses to determine more precisely the radiological and radioecological status of the environment. All these measurements confirm the very low environmental impact of radioactive discharges from the NPPs and a general reduction in the activity of artificial gamma-emitting radionuclides measured in the monitored environmental matrices.

It is to be noted that specific surveillance actions can also be implemented further to certain events that could lead to one-off contamination situations. In the context of the post-Fukushima follow-up for example, nearly 500 gamma spectrometry analyses on aerosol filters and nearly 200 on iodine traps were carried out over a seven-week period in addition to the monitoring of the installations required by the regulations. All the results were transmitted daily to ASN and to the IRSN emergency centre, which thus had a constantly updated map of the air masses above France.

#### 4.2.5. Radiation protection and limiting of effluents at the ILL

The average individual dose for the ILL is very low, at 0.018 mSv. The maximum individual dose (3.16 mSv) was received by a person carrying out mechanical maintenance work. For information, the zero doses indicated by the approved dosimetry laboratories correspond to doses that are below the dosimeter recording threshold, that is to say 0.05 mSv.

With regard to internal exposure, only exposure to tritium is above the detection limits and the collective dose is 1.103 mSv divided among 27 persons at the ILL.

	ILL	EMBL	Experimenter	Companies	Total
Number of persons monitored	424	30	1587	454	2495
Number of zero doses	331	30	1511	446	2318
Collective dose [Man.mSv]	30,72	0,00	12,80	1,41	44,93
Maximum individual dose [mSv]	3,16	0,000	0,80	0,45	3,16
Average individual dose [mSv]	0,072	0,000	0,008	0,003	0,018

TABLE 21 : DOSES RECEIVED IN 2012 BY PERSON WORKING AT ILL

## 5 | EMERGENCY PREPAREDNESS (ARTICLE 25)

1. Each Contracting Party shall ensure that before and during operation of a spent fuel or radioactive waste management facility there are appropriate on-site and, if necessary, off-site emergency plans. Such emergency plans should be tested at an appropriate frequency.

2. Each Contracting Party shall take the appropriate steps for the preparation and testing of emergency plans for its territory insofar as it is likely to be affected in the event of a radiological emergency at a spent fuel or radioactive waste management facility in the vicinity of its territory.

### 5.1. General emergency preparedness in BNIs

The system set in place by public authorities in case of incident or accident relies on a series of legal instruments relating to nuclear safety, radiation protection, public order, emergency preparedness and emergency plans.

*Law No. 2004-811 of 13 August 2004 Concerning the Modernisation of Emergency Preparedness* provides for an updated risk listing, the revamping of operational planning, the performance of drills involving the population, public information and training, operational watch and alert.

The scope of a nuclear crisis and, more *generally*, of radiological emergencies is provided by the national plan “Major nuclear or radiological accident” (plan “*Accident nucléaire ou radiologique majeur*”) of February 2014 and by the *Interministerial directive of 7 April 2005*.

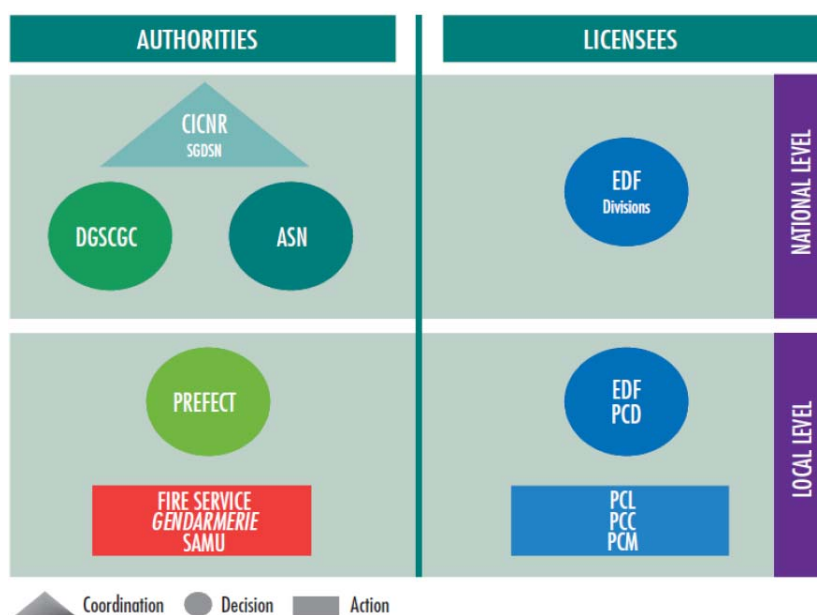


FIGURE 12 : TYPICAL DIAGRAM OF CRISIS ORGANISATION IN CASE OF ACCIDENT AFFECTING A NUCLEAR REACTOR OPERATED BY EDF

CICNR : <i>Comité interministériel aux crises nucléaires ou radiologique</i> – Interministerial Committee for Nuclear or Radiological Emergencies	PCL : <i>Poste de commandement local</i> – Local Command Post
SGDSN : <i>Secrétariat général de la défense et de la sécurité nationale</i> – Secretariat-General for National Defence and Security	PCC : <i>Poste de commandement contrôle</i> – Supervision Command Post
DGSCGC : <i>Direction générale de la Défense et de la sécurité civile et de la gestion des crises</i> – General-Directorate for Defence, Civil Security Direction and crisis management	PCM : <i>Poste de commandement moyens</i> – Resources Command Post
	PCD : <i>Poste de commandement de direction</i> – Management Command Post

The information of neighbouring States in the event of radiological emergency is covered by the *Early Notification Convention of 26 September 1986*, which was ratified by France in 1989. In addition, bilateral conventions exist with the authorities of bordering countries.

### 5.1.1. Local organisation

Only two parties are authorised to take operational decisions during an emergency situation:

- the operator of the BNI in which the accident occurred, who must implement an organisation and sufficient means to control the accident, to assess and to limit its impact of the accident, to protect persons on site, as well as to alert public authorities and to inform them on a regular basis. That procedure is described beforehand in the On-site Emergency Plan (*Plan d'urgence interne* – PUI) that the operator is required to prepare, and
- the Prefect of the *département* in which the facility is located, who is responsible for deciding which steps must be taken in order to protect the population and property threatened by the accident. He acts within the framework of an Off-site Emergency Plan (*Plan particulier d'intervention* – PPI), which he has specifically prepared for the facility involved. In that respect, he is responsible for co-ordinating all committed public and private means, as well as physical and human resources referred to in the Off-site Emergency Plan. He ensures also that the population and elected representatives are kept properly informed. Through its territorial divisions, ASN assists the Prefect in developing plans and managing the situation.

### 5.1.2. National organisation

The national "major nuclear or radiological accident" plan of February 2014 covers the most serious radiological emergency situations concerning BNIs or the transport of radioactive materials. It details the emergency management organisation, the response strategies and principles, and contains a decision support guide that is available to the Government.

In the exercise of their mission, relevant Ministries and ASN join efforts to advise the Prefect on the protective steps to be taken. More particularly, they provide the Prefect with information and advice likely to help him assess the situation, the scale of the incident or accident, and its potential developments.

#### 5.1.2.1. GENERAL PRINCIPLE

The defence-in-depth principle involves that severe accidents, even with low probability, be taken into account in the drafting of emergency plans in order to develop the required steps to protect the site staff and the population, and to control the accident on site.

There are two types of emergency response plans for BNIs at local level, as follows:

- the On-site Emergency Plan, drawn up by the operator, is designed to restore the safety of the facility and to mitigate the impact of the accident. It specifies the system and the means to be deployed on site. It also comprises provisions in order to ensure that public authorities are informed promptly, and
- the Off-site Emergency Plan or Emergency Preparedness Plan (*ORganisation des SECours* – ORSEC), drawn up by the Prefect, is designed to ensure the short-term protection of the population, if threatened, and to support the operator with outside response means. It specifies the respective missions of the various relevant services, the information and alert diagrams as well as physical and human resources.

#### 5.1.2.2. TECHNICAL BASES AND COUNTERMEASURES OF EMERGENCY PLANS

The content of emergency response plans must provide suitable responses to BNI accidents. In order to achieve that goal, a technical basis must be developed, which means adopting one or several accident scenarios in order to determine the range of potential consequences, as well as the nature and scope of the

means to be deployed. The task is difficult, because actual significant accidents are very rare, and the approach relies primarily on a theoretical and conservative approach first to assess source terms (i.e., the quantities of dangerous materials being discharged), then to calculate their dispersal into the environment and lastly, to evaluate their radiological and non-radiological impact (toxic leak, fire, explosion).

On the basis of the regulatory response levels, it is then possible to prescribe specific countermeasures in the off-site emergency plan (i.e., justified protective actions for populations in order to mitigate the direct impact of the discharge). Potential steps, from a radiological standpoint, include the following:

- taking shelter indoors, in order to protect the residents from direct irradiation by a radioactive plume and to minimise inhalation of radioactive substances;
- administration of stable iodine, if the discharge involves radioiodine, and
- evacuation, if the previous steps offer insufficient protection owing to the activity levels of the discharges.

It should be noted that the Off-site Emergency Plan only provides for emergency measures and do not in any way preclude further steps, such as foodstuff consumption restrictions or cleanup of contaminated areas, which could be taken in the longer term and over a broader area. The national plan “Major nuclear or radiological accident” provides principles for the long term management of a crisis on the post-accidental aspects.

## 5.2. ASN role and organisation

### 5.2.1. ASN missions in case of emergency

In emergency situations and in accordance with the provisions of the *TSN Act*, ASN supports the government on all issues pertaining to its competence. It addresses its recommendations on the measures to be taken from a medical and health standpoint or with regard to emergency preparedness. Together with the support of the IRSN, ASN assumes four duties, as follows:

- to ensure the soundness of the steps taken by the operator and supervise him;
- to advise the government and its representatives at local level;
- to take part in the dissemination of information, and
- to act as competent authority in order in the framework of international conventions.

### 5.2.2. Prescribed ASN structure with regard to nuclear safety

When ASN moved to its new head office in Montrouge in March 2013 it was able to set up a new emergency organisation based on the lessons learned from the Fukushima accident, during which ASN activated its emergency centre for one month.

It comprises:

- at national level, in Montrouge:
  - a "strategy" command post manned by the ASN Commission which may be brought to take decisions and issue requirements to the licensees of the facilities concerned in emergency situations;
  - a "technical command post that is in constant contact with its technical support - IRSN, and with the ASN Commission. Its role is to adopt positions to advise the Prefect, who is the emergency operations director;
  - a "communication" command post. The Chairman of ASN or his representative acts as spokesman, separately from the role of head of the technical command post.
- at local level:
  - ASN representatives assisting the Prefect in his/her decisions and communications;
  - ASN inspectors present on the accident-stricken site
  - ASN is supported by an analysis team located at IRSN's emergency technical centre (ETC).
- In the event of an accident abroad, ASN could send one of its representatives to assist the French embassy in the country of the accident.

### 5.2.3. Role and organisation of operators in case of emergency

The operator's emergency response organisation is designed to support the operation team in the event of an accident and must ensure the following tasks:

- on site, triggering the PUI;
- off site, mobilising accident experts from national emergency response teams (*équipe nationale de crise* – ENC), in order to help site managers, and
- informing public authorities that may, depending on the gravity of the situation, trigger the PPI.

### 5.2.4. ASN's role in emergency preparedness

#### 5.2.4.1. APPROVAL AND ENFORCEMENT CONTROL OF ON-SITE EMERGENCY PLANS

Since January 1990, the PUI, together with the safety report and the general operating rules, has been part of the safety documents to be submitted by the operator to ASN at least six months prior to using any radioactive materials in his BNI. In that context, the PUI is analysed by the IRSN and submitted to the relevant GPE for its opinion.

ASN ensures the sound enforcement of PUIs, notably during inspections.

#### 5.2.4.2. PARTICIPATION IN THE DEVELOPMENT OF OFF-SITE EMERGENCY PLANS

Pursuant to *Decree No. 2005-1157 of 13 September 2005 Concerning the ORSEC Plan*, the Prefect is responsible for drawing up and approving the relevant PPI. ASN assists the Prefect by analysing the operators' technical data in order to determine the nature and scope of the impact. That analysis is conducted with the IRSN's technical support with due account of the latest information on serious accidents and radioactive-material dispersal. ASN also ensures consistency between PPIs and PUIs.

In addition, ASN provides its opinion on the aspect relating to the transport of radioactive materials within the ORSEC plans developed by the Prefects.

#### 5.2.4.3. POST-ACCIDENT STEERING COMMITTEE

In 2005 ASN set up the "CODIRPA", a Steering Committee for managing the post-accident phase, which is widely open to the stakeholders concerned. In November 2012, ASN sent the Prime Minister elements of the doctrine drafted by the CODIRPA, covering exit from the emergency phase, and the transition and long-term phases, accompanied by an opinion from the ASN Commission. These elements were then posted on [www.asn.fr](http://www.asn.fr) and widely circulated at local, national and international level. 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 2013, 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 disaster, but also to ensure support for the preparatory work to be organised in France at regional level. Some questions are also still on hold at the end of the first phase of the CODIRPA's work and the consideration 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 supplement the elements of doctrine with respect to the different accident situations;
- assist with regional implementation of the elements of post-accident management; and
- participate in the international actions on the post-accident theme, share and take into consideration the results of these actions.

The new duties of the CODIRPA will focus on watching over, supporting and analysing the various post-accident preparation processes with the aim of periodically proposing updates to the doctrine. The new programme is set for a five-year period.

#### 5.2.4.4. CRISIS EXERCISES

Since the overall mechanism and structure must be tested on a regular basis in order to be fully operational, nuclear and radiological emergency exercises are organised. Governed by an annual circular, those exercises involve the operator, local and national public authorities (e.g., prefectures), ASN and the IRSN. By testing emergency plans, the structure and procedures, they contribute to the training of relevant agents. Their main purposes are determined at the beginning of each exercise and aim mostly at assessing correctly the situation, in returning the deficient facility to a safe state, in taking appropriate measures to protect the populations and in ensuring sound communications with the media and the public concerned. In parallel, they also provide an opportunity to test the alert system of national and international authorities.

### 5.3. Emergency preparedness for accidents in non-BNIs

In conjunction with the relevant Ministries and stakeholders, ASN drafted the Interministerial Circular DGSNR/DHOS/DDSC No. 2005/1390 of 23 December 2005, which specifies:

- the context of the response;
- the responsibilities of the different actors;
- the standard procedure for warning public authorities;
- the response principles, and
- a list of likely services to provide assistance.

## 6 | DECOMMISSIONING (ARTICLE 26)

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*Each Contracting Party shall take the appropriate steps to ensure the safety of decommissioning of a nuclear facility. Such steps shall ensure that:*

- i) qualified staff and adequate financial resources are available;*
  - ii) the provisions of Article 24 with respect to operational radiation protection, discharges and unplanned and uncontrolled releases are applied;*
  - iii) the provisions of Article 25 with respect to emergency preparedness are applied; and;*
  - iv) records of information important to decommissioning are kept.*
- 

### 6.1. ASN requirements concerning BNIs

#### 6.1.1. Definitions

ASN has provided the following definitions:

**Clean-out:** corresponds to the operations undertaken in order to reduce or to eliminate any residual radioactivity or any other residual dangerous substance.

**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 substances, and radioactive substances in particular, 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. In the final stage, and subject to certain conditions, the installation can be delicensed.

**Delicensing:** administrative procedure that consists in deleting the installation from the list of "basic nuclear installations" (BNIs). In this case the installation is no longer subject to the legal and administrative system of the BNIs. More specifically, delicensing lifts part or all of the regulatory controls applicable to a BNI. This implies that the decommissioning work has been carried out and that the state of the installation with respect to the objectives set by the decree (particularly with regard to the final targeted status) has been proven by the licensee).

Since a large number of BNIs were built in France between 1950 and 1990, many of them have been shut down over the last 15 years or so, or have entered into their decommissioning phase. As mentioned in § D.5, more than 30 facilities of all types (nuclear power or research reactors, laboratories, fuel-processing plants, waste-management facilities, etc.) were already shut down or undergoing decommissioning in 2013. In that

context, the safety and radiation protection of decommissioning operations have gradually become major topics for ASN.

### 6.1.2. Decommissioning policy and strategy

At the international level, the following three main strategies have been developed by the IAEA:

- deferred dismantling;
- safe containment, and
- immediate dismantling.

In accordance with IAEA recommendations, for several years now, ASN has been recommending the immediate dismantling strategy and the need to remove all the dangerous substances during this phase. The aim of this strategy is more particularly to avoid placing the technical and financial burden of dismantling on the future generations. ASN has indicated that if the licensee chooses any other strategy, it must be supported by sound arguments.

These principles have been set out in two documents, one entitled "ASN policy notice concerning the decommissioning and delicensing of basic nuclear installations in France" and the other "The basic principles of the ASN doctrine for the management of sites contaminated by radioactive substances". The first document (the ASN decommissioning policy) was published in April 2009 in version 0.v3 after having been submitted to the public for comments in 2008 before being presented to the HCTISN (the document is available in English on the ASN website). The second document (basic principles concerning contaminated sites) was published in October 2012.

The general principles of ASN have been transformed into requirements by the BNI order:

- "the decommissioning plan justifies the envisaged time – which shall be as short as possible – between final operating shutdown of the installation and its decommissioning".
- "the final state reached on completion of decommissioning must be such that it prevents the risks or inconveniences that the site may represent for public health and safety or for protection of nature and the environment, in view more particularly of the projections for reuse of the site or buildings and the best post-operational cleanout and decommissioning methods available under economically acceptable conditions."

These principles are set out in guide (Guide No.6 "Final shutdown, decommissioning and delicensing of basic nuclear installations in France" and draft Guide No.14 "Complete clean-out methodologies permissible in basic nuclear installations in France" published in June 2010. A guide devoted to the clean-out of the soils in BNIs is under preparation.

#### An overall vision of the decommissioning of an installation

In accordance with legislation and the regulations, ASN requires that a strict distinction be made between the operating and decommissioning phases (see § E.2.2.4.5). In fact, the decommissioning phase includes specificities in terms of risks and radiation protection within the technical context of a fast-evolving facility. Hence, it must take place within the framework of a specific safety reference system once the licence has been granted by decree. Certain preparatory or pilot activities may however be conducted between the shutdown of the facility and the publication of the decree, but they must be compatible with the licensing decree and remain limited.

ASN favours an overall vision of every decommissioning project, which means that the case submitted by the operator in support of his application must describe the entire set of scheduled activities from the final shutdown up to the achievement of the final state being sought. That case must identify the main technical and administrative steps. With regard to regulations, that task is reflected by the notion of a single licensing decree for final shutdown. That procedure prevents the project from being fractioned into blocks and improves the consistency of the overall operations.

### Managing radioactive waste

ASN considers that managing waste resulting from decommissioning operations constitutes a significant element that conditions the sound occurrence of decommissioning programmes under way (availability of systems, management of waste streams).

This is because the decommissioning of a nuclear installation necessitates the availability of a management route for the removal of all the waste resulting from the decommissioning operations, or at least its storage under suitably safe conditions. Consequently, ASN always assesses the conditions of waste management proposed to it by the licensees.

Readers are reminded that there is no release threshold for waste that is or could be contaminated. The Cires waste disposal facility for very low level (VLL) waste can accept the least radioactive waste coming from potential radioactive waste production areas (in accordance with the installation "waste zoning plan"). Particular attention must however be paid to the optimisation of VLL waste management to avoid prematurely reaching capacity at the Cires facility. ASN encourages initiatives aiming at recycling VLL waste - particularly metallic waste and rubble - in the nuclear domain, which is confirmed by the *Decree of 27 December 2013* (see § F.6.3.2 below).

### Need for particular vigilance

Lastly, ASN considers that decommissioning work sites require particular vigilance in terms of worker radiation protection. This is because the change, sometimes rapid, in the physical state of the installation and the risks it presents raises the constant question of the appropriateness of the means of surveillance deployed. It is often necessary to replace, either temporarily or lastingly, the centralised means of operating surveillance by other more appropriate means of surveillance.

### Two assessment levels

Operators are submitted to a dual assessment level, as follows.

The first level concerns the overall strategy implemented by an operator who has several facilities to dismantle (EDF, CEA, and AREVA) and whose main objective is to review, in addition to the proposed general principles:

- the priorities to consider, with due account of the state of the facilities and their safety;
- the management policy for waste and effluents generated by decommissioning and, more particularly, the availability of matching systems;
- the technical feasibility of the scenarios submitted for ongoing or upcoming decommissioning worksites, and
- the specific structure set in place to manage those decommissioning worksites.

The second assessment level concerns every facility to be dismantled and, more particularly, the safety and radiation protection of the operations to be performed. Its purpose is to assess the measures proposed by the operator in the supporting case of his definitive shutdown and decommissioning-licence application (or during the periodical reviews of the facility).

### Funding

ASN also considers that the financial aspect of the future decommissioning activities and the implementation of dedicated assets contribute to the safety of future decommissioning activities.

### 6.1.3. Regulatory requirements

Specific regulatory requirements for decommissioning are mentioned in § E.2.2.4.5. Readers are reminded that they figure chiefly in the *Environment Code*, the *BNi Procedures Decree* and the *BNi Order*.

Guides No. 6 and No. 14 accompany the regulatory provisions. As indicated in § E.2.2.5.2, the ASN guides contain recommendations that define safety objectives and describe practices ASN considers to be satisfactory to achieve them.

The following paragraphs clarify a few significant issues.

#### 6.1.3.1. DECOMMISSIONING PLAN

Regulations require that the operator provides a decommissioning plan for every BNI as early as he submits his creation-licence application. That plan must be updated on a regular basis and notably when the operator notifies the decision for final shutdown (at least three years before the date of the final shutdown) and when submitting the supporting case of the final-shutdown- and decommissioning-licence application at least one year before the date of final shutdown). For installations whose authorisation preceded this requirement, the BNI order requires creation of this plan no later than the next 10-year periodic safety review.

The plan must describe notably the following, with the necessary justifications:

- the measures taken at the design stage in order to facilitate decommissioning, together with the measures to preserve the history of the facility and the accessibility to data, and to maintain skills and the knowledge of the facility;
- *the planned operations*, the methodology and the decommissioning steps, the equipment, the schedules;
- *the safety and radiation protection objectives*;
- *the waste management procedures, taking account of the existing or projected management solutions, and the effluent management procedures*;
- *the final status after decommissioning*, the projections for the future use of the site, the assessment of the impact of the installation and the site after reaching the final state and the potential modalities to monitor it.

It is similar to the plan described by the IAEA in Document WS-R-5.

A typical summary is proposed in the above-mentioned Guide No. 6.

#### 6.1.3.2. LICENSING DECREE

Regulatory aspects are detailed in § E.2.2.4.5. It should be noted here that, according to the *Environment Code*, the shutdown and decommissioning of any BNI are subject to a prerequisite licence, to be delivered by decree of the ministry in charge of nuclear safety after a public inquiry has been held and after ASN has issued its opinion.

The case submitted by the operator with his licence application for the shutdown and decommissioning of his facility must describe the overall work being planned until the final state reached. It must detail the scheduled work over the short term (few years). The other activities to be carried out at a further date have to be presented, possibly with fewer details, but will be subject to a deadline in the decree, if the stakes warrant it.

In the supporting case of his licence application for final shutdown and decommissioning (with the understanding that it must notably update the report referred to the *Environment Code* concerning his long-term costs for decommissioning and radioactive-waste management), the operator must include an updated overview of his technical and financial capabilities, including its experience, resources and the envisaged organisation.

The decree must specify which final state to be reached, the timeframe to achieve it and the potential steps and hold points requiring a pre-agreement for launching the corresponding works.

Technical prescriptions to be issued by ASN complete the decree and address topics, such as incident and accident prevention and the mitigation of their impact, discharges, as well as the information modalities for ASN and the public.

#### 6.1.3.3. ASN LICENCES AND INTERNAL AUTHORISATIONS

For hold points concerning major activities as set in the licensing decree for final shutdown and decommissioning, the operator must submit a case to ASN in order to obtain its prerequisite approval for the work to be done. In the case where the work would constitute a significant change in the elements presented in support of the licence application, an amendment to the decree would be required.

Over and above those hold points, the operator must declare to ASN all modifications (steps, works, procedures, etc.) that may have potential consequences on safety and provide the necessary justifying documents and updates.

In case of activities or minor importance, ASN may dispense the operator with the declaration procedure for a modification to the facility, provided that the operator set in place an internal control mechanism with sufficient quality, autonomy and transparency guarantees (“internal authorisations system”). That possibility, included in the *BNi procedures Decree*, ensures that the operator has the necessary industrial flexibility. But it only applies to operations that must not significantly call into question the safety report or significantly increase the impact on safety, public health and safety or the protection of nature. An ASN resolution dated 11 July 2008 specifies the requirements and the methods of ASN approval and oversight of an internal authorisation system.

#### 6.1.3.4. PERIODICAL SAFETY REVIEWS

For every BNi undergoing decommissioning, a safety review must be prepared every 10 years (unless otherwise prescribed), as in the case of BNIs in service (see § E.2.2.3.1).

#### 6.1.3.5. DELICENSING

As decommissioning operations progress, nuclear-waste zones are cleaned-out and may be entitled for delicensing in conventional-waste zones. The operator must declare to ASN any zone he wishes to delicense and must submit in support of his application a justifying case including a status report on the clean-out of the zone involved. Draft Guide No. 14 provides a standard summary of such status report. ASN maintains the right to carry out an inspection with intakes and measurements before granting its approval.

Once all zones have been cleaned up and when the final state seems to have been reached, the operator may apply for his facility to be delicensed. The legal and regulatory aspects concerning such delicensing are detailed in § E.2.2.4.5.4. ASN is responsible for verifying through spot checks on site that the objectives have actually been met.

The procedure ends after the case has been transmitted to the Prefect, once the opinions of the communes and of the CLI gathered, by an ASN’s resolutions, which has been validated by the Minister in charge of nuclear safety. It appears necessary to preserve the memory of the past existence of BNIs after their delicensing and to set in place, if need be, any restrictions of use adapted to the final state of the site. Two cases may occur as follows:

- either the operator is able to demonstrate that the decommissioned facility and its footprint involve no risk, or in other words, that they are exempt from any radioactive or chemical and, in such case, a conventional easement in favour of the State is systematically instituted. The purpose of the easement is to preserve the information concerning the presence of an older BNi on the concerned parcels, thus informing the successive buyers;
- or the operator is not able to demonstrate the absence of any residual radioactive or chemical pollution, and, in such case, public-utility easements are set in place and may contain a certain number of site-use restrictions or monitoring measurements to be made. In that case, a public inquiry may be necessary.

#### 6.1.4. Financing of decommissioning

In addition, the *Environment Code* requires BNi operators to assess the decommissioning charges of their facilities and the management charges for their spent fuel and radioactive waste. Furthermore, they must constitute the accruing provisions for those overall charges and allocate sufficient exclusive assets to cover those provisions. In order to ensure compliance with those requirements, specific controls are prescribed by law (see § B.1.7 and § F.2.3.).

## 6.2. Steps taken by BNi operators

### 6.2.1. Clean-out and decommissioning of CEA facilities

The strategy of CEA consists whenever possible in starting the installation decommissioning steps without delay after installation shutdown. As soon as an installation stops operating, its radioactive clean-out begins under the prime contractorship of specialised companies.

This strategy, which is applied at the Grenoble centre, has enabled the clean-out and decommissioning programme to be completed within the planned times.

The priority objectives of CEA are now the following:

- clean-out and decommissioning of the installations at the Fontenay-aux-Roses research centre;
- at Marcoule, decommissioning of the UP1 plant in priority (secret basic nuclear installation).

The number of installations to be dealt with makes this a very large programme, in both size and cost. CEA currently estimates the total cost of the works at roughly 9.9 G€ (excluding contingencies) in gross value.

With regard to the techniques to be used, the variety of facilities requiring clean-out limits the possibilities of knowledge transfer and feedback from one facility to another, but the extensive experience developed since the 1960s means that current projects may be approached thanks to the feedback from past scenarios not only concerning decommissioning technology, monitoring and measurement techniques, R&D programmes to be undertaken in relation with the operations to carry out, the packaging of waste, waste management, the optimisation of radiological protection, and structure and soil-cleanup techniques, etc., but also about project management and regulatory procedures.

The lack of processing facilities and of certain final disposal solutions for certain waste categories, resulting especially from decommissioning operations (special waste, such as radioactive graphite or free asbestos bearing radioactive waste) raises an additional obstacle for activities.

### 6.2.2. Steps taken by AREVA

All nuclear facilities that the operator intends to shut down definitely are covered by specific programmes consisting in:

- preparing the final shutdown via the facility's safety reference system in service, which may require specific licences, and
- cleaning out and dismantling the equipment and structural elements in the framework of a reference system relating to the final shutdown and decommissioning of the facility.

The necessary costs for the performance of decommissioning operations, as well as those associated with the processing of the waste generated by those operations and with their management, are covered by financial provisions (see § F.2.2.3) and a decommissioning plan, which will be developed henceforth as early as the preliminary phases of the facility.

The objective of decommissioning and clean-out operations is to guarantee not only the intrinsic safety of structures and equipment expected to stay in place, but also the absence of any environmental impact. AREVA is implementing a recovery policy for the sites involved through research and the promotion of recycling projects that are consistent with the constraints imposed by their final state and local regulations.

At the end of 2013, the clean-out and decommissioning of the Group's French installations concerned were at varying degrees of advancement:

- The last stage of administrative delicensing is being completed for SICN Annecy (ICPE) and Veurey (BNI 65)
- For the BNIs that constitute the UP2 400 plant of La Hague: BNI 80 obtained its final shutdown and decommissioning (MAD/DEM) decree in 2009, BNIs 33, 38 and 47 obtained their MAD/DEM decrees in November 2013, some of which are partial and will require two new complete MAD/DEM applications in June 2015. The process for modifying the creation authorisation decree (DAC) for BNI 118 is in progress. The public inquiry ran satisfactorily in February 2014.
- For the EURODIF Georges Besse 1 plant, the rinsing of the PRISME facilities is in progress after obtaining the decree of 24 May 2013. This decree sets the date of 31 March 2015 for lodging the MAD/DEM application.
- Revision (02/2014) of the final shutdown and decommissioning application file for BNI 105 of COMURHEX Pierrelatte.

The specific organisation set up by AREVA by bringing together the Valorisation and Clean-out Business Units (BU) to create the Decommissioning and Services (D&S) Operational Division enables the abovementioned activities to be treated coherently.

The main missions of the D&S are the clean-out and decommissioning of the AREVA installations and offering industrial operator services to French customers. This organisation incorporates in particular the Group's clean-out and decommissioning service task forces. This is in line with AREVA's choice to favour the immediate dismantling of its installations.

Decommissioning and clean-out operations are recorded and archived at least until the waste has been eliminated and the facility has been decommissioned.

### 6.2.3. Steps taken by EDF

The objective of the EDF's current deconstruction programme is to complete the decommissioning of the following 10 BNIs:

- eight first-generation reactors (six GGRs at Chinon, Saint-Laurent-des-Eaux and Bugey; the Brennilis HWR, jointly built and operated with the CEA, and the Chooz-A PWR reactor);
- the SUPERPHÉNIX fast-neutron reactor at Creys-Malville, and
- the graphite-sleeve interim-storage facility at Saint-Laurent-des-Eaux.

That programme includes also the construction and operation of a conditioning and storage facility for activated waste (ICEDA) that will accommodate IL-LL deconstruction waste, pending the commissioning of the final outlet for that waste (*Waste Act*).

Type of facility	Unit	Power (MWe)	Commissioning year	Shutdown year	BNI No.
6 GGR units	Chinon A1	70 MWe	1963	1973	133
	Chinon A2	200 MWe	1965	1985	153
	Chinon A3	480 MWe	1966	1990	161
	Saint-Laurent A1	480 MWe	1969	1990	46
	Saint-Laurent A2	515 MWe	1971	1992	
	Bugey 1	540 MWe	1972	1994	45
1 HWR	Brennilis	70 MWe	1967	1985	162
1 PWR	Chooz A	300 MWe	1967	1991	163
1 FNR ( <i>Superphénix</i> )	Creys-Malville	1200 MWe	1986	1997	91
2 silos at Saint-Laurent	Silos	-	-	-	74
1 conditioning and storage facility (ICEDA) under construction	ICEDA				To come

TABLE 22 : EDF FACILITIES INVOLVED IN THE DECOMMISSIONING PROGRAMME

Until 2001, the preferred scenario was to dismantle immediately power reactors up to Level 2 (removal of special fissile materials and readily-dismantled parts, maximum reduction of the contained zone and adjustment of the outside barrier) and to transform it into a basic nuclear storage facility (*installation nucléaire de base et d'entreposage* – INBE). The so-called “Level-3” complete decommissioning was envisaged after several decades of containment.

Since the 2001 decision to speed up the deconstruction programme, the current choice is to deconstruct them as soon as possible.

Facility	Submission of case for final shutdown and decommissioning decree (DAD <sup>18</sup> )	Beginning of public inquiry	CIINB <sup>19</sup>	Publication of decree for final shutdown and decommissioning
Creys Malville	06/05/03	01/04/04	11/05/05	21/03/06
Brennilis	22/07/03	NA	06/07/05	12/02/06
Chooz A	30/11/04	28/08/06	08/12/06	29/09/07
Bugey 1	29/09/05	13/06/06	22/02/08	20/11/08
Saint-Laurent A	11/10/06	26/01/07	09/09/09	20/05/10
Chinon A	29/09/06	02/03/07	09/09/09	20/05/10

TABLE 23 : ADMINISTRATIVE DEADLINES FOR A FULL-DECOMMISSIONING DECREE

The duration of the programme such as it was initiated in 2002 was of the order of 25 years. The time necessary for Andra to provide the disposal facility for Low-Level Long-Lived (LLW-LL) waste - planned in accordance with the waste act - to permit the disposal of Graphite waste, induces an offset in the gas-cooled reactor decommissioning operations.

To succeed with this programme, six projects have been created within the CIDEN (Nuclear Environmental and Decommissioning Engineering Centre), a unit of the Nuclear Engineering Division dedicated to decommissioning, namely Chooz A, Creys-Malville, Brennilis, Bugey 1, Saint Laurent A (grouping plant units A1 / A2 and the graphite sleeves), Chinon A grouping the three reactors A1, A2 and A3 - plus the packaging and storage facility for "B" LLW-LL waste (ICEDA, which is currently under construction.

The corresponding human and financial resources have been mentioned in § F.2.2.4.

These measures guarantee that these operations will be able to be carried out under satisfactory conditions.

### 6.3. ASN analysis

ASN feels that current regulations allow decommissioning programmes for nuclear facilities to be undertaken under good conditions. These regulations include basic requirements to ensure the safety of the relevant operations and the soundness of the final state of the facilities after decommissioning. Similarly, it provides the necessary flexibility to proceed with such operations (with one single licensing decree per given BNI, but with potential deadlines and the possibility to rely on an internal authorisation for minor operations).

On the basis of the BNI order and the reference safety levels published by WENRA in 2013, ASN will publish a resolution to detail some of its expectations and publish the above-mentioned Guide No.14 (full-clean-out methodologies in BNIs). Lastly, ASN will issue a clean-out guide for the polluted soil of decommissioning sites.

#### 6.3.1. Operators' policy and strategy

ASN considers that the current strategy of the major operators (EDF, CEA, and AREVA NC) is consistent with the objectives described in its policy.

All those operators have committed themselves to a strategy for immediate decommissioning. In general, the final state being sought refers to the total evacuation of radioactive substances. ASN considers that the licensees must have an ambitious approach and aim for the complete clean-out of their installation. The management of the radioactive waste is analysed and taken into account. This point is important because the recovery and conditioning of historical waste may prove to be a hindering prerequisite with regard to the decommissioning of a facility.

<sup>18</sup> Decommissioning licensing decree (*Décret d'autorisation de démantèlement* – DAD).

<sup>19</sup> CIINB: *Commission interministérielle d'information relative aux INB* (Interministerial Information Commission on BNIs). It was cancelled in 2010 (see § E.3.4.3.1).

However, ASN has noted delays in decommissioning operations, with due account of a certain number of problems, such as the initial state to discover in more detail, the recovery of historical waste, the unavailability of waste outlets, some cases of delicate demolition, the need to capitalise experience feedback before launching other activities on GGR boxes, etc.) as well as, in certain situations, the licensees giving insufficient priority to this work. This is why ASN considers it vital to periodically review - at least once every 10 years - the overall strategies of each licensee to ascertain that they are compatible with the French policy of immediate dismantling of the nuclear installations, as specified in § F 6.1.2.

In 2009, EDF submitted an updated version of its decommissioning strategy. The document took stock of the advances of the programme, pointed out significant milestones for the future and presented the state of the reflections on the dismantling strategy of the current PWR fleet. ASN then estimated that the principles of the strategy were basically satisfactory but required some additions, particularly with regard to alternative solutions for the management of graphite waste. ASN indicated to EDF in particular that there was no need to wait for the commissioning of a low level, long-lived waste repository that could accept the LLW-LL graphite waste before decommissioning the gas-cooled reactor pressure vessels, but that it was necessary to consider the possibility of interim storage. In September 2013, EDF sent a new update of its decommissioning strategy to ASN, which will examine it in 2015 along with the waste management strategy. Particular attention shall be paid to EDF's proposals for the future decommissioning of its nuclear power plants, notably taking account of the lessons learned from the Chooz A power plant (which has a pressurised water reactor of similar technology to the nuclear power reactors currently in operation).

The decommissioning strategy proposed by CEA and examined in 2006 had been considered on the whole to be satisfactory from the safety aspects. However, in view of the delays and the pushing back of several deadlines for certain installations, CEA delivered an interim report to ASN in 2011 at ASN's request, presenting an update of its decommissioning strategy, justifying the deadlines and explaining the reasons for the delays. ASN's reply focuses on the priority that must be given to immediate dismantling, on the level of clean-out to be achieved and on the deadlines to meet.

With regard to AREVA, ASN will shortly be requesting an update of the decommissioning strategy applicable to all the Group's installations, along with that relative to radioactive waste management, given the importance of legacy waste retrieval which is a determining factor in many decommissioning operations.

### **6.3.2. Recovery of VLL materials**

Studies into the recycling of VLL rubble and metal waste were carried out for the preceding PNGMDR (i.e. covering the 2010-2012 period). These studies revealed that recycling of this type of waste in the nuclear sector. This is the only recycling route authorised to date by ASN. It could be envisaged technically and would have the advantage of reducing the disposal space occupied in the Cires facility.

The industrial feasibility has not yet been confirmed, particularly with regard to the recycling of ferrous metal waste. The use of a dedicated foundry, for the fabrication of storage containers for example, is a solution that merits further examination.

It should be noted that decommissioning of the Georges Besse I plant of Eurodif should produce about 130,000 tonnes of metal waste as from 2021, which shows the importance of the recycling issue.

With regard to the VLA rubble, the studies present an utilisation scenario for finely crushed materials which could be used as backfill for the Cires vaults.

The *Decree of 27 December 2013* specifies the following points:

- Andra, AREVA, CEA and EDF must assess the methods for establishing a recycling process for metallic materials (report to be submitted by the end of 2014);
- Andra must carry out studies on the setting up of a recycling process for VLL rubble at Cires (summary report to be submitted by end of June 2014).

ASN and ASND will be asked for their opinion on these reports.

### 6.3.3. Internal authorisations

ASN had approved the internal-authorisation system in certain CEA facilities and also of AREVA-NC at La Hague, in March and December 2010, respectively. In 2004, ASN authorised EDF to implement a system of internal authorisation for the installations undergoing decommissioning. In order to comply with the *BNV Procedures decree* and ASN Resolution of 11 July 2008, EDF submitted a file presenting the update of its internal authorisations system in 2009. The discussions with EDF are now finished and the internal authorisations system proposed by EDF for its installations undergoing decommissioning was approved by ASN Resolution of 15 April 2014.

### 6.3.4. Site activities

#### 6.3.4.1. EDF / BRENNILIS NPP

Following the cancellation of the licensing decree for the decommissioning of the Brennilis NPP of 2006, a new case was sent in 2008 and submitted to a public inquiry. EDF, in accordance with this decree, has submitted a new complete decommissioning authorisation application for the Brennilis NPP; ASN gave its opinion on the acceptability of the file to the Minister responsible for nuclear safety and considered that in the light of the cancellation of the building permit for the ICEDA - the facility which EDF proposes using for storage of the MLW-LL waste - and lacking alternative solutions, the examination of the file could not be continued.

Lastly it is noteworthy that pursuant to article 37 of the Euratom Treaty, the European Commission was consulted about the submitted authorisation application and gave a favourable opinion to it in May 2010.

Through two resolutions dated 1 September 2011, ASN has regulated the conditions and limits for water intakes and effluent discharges.

#### 6.3.4.2. EDF / GAS-COOLED REACTORS

The decrees authorising the final shutdown and decommissioning operations have been published for Bugey 1 (November 2008), Chinon A1, A2 and A3 (May 2010, Saint Laurent -des-Eaux A1 and A2 (May 2010).

EDF plans starting the demolition of the gas-cooled reactor vessels with those of Bugey 1. To that end, EDF has appraised the condition of the bottom section of this reactor vessel to get a better picture of the state of the installation. The experience feedback from this appraisal was reused on Saint Laurent A1 and A2. Furthermore, EDF has made a radiological inventory of the graphite stacks for all the gas-cooled reactors.

As indicated above in § F.6.3.1, one of problems with the dismantling of the gas-cooled reactor vessels is what is to become of the graphite stacks situated inside them.

In March 2013 ASN performed an in-depth inspection of the Chinon A and Saint-Laurent A gas-cooled reactors undergoing decommissioning. The subjects addressed were chosen considering the main risk areas of the decommissioning operations: waste management, control of radioactive material containment and radiation protection activities. This inspection revealed the good level of involvement of the local teams and satisfactory radiation protection practises on the ongoing work sites. Several lines of progress were identified.

#### 6.3.4.3. EDF / CHOOZ A REACTOR (PWR-TYPE REACTOR)

The licensing decree for the decommissioning of the Chooz-A reactor was issued in September 2007.

The decommissioning of this power plant is considered to be a precursor for the future decommissioning of the pressurised water reactors, the technology used in the French nuclear power reactors currently in operation.

The decommissioning operations *per se* on the primary circuit (except for the dismantling of the reactor vessel) were subject to a licence as a deadline in the above-mentioned decree and were eventually carried out from 2011 to 2013. The matching case was accompanied by an update of the safety report and of the general operating rules. ASN licensed the launching of that work provided that a certain number of technical prescriptions be met.

The four steam generators were removed and decontaminated. Two of them are already at the Cires disposal facility. The other two are stored there pending disposal during 2014. Dismantling of the reactor vessel requires prior authorisation from ASN. This was given by ASN Resolution dated 3 March 2014, under the conditions defined in the file appended to the EDF application and in accordance with the prescriptions set in ASN Resolution of 25 February 2014.

#### 6.3.4.4. EDF / SUPERPHENIX REACTOR (FAST-NEUTRON REACTOR)

The decommissioning decree for the *Superphénix* reactor was published in March 2006.

After examining the files submitted by the licensee, ASN authorised EDF to commission the sodium treatment facility (TNA) and the storage of the future blocks of soda concrete.

The primary sodium has been treated and the secondary sodium is in the course of treatment in the TNA facility. The soda concrete blocks are stored on site in a building authorised by ANS. The primary components (pumps and intermediate heat exchangers) situated in the reactor vessel have been dismantled. Dismantling of the secondary loops is in progress.

#### 6.3.4.5. CEA / FONTENAY-AUX-ROSES AND GRENOBLE FACILITIES

Both the Fontenay-aux-Roses and Grenoble facilities are being dismantled.

At Fontenay-aux-Roses, the decommissioning of the PROCÉDE and SUPPORT installations was authorised by two decrees dated 30 June 2006. The initially planned duration for the decommissioning operations was about ten years, but on account of the strong presumptions of the presence of contamination under one of the buildings, and difficulties the licensee had not anticipated, the operations will go beyond the originally planned date. In 2015, CEA should submit a modification application for the final shutdown and decommissioning decree, which ASN will examine.

At *Grenoble*, there used to be six nuclear facilities, as follows:

- the SILOETTE reactor (BNI-21) was decommissioned in 2007;
- the MÉLUSINE (BNI-19) reactor is already cleaned out and has moved to the delicensing procedure;
- the Mathematics Laboratory (*Laboratoire de mathématiques – LAMA*), whose clean-out is nearing completion. Part of the premises (basement) was delicensed in 2011 in the waste zoning sense, using the internal authorisations procedure, the conditions of which were set by the resolution mentioned above (§ F.6.3.3). In 2013, CEA continued the clean-out of the very high level cells.
- the radioactive waste treatment station and the Interim radioactive waste decay storage facility for which the final shutdown decree was published in 2008.
- the SILOE reactor for which the final shutdown and decommissioning decree was published in 2005 then modified in 2010 and 2012 to adapt the end of decommissioning date (1 April 2014) to allow the operations to be completed smoothly, and in particular the initially planned final state to be achieved.

#### 6.3.4.6. CEA / CADARACHE FACILITY

The HARMONIE reactor is fully decommissioned and then delicensed in 2009.

In June 2012, CEA transmitted the update of its decommissioning strategy for the RAPSODIE facility. It plans for the project as a whole to span some thirty years until 2049. For ASN, implementing such a strategy, which is similar to deferred dismantling, can only be envisaged if it is duly justified, giving detailed reasons why immediate dismantling cannot be implemented. ASN therefore asked CEA to send it an update of the installation decommissioning plan, providing all the necessary information to justify the chosen decommissioning strategy.

The decree for the final shutdown and decommissioning of the Enriched Uranium Workshop (*Atelier d'uranium enrichi – ATUE*) was published in 2006. However, technical and economic problems occurred during the operations, thus leading the operator to request a five-year delay and, hence, a modification of the decree. Considering that the envisaged modifications were sufficiently significant to require a new authorisation, ASN asked the licensee to submit a complete authorisation modification application file so that it can undergo the required public consultations. CEA submitted the file in question at the end of February 2014.

The decree for the final shutdown and decommissioning of the Plutonium Technology Workshop (*Atelier de technologie du plutonium* – ATPu) and of the Physico-chemical Coolant Process Laboratory (*Laboratoire des procédés physico-chimiques caloporteurs* – LPC) was issued in March 2009. The incident that the CEA declared in October 2009 involved the underestimation of plutonium deposits in glove boxes was classified as Level 2 on the INES scale. Resolutions made by ASN in October 2009 suspended the operations under way and specified modalities for operations to resume. In 2010, certain operations have been gradually licensed on the basis of the safety cases reviewed by ASN. ASN decided to submit the ATPu decommissioning operations to several prescriptions (two resolutions released in October 2010) and will remain vigilant with regard to safety-criticality aspects. The decommissioning work on these two installations continued in 2012 and 2013.

#### 6.3.4.7. CEA / SITE DE SACLAY

For the LHA laboratory, the final shutdown and decommissioning decree was signed on 18 September 2008. In 2013 the CEA sent its clean-out methodology applicable for all the cells (apart from three of them) to ASN for approval. ASN requested additional information.

CEA submitted the final shutdown and decommissioning application file for the ULYSSE reactor in 2009. During the examination of the request, CEA proposed a new organisation involving a substantial amount of subcontracting of BNI decommissioning and operational management operations. This proposal gave rise to numerous questions from the CLI and the public. In 2013 CEA communicated additional information on the effective implementation of the new organisation for the installation decommissioning operations. This information enables the examining of the final shutdown and decommissioning application to be continued.

#### 6.3.4.8. AREVA NC/LA HAGUE

The first application case for final shutdown and decommissioning concerns BNI-80, the High-activity Oxide Workshop (*Atelier, Haute activité oxydes* – HAO). The decree was published in 2009. It provides for four hold points to be approved by ASN prior to the continuation of operations.

The first of these hold points concerns the retrieval and packaging operations for the waste contained in the HAO silo and in the organised disposal of hulls (SOC) facility. Between July and December 2010, the licensee sent ASN a set of files relative to the safety of these operations, and those files underwent a technical examination. In a resolution of 13 March 2012, ASN partially lifted this hold point, by authorising the licensee to carry out preparatory operations prior to retrieval and packaging of waste from the HAO silo and the SOC facility. A second draft resolution concerning the authorisation for construction of the unit for retrieving and packaging the waste from the HAO silo and the SOC is under preparation and should be issued in the first half of 2014.

In October 2008, AREVA NC submitted three final shutdown and decommissioning applications for BNI 33 (UP 2-400), BNI 38 (STE2 and AT1 unit) and BNI 47 (ELAN IIB). After a drawn-out examination of the files, ASN produced a draft decree for each BNI and in September 2013 it submitted a report to the Minister in charge of nuclear safety. The decrees authorising AREVA NC to proceed with final shutdown and decommissioning operations on the three BNIs were published in November 2013. The licensee must however submit, before 30th June 2015, a complete decommissioning authorisation file for BNIs 33 and 38 containing all the elements mentioned in the *BNI procedures decree*.

In its opinions concerning BNIs 33 and 38, ASN underlines two points. First of all, the complete decommissioning authorisation application file to be submitted by the licensee must effectively contain sufficient elements to enable the public to be properly informed of the issues associated with all the waste retrieval and packaging operations, and with the decommissioning and clean-out operations, and this file must form the subject of a public inquiry in accordance with the provisions of Article L. 593-26 of the Environment Code. Furthermore, during the preparation for the decommissioning operations, the licensee must take full advantage of the knowledge of the history of the installation acquired by the operating personnel.

#### 6.3.4.9. SICN PLANT AT VEUREY-VOROIZE

As the decommissioning work has been completed, delicensing of the facilities can now be envisaged. The site nevertheless displays residual though limited 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 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. The delicensing of the two BNIs 65 and 90 will not be able to be declared within the framework provided by the *BNi procedures decree* until these institutional controls have effectively been put into place by the Prefect of the Isère département, following the examination procedure which includes a public inquiry.

#### 6.3.5. Experience feedback from the Fukushima nuclear 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.

This concerns the EDF BNIs undergoing decommissioning and CEA's ATPu, PHENIX, and RAPSODIE installations.

The Advisory Committees of experts which met to discuss the licensee's proposals made a number of recommendations. ASN will formalise its position on the Advisory Committees' recommendations and licensee's proposals in 2014.

### 6.4. State control for securing decommissioning funds for BNIs

State-control procedures for securing BNI- decommissioning funds are the same as those applicable to those for securing the funding of "long-term charges", such as those described in § F.6.4. In fact, *Environment Code* provides for a financial-securing mechanism covering the management of radioactive waste and spent fuel, as well as the decommissioning charges for BNIs.

### 6.5. ICPEs and mines

#### 6.5.1. ICPEs

Site-clean-out conditions after the final shutdown of ICPEs may be included in the licensing decree, In the case of facilities subject to a declaration, site-clean-out conditions after operation must be specified in the impact statement supplied with the declaration.

According to ICPE Regulations, any operator who intends to cease his activities must give the Prefect at least one month's notice of the end of operations. In the case of waste-storage facilities that are licensed for a limited term, notice must be given at least six months before the expiry date of the licence.

For facilities subject to a declaration, the notice must indicate the nature of site-clean-out steps been taken or planned. The site has to be returned in a state such that is compatible with any future industrial or commercial activity.

For licensed facilities, the operator must enclose with the notification an updated map of the facility's footprint and a memorandum on the site status, which must specify which steps have been taken or planned to ensure environmental protection.

The memorandum must also cover the following topics:

- the removal or disposal of all hazardous products; the elimination of fire and explosion hazards, as well as the removal of all waste present on the site;
- the decontamination of the facility site and of any polluted groundwater;
- the landscaping of the facility site into the surrounding environment, and
- if necessary, the monitoring of the facility's impact on the surrounding environment.

The operator must return the site to a condition such that there is no more hazard or inconvenience for the neighbourhood or the environment. If the rehabilitation work has not been included in the licence order or

requires clarification, the former operator and the mayor of the relevant commune must enter into negotiations in order to determine the future use of the site. Failing a favourable outcome of those negotiations, the Prefect is responsible for deciding about the fate of the site in relation to the last operating term, except if it is not compatible with valid urban-planning documents at the time when operations stopped. The ICPE Inspectorate may suggest to the Prefect to issue a complementary order setting the requirements for the rehabilitation of the site.

The Prefect must be kept informed about the clean-out work as prescribed by the licensing order or any complementary decree. The ICPE inspector confirms the conformity of the work in a follow-up report.

If the ownership of the land is transferred, the buyer must be informed not only that an ICPE subject to a licence has been operated on the land, but also of any residual-pollution issues on the site.

It should be noted that the Prefect can issue an order imposing on the prescriptions necessary for protection of the environment at any time, even after the site has been cleaned out.

### **6.5.2. Mines**

The end of a mining operation is marked by a dual procedure: the final cessation of work to be declared to the Prefect and a claim waiver to be validated by the Minister in charge of mines. The purpose of those procedures is to release the operator from the jurisdiction of the mine police, provided that he has met all his obligations.

If the formal acknowledgment of the declaration for final cessation of work, followed by a claim waiver, do not allow for the operator to be tracked back through the special mining police, the third-party liability of operators and claim holders still remains permanent. Since the *30 March 1999 Law*, with regard to the disappearance or default of any responsible party since the *1999 Law*, the State assumes the full role of guarantor for repairing damages and, henceforth, replaces the responsible party in any legal action taken by the victims. On completion of the work stoppage procedure, the licensee can transfer to the State the management of the hydraulic safety facilities (treatment plant for example) and the surveillance of mining risks. This transfer is accompanied by a cash payment corresponding to the maintenance of the facilities for a 10 year period.

In most cases, the formal acknowledgement of the declaration for the final cessation of mining activities involving radioactive substances requires the operator to monitor the overall former parameters prescribed for the operating lifetime. If monitoring detects no disturbances, complementary orders may lift any or all monitoring requirements. Since ICPEs represent the prevailing source of radioactive pollution, mine-police orders merely accompany related ICPE orders.



# SECTION G | SAFETY OF SPENT FUEL MANAGEMENT

## (ART. 4 TO 10)

### 1 | GENERAL SAFETY REQUIREMENTS (ARTICLE 4)

*Each Contracting Party shall take the appropriate measures to ensure that all stages of spent fuel management, individuals, society and the environment are adequately protected against radiological hazards.*

*In so doing, each Contracting Party shall take the appropriate measures:*

- i) to ensure that criticality and removal of residual heat generated during spent fuel management are adequately assessed;*
- ii) to ensure that the generation of radioactive waste associated with spent fuel management is kept to the minimum practicable, consistent with the type of fuel cycle policy adopted;*
- iii) to take into account interdependencies among the different steps in spent fuel management*
- iv) to provide for effective protection of individuals, society and the environment, by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which as due regard to internationally endorsed criteria and standards;*
- v) to take into account the biological, chemical and other hazards that may be associated with spent fuel management;*
- vi) to strive to avoid actions that impose reasonable predictable impacts on future generations greater than those permitted for the current generation, and*
- vii) to aim to avoid imposing undue burdens on future generations.*

#### 1.1. Regulatory framework and ASN control

In France, any spent-fuel management facility constitutes a BNI or part of a BNI. In that respect, the fuel-management facilities are subject to general safety provisions, as described in § E.2.2.

The Environment Code stipulates that the creation of an installation requires authorisation (Article L. 593-7 of the Environment Code). On this occasion, the documents produced by the licensee must include a safety report comprising the “inventory of risks of all origins presented by the planned installation and the analysis of the steps taken to prevent these risks, plus a description of the measures such as to limit the probability of accidents and mitigate their effects” (*BNI Procedures Decree*). The law also requires that the licensee of a BNI periodically conduct a safety review of its facility, taking account of international best practices. The criticality, residual heat removal, chemical risks, biological risks and limitation of waste production, in addition to the risks related to radioactivity, must be taken into account (in particular see the BNI Order).

The principle of French legislation is to avoid placing an excessive burden on future generations. Article L.542-1 of the Environment Code in particular makes this an essential objective (see § H.1.1 below). A Programme Act, supplemented by a national plan revised every three years, thus sets objectives with deadlines and indicates the procedures to be followed (more specifically for deep geological disposal, for which the law has set a commissioning target of 2025). The Environment Code also defines requirements concerning the evaluation of long-term costs, the provisions to be taken into account by the licensees and their coverage by dedicated assets (see § B.1.7.1 and § F.2.3.2). These requirements concerning the financing of long-term costs apply to the management of radioactive waste and of fuels and to the decommissioning of all the facilities. ASN also recommended immediate dismantling, which also complies with the principle of limiting the burden placed on future generations.

One important aspect of fuel cycle safety is the required consistency between changes to the envisaged NPP fuel management and the characteristics and possible changes to the cycle facilities (back end and front end of the cycle and management of radioactive waste). This consistency must be checked, taking

account of the texts applicable to the fuel cycle facilities and to the transport of radioactive and fissile materials, more specifically: the facility creation authorisation decrees, the liquid and gaseous effluent discharge and water intake license orders and the associated ASN resolutions, the technical prescriptions and the regulations on the transport of radioactive materials.

As the overall prime contractor, EDF must be familiar with the technical and administrative constraints of the fuel cycle in order to be ready to deal with interdependencies among the various steps: processing of the materials to be used, fuel fabrication, loading into the reactor, transport of materials, disposal of spent fuel, delivery and storage, processing (if applicable), effluent discharges and waste management.

Each new management of the fuel assemblies loaded into the reactors must be authorised by ASN. ASN may then issue prescriptions with which EDF must comply.

With regard to monitoring of the facilities, ASN's actions notably comprise:

- checking the main steps in the life of the fuel cycle nuclear facilities, involving:
  - examining the authorisation or modification applications for existing facilities,
  - reviewing the safety files,
  - checking the conditions for final shutdown of the facilities,
  - examining the safety measures taken by the head office departments;
- checking the organisation of the licensees. More specifically by means of inspections, this involves checking the organisation and the means deployed by the licensee in order to assume its responsibilities (without however imposing any particular type of organisation). The goal is also to verify that social, organisational and human factors are also taken into consideration;
- checking that operating experience feedback is taken into account;
- checking that the overall consistency of the fuel cycle mentioned above is correctly established.

Operators assume responsibility for selecting sites, technologies and processes. The role of ASN is to check whether those choices lead to an acceptable safety level that is consistent with regulations and the objective to reduce hazards. The operator must demonstrate that those choices are acceptable in terms of safety and that no other option would be safer. Among other things, the operator must demonstrate that he is actually minimising his production of effluents and waste.

## 1.2. Safety policies of BNl operators

### 1.2.1. CEA's and ILL's safety policy

The CEA's safety policy is to prevent the risk of dissemination of radioactive materials and to limit occupational exposures to ionising radiation. It consists in preventing the dispersal of radioactive materials and in minimising occupational radiation exposures. In order to achieve that goal, successive lines of defence, such as actual physical barriers (equipment, containments, etc.) and organisational resources (control resources, procedures, etc.) are used to isolate radioactive substances from staff and the environment.

Nuclear safety is one of the CEA's top priorities. The implementation of this priority must guarantee that the corresponding appropriate decisions and steps are taken. This attitude is what constitutes the "safety culture". The CEA's nuclear-safety structure relies on an unbroken line of accountability.

The Chairman is responsible for taking any measures required to implement any legislative, regulatory and specific provisions and requirements applicable to all activities involving a nuclear risk, and for organising nuclear safety at the CEA.

He is assisted by the Director of the Nuclear Safety and Protection Division and relies on the other functional directors, who are in charge of preparing corporate decisions and on the Nuclear Safety Strategy Committee, the body responsible for preparing corporate decisions relating to objectives, strategic development and operations in the area of nuclear safety.

Under the Chairman's authority, the CEA's skills and responsibilities with regard to nuclear safety are divided between line managers, support resources and inspections.

Line managers are supported by a network of experts in the different areas of safety, logistic support and methodological and operational support available on every CEA site.

By delegation, facility managers are responsible for nuclear safety regarding the activities, facilities and materials placed under their jurisdiction.

With reference to current nuclear-safety objectives, the Level-2 inspection function consists in checking the efficiency, appropriateness and internal control of the structure, resources and actions implemented by line managers. The inspection function is performed by other entities than those involved in line management and operates at the level of the CEA's Directorate-General and of each site directorate.

The CEA has developed an internal-authorisation system based on the submission of a licence-application case (*dossier de demande d'autorisation*) by the relevant line manager to the site director of the facility involved. In turn, the site director requests approval from the inspection section of his site and, if necessary, from a safety Committee he convenes and which consists of permanent members and experts appointed by the Chairman regarding the specific needs of the operation involved.

### 1.2.2. AREVA's safety policy

The integration of nuclear safety is also a priority for AREVA. It is involved in formal commitments in nuclear safety and radiation protection in a *Nuclear Safety Charter*, as mentioned in § F.3.2.3, seeking at ensuring a high level of safety during all lifetime phases.

The primary responsibility of the operator is clearly mentioned in that charter: the director of every establishment is liable for safety and radiation protection on his own premises. The levels for responsibility delegation are set within every entity in connection with the operational line of management and within the limits of the attributed skills. The organisation in place is able to meet legal and regulatory requirements, notably in the fields of nuclear safety, radiation protection and transport security.

Internal controls, over and above the “zero level” technical control, are carried out by independent staff members from the operating teams, as follows:

- Level-1 controls are performed on behalf of the director of the entity and consist mostly in verifying that the safety reference system and the delegation system are applied correctly, and
- Level-2 controls are performed by the team of safety inspectors duly designated by the *Directoire*.

The defence-in-depth concept is the basic principle for the safety of nuclear facilities. It is characterised by the implementation of a large number of protection levels, based on preliminary risk analyses. Those levels rely on technical specificities, a structure, procedures, operating modes and relevant skills. Any industrial project, evolution in operations or change in an existing facility must be the subject of a preliminary analysis as associated risks.

The lessons to be learnt from experience feedback are developed at different levels and their dissemination for the benefit of all entities within the group is the responsibility of the specialist network of the General Inspectorate (*Inspection générale*).

Any person working in those facilities, whether a paid employee or one of its subcontractors, must be informed of the risks associated with his/her workstation and of the measures being taken with regard to risk prevention and control. Any such person has an alert duty, if he/she notes any characterised malfunction or a violation of any legal obligation. He/she benefits from the same forms of protection, irrespective of his/her statute. He/she must be trained and order to intervene in the implementation of actions involving risk prevention and safety improvements.

The protection of workers against ionising radiation is a clearly-stated priority, not only for the paid employees of the group, but also for external interveners. AREVA's objective is to bring down to a maximum of 20 mSv/a all individual doses received by exposed collaborators in its facilities, or conducting service activities at their customers, irrespective of the country involved.

Nuclear events are assessed in accordance with the INES scale and are made public in France, as soon as their level on the scale is equal or higher than Level 1.

The management of emergency situations is organised in order to ensure the largest reactivity and the best efficiency as close as possible to the theatre of operations. Regular exercises are organised to train the intervention teams and to draw lessons in terms of organisation, skill improvement, communications and stakeholder implications in order to achieve the best control level over altered situations or exceptional events.

AREVA seeks to provide reliable and relevant information in order for any person to appreciate objectively the state of safety in AREVA facilities. In accordance with the provisions of the *Environment Code*, sites must establish and distribute every year a report on nuclear safety. That report must be submitted to the Committee for Hygiene, Security and Working Conditions (*Comité d'hygiène, de sécurité et des conditions de travail* – CHSCT) of the facility before publication. Furthermore, in accordance with the provisions of the *Nuclear Safety Charter*, the General Inspectorate must prepare the annual report on the state of safety of the group's facilities, which is presented to the Executive Committee (*Direction générale – EXCOM*) and to the Monitoring Council (*Conseil de surveillance*) of the Group, and make it public.

The soundness of the principles defined by AREVA's *Nuclear Safety Charter* and the efficiency of the actions to which they led remain fully adapted and were rarely questioned with regard to experience feedback over the last six years and to stakeholders' expectations. A new edition of the *Charter* including notably the organisational changes that occurred within the Group in the meantime is in preparation.

### 1.2.3. EDF's Safety Policy

The responsibility of nuclear operator within the EDF Group is divided into four main levels: the Chairman (*Président*); the Senior Executive Vice-President for Production and Engineering (*Directeur général adjoint de la Division Production Ingénierie* – DPI), the Director of the Nuclear Power Generation Division (*Directeur de la Division de la production nucléaire* – DPN), who is responsible for the operation of the entire French NPP fleet, and individual NPP managers. In the particular case of a BNI being dismantled and located on an isolated site, the function of EDF SA representative is endorsed by the Director of the Nuclear Engineering Division, under the authority of the Deputy Director for Production and Engineering...

The primacy given to safety within EDF is based on a corporate policy that places safety and radiation protection at the very core of the company's concerns and priorities (the latest version of the policy was published in 2000), and on an operational safety management system and a quality management system.

The guiding principles of the safety-management system ensure that particular attention is paid to:

- the strict compliance with safety and radiation-protection requirements and corresponding prescriptions;
- clearly-defined nuclear-safety responsibilities;
- the availability of adapted skills and the integration of human performance in design and operation, and
- the responsibility and commitment of all parties involved, based on the recognition that human competence is one of the key contributor in the safety chain and a prime vector in achieving progress;
- over and above the prescriptions, implementing the company's desire for progress and performance in the field of safety; and
- developing various oversight and verification systems able to measure the effectiveness of the safety management system and correct any deviations or drift and enabling in-depth progress in operating quality to be achieved.

EDF aims to be exemplary regarding transparency and nuclear safety, in order to be able to improve the economic output of the industrial tool while improving jointly safety, radiological protection and the environment.

### 1.2.4. ILL's Safety Policy

As far as the ILL is concerned, the smooth running of activities consists in preventing the dispersal of radioactive materials and in limiting occupational radiation exposures.

The Institute carries out risk analysis to develop adequate steps to prevent or limit the consequences of hypothetical accidents; it also monitors the quality of the implemented steps.

The nuclear-safety structure at the ILL is based on accountability, inspections and simple decision-making processes. The ILL also relies on outside competences and expertise in that area. All employees in charge of safety and radiation protection report directly to management, and inspections are carried out by the Co-ordination and Quality Assurance Office (*Bureau de coordination et d'assurance de la qualité – BCAQ*).

More particularly, insofar as spent-fuel management is concerned, fuel elements may be shipped to La Hague. The stress tests conducted in 2011 demonstrated the robustness of the RHF to external hazards and there are still two lines of defence (prevention and mitigation) to avoid these hazards and limit their consequences. Thanks to the steps provided for further to these stress tests, all the accident scenarios including these external hazards, regardless of the operating situation, are contained within the 500m radius safety perimeter. The implementation of these provisions is well advanced, with the new emergency control post being available as of July 2014. The programme of works runs until 2016.

### 1.3. ASN Analysis

As mentioned above, ASN checks the overall consistency of the industrial choices made for fuel management in terms of safety and the regulatory framework.

In response to a request from ASN, EDF sent a file entitled “Impact Cycle 2007” in late 2008. This file updates that of 2000 with a view to ensuring the overall consistency of the fuel cycle in the future years in order to take into account the evolutions induced by the use of new fuel types in fuel-cycle facilities, as well as the waste quantity and quality to be generated. The report was examined on 30 June 2010 by the GPEs for the laboratories, plants and waste.

In its letter of 5 May 2011, ASN sent EDF several requests, more specifically:

- carry out a true sensitivity analysis concerning the level of electricity production of nuclear origin;
- evaluate margins in terms of underwater spent fuel storage capacity for the 2020 time-frame;
- more clearly define the changes to its strategy in terms of fuel management, notably after the almost total abandonment of the “high burn up fraction” fuel management systems.

During the course of the years 2012 and 2013, EDF responded to the majority of these requests and sent the first update notice concerning the fuel cycle and its developments, a notice which should be updated every two years.

ASN thus reinforced its oversight of the fuel cycle and its developments by asking EDF for two-yearly update notices, by reviewing them and by submitting additional requests on certain points, pending a general revision of the cycle file in 2016. ASN thus focuses in particular on monitoring the degree of occupancy of the underwater storage capacity for spent fuels (AREVA and EDF) and the foreseeable time of saturation, which is one of the key points of the cycle.

ASN's oversight with regard to the periodic safety reviews is dealt with in § G.2.3 below.

The steps taken further to the stress tests carried out following the accident at Fukushima Daiichi are dealt with in § A.3. It should be remembered that the stress tests look at extreme situations and thus supplement the permanent safety approach.

In § G.2.2.3.1 and G.2.2.3.2 below, EDF describes in detail the steps to be taken.

ASN also runs field checks on implementation of the post-Fukushima improvements.

ASN has initiated the process to review safety management within the AREVA group for the BNIs it operates. The file sent by AREVA in early 2010 was reviewed by ASN and its technical support organisation and presented to the Advisory Committee concerned. On the basis of this review, ASN sent its conclusions to AREVA in September 2012. Since then, ASN has been monitoring the steps taken by the licensee. An inspection of the AREVA head office departments took place on 12 December 2013 on the topic of operating experience feedback. ASN was thus able to check the elements transmitted by AREVA, more specifically the deployment of its overall experience feedback process. ASN identified some areas for improvement, the implementation of which will need to be scheduled.

With regard to social, organisational and human factors (SOHF), the approach began to be centralised within the AREVA group as of 2008, when the Group's head office departments employed an SOHF

specialist. The above-mentioned review of safety management by AREVA also covered SOHF. On this occasion, AREVA made a number of commitments. Various measures and means were put into place in this field. ASN considers that the effectiveness of these measures must be assessed over a certain period in order to issue the resolutions which could prove necessary in the light of this assessment.

## 2 | EXISTING FACILITIES (ARTICLE 5)

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*Each Contracting Party shall take the appropriate steps to review the safety of any spent fuel management facility existing at the time the Convention enters into force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such facility.*

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### 2.1. Regulatory framework and ASN requirements of BNIs

In order to take into account facility ageing and changes in safety expectations, the law requires every operator not only to analyse experience feedback on a continuous basis, but also to re-examine periodically the safety aspects of his BNIs every 10 years (see § E.2.2.3.1.4).

The purpose of such provision is to ensure the constant improvement of safety in facilities and leads often to changes in the facility or in the scope of its operation. For instance, issues relating to behaviour in case of earthquake often lead to recognise the need for reinforcing facilities, the feasibility assessment of which may encourage the operator to shut it down over the more or less short term.

Such is the case of the Plutonium Technological Workshop (Atelier de technologie du plutonium – ATPu) at Cadarache or of the workshops of the La Hague UP2-400 Plant.

In order to compensate for those shutdowns or to enable themselves to carve out a position on new markets, several operators have applied to modify their licences especially in order to increase their production capacity (MÉLOX, FBFC) or to distribute it differently among their production units (UP2 and UP3 Plants at La Hague).

### 2.2. Safety review of facilities by BNI operators

#### 2.2.1. CEA's and ILL's safety review

The structure implemented at the CEA for safety-reassessment purposes takes the form of a project. Given the stakes involved and the resources needed to perform them, all safety reassessments, whether scheduled or under consideration, are covered in a multi-year plan, which, in theory and for each facility, should be performed every 10 years (although it may extend to 15 years). It should also include any major planned changes and, where appropriate, the provisional date for the end of the facility's lifetime.

The primary objective of the periodic safety review is to assess the safety of the facility and identify any deviations from the baseline safety requirements in force and from the current safety and radiation protection regulations and practices.

Before reassessment, the CEA must specify its strategy for each of its facilities with regard to the nature and sustainability of the future operating functions and missions of the facility.

The second objective is to take adequate compensatory steps in order:

- to bring the facility up to the highest safety level reasonably possible, in view of the remaining timescale of its operating life, and depending on the estimated cost of any safety-related changes;
- to reduce future occupational exposures during the operating phase in accordance with the ALARA principle, focusing as a priority on the most exposed workstations, and
- to reduce nuisances on the environment (discharges and waste) according to the ALARA principle, focusing especially on eliminating the production of waste for which there is no processing technology available, minimising discharges into the environment, encouraging internal recycling procedures and improving safety in integrated storage areas within the facility.

The CEA proposes a number of steps designed to upgrade safety in its facilities, by reinforcing certain lines of defence or adding others, as reflected in requirements regarding key safety factors (systems and equipment or operating rules).

Those steps are then submitted to a safety analysis. The conclusions of the reassessment are presented to ASN, which in turn provides its opinion, before any change is made and before any safety demonstration of the upgraded facility is conducted. The facility's safety reference system is then updated.

Hence, the safety reassessment may result in changes (structures, equipment, operating rules, etc.), exceptional maintenance and upgrading work, upkeep and clean-out activities, as well as the revision of operating documents.

### **2.2.2. AREVA's safety review**

The periodic safety reviews are a continuous and highly demanding process. The ten-yearly safety review is an important milestone in terms of the safety of the facilities and its benefits are widely recognised internationally. It participates in and explicitly determines the continuous measures taken to maintain and improve the level of safety in nuclear facilities.

Within the Group, this today requires permanent action, on the one hand owing to the annual number of facilities being reviewed or for which the file is under examination and, on the other, to the implementation of improvement measures resulting from the review.

This process has been regulated for several years in France and is based on two strong technical components: the conformity check and the safety reassessment.

Emphasis is first of all placed on the conformity check. The conformity check on a facility consists in ensuring that the regulatory changes and the changes to the facility and its operations, as a result of modifications (technical, process, production, organisation, etc.) or its ageing, do not compromise the design safety analyses and remain in conformity with the authorised operating range. This conformity check is based on the facility's baseline requirements, which are permanently kept up to date. These baseline requirements comprise texts at several levels: regulatory texts both general and specific to the facility, to discharges and to water intake, codes and standards, letters and correspondence with the Authorities (ASN prescriptions, Advisory Committee follow-up, licensee undertakings, etc.) directives, standards and requirements from the group, facility baseline requirements (safety report, general operating rules, on-site emergency plan, waste study, decommissioning plan, impact assessment, etc.).

A programme of physical verification of the facility, in addition to permanent measures in this field, is defined and implemented. The licensee gives priority to equipment and elements important for protection (EIP) which take part in controlling the BNI's safety functions. The licensee also demonstrates its management of facility ageing. It proposes adaptations to its maintenance or monitoring programmes and the implementation of compensatory measures, based on studies of ageing phenomena and the lessons it has learned from operating experience feedback.

A plan to check the conformity of operating practices with the documents of the applicable safety baseline requirements is also defined and implemented.

A plan to restore conformity is defined and implemented as applicable.

The safety reassessment is an opportunity to reanalyse the safety of the facility in the light of current safety and radiation protection regulations and practices (in particular, guides, standards and basic safety rules), incorporating all operating experience feedback from the facility (dosimetry, effluents, waste, anomalies and incidents, etc.) as well as from accidents which affected similar facilities in France or abroad. It leads to the identification of areas for improvement of the facilities or their operations.

### **2.2.3. EDF's safety review**

#### **2.2.3.1. EDF'S SAFETY REASSESSMENT PROCESS OF EXISTING FACILITIES**

EDF conducts regular safety reassessments per technical series. For reactors, the process includes a compliance check with their standard state, consistent with the safety requirements prescribed in the safety reference system; it is implemented in conjunction with the decennial inspections of nuclear systems for pressure vessels.

The process is divided into three phases:

- a description of the safety reference system, consisting of a set of rules, criteria and specifications applicable to a plant series;
- a compliance demonstration of the standard state of each unit series with the safety reference system, followed by a compliance check of all reactor units with the reference state, and
- an assessment of the topicality and thoroughness of the reference system for safety requirements, based on the examination of all major safety-related feedback, followed by the potential identification of any changes that need to be brought to the standard state of the plant series during the decennial inspection.

The process ensures the conformity of reactors with the reference system. It also highlights any safety aspect requiring further analysis, particularly on the basis of French or foreign experience feedback and changing knowledge. The analysis may lead to changes in the reference system, corresponding to a new reference status, together with an update of the safety analysis report.

During any safety review, EDF identifies all aspects requiring:

- additional analysis concerning the safety demonstration of the reference facility, and
- further specific checks to be conducted on units.

Corresponding checks are carried out during decennial inspections of the units in the various plant series.

Any new fact is examined and the most sensitive items are assessed in terms of their impact on the safety level within the plant series. Changes are made to the safety reference system according to their benefits and their industrial feasibility. If necessary, verification studies may be repeated.

Probabilistic safety studies may be involved, especially when searching for and analysing accident-warning signs, or when ranking main risk components and assessing the safety level.

Following each ten-yearly outage inspection and periodic safety review, the baseline safety requirements for each plant series changes by incorporating the improvements made. Following this work on each unit, a report is sent to ASN so that it can rule on the conditions for continued operation for a further period of 10 years. At present, following the third ten-yearly outage inspections and the periodic safety review of the 900 MW plant series, ASN issued a favourable opinion for continued operation for a further ten years, in certain conditions, concerning the units of the 900 MW plant series at Tricastin 1, Fessenheim 1, Bugey 2 and Fessenheim 2.

### Changes following implementation of the post-Fukushima measures

Following the nuclear accident in the Fukushima nuclear power plant (see § A.3), a stress tests procedure was initiated. In September 2011, EDF presented ASN with the stress test reports for the units in extreme situations, for each site. This approach (i) consolidated the existing margins of the NPP units with regard to external hazards included in the current baseline requirements and (ii) defined a first batch of proposed modifications to be implemented in the short and medium term, designed to deal with extreme situations.

In June 2012, ASN issued a range of prescriptions concerning additional requirements designed to deal with extreme risks and prevent accidents and, should an accident occur, to mitigate the effects and avoid off-site, long-term contamination.

For EDF's nuclear reactors, these new requirements correspond to major works and investments, which began in 2012 and will be spread over several years:

- the deployment of a “hardened safety core” of material and organisational measures such as to control the fundamental safety functions in extreme situations. Its goal is to prevent a severe accident or limit its progression, to limit large-scale radioactive releases and enable the licensee, even in extreme situations, to carry out its emergency management duties. The equipment to be part of this hardened safety core shall be designed to withstand major events (earthquake, flooding, etc.) on a scale greater than that considered when determining the strength of the facilities. This “hardened safety core” will include an additional “bunkerised” ultimate back-up diesel generator set for each reactor, a diversified emergency water supply system, and an emergency management centre able to withstand a large-scale event;

- as of 2012, gradual deployment of the “Nuclear Rapid Intervention Force” (FARN), a national EDF internal response force comprising specialised teams and equipment, able to take over from the crews on a site affected by an accident and deploy additional emergency response means within less than 24 hours, with operations beginning on the site within 12 hours following mobilisation. This system could be common to several nuclear sites. The system has been partially operational (for intervention on one reactor of any one of the sites) since late 2012 and will be fully operational in late 2015 (Gravelines – for 6 units);
- new baseline requirements for the on-site emergency plan (PUI) were deployed on all the sites as of 15 November 2012; it takes account of accident situations simultaneously affecting several facilities on the same site;
- for the reactor spent fuel pits, the implementation of reinforced measures to reduce the risk of uncovering of the fuel, including an emergency make-up system which should be in place as of 2015, jointly with installation of an ultimate back-up diesel generator set on the units.

#### 2.2.3.2. APPLICATION TO THE SAFETY OF ON-SITE SPENT-FUEL COOLING PONDS AND TO SPENT-FUEL STORAGE AND DISPOSAL OPERATIONS

The safety review encompasses the safety the fuel building and spent-fuel cooling pond (seismic resistance, cooling capacity and limitations, monitoring, incidental operating procedures).

Among the thematic reassessments, a special mention should be made of EDF's committed technical review on the control of criticality risks, which led to consider that such risks were well under control in general during the spent fuel storage and disposal phases. Hence, the results of the completed studies complete the criticality reference system of the safety report.

Of the main changes made following integration of the VD3 900MWe safety baseline requirements, one could mention inclusion of the risks of rapid emptying of the spent fuel pits. The modifications to be implemented are designed to increase the time available to the operator to return the fuel assemblies being handled to a safe position: automatic shutdown of the pit pumps when the very low level is reached and measurement of the emptying rate.

Finally, as mentioned above, the design and the strength of spent fuel pits in the NPPs were examined during the stress tests performed following the accident to the Fukushima Daiichi NPP (see above).

In particular, in response to the ASN prescription concerning the provisions designed to reinforce prevention of the risk of accidental emptying of the fuel building pool, EDF presented the changes to be made to its facilities:

- re-sizing of the siphon-breaker on the cooling system discharge line in order to prevent complete and rapid emptying of the pool by siphoning in the event of a connected line rupture;
- automation of isolation of the cooling system intake line, thus avoiding gravity emptying of the pool by the suction line;
- feasibility studies to deal with the case of a break on the transfer tube.
- prevention of the risk of rapid loss of water inventory in the storage compartment in the event of hypothetical transfer tube or drain line leak situations in the transfer compartment or the BR pool compartments;
- robustness of the pool instrumentation to ensure management of the situation and in particular management of water make-up;
- ultimate emergency make-up system which should be installed as of 2015, jointly with installation of an ultimate back-up diesel generator set on the units (see above).

#### 2.2.3.3. TRANSPORT SAFETY

Following the compliance problems encountered in the past with regard to the compliance with spent-fuel transportation cleanliness limits, EDF conducted a project review, which led to a number of quality-assurance recommendations and steps concerning the enforcement of transport regulations.

EDF has taken into account the experience feedback concerning the cleanliness limits for the shipment of radioactive materials and waste, as well as of spent fuel, by abiding to a set of good-practice rules completing official regulations and constituting the “Shipment Reference Framework” (*Référentiel transport*), as follows:

- the responsibility of conveyers, particularly for the quality of checks and shipment documents;
- the qualification of the conveyors hired by EDF;
- the declaration, analysis and experience feedback from shipment incidents in case of deviations;
- the creation of local and national shipment-security advisers, in accordance with regulations, and
- the requirement for an emergency plan for conveyers.

#### 2.2.4. Safety review by the ILL

For the safety review scheduled in 2017, the ILL must specify its strategy for the definition and long-term continuity of the future functions and operational missions of the facility.

The ILL takes appropriate measures to:

- bring the facility to a level that is as safe as reasonably achievable;
- reduce subsequent exposure of the operating personnel to a level that is as low as reasonably achievable, and
- reduce environmental harm (discharges and waste) to a level that is as low as reasonably achievable.

The ILL takes measures to reinforce the lines of defence (prevention, mitigation) or add extra lines, taking the form of requirements concerning elements important for protection.

These provisions are then the subject of a safety analysis. The conclusions of the review are presented to ASN, which issues a position statement, before the modifications are made and the modified facility's safety demonstration is carried out. The facility's baseline safety requirements are then updated.

Thanks to the regular investments made on the RHF, the periodic safety review should lead to a very limited number of modifications (structures, equipment, operating rules, etc.) and limited maintenance and upgrade work.

#### 2.3. ASN analysis

Pursuant to the law, the licensees of the AREVA group implemented the periodic safety review approach for their facilities, which should all have been reviewed by 2 November 2017. The safety review file for the UP3 plant at La Hague has been transmitted to ASN. ASN will analyse and evaluate the pertinence and quality of this review by the licensee, from both a methodology viewpoint and in terms of results. Of the five Advisory Committee meetings scheduled to prepare for the ASN position statement, three meetings have already been held:

- The first, in June 2012, examined the method and the data used by AREVA to perform this review and the approach used to identify the elements important for safety and its application to the UP3 plant;
- The second, in June 2013, examined operating experience feedback, notably with regard to the incidents that affected UP3;
- The third, on 14 January 2014, was devoted to safety measures applicable to on-site transport packaging.

The next meetings of the Advisory Committee will focus on a decision concerning the current safety level of UP3 and its continued operation, by examining the following in turn:

- The conformity of the elements important for the protection of the units making up the UP3 plant with the defined safety requirements, more specifically with respect to any changes they have undergone and their ageing;
- The safety reassessment by the licensee, more specifically in relation to changes to the regulations, best practices, experience feedback from operation of the facility and the action programme established by the licensee to improve the safety of its facility.

Following these meetings, which will be spread over the year 2014, ASN will issue its opinion in 2015, in a resolution which will also present technical prescriptions, as well as a report to the Minister responsible for nuclear safety.

Safety management within the AREVA group is dealt with in § G.1.3 above.

With regard to CEA, the review of its spent fuel management strategy was carried out and the Advisory Committee of Experts issued its opinion in February 2012. This review also concerned the CEA strategy for the management of CEA radioactive waste and disused sealed sources (see § H.1.3). The spent fuels management strategy adopted by CEA was considered to be on the whole satisfactory. A few points will however need to be improved.

ASN's position concerning the stress tests following the Fukushima Daiichi accident is given in Chapter A.3 above.

### 3 | SITING PROJECTS (ARTICLE 6)

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*1. Each Contracting Party shall take the appropriate steps to ensure that procedures are established and implemented for a proposed spent fuel management facility:*

- i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime;*
- ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment;*
- iii) to make information on the safety of such a facility available to members of the public;*
- iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request, with general data relating to the facility to enable them to evaluate the likely safety impact upon their territory.*

*2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 4.*

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All facilities involved in spent-fuel management are BNIs or part of BNI.

Hence, any new facility is subject to the general BNI regulations, which, with regard to siting, are detailed in § E.2.2.2.

There is currently no siting project for any spent-fuel management facility in France.

### 4 | FACILITY DESIGN AND CONSTRUCTION (ARTICLE 7)

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*Each Contracting Party shall take the appropriate steps to ensure that:*

- i. the design and construction of a spent fuel management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;*
  - ii. at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a spent fuel management facility are taken into account;*
  - iii. the technologies incorporated in the design and construction of a spent fuel management facility are supported by experience, testing or analysis.*
- 

The BNI general regulations apply to spent fuel management facilities. They are described in Chapters E.2 and F.4 (see § E.2.2.3 for the procedures, § E.2.2.5 for the technical rules and § F.4.1.4 for discharges).

The technologies used for design and construction are based on experience, tests or analyses, in accordance with the legislation and the regulations.

The steps taken by the licensees in terms of safety are presented in § G.2.2.

ASN ensures implementation of the regulations through the analyses and inspections it conducts in accordance with procedures presented in § E.2.2.6 and § E.2.2.7. ASN actions concerning the periodic safety reviews performed by AREVA and CEA are presented in § G.2.3.

Finally, with regard to the technical provisions for delicensing of a BNI, the *BNI Procedures Decree* stipulates that the creation authorisation application for a BNI must include a decommissioning plan for the planned facility (see § F.6.1.3.1).

## 5 | SAFETY ASSESSMENT OF FACILITIES (ARTICLE 8)

*Each Contracting Party shall take the appropriate steps to ensure that:*

- i. before construction of a spent fuel management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;*
- ii. before the operation of a spent fuel management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph i).*

The BNI general regulations apply to spent fuel management facilities. They are described in Chapter E.2. The licensee must in particular submit a file to support its BNI creation authorisation application, notably comprising a preliminary safety report, an impact assessment and a risk management study.

After construction and testing, the licensee shall, to support its facility commissioning application, provide a file comprising in particular the updated preliminary safety report, the general operating rules and a revised decommissioning plan. After checking that the licensee meets the specified objectives and rules, ASN authorises commissioning of the facility. It may make this authorisation conditional on the licensee taking account of a certain number of comments.

Any operating authorisation given to a facility includes a limit date for final commissioning, which must take place after a few years of operation and after evaluation of the safety report and the general operating rules. ASN's resolution authorising commissioning sets the time by which the licensee must present ASN with a start-up completion file for the facility. This file must contain a summary report on the facility's start-up tests, a summary of the operating experience acquired and updates of the documents transmitted for the commissioning application. If a BNI is not commissioned within the time set by the decree authorising its creation, a decree issued on the advice of ASN may revoke the facility's authorisation.

If a BNI ceases to operate for a continuous period of more than two years, the Minister responsible for nuclear safety may, in an order issued on the advice of ASN, prohibit the resumption of operation of the facility and ask the licensee, within a time set by the Minister, to submit a final shutdown and decommissioning authorisation application for the facility.

All measures to be taken by operators are described in § G.2.2, which deals with existing facilities.

ASN must ensure the actual implementation of those regulations through the analyses and inspections it carries out according to the modalities described in § E.2.2.6 and E.2.2.7.

## 6 | OPERATION OF FACILITIES (ARTICLE 9)

*Each Contracting Party shall take the appropriate steps to ensure that:*

- i. the licence to operate a spent fuel management facility is based upon appropriate assessments as specified in Article 8 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;*
- ii. operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 8, are defined and revised as necessary;*
- iii. operation, maintenance, monitoring, inspection and testing of a spent fuel management facility are conducted in accordance with established procedures;*
- iv. engineering and technical support in all safety-related fields are available throughout the operating lifetime of a spent fuel management facility;*
- v. incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;*
- vi. programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;*
- vii. decommissioning plans for spent fuel management facility are prepared and updated, as necessary, using information obtained during the operating lifetime of the facility, and are renewed by the regulatory body.*

### 6.1. Licensing process

The general BNI regulations, which include spent-fuel management facilities, are described in § E.2.2.4 and E.2.2.5, with regard to the operating licence.

## 6.2. BNI operators' practices

### 6.2.1. CEA's operational safety practices

Licences are issued to the CEA in accordance with the procedures described in § E.2. Operational safety is ensured in accordance with general and specific regulations; it also includes regular reassessment, as described in § G.2.2.1.

The quality and sustainability of technological and engineering support means are ensured by the quality-assurance initiatives described in § F.3.2.2 and by human and physical resources described in § F.2.2.2. Insofar as decommissioning is concerned, practices are described in § F.6.

The safety reference systems for CEA facilities are drawn up within the framework of the commissioning-licence application and updated either in the event of any change or during safety reassessments. They consist of a safety report, general operating rules, also drawn up by the licensee, and technical prescriptions imposed by ASN. Those reference systems determine the operational uses licensed by ASN.

The documents constituting the safety reference systems are completed by a set of procedures and operating methods drawn up by the operators with a view to ensuring that all operating procedures performed at the facility are consistent with the safety reference systems and their scope.

Any incident occurring at a CEA facility must be notified to ASN in real time. All incidents are analysed to identify the root causes and to define any corrective and preventive action to be taken to avoid any recurrence. An incident report must be prepared and sent to ASN within two months.

In 1999, the CEA has set up a Central Experience Database (*Fichier central de l'expérience*), which provides all parties concerned with information on incidents, together with an incident analysis guide, designed to harmonise the drafting of incident reports, to improve their evaluation and to codify results.

By drawing on those incident reports, the CEA is able to gather invaluable lessons for improving safety at its facilities, identifying generic safety-related weaknesses, defining targeted improvement areas and ensuring the broadest possible dissemination of such information.

### 6.2.2. AREVA's operational safety practices

Operations comply with the facility's baseline requirements described in § G.2.2.2. During the periodic safety reviews, a plan to check the conformity of operating practices is drawn up and implemented. It takes account of the permanent or temporary operating instructions, the main operating procedures, the main maintenance procedures and the degraded operating instructions. Particular attention is given to ergonomics and to the availability of documentation at the workstations as well as consideration of changes to the operating rules and the organisation. The licensee's processes concerning deviation management, change management and documentary modifications and management, which take part in keeping the baseline requirements up to date, are described and analysed. Their effectiveness is also justified.

Outside these review periods, support for the operators and a regular check on the application of or familiarity with any new procedure by the management and/or head of the facility are essential in order to manage particular workplace situations. This support is also important on decommissioning worksites, in which the environment and working conditions are constantly changing, as equipment dismantling progresses. Risk management is frequently based partly on operating rules, which must minimise the potential risk of human error. It is then important that the understanding and justification of the operating constraints be perceived to be commensurate with the issues and stakes by those responsible for implementing them. Training, competence assessment and information measures are taken at all hierarchical levels.

### 6.2.3. EDF's operational safety practices

Licences are issued to EDF in accordance with the procedures described in section E.2. Operation is conducted in accordance with general and specific regulations, as described in § G.2.2.2. The quality and sustainability of technological and engineering support means are guaranteed by the quality dispositions

described in § F.3.2.4 and by the human and physical resources described in § F.2.2.4. With regard to decommissioning, practices are described in § F.6.

#### 6.2.4. ILL operational safety practices

The RHF safety baseline requirements are defined in the commissioning authorisation application and updated in the event of modifications or during the periodic safety reviews. These baseline requirements define the operating range authorised by ASN.

These baseline safety requirements are supplemented by a range of procedures and operating methods drafted by the licensees, generally by the operators; their purpose is to allow performance of operations in the field consistently with the baseline safety requirements and their operating range.

ASN is notified in real time of any incidents which have occurred. These incidents are then analysed in order to identify their underlying causes and define the corrective and preventive measures to be taken to prevent them from happening again. The incident report is produced and transmitted to ASN within 2 months.

Based on an analysis of the incident reports, ILL learns the lessons of use for improving the safety of its facilities, identifies generic safety weaknesses, defines targeted areas for progress and ensures the broadest possible dissemination.

#### 6.3. ASN analysis

Through its analytical, inspection and penalty systems, ASN ensures on a permanent basis that operators comply with the general BNI regulations, which include all spent-fuel management facilities and are described in § E.2.2.4 and E.2.2.5 with regard to their operation.

## 7 | FINAL DISPOSAL OF SPENT FUEL (ARTICLE 10)

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*If, pursuant to its own legislative and regulatory framework, a Contracting Party has designated spent fuel for disposal, the disposal of such spent fuel shall be in accordance with the obligations of Chapter 3 relating to the disposal of radioactive waste.*

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In France, spent fuel is designated for final disposal, except in rare cases, spent fuel from experimental reactors.

In accordance with the provisions of the Environment Code, EDF's approach is to process the entire spent-fuel inventory generated by existing nuclear reactors. The idea is also to process only the quantity of spent fuel corresponding to the amount of recyclable plutonium on line (except for technical details) in reactors licensed to receive MOX fuel. Consequently, there is a difference between the quantity of spent fuel, which has been removed in the past, from reactors and the quantity of processed spent fuel, with due account of the current plutonium-recycling capabilities.

Only UOX fuels are currently processed, with spent URE and MOX fuels stored pending deployment of a fleet of generation IV fast neutron reactors.

The *decree of 27 December 2013* requires that Andra update its assessment of the feasibility of direct disposal of spent fuels, which it presented in 2005, taking account of changes in knowledge and designs since then. This study must concern all spent fuels. In late 2012, Andra submitted an interim report on the study into direct disposal of fuels from PWR and FNR reactors.

The feasibility of the disposal of spent fuels is covered with a view to the long term. The operation of Cigéo is scheduled to last for more than a century. This long duration entails the gradual development of disposal structures, in successive tranches. Cigéo is designed to be flexible so that it can adapt to any changes in energy policy and its consequences on the nature and volume of waste that would then be produced. Given the volume of existing waste to be disposed of, the impact of a change in energy policy would only have consequences on Cigéo operations by the 2070 time-frame.

# SECTION H | SAFETY OF RADIOACTIVE WASTE MANAGEMENT (ART. 11 TO 17)

## 1 | GENERAL SAFETY REQUIREMENTS (ARTICLE 11)

*Each Contracting Party shall take the appropriate steps to ensure that at all stages of radioactive waste management individuals, society and the environment are adequately protected against radiological and other hazards.*

*In so doing, each Contracting Party shall take the appropriate steps to:*

- i. ensure that criticality and removal of residual heat generated during radioactive waste management are adequately addressed;*
- ii. ensure that the generation of radioactive waste is kept to the minimum practicable;*
- iii. take into account interdependencies among the different steps in radioactive waste management;*
- iv. provide for effective protection of individuals, society and the environment by applying at the national level suitable protective methods as approved by the regulatory body, in the framework of its national legislation which has due regard to internationally endorsed criteria and standards;*
- v. take into account the biological, chemical and other hazards that may be associated with radioactive waste management;*
- vi. strive to avoid actions that impose reasonably predictable impacts on future generations greater than those permitted for the current practices;*
- vii. aim to avoid imposing undue burdens on future generations.*

### 1.1. ASN requirements

For basic nuclear installations (BNI) the Environment Code sets an objective of protecting public health and safety as well as nature and the environment. Within the context of this section H of the report, the BNIs concerned are processing or packaging, storage and disposal BNIs.

This same objective appears in the Waste Act, which states the principle that *“the sustainable management of radioactive materials and waste of all types (...) is ensured such as to protect the health of individuals, safety and the environment”* (see Article L. 542-1 of the Environment Code). It also stipulates that *“research and the implementation of means necessary for final safeguarding of radioactive waste are carried out in order to prevent or limit the burden to be borne by future generations”*.

These objectives and principles are contained in the various Acts and regulatory texts (see § E).

In particular Article L. 542-1-2 of the *Environment Code* orders that a national plan for radioactive materials and waste be drawn up, the objectives of which are recalled in § A.2.2.1 and B.1.3.1 above.

This same Article requires that *“the reduction in the quantity and harmfulness of radioactive waste is sought, more specifically through the processing of spent fuels and the processing and packaging of radioactive waste”*.

The *BNI Procedures Decree* and the *BNI Order* specify requirements in this field. Thus the *BNI Procedures Decree* orders that every BNI licensee produce a *“study of the management of waste from the facility, indicating the licensee’s objectives for limiting the volume and radiological, chemical and biological toxicity of the waste produced in its facilities and, through reuse and processing of the waste thus produced, reducing the need for final disposal reserved for ultimate waste”*.

In accordance with the *BNI Order*, the licensees must, when packaging their radioactive waste, ensure the compatibility of the waste packages produced with the conditions specified for their subsequent management. In this way, the licensees take account of the interdependency between the various steps in the management of radioactive waste.

With regard to existing or planned facilities, all risks must be considered, notably in safety reports and in studies concerning new projects. That includes criticality risks and the consequences of thermal releases if any. All risks pertaining to toxic chemicals must also be taken into account.

The requirements concerning integrated safety management and the safety demonstration are included in the *BNI Order*.

The obligations of the BNI or future BNI licensees are thus defined by Acts, decrees and ministerial orders, supplemented by ASN resolutions and prescriptions (see § E). In addition, basic safety rules and ASN guides (see § E.2.2.5.2) define safety objectives and describe the practices that ASN considers to be satisfactory for achieving them.

## 1.2. Steps taken by BNI operators

### 1.2.1. Steps taken by waste producers (CEA, AREVA, EDF and ILL)

Waste-management activities in BNIs must include the following major phases:

- “waste zoning” (see § B.5.2.1);
- collection;
- sorting;
- characterisation;
- treatment;
- storage, and
- shipment.

Collection and sorting constitute sensitive phases in waste-management activities in BNIs.

Waste is collected selectively, either directly during normal operations or by staff on worksites. As early as the collection phase, the physical management of radioactive waste must be clearly segregated from that of conventional waste.

The waste is generally sorted according to its physico-chemical form (pre-characterisation).

Once sorted, the waste must be characterised qualitatively and quantitatively with regard to mass, physico-chemical properties and composition, potential radioactive content, etc. Such characterisation must be consistent with existing regulations and technical specifications, notably concerning treatment, conditioning, elimination or recovery processes.

In the framework of elimination or recovery systems, waste may only be shipped to industrial facilities that are licensed to receive such waste. However, the assigned purpose is to ship those residues through those systems as soon as possible in order to minimise interim storage on production sites. Special provisions apply to the transport of radioactive waste in accordance with transport regulations.

Traceability of waste-management steps must be guaranteed, from their characterisation up to their elimination or recovery site.

Lastly, the management of each waste category must be described and analysed in the “waste surveys” to be conducted by each production site in order to seek improvement and optimisation venues and to establish a reference system.

All “waste studies” prepared by the CEA, AREVA, EDF and ILL are updated on a regular basis and submitted to ASN for approval.

On the basis of that reference system, every operator must prepare an annual management report of his waste, according to a specified format described in ASN specifications, and send it to ASN and to all

competent territorial authorities. All information contained in that report must be accessible to the public, unless protected by trade or defence secret.

For each of their sites, EDF, AREVA, ILL and the CEA must prepare annual reports describing the steps that were taken with regard to safety and radiation protection, incidents, measured discharges into the environment, as well as stored waste in BNIs.

### 1.2.2. Waste disposal process towards CENTRACO and ANDRA

The constitution and follow-up of radioactive-waste shipment programmes are drawn up after consultation between all entities concerned and notification of the conveyors, with due regard to the different disposal systems available: fusion and incineration at CENTRACO, the CSA. The quality of those shipments must be monitored.

### 1.2.3. Steps taken by ANDRA

ANDRA's radiation-protection goals, as described in § F.4.2.1.1, are based on current regulations and include dose criteria that are consistent with the ALARA principle, especially over the long term, and correspond to a fraction of the maximum admissible dose prescribed by current regulations

With regard to risks associated with the potential chemical toxicity of the waste and in accordance with RFS III.2.e, III.2.f and the ASN guide replacing the latest one, ANDRA requires producers to quantify the amount of radionuclides that are present in the waste and are subject to the regulations for hazardous waste or for water quality. Those radionuclides are submitted to impact assessments of the disposal facilities involved. Specific actions are also undertaken to reduce their quantities in delivered packages, especially in the case of lead.

Reducing the volume of delivered waste is a common objective for all waste producers and ANDRA. It reduces the footprint requirements of the disposal facility. It is achieved chiefly through efficient packaging processes (compacting, incineration) and through a strict control of the materials brought into the controlled areas of the facilities. Figure 8 shows the evolution of deliveries of LIL-SL packages since 1969.

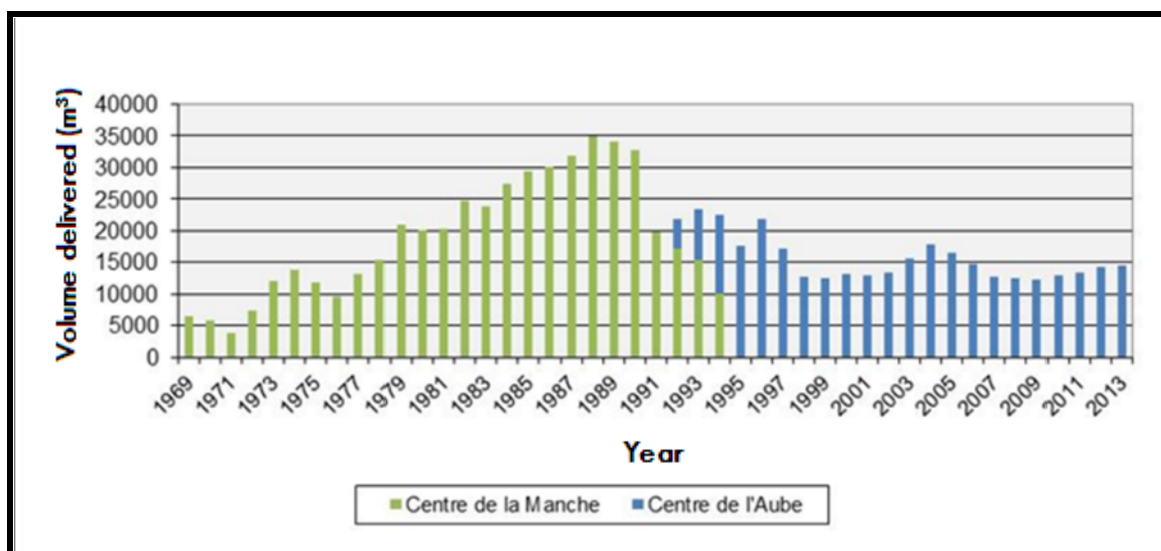


FIGURE 13 : DELIVERED VOLUMES OF LIL/SL-WASTE PACKAGES SINCE 1969.

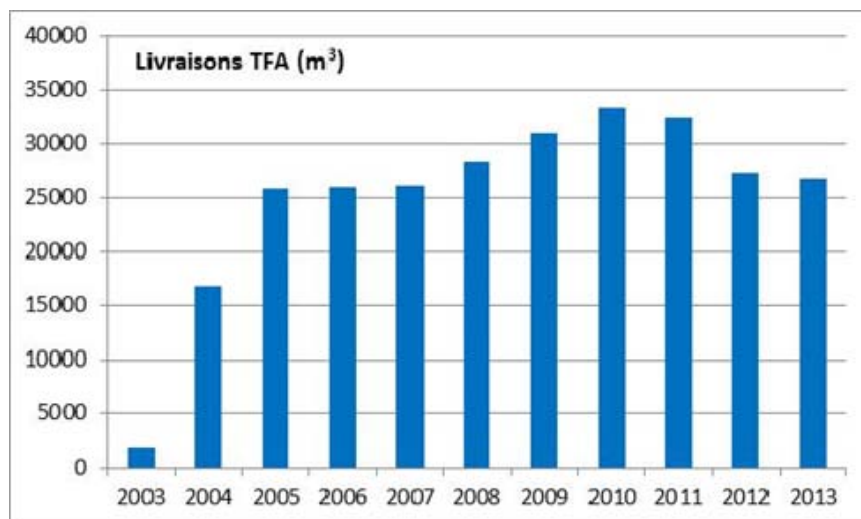


FIGURE 14 : DELIVERIES OF VLL-WASTE PACKAGES

The short, medium and long-term safety management of waste disposal facilities requires control of the quality of the waste packages they accept. This quality is described in specifications which set the conditions to be met by the waste and the waste packages in order to be admitted in such facilities. These specifications constitute a reference system for nuclear operators producing waste packages. More specifically, they concern the prevention of radiological, chemical, fire and criticality hazards. During the operation of the facility, an acceptance process called the “certification process” run by ANDRA is applied for each waste-package type proposed by the producer, in order to guarantee that it complies with ANDRA specifications.

That approach is now used at the Cires.

In the case of HL-IL/LL waste for which investigations are under way for their deep geological disposal, packages were designed in accordance with RFS III.2.f, which has now been superseded by a new guide. In accordance with the Waste Act, ANDRA is also responsible for providing its opinion to administrative authorities on new conditioning projects.

As regards the planned shallow disposal facility for radium-bearing, graphite and other LL-LL waste awaiting conditioning, ANDRA is not only investigating the most appropriate packaging means with nuclear operators who own radioactive waste, but also developing disposal concepts in parallel.

The principles previously mentioned, both for the packages intended for operational disposal centres and those intended for planned disposal centres, will be incorporated into an ASN resolution and guide (see § H6.2 below).

### 1.3. ASN's analysis for BNIs

ASN controls the steps taken by operators in order to comply with regulatory requirements (See. section E, § H.2 to H.7). This control concerns all their safety, radiation protection and environmental protection obligations. It covers all steps in the life of the facilities (design, construction, commissioning, operation, final shutdown and decommissioning, monitoring phase for disposal facilities). It applies to the existing and planned facilities as well as to waste packaging modes:

- ASN reviews from a technical standpoint all cases and supporting documents submitted by operators, notably in accordance with the *BNi Procedures Decree* (creation authorisation application file, final shutdown and decommissioning file, transition to monitoring phase, modifications, periodic safety review files, etc.);
- ASN carries out inspections on the operator's sites and services. This includes inspections at Andra to ensure correct implementation of approval issue processes for packages which are to be delivered to its disposal centres.

This control entails prescriptions, follow-up letters, additional assessments, administrative and penal sanctions, etc.

ASN also examines reports, studies and proposals made by the licensees in order to meet the requirements of the decrees establishing the prescriptions of the PNGMDR, issued pursuant to Article L. 542-1-2 of the Environment Code. In this case, ASN issues opinions on the elements submitted in accordance with these decrees. Seven opinions were thus issued in 2012, one in 2013 and one in 2014 on the studies transmitted in accordance with the *decree and the order of 23 April 2012*, establishing the prescriptions of the 2010-2012 PNGMDR.

ASN also considers that it is important to examine the policy and overall strategy of each of the major nuclear licensees with regard to radioactive waste management. EDF, CEA and AREVA NC are therefore asked to periodically produce a file presenting their policy and their strategy. The frequency is about 10 years.

EDF's policy and strategy with regard to radioactive waste (operating and historical waste) were reviewed in 2002 and those of AREVA NC in 2005. A revision of the EDF file was transmitted to ASN, which will examine it in 2014 prior to review by the Advisory Committees in 2015. With regard to AREVA NC, ASN has decided repeating the exercise on all this company's sites for a review by the Advisory Committees in about 2017. Concerning CEA, the strategy review has been held and the Advisory Committee issued its opinion in February 2012. It deals mostly with the CEA's structure to ensure the sound management of all waste being generated by those facilities (including historical waste) and the existence of suitable means to achieve that goal: new waste-processing or storage facility projects, renovation of existing facilities, development of conditioning processes and development of transport packages. Progress with respect to the previous review in 1999 was noted and emphasis was placed on the issues and challenges for the coming years.

More generally speaking, EDF's policy with regard to fuel use (combustion rate, MOX fuel management, URE fuel, etc.) has an impact on the facilities of the cycle and on the quantities and the quality of the resulting waste. That is the reason why what had been reviewed in 2001 and 2002 was checked again in 2010 remains monitored by ASN.

#### 1.4. Case of ICPE Facilities and Mining Waste

As has already been mentioned in this report, radioactive waste from ICPE facilities is managed in the same routes as that from BNIs. Management safety is therefore identical.

In France, the last uranium mine closed down in 2001. Hence, the mining industry no longer produces new waste, but the public and the environment must continue to be protected from historical waste, particularly in the case of mine and ore-processing disposal sites, which are classified as ICPEs. With regard to mine tailings, the 22 July 2009 Circular requires explicitly the operator to draw an inventory of all mine tailings that have been reused in the public field. Following that inventory, the operator must also verify that the proposed uses of the soil are acceptable on environmental and hygienic grounds. In case of incompatibility, remediation actions will need to be implemented in connection with public authorities. In the event of any incompatibility, remediation measures will be taken together with the public authorities. The Ministry for Ecology issued an instruction under signature of the Prefects on 8 August 2013, with regard to its services in the DREAL, in order to manage this operation. This instruction manages the process of inventorying and removing the waste rock reused in the public domain. It more specifically clarifies the conditions for information of the public concerning the results of the inventory, defines the methodology for performance of the work and specifies the memory conservation process. This action is overseen by the administrative authority (Prefect) with the support of the regional directorates for the environment, land-planning and housing (DREAL) in collaboration with ASN and the local regional health agencies (ARS).

#### 1.5. Case of industrial activities outside the nuclear field, research activities, medical activities

The case of industrial activities outside the nuclear field, of research activities and of medical activities, is dealt with in § B.6.2.

## 2 | EXISTING FACILITIES AND PAST PRACTICES (ARTICLE 12)

*Each Contracting Party shall in due course take the appropriate steps to review:*

- i) the safety of any radioactive waste management existing at the time the Convention enters in to force for that Contracting Party and to ensure that, if necessary, all reasonably practicable improvements are made to upgrade the safety of such a facility;*
- ii) the results of past practices in order to determine whether any intervention is needed for reasons of radiation protection bearing in mind that the reduction in detriment resulting from the reduction in dose should be sufficient to justify the harm and the costs, including the social costs, of the intervention.*

### 2.1. ASN requirements for BNIs

A periodic safety review of BNIs is undergone periodically (See § E.2.2.3.1). A draft ASN resolution concerning the BNI periodic safety reviews, setting out the obligations of the licensees, was issued for public consultation in 2013 and the final version of the resolution should be published shortly.

If necessary, ASN requires the operator to take all appropriate measures to improve safety. That is normally the case for certain old storage facilities. COGEMA (now AREVA NC), the CEA and EDF used to store radioactive waste on certain sites (e.g., La Hague, Saclay, Marcoule, Cadarache, Saint-Laurent-des-Eaux) according to the regulations and state-of-the-art techniques of the time. The absence or obsolescence of conditioning of the stored waste and the original expected lifetime of those storage facilities, associated with the increase in safety requirements since then, now require that safety-improvement actions be implemented. In these conditions this legacy waste generally has to be retrieved and packaged so that it can be taken away either to existing disposal facilities or to storage facilities with a satisfactory level of safety. In this respect, it is recalled that, in accordance with Article L. 542-1-3 of the Environment Code, the owners of intermediate level, long-lived waste produced before 2015 must package it no later than 2030. In certain cases, the time for this waste retrieval and packaging (RCD) and the level of safety of storage is such that ASN has to require reinforcement of the safety of the facility (case of the silos at Saint-Laurent for example).

In addition, AREVA NC and CEA, as well as EDF for sites undergoing decommissioning and six facilities in service, have completed the search for legacy waste disposal sites. The main legacy waste disposal sites identified are mentioned in the PNGMDR available on the ASN website. The management strategies (in-situ disposal or waste disposal in routes dedicated to radioactive waste) are also presented and are based on a “cost/benefit” analysis taking account of environment, radiation protection, technical, etc. aspects. However, according to the ASN opinion dated 4 October 2012, additional investigations are required in certain areas where legacy disposal sites are suspected. Consequently, the *decree of 27 December 2013* requires that the BNI licensees continue their search for legacy disposal sites within the perimeter or vicinity of their facility. The licensees shall submit a report on their investigations before the end of 2014, along with the planned management strategies.

The case of the Malvési site is worth mentioning. On this site, the Comurhex Malvési (AREVA NC) facility has since 1960 been converting natural uranium from the uranium tetrafluoride mines. The residues and effluents resulting from the process are managed on the site in lagoons after neutralisation with lime, in settling ponds (B1 and B6) and evaporation ponds (B7 to B12). This waste primarily contains natural radionuclides. However, traces of artificial radionuclides, linked to past activity involving the conversion of the uranium resulting from the processing of spent fuels, have been brought to light in ponds B1 and B2, now disused. These ponds contain about 280,000 m<sup>3</sup> of sludge, over the top of 300,000 m<sup>3</sup> of waste rock and mining residues resulting from the sulphur works prior to reconversion of the site. At the request of ASN, the status of these settling ponds was changed from that of an ICPE to that of a BNI (see ASN resolution of 22 December 2009). In accordance with the prescriptions in this resolution, the licensee, Comurhex, submitted a creation authorisation application for this facility at the end of 2010. This file was examined according to the regulatory procedures and the creation-license decree for this BNI, called ECRIN, should appear in 2014. In late 2011, AREVA NC submitted a study proposing long-term management solutions for the waste stored in ponds B1 and B2 and management procedures for new waste produced. ASN issued an opinion dated 4 October 2012 on these proposals and the *decree of 27 December 2013* consequently set the licensee’s obligations in this field.

With regard to ICPEs, it is possible at any moment to update the licensing order of any facility by means of further orders; in practice, those additional orders are issued every 10 years for the most important ICPEs on the proposal of the ICPE Inspectorate and after consultation with the CODERST.

## 2.2. Steps taken by BNI operators

### 2.2.1. Steps taken by ANDRA

The CSM was in service from 1969 to 1994. During that period, both regulations and safety principles evolved. The first editions of RFS I.2 and III.2.e date back to 1982 and 1985, respectively. ANDRA concentrated its efforts on adapting its operating methods to the changes in the regulations. For past practices, which no longer comply with current regulations, ANDRA checks that they are still compatible with the safety objectives. The measures regarding the CSM are described in § D.3.2.2.1 and H.7.

### 2.2.2. Steps taken by the CEA

Historical waste includes all residues resulting from various former practices at a time when current technological solutions were not available. It is often similar to current waste but, given the diversity of storage solutions and changes in waste-management conditions and processes, it raises specific problems relating to recovery, characterisation and treatment.

The waste involved includes mainly the following:

- liquid aqueous and organic waste, contained in tanks, carboys or drums;
- solid waste placed generally in drums, which are stored in pits, cells or ditches; and
- solid waste buried in open ground under various forms (in bulk wrapped in vinyl, in metal drums or concrete casks).

CEA's objective is to retrieve and package this waste with appropriate treatment so that it can be sent to existing routes or routes currently being created.

In this approach, among that waste, priority is given to the recovery of liquid organic and aqueous waste; in 10 years' time, the percentage of recovered old organic effluents that used to be stored on sites is in the order of 80%.

CEA is also continuing with the reduction of the source term of its facilities resulting from solid waste. After sorting, this waste is either sent to the Andra CSA or Cires, or stored in the centres, pending Andra's definition of the ILW-LL and LLW-LL disposal packages. The contaminated waste is packaged in cement-encapsulated packages for storage in BNI 164 (CEDRA). The highly radioactive waste should, as of 2018, be stored in a future dedicated facility in the Marcoule centre (DIADEM). When Andra has defined the acceptance specifications for the ILW-LL and LLW-LL packages, CEA will build specific packaging units for the primary packages of LLW-LL waste and, to a lesser extent, ILW-LL primary packages, for direct packaging in disposal containers and shipment to the future disposal centres.

It should be noted that, in the framework of the denuclearisation of the Grenoble Centre, all historical waste being stored on site were characterised, recovered and evacuated. The recovery programme for such waste is continuing on the other CEA sites, especially at Fontenay-aux-Roses and Marcoule (UP1 Plant), and at Saclay and Cadarache as well. The objective is, once the waste is sorted, to direct it either towards ANDRA.

### 2.2.3. Steps taken by AREVA: recovery of La Hague's historical waste

Part of the waste resulting from the operation of the UP 2-400 Plant is stored at La Hague pending the commissioning of compatible final-storage facilities with their radiological and physico-chemical characteristics. Those residues are the topic of a recovery and reconditioning programme (*Programme de reprise et reconditionnement* – RCD) with a view for subsequent evacuation. The programme is managed by the Decommissioning and Services Division at La Hague (*Démantèlement et Services* – D&S), which also leads and carries out the projects of the RCDMAD/DEM Programme. The constitution of this operational Division marks an improvement by grouping projects and decommissioning under the same governance, thus improving co-operation.

The waste generated by the UP 2-400 plant will be processed and conditioned either in existing facilities (UP2-800/UP3), which are already in service, or in new facilities to be built.

Almost all fission products have already been vitrified. The vitrification of solutions with high molybdenum concentrations, which are not compatible with the current vitrification solution in hot crucible (corrosion aspect), has been initiated early 2013 thanks to the new vitrification process in cold crucibles.

Technological waste contaminated with  $\alpha$  radiation, which had been stored in steel drums and placed in Building No. 19 and are being recovered; the operation should be completed by 2015. The historical waste resulting from the UP2-400 Plant are being transferred to the UCD in order to be processed mechanically (sorting and conditioning) and/or chemically (decontamination by leaching), then to AD2 to be conditioned into cemented packages. More recent waste originating from the MÉLOX or ASDPu facilities at Cadarache will be transferred to the STE3 Workshop pending their processing.

The sludge, which have been stored in the STE2 Workshop should be recovered starting in 2020 in order to be treated thermally by a drying process and compacted, as a substitute for bitumisation, as originally planned. The new process should be implemented in the STE3 Workshop.

During their recovery, all waste contained in the HAO silo will be sorted in a new cell to be created, whereas structural waste (hulls and end-pieces) will be transferred to the ACC Workshop for compacting purposes; technological waste (aluminium covers) will be sheared and stored in cursors within the SOC pools before being conditioned in CBF-K fibrous packages; the filler fines and resins will be recovered and transferred in a new cementation cell beside the recovery cell in order to be cemented into drums. The cursors that are stored in pools Nos. S1, S2 and S3 of the SOC will be transferred to the HAO silo's sorting and recovery cell, where they will be emptied, while the hulls and end-pieces they contain will undergo the same treatment as the structural waste of the HAO silo, whereas technological waste (empty cursors, covers, etc.) will be conditioned in CBF-K packages, after shearing and decontamination, if need be.

GCR waste from silos 115 and the SOD will be retrieved according to a scenario being studied, giving priority to sorting and processing in appropriate routes.

GCR waste from silo 130 will be retrieved as soon as possible. It will be temporarily stored in DE/EDS in ECE drums.

#### 2.2.4. Steps taken by EDF

##### 2.2.4.1. WASTE CONDITIONING AND DISPOSAL ON EDF OPERATING SITES

For several years, EDF's NPPs have been required to store certain packaged or unpackaged waste in their own facilities, owing to:

- the lack of appropriate treatment or disposal systems;
- changes in the technical specifications of disposal facilities, since they are no longer allowed to accept certain historical packages, and
- various regulatory changes that modified certain practices (halt in the disposal of “non-radioactive” waste within conventional disposal systems) or immobilised certain packages on production sites (failure to meet shipping criteria).

The situation has changed for the better, particularly as a result of the commissioning of SOCODEI's CENTRACO Plant (see § B.6.1.1), ANDRA's Cires for VLL waste and of the policy adopted by EDF for line disposal and lean management of waste.

In addition, EDF has built and commissioned dedicated, regulated areas for VLL waste storage on its 19 NPP sites pending removal, thus enabling the LL/IL waste intended for the CSA and stored in specifically-designed auxiliary waste-conditioning buildings (*bâtiment auxiliaire de conditionnement des déchets* – BAC) and effluent-treatment buildings (*bâtiment de traitement des effluents* – BTE) to be separated from the VLL waste stored on VLL-waste areas at BNIs and intended for disposal at the Cires.

Various ongoing actions have ended up in concrete results, such as:

- the reduction in the quantities of concrete casks and drums present in BACs and BTEs, by optimising the entire “shipping” process, with due account of the need for prompt disposal at the CSA;

- the decrease in the quantity of non-conforming packages that may delay their shipment;
- the development of a metal container type package appropriate for repackaging certain non-conforming concrete hulls,
- the reduction at the production source (ion-exchange resins, water filters, technological waste);
- the optimisation of treatment or disposal options by broader sorting (VLL/low-level, compactable, incinerable/non-incinerable waste, etc.);
- the incineration of larger volumes of evaporation concentrates;
- “waste zoning”.

Those actions are ongoing and are consistent with the application on sites of the operating rules for the management of radioactive waste in their facilities.

#### 2.2.4.2. WASTE CONDITIONING AND EVACUATION ON EDF DECOMMISSIONING SITES

All waste resulting from decommissioning operations is managed as any other operating waste from NPPs in service. They are characterised, sorted and conditioned before being shipped towards compatible storage facilities in service or towards CENTRACO’s fusion and incineration facilities.

IL/LL waste will be stored pending the availability of the deep geological repository prescribe by the *Waste Act*.

According to current studies, the ongoing deconstruction of 10 BNIs, including eight Generation-1 reactors, the SUPERPHÉNIX reactor at Creys-Malville and the graphite-sleeve storage facility at Saint-Laurent-des-Eaux will generate a total of approximately 1 million tonnes of waste, of which the radioactive share represents about 18% (by weight) as follows:

- 80,000 t of “conventional” waste, containing no radioactive element and most of which consisting of concrete and cleaned-up rubble to be used to fill holes left by the deconstructed facilities on the site, and
- 250,000 t of mostly SL radioactive waste (20%), intended for permanent storage after packaging, and for which the procedures exist or remain to be created.

Those radioactive residues are divided as follows:

- VLL waste includes concrete, rubble and earth; it represents about 115,000 t and will be stored at the Cires;
- LIL-SL waste consists mostly of equipment that was used to contain or to transport radioactive fluids (pipes, valves, tanks, etc.) and represents about 53,000 t. There is also safe, permanent storage at ANDRA’s CSA;
- IL-LL waste is made up of metal parts that became radioactive under the action of neutrons from the reactor core (about 300 t). While waiting for solutions proposed by the *Waste Act* to come into operation (deep geological repositories being the benchmark solution, for commissioning by 2025), EDF must package IL-LL waste and set up a temporary storage solution. Such is the purpose of the ICEDA Project, which is under construction at the Bugey NPP, Ain département, before transferring the waste to ANDRA’s deep geological repository prescribed by the *Waste Act*, when available, and
- LL-LL radioactive waste from GGRs (around 17,000 t), for which the *Waste Act* provides for the commissioning of a waste repository, on which the successful completion of GGR-decommissioning operations depends.
- In addition, the sodium from the Creys-Malville NPP (around 5,500 t of sodium from the reactor vessel and the non-radioactive secondary systems) will be converted into sodium hydroxide, via an industrial process developed by the CEA, then safely packaged by placing it in concrete blocks. Those VLL radioactive concrete blocks (about 63,000 t) will then be stored on site for about 30 years, during which their radioactivity level will decrease close to that of natural radioactivity.

## 2.3. ASN analysis on BNIs

### 2.3.1. Existing facilities

As mentioned above, the existing facilities undergo periodic safety reviews. In accordance with Article L. 593-19, after each review, the licensee sends ASN a report comprising the conclusions and, as necessary, the steps it envisages taking to remedy the anomalies found and to improve the safety of its facility. ASN sends the Minister responsible for nuclear safety its opinion on this report and issues a position statement concerning continued operation. It sends the licensee special requests with a schedule for the expected answers. New technical prescriptions to be implemented by the licensee may be set. ASN also conducts inspections which are followed up by a letter to the licensee concerned.

### 2.3.2. Legacy waste

Most of the waste produced to date is packaged. However, some waste, known as legacy waste, is not packaged or is inadequately packaged (deterioration of the containers for instance) and is incompatible with the subsequent management procedures as required in Article 6.7 of the *BNI Order*.

Although progress has been observed in the retrieval of legacy waste, ASN had to ask the licensees to step up their efforts to meet the deadlines necessary to ensure the safety of the legacy waste storage sites and achieve the 2030 goal set by Article L. 542-1-3 for the end of ILW-LL waste packaging operations.

The following significant examples are detailed below:

- graphite sleeves stored by EDF (Saint-Laurent-des-eaux);
- sludge resulting from the processing of UP2-400 effluents at La Hague (AREVA NC, La Hague);
- alpha waste from Building No. 119 (AREVA NC);
- waste from Silo No. 130 at La Hague (AREVA NC);
- tritiated waste (CEA and others);
- waste from BNI-56 (CEA);
- waste from BNI-72 and BNI-35 (CEA).

#### 2.3.2.1. GRAPHITE SLEEVES STORED BY EDF

This is fuel structure waste from the old gas-cooled reactor (GCR) series. Its long-term management is being studied by EDF and by Andra under the LLW-LL type waste disposal project (see section B above). In the meantime, this waste is stored, mainly in the Saint-Laurent-des-Eaux silos. The tonnage is about 2,000 t (as compared with the 970 t stored at La Hague and the 760 t stored in Marcoule). The Saint-Laurent-des-Eaux silos consist of two semi-buried reinforced concrete bunkers, with a steel lining. They were filled in 1994.

Given the delay in the graphite waste disposal project and in response to ASN's request for improved safety concerning the Saint-Laurent silos, EDF presented a solution in July 2007 consisting in installing a containment barrier around them. Following examination by ASN, additional requests and then approval, work to install a geotechnical containment acting as a barrier was carried out in 2010. The licensee sent the periodic safety review file in early 2010 and the examination of this file more specifically concerned the data concerning this containment and the associated equipment. ASN then informed EDF that the use of the facility thus reinforced and monitored (under surveillance since 1994) as a storage centre could continue provided that EDF met the undertakings it made at the examination of the periodic safety review file.

#### 2.3.2.2. SLUDGES RESULTING FROM TREATMENT OF UP2-400 EFFLUENTS IN LA HAGUE

From 1966 to the end of the 1990s, the effluents from the UP2-400 plant were treated in the STE2 facility by chemical co-precipitation. The sludge resulting from this process (a volume of 9,300 m<sup>3</sup> representing about 3,400 t of salts) were stored in buried silos as and when they were produced.

The main risk consists in the dissemination of radioactive substances due to the single containment barrier formed by the silo walls, whose current state is not well known and whose evolution over time is not easily foreseeable.

Over the last few years, the operator has set and tested the sludge-recovery and transfer modalities as a prerequisite for any processing and conditioning.

The operator's initial project was to use the STE3 Bitumisation Workshop in order to dehydrate and to embed STE2 smudges in bitumen. Confronted with the problem to justify the safety of the process in light of the historical background of those sludge and of their characteristics, ASN adopted a Resolution, on 2 September 2008, with a view to requiring another treatment and conditioning process.

The operator then proposed a process aiming at producing powder discs (by sludge drying and then compacting of the resulted powder in discs) to be packaged in casks, the cask empty part to be filled by an inert material such as sand (See § H.2.2.3). On 4 January 2011, ASN issued a resolution on the follow-up of this proposal. ASN considers that this type of package – for storage purposes - could be accepted but complementary studies have to be carried out prior to any decision on its acceptance for storage. ASN asked for an annual report on the progress of R&D work and remains vigilant with regard to the proposals made by AREVA for the development of this type of package.

#### 2.3.2.3. ALPHA WASTE OF LA HAGUE BUILDING NO. 119

Building No. 119 contains drums of technological waste with an alpha-prevailing spectrum and presence of organic materials.

Since ASN considers that the safety of the building is not satisfactory with regard to seismic and fire risks, ASN has requested in 2006 to empty the building. The operator destocked a large part of the stored drums (Cf. § H.2.2.3).

#### 2.3.2.4. OTHER AREVA NC LEGACY WASTE

With regard to HLW legacy waste, virtually all of the fission products (FP) have today been vitrified. All that remains are FP solutions with a high molybdenum content from the GCR fuels (about 230 m<sup>3</sup>), which required the development of a new technology, called cold crucible. After ASN approval of the facility and the packaging (packaging baseline requirements including production specifications), four containers were produced, but a certain number of technical problems delayed the industrial scale production of this type of package.

For the other legacy waste, of the ILW-LL, LLW/ILW-SL, LLW-LL or VLLW types (stored mainly in silos 115, 130 and HAO see § H.2.2.3), AREVA NC is examining the possibility of adapting the existing processes (compacting, cement-encapsulation, vitrification) and periodically informs ASN of the progress of these studies with a view to obtaining the license to produce packages as mentioned in Article 6.7 of the BNI order.

Packaging of this LLW/ILW-SL or VLLW type waste requires approval from Andra for its disposal in the CSA or Cires.

#### 2.3.2.5. CEA HISTORICAL WASTE AT CADARACHE

The CEA's historical waste at Cadarache is stored in BNI-56, called "Storage Park" (*Parc d'entreposage*). Part of that facility consists of five trenches that were filled with different types of solid LIL waste between 1969 and 1974, and then covered with earth. At the time, it consisted in an experimental waste-storage facility.

The work to retrieve waste from the first trench, that is trench T2, experienced difficulties linked notably to the stability of the foundations and walls of the embankment. The work is scheduled to be completed no earlier than late 2015. For the other trenches, the waste retrieval work will require major modifications to the facility. CEA will use experience feedback from trench T2 to define its retrieval strategy.

In the old ditches of BNI-56 is also stored some irradiating IL waste under conditions that are no more consistent with current safety requirements. CEA has begun to retrieve stainless steel packages from pit F6 and low radioactivity waste from pit F3.

For retrieval from the other pits, CEA intends to implement new processes. ASN informed CEA that these modifications will be examined with the final shutdown and decommissioning authorisation application

required for no later than the second half of 2015, accompanied by the facility's periodic safety review file.

ASN must ensure that the significant recourse to subcontractors for the destocking of BNI-56 occurs under sound conditions for the safety of the facility and that the operator monitors his service providers accordingly.

In addition to BNI, it should be noted that all the plutonium-bearing by-products stored in the PEGASE reactor facility (BNI 22) have been processed, repackaged and transferred for storage in the CEDRA facility. ASN considers that a significant step has thus been reached.

#### 2.3.2.6. CEA HISTORICAL WASTE AT SACLAY

BNI 72 is used for storage, characterisation and packaging of the waste produced by the Saclay centre. The facility also recovers disused sources from CEA. Legacy waste and spent fuels are stored in pits, pools or blocks.

In early 2009, at the request of ASN, the competent Advisory Committee evaluated the periodic safety review file transmitted by the licensee. On this occasion, CEA made a certain number of undertakings, including that of shutting down the processing units within 10 years and, within this same time frame, to remove the waste stored in the storage pool and blocks.

The storage removal operations require considerable technical and human resources and CEA had to deal with unexpected situations at the beginning. More specifically as a result of the inspections carried out in-situ, ASN considers that the organisation and means need to be reinforced. The facility must undergo final shutdown no later than 2018.

With regard to BNI-35, *Decree No. 2004-25 of 8 January 2004* for modifying the facility requires the CEA to evacuate all vessels containing older radioactive concentrates by 2013 at the latest. In addition, ASN has requested the CEA to evacuate all HL organic effluents from the facility by the second half of 2014. The high level radioactive organic effluents were removed and the remaining source term at the end of 2013, approximately 55% of the initial source term (about 10,600 GBq), consists of intermediate level effluents. The delay in the removal of the other effluents stems notably from CEA's problems with commissioning the STELLA facility designed to package this waste. An ASN resolution should appear in 2014 to set deadlines for retrieval of effluents from building 393.

#### 2.3.2.7. ASN CONCLUSIONS CONCERNING LEGACY WASTE

The various preceding examples show the difficulties inherent in retrieving and packaging legacy waste. The problems encountered are notably the following:

- the data concerning legacy waste are imperfect. When it was stored, the conditions of traceability and quality assurance were not the same as today. Its characterisation prior to retrieval is therefore based on the available records of its production, on a few samples and, as necessary, by calculation and can only be accurately determined once the waste has been retrieved for treatment/packaging;
- legacy waste is often heterogeneous (this is more specifically the case with the waste in silos 115, 130, HAO);
- the licensees have to deal with treatment/packaging problems with this waste and must often develop specific processes, in a context which is made difficult by the fact that the specifications for acceptance in the planned disposal routes have not yet been defined;
- the licensees have to deal with technical retrieval difficulties;
- the licensees use industrial strategies which have undergone significant changes and these subjects were given no appropriate prioritisation in the licensees' overall strategy.

All these problems often lead to delays and cost overruns. Solving the problems posed by the legacy waste and removal from storage means that the projects have to be taken into consideration very early on in the process, with particularly close monitoring on the part of ASN.

ASN will be particularly attentive to compliance with the deadlines for the waste retrieval and packaging programmes implemented by the licensees.

The challenges for the three major licensees are the following:

- For EDF, the main challenge is the management of graphite waste. Given the delay in the disposal project for this type of waste and the possible new guidelines for its treatment, ASN reminded EDF of the importance of ensuring that decommissioning of the GCR reactor compartments and graphite sleeves storage silos is not dependent on the commissioning of a low level, long-lived waste disposal facility, but that alternative solutions should be sought.
- For AREVA NC, the retrieval of legacy waste is an important AREVA undertaking made within the framework of the ministerial authorisations for start-up of new spent fuel processing plants in the 1990s. The initial schedule has drifted significantly and the deadlines can no longer be pushed back because the buildings in which the waste is stored are ageing and no longer meet current safety standards. ASN is working on a draft resolution on the waste retrieval and packaging programme (RCD) designed to provide a regulatory framework for the progress and performance of the AREVA RCD programme according to the safety issues of the operations. This project was submitted to the licensee in July 2013 for regulation consultation and will be open to public consultation in 2014.
- For CEA, the two main issues are on the one hand the deployment of new waste treatment and storage facilities within a time-frame compatible with the shutdown programme for old facilities in which the level of safety no longer complies with current requirements and, on the other, running legacy waste storage removal projects. ASN observed that CEA is experiencing difficulties with managing these two issues, even if certain projects have made progress. ASN is monitoring the progress of CEA's programmes very closely.

The *decree of 27 December 2013* requires that by 31 December 2014, EDF, AREVA and CEA present their progress in characterisation of the ILW-LL waste and the consolidated design options for new packages appropriate for the disposal route as envisaged. EDF, AREVA and CEA shall also indicate their strategy for meeting the 2030 goal mentioned in § H.2.3.2 above. ASN, ASND (for the licensees of defence-related facilities) and Andra will be contacted concerning this study and this strategy. This concerns not only legacy waste that is no longer produced (the main types are mentioned above), but also the share of the waste still in production and which was produced until 2015 (notably tritiated waste and the alpha waste mentioned below).

### 2.3.3. Tritiated waste

Most of the tritiated waste produced in France is operating and decommissioning waste from the facilities linked to CEA's military applications (98%), the rest coming from small producers outside the nuclear power generating sector. As at the end of 2010, it represented about 4,500 m<sup>3</sup> for a radiological inventory of about 5,000 TBq.

The solutions currently operational for long-term management of tritiated waste are extremely limited. In these conditions, most of the waste is stored on the CEA sites, in particular Valduc and Marcoule.

The studies carried out by CEA concern the methods for storage of tritiated waste with no disposal route, in order to allow radioactive decay. These studies take account of the CEA stock and future production, more specifically that from ITER until 2060, the scheduled date for the end of decommissioning. The forecast inventory of tritiated waste concerned, that is solid tritiated waste, comes out at about 30,000 m<sup>3</sup> for activity of about 35,000 TBq.

CEA has defined six main families of solid tritiated waste for which there is no disposal solution. Each family is associated with a storage concept that is long enough to allow decay of the tritium activity of the packages and their acceptance in Andra's existing and future disposal centres. The planned storage facilities should be gradually built and commissioned by 2055.

Following a study submitted by Andra and CEA in accordance with the 2010-2012 PNGMDR, it was accepted and incorporated into the 2013-2015 PNGMDR that the solid tritiated waste from the small producers outside the nuclear power generating sector would be stored with the waste produced by the ITER facility.

The inventory of liquid and gaseous tritiated waste from the small producers outside the nuclear power generating sector represents a small share of the total inventory of tritiated waste, but this waste requires prior treatment so that it can be managed in dedicated disposal routes.

The ASN opinion dated 7 June 2012 notes the quality of CEA's presentation of the elements requested by the 2010-2012 PNGMDR (progress made in the programme to create storage facilities and various technical aspects). It recommends the continuation of the studies on the management of liquid or gaseous tritiated waste from the small producers. The *decree of 27 December 2013* lists the studies to be carried out by Andra concerning this type of liquid or gaseous tritiated waste.

#### **2.3.4. Technological alpha waste from AREVA NC and CEA not acceptable for surface disposal**

Technological alpha waste from AREVA NC comes mainly from the La Hague and MELOX plants. In accordance with an ASN resolution dated 23 February 2010, AREVA NC presented the progress of its work to define an alternative package to the compacted waste package. The new treatment and packaging mode proposed by the licensee is based on an incineration/fusion/vitrification process enabling packages to be manufactured on the basis of principles more conducive to safe storage and disposal.

The *decree of 27 December 2013* stipulates that AREVA and CEA must transmit an interim report on the process adopted, before 31 December 2014, along with a development calendar for this process, justifying it with respect to the 2030 objective mentioned in § H.2.3.2 above. This decree states that ASN, ASND and Andra must be contacted for their opinion on this report.

#### **2.4. Historical waste from non-BNIs**

The current policy and practices regarding historical waste from non-BNIs are described in the general framework appearing in § B.5 and B.6.

In the case of ICPEs, regulations allow competent authorities to review licences in order to improve the operation of older facilities, such as mine-tailing storage facilities.

Inventory of polluted sites by radioactivity is detailed in § D.3.1.4.

The management of polluted sites has been the subject of continuous measures by the public authorities for several years.

The circular of 17 November 2008, intended for the Prefects, describes the administrative procedure applicable to the management of radioactive polluted sites subject to the ICPE system or the Public Health Code system, whether the party responsible is solvent or has defaulted. This circular thus allows treatment of legacy radioactive contamination on sites caused by past craft or industrial activities involving radioactivity (often radium), these sites not generally being ICPEs.

The Prefect calls on the opinions of ASN and the classified installations inspectorate (when these latter are concerned) to validate the site remediation project and oversees the implementation of remediation measures by means of an order of the Prefect. In the event of residual pollution after the work, he may implement normal restrictions or institutional controls.

The methodological guide for management of industrial sites potentially contaminated by radioactive substances, which appeared in 2011, describes the applicable approach for dealing with various situations liable to be encountered when remediating sites potentially contaminated by radioactive substances. It aims to provide the various actors with a common methodological base for simultaneous, joint management of all the risks presented by such a site. It in particular specifies the necessary justifications to be provided by the party responsible for remediation of the site to the competent authorities. In accordance with the radiation protection principles specified in Article L1333-1 of the Public Health Code, the cost-benefit analysis specified in Chapter 5 of the guide must first of all aim to reduce exposure of individuals to ionising radiation as a result of the use of the site and the remediation operations as far as is reasonably achievable. This cost-benefit analysis must also take into consideration the robustness of the envisaged management solutions. Thus, the removal of as much pollution as possible, in order to aim for complete clean-up, is the primary objective in order to avoid having to resort to subsequent additional pollution clean-up operations.

In the case of use for housing in particular, removal of the pollution that is as complete as possible is the reference method.

However, for specific cases, the decision may be taken not to carry out maximum remediation if the residual dosimetric impact remains acceptable for the intended usage, for example when the waste generated would be too great in volume or for which there is no solution. In any case, in this type of situation, steps must be taken with regard with the transfer pathways to reduce exposure as far as possible, put in place appropriate environmental monitoring of the site and, as applicable, of the entire zone affected, to prefer reversible technical solutions allowing possible subsequent clean-up, to implement institutional controls and take all steps to conserve the memory of the site and ensure appropriate public information.

If the party responsible has defaulted, decontamination of the site is carried out as part of Andra's public interest duties as defined by the Waste Act.

Andra then intervenes to coordinate the remediation of polluted sites under mandate from the Prefects on the territory on which these sites are located.

In all cases, the remediation objectives are sent to ASN for its opinion and actual attainment of the site remediation objectives can be checked following the decontamination operations. In October 2012, ASN published the basic principles of its doctrine for sites and soils contaminated by radioactive substances, the principles which it uses as the basis when issuing its opinions.

### 3 | SITING PROJECTS (ARTICLE 13)

*1. Each Contracting Party shall take all appropriate steps to ensure that procedures are established and implemented for a proposed radioactive waste management facility:*

- i) to evaluate all relevant site-related factors likely to affect the safety of such a facility during its operating lifetime as well as that of a disposal facility after closure;*
- ii) to evaluate the likely safety impact of such a facility on individuals, society and the environment taking into account the possible evolution of the site conditions of disposal facilities after closure;*
- iii) to make information on the safety of such a facility available to members of the public;*
- iv) to consult Contracting Parties in the vicinity of such a facility, insofar as they are likely to be affected by that facility, and provide them, upon their request with general data relating to the facility to enable them to evaluate the likely safety impact of the facility upon their territory.*

*2. In so doing, each Contracting Party shall take the appropriate steps to ensure that such facilities shall not have unacceptable effects on other Contracting Parties by being sited in accordance with the general safety requirements of Article 11.*

#### 3.1. Regulatory framework and ASN requirements for BNI projects

The siting procedure for any future BNI is detailed in § E.2.2.2.

More particularly with regard to the implementation of a disposal facility, ASN has published the following RFS and safety guide:

- RFS I-2 (published in 1982 and revised in 1984), for surface storage facilities for LIL/SL waste; and
- a safety guide published in February 2008 for the deep geological disposal of HL radioactive waste.

Concerning LL-LL waste, ASN published in June 2008 a general safety orientation notice for the siting of the of a relevant storage facility.

These documents, the role of which is specified in § E.2.2.5.2, define the objectives to be adopted for radioactive waste disposal facilities, as early as the site investigation and facility design phases, to ensure safety after closure. They in particular deal with the geological medium and the technical siting criteria.

A legislative mechanism may prove necessary to implement any new storage facility. It is notably the case for a deep geological repository and its prerequisite facility, which consists in a URL. The 1991 Law had prescribed that any project for a URL be the subject of a consultation mission with elected officials and the populations. That mission was set by decree. According to the same law, the licence should be granted to build and to operate the URL by decree on the basis of a technical application to be submitted by ANDRA, after public inquiry and opinion of stakeholders. In practice, ANDRA submitted in 1996 three applications, each corresponding to a different site. Only the creation of the Eastern Laboratory Site, at Bure, was licensed in 1999.

Article L. 542-10-1 of the Environment Code prescribes a certain number of specific requirements concerning the creation application for a deep geological formation repository which requires that such application refer a given deep geological formation, which has been investigated through a URL.

The procedures concerning any BNI creation authorisation application are given in § E.2.2.3.1 and E.2.2.3.2. They are clarified and supplemented by Article L. 542-10-1 of the Environment Code with regard to the authorisation for disposal in a deep geological formation. The Environment Code provides for public information. Application to create a waste-disposal facility are systematically submitted to public inquiries. On every site (disposal facility, URL) is created a CLI, consisting of State representatives, elected officials and association members. In the case of the deep geological formation repository, specific modalities are set such as: organisation of a public debate, report of the national Commission of evaluation, ASN's opinion, local communities' opinion, OPESCT's opinion, the prerequisite adoption of a reversibility law, etc. All this process is publicly available.

In the event that a project is likely to have an impact on the environment of another State, Article R. 122-11 of the French *Environment Code* and Article 13-II of *BNI Procedures Decree* provide for information and consultation measures with the involvement of the State. In addition, the same decree specifies that “the licence to create a facility likely to discharge radioactive effluents in the environment shall only be delivered after reception of the opinion of the Commission of European Communities taken in accordance with Article 37 of the *EURATOM Treaty* or, in the absence of such opinion, after six months of the request to the Commission”.

## 3.2. Steps taken by BNI operators

### 3.2.1. Steps taken by ANDRA

In the context of the investigations conducted under the *Waste Act*, ANDRA is in charge of the R&D Programme for the implementation of the deep geological repository to be commissioned in 2025, subject to the creation authorisation application acceptance. The Programme monitors the investigations and studies that were carried out under the *1991 Law* and integrated in ANDRA's *2005 Clay Report (Dossier Argile 2005 - [www.andra.fr](http://www.andra.fr))*.

The 2005 Clay Report contains notably a description of the acquired knowledge at and around the MHM-URL, a summary of all design studies for a deep geological repository until then (including reversibility aspects).

Thanks to the research results achieved by the MHM-URL, it was possible to demonstrate in 2005 that a deep geological repository for HL/IL-LL waste was feasible within the Callovo-Oxfordian argillite layer under review.

In 2009, Andra presented the safety, reversibility and design options. These were examined by ASN and its technical support organisation, IRSN, in 2010, more specifically to identify the main elements to be supplemented for the creation authorisation application.

In 2010, Andra carried out a detailed geological survey of the zone studied for siting of the repository, using 3D seismic means. In its November 2011 assessment report, the National Review Board (CNE) stressed the point that the new seismic campaign confirms the excellent homogeneity of this zone. The CNE also considers that Andra now has a geological model justifying the transposition of the data produced from the information acquired in the underground laboratory to the zone being studied for siting of the repository.

In 2012, Andra initiated industrial design studies for the repository. These studies are based on the main principles adopted following 20 years of research, to ensure the long-term safety of the repository. The results of the preliminary studies were assessed in 2013 by ASN and the CNE and were presented to the public debate. Andra's follow-up to the public debate and the recommendations of the CNE will be taken into account in the subsequent studies. In 2015, Andra will send ASN a safety options file and a technical retrievability options file to prepare for examination of the Cigéo creation authorisation application. On the basis of these elements and the final preliminary studies, Andra will finalise the creation authorisation application for the end of 2017.

In accordance with the provisions of the Euratom treaty, the European Commission will be involved in the authorisation process. More specifically, Andra will send the European Commission a file concerning

radioactive effluent discharges; the Cigéo creation authorisation may only be granted after the Commission has issued its opinion on this file.

Andra is also in charge of the disposal project for LLW-LL waste for which there is at present no solution, such as graphite waste (stacks and sleeves) and radium-bearing waste.

In 2008, the siting process for a repository able to accept LLW-LL type waste was unsuccessful. Further to the guidelines given in the 2010-2012 PNGMDR and the recommendations of the High Committee for Transparency and Information on Nuclear Security (HCTISN) which analysed the lessons learned from the siting process, Andra submitted proposals to the Government in 2012 for continuation of the project. In 2013, the Ministry for Ecology, Sustainable Development and Energy asked Andra to continue the siting work, both on sites already housing nuclear facilities and in areas where communes had submitted their candidacy in 2008, as recommended by the HCTISN. In 2013, geological investigations were carried out in the vicinity of Andra's existing disposal centres in the Aube département, jointly with local actors. On the basis of the study report and the research to be presented by Andra in 2015, the State could decide on guidelines for the future of the project.

### 3.2.2. Steps taken by the CEA

CEA is building its new nuclear facilities only on its centres which already host other facilities. In practice, the host sites are now almost exclusively Cadarache and Marcoule, which are remote from urban areas and offer intrinsic characteristics that are favourable to the siting of such facilities. In the Saclay centre, new facility projects can occasionally be initiated, but they generally either replace older facilities that are hard to maintain to current safety standards (this was the case with the Centre's Stella liquid effluent treatment plant), or facilities with low potential impact dedicated to post-operational radioactive clean-out of facilities that have been shut down.

The general waste management strategy at CEA therefore aims, following initial packaging in their production centre, to send to Cadarache or Marcoule waste that requires more extensive treatment, packaging and possible storage pending opening of a disposal route. The corresponding facilities are built in compliance with the regulations and the local residents are both informed and consulted, more specifically through public inquiries. A public inquiry is thus scheduled for 2014 in Marcoule for the Diadem radioactive waste storage facility and for various sodium waste treatment facilities made necessary by the decommissioning of the Phenix reactor.

### 3.3. ASN analysis for BNIs

ASN ensures compliance with the regulations by reviewing the files presented by the licensees and by carrying out inspections.

With regard to the deep geological disposal project, ASN sent the Government the following opinions in recent years:

- in early 2010 a positive opinion on Andra's proposal for a zone of interest favourable for siting of such a repository, in which additional geological investigations will be carried out;
- on 10 May 2011 an opinion concerning the benefits to be gained from continuing research and experimentation work in the Meuse/Haute-Marne underground laboratory;
- on 26 July 2011 an opinion on the file transmitted in late 2009 by Andra, more specifically presenting an update of the safety and reversibility options for the disposal facility and the inventory of waste adopted for the design of the facility;
- on 16 May 2013 an opinion on the documents produced by Andra since 2009. In this opinion, ASN recalls certain principles which as project manager, Andra must follow, notably the need to maintain the radiological impact as low as possible in the light of current scientific knowledge, current technology and economic and social factors. While underlining the quality of the work done by Andra, ASN makes a number of recommendations for the future studies and work. ASN specifies the principles it adopts for the waste inventory, with a view to the future review of the repository creation authorisation application and any modification requests made during operation.

Finally, in December 2013, ASN published a letter which it sent to Andra following the review of a file entitled “*Projet Cigéo – Esquisse Jesq03* (2012)”. This file concisely presents “the overall architecture adopted for the design studies” and more particularly specifies the project design changes and their impact on safety by comparison with the file transmitted in late July 2009.

ASN noted that Andra has taken account of the main recommendations it made in 2011 concerning the operating risks and considers that certain new design elements will reinforce safety in this respect. ASN thus stresses that certain options chosen by Andra must be justified in detail and their influence on safety explained in the facility’s creation authorisation application file.

All these opinions can be consulted in French on the ASN website.

Through follow-up visits to the underground laboratory, ASN ensures that the experiments carried out in accordance with the Waste Act follow processes guaranteeing the quality of the results obtained.

### 3.4. ICPEs and mine tailings

Environmental acceptability is the founding principle of ICPE regulations.

In accordance with European directives for all facilities subject to licence, any application must comprise a study analysing the impact of the project on the environment. Its content must be commensurate with the scale of the planned work and the foreseeable consequences. The impact assessment must include:

- an analysis of the initial state of the site and of the environment, particularly with regard to natural resources, tangible assets and the cultural heritage likely to be affected by the project;
- an analysis of the direct and indirect, temporary and permanent effects of the facility on the environment;
- an analysis of the environmental effects in combination with other projects;
- the reasons for which, particularly in terms of environmental concerns, the project was selected among possible solutions; and
- the measures planned by the applicant to eliminate, to restrict and, if possible, to compensate any inconvenience induced by the facility.

The licence application must also include a risk analysis, consisting of a description of likely accidents to occur due to potential external causes, with due account of the planned location involved, as well as an overview of the potential hazards of the facility in case of accident.

The content of the hazard and impact assessments, and all aspects of the licence application case, must be made public and submitted to the populations concerned for comments through the framework of a public inquiry.

The general regulations for mining industries set specific rules for the management of ore-tailing and waste disposal sites, if the uranium concentration exceeds 0.03%.

A management plan for those disposal sites must be established and specify appropriate steps to be taken to limit the radiological impact on the environment.

Those disposal sites must be monitored by their operators until such time when their radiological impact on the environment is acceptable.

## 4 | FACILITY DESIGN AND CONSTRUCTION (ARTICLE 14)

*Each Contracting Party shall take the appropriate steps to ensure that:*

- i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;*
- ii) at the design stage, conceptual plans and, as necessary, technical provisions for the decommissioning of a radioactive waste management facility other than a disposal facility are taken into account;*
- iii) at the design stage, technical provisions for the closure of a disposal facility are prepared;*
- iv) the technologies incorporated in the design and construction of a radioactive waste management facility are supported by experience, testing or analysis.*

### 4.1. ASN requirements for BNIs

The general regulations for BNI design and construction are described in § E.2.2.3 with regard to procedures, in § E.2.2.5 with regard to technical rules and in § F.4.1.4.1 with regard to discharges. Over and above general regulatory requirements, ASN may issue technical prescriptions pertaining to the design, construction or operation of any planned facility. These prescriptions thus supplement the facility's creation authorisation decree.

For a disposal facility and in accordance with the *BNI Order*, the choice of geological medium, the design and construction of a radioactive waste disposal facility, its operation and its transition to the monitoring phase are defined in order to provide passive protection for persons and the environment from the radioactive substances and the toxic chemicals contained in the radioactive waste. This protection should not require any intervention after a monitoring period, determined according to the radioactive waste emplaced and the type of repository. The licensee shall demonstrate that the design meets these objectives as well as its technical feasibility.

The technologies used in the design and construction of a radioactive waste management facility must draw on experience, tests and analyses. This is notably the case with the deep geological disposal project, thanks to the underground laboratory. This is also the case of waste treatment/packaging, storage or disposal BNIs, for which the processes and equipment which are elements important for protection, must be based on proven technologies or, in the case of a prototype, must be the subject of qualification files, for which tests are systematically performed in the facility before it is commissioned.

For other facilities than disposal facilities, the operator must take all necessary measures as early as the design stage in order to facilitate its decommissioning and to limit the production of resulting waste.

According to the Environment Code, the operator must demonstrate, as early as his creation-licence application, that his proposed general decommissioning principles are able to prevent or to limit potential risks or inconveniences of the facility; similarly, he is required to demonstrate that his proposed method for maintaining and monitoring his radioactive-waste disposal facilities after closure are also able to prevent or to limit such risks or inconveniences. The *BNI Procedures Decree* specifies that the creation-licence application must include a decommissioning plan. It presents the proposed principles and phases for the decommissioning of the facility, as well as for the rehabilitation and subsequent monitoring of the site. It must also justify the timeframe between the final shutdown and the dismantling of the facility.

ASN feels that the following items are especially important as early as the design and construction phases of any new facility:

- the selected materials;
- effective measures to facilitate decommissioning operations;
- circuit-related measures in order to prevent active deposits, in order to limit any extension of contamination and to facilitate not only the decontamination of premises and equipment, but also the electrical shut-off of the buildings, and
- the collection and archiving of necessary documents and data.

The description of the steps taken during the design stage in order to facilitate decommissioning and to limit the production of resulting waste used to be rather brief in the past. At present, owing to the new regulatory requirements (decommissioning plan, waste studies), this is more detailed for new BNIs.

For a waste disposal facility, the *BNI Procedures Decree* requires that, in the creation authorisation application, the decommissioning plan be replaced by a document presenting the means envisaged, as of the design stage, for final shutdown and subsequent monitoring of the facility. This document must include an initial safety analysis of the facility following final shutdown and transition to the monitoring phase.

## 4.2. ICPEs

For radioactive-waste management facilities constituting ICPEs, the general ICPE regulations apply, as described in § E.2.3.1 with respect to design and construction.

The regulatory body (the Prefect in each *département*) ensures that those regulations are duly enforced through the analyses and inspections it conducts according to the modalities described in § E.2.3.3.

## 5 | SAFETY ASSESSMENT OF FACILITIES (ARTICLE 15)

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*Each Contracting Party shall take the appropriate steps to ensure that:*

- i) before construction of a radioactive waste management facility, a systematic safety assessment and an environmental assessment appropriate to the hazard presented by the facility and covering its operating lifetime shall be carried out;*
  - ii) in addition, before construction of a disposal facility, a systematic safety assessment and an environmental assessment for the period following closure shall be carried out and the results evaluated against the criteria established by the regulatory body;*
  - iii) before the operation of a radioactive waste management facility, updated and detailed versions of the safety assessment and of the environmental assessment shall be prepared when deemed necessary to complement the assessments referred to in paragraph (i).*
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### 5.1. Regulatory Framework and ASN requirements for BNIs

The BNI general regulations apply to radioactive waste-management facilities pertaining to that category, set by decree, due to their radiological content.

Requirements and modalities for safety-assessment purposes were described in § E.2.2.3.1 and E.2.2.4, whereas the general principles are reiterated below.

In order to apply for a licence to create a disposal facility, the applicant must provide a certain number of data and studies, notably a preliminary safety report and the impact study prescribed by the *Environment Code*. All lifetime phases of the facility must be reviewed (including its decommissioning or, in the case of a disposal facility, the subsequent period after shutdown). ASN reviews the preliminary safety report and forwards its opinion to the Minister for the drafting of the decree licensing or denying the creation of the facility.

The main requirements concerning the preliminary safety report are defined in Article 10 of the *BNI Procedures Decree* and the *BNI Order*. Among other things, this latter specifies the principles and procedures relating to the safety case. The licensee must in particular apply the principle of defence in depth. The order specifies how this principle is to be applied.

On its website, ASN has posted a draft resolution for public consultation and opinion, defining the requirements concerning the BNI safety reports. This draft more specifically stipulates the elements to be included in the safety report. Furthermore, as mentioned in § H3.1 above, ASN has issued basic safety rules and safety guides to define the objectives to be adopted from the outset, to ensure the safety of the facility, including safety after closure when dealing with a repository.

It should be noted that the operator may, even before initiating the licensing procedure, request ASN's opinion on all or part of his selected options for the safety of the future facility. That preparatory procedure does not replace any of the subsequent regulatory reviews, but is consistent with a process aiming at clarifying, from the early stages of the studies, the basic safety principles for the future facility.

Once the facility is built and for the facility commissioning, hence for the first introduction of radioactive substances, the operator must submit a specific report to ASN as specified in § E.2.2.4.1.

Once the case reviewed and, if the conclusions of that review are favourable, ASN may license the commissioning of the facility. In its Resolution, ASN then must set the deadline after which the operator must submit an end-of-commissioning report for the facility (Cf. E.2.2.4.2).

Licences do not include any time limit. However, periodic safety reviews must be carried out every 10 years. It should be noted that the implementation decree may set a different timescale, if the specificities of the facility warrant it and ASN may suspend the license in the event of imminent danger.

Some clarifications concerning the safety assessment and the environmental assessment of the disposal facilities, for the period following closure, are given below. Two types of situations are to be considered:

- the reference situation, based on a scenario involving the normal evolution of the disposal facility, and
- so-called “altered evolution” scenarios, resulting from uncertain events that are more or less likely, whether they are natural or associated with human actions.

The impact assessment under normal-evolution conditions must be based on a deterministic approach with reasonably conservative models and parameters. Uncertainty studies must be conducted. If the assessment involves a value above 0.25 mSv/a, it would be appropriate either to reduce uncertainties by an adapted research programme or to revise the design of the facility. In the case of a deep geological repository, the quoted value of 0.25 mSv/a would be maintained as a reference value for any timescale above 10,000 years.

With altered situations, assessments may lead to exposures in excess of 0.25 mSv/a, in which case the criteria to judge whether the impact is acceptable or not refer to the exposure mode and time, as well as to the conservative aspect of the selected assessment hypotheses (as specified in § D.3.2.2.2).

For instance, in the case of the CSA in the Aube *département*, the following altered scenarios have been selected for the phase following the 300-year monitoring period:

- conventional intrusion scenarios leading to air transfer (road works, homes, children’s playgrounds), and
- various scenarios leading to a water transfer in the aquifer (barrier failure, water feed wall).

In addition, the Safety Guide of 12 February 2008 for the final geological disposal of radioactive waste provides for an initial period of 500 years corresponding to the memory preservation of the repository, thus allowing very little probability for human intrusions in the disposal area. That period corresponds also to a significant radioactive decay of the short-lived or medium-lived radionuclides involved.

## 5.2. Steps taken by BNI operators

### 5.2.1. ANDRA practices

For the creation of the CSA, the safety and environmental assessments dealt not only with the operating phase, but also with the 300-year monitoring phase, and the subsequent post-monitoring phase, which rests on the implementation of passive safety measures. The design of the disposal structures and the specifications applicable to CSA waste packages take into account all lifetime phases mentioned before. In addition, preparations for the CSM’s transition unto its post-closure monitoring phase were made by applying the same conditions as for the creation of a new BNI.

Concerning the Cires, which is subject to ICPE rather than BNI regulations, a comparable scheme was followed, with the production of safety studies and environmental impact assessments, concerning not only construction and operation, but also the long-term future of the facility after closure. These studies are updated each time the facility is modified.

### 5.2.2. Practices of other operators (CEA, Areva, EDF)

The CEA, AREVA and EDF practices are identical to those implemented for spent-fuel management facilities as described in § G.2.2.

### 5.3. ASN analysis for BNIs

The deep geological disposal project is still at a phase which precedes the creation authorisation application. The ASN analysis is described in § H.3.3 above.

Existing disposal facilities are for their part periodically reviewed. The CSA leads to no particular comments, other than that ASN is in favour of Andra's project concerning the development of its on-site package inspection capacity (see § H.6.3 below). As for the CSM, it is dealt with in § H.7.1 below.

### 5.4. ICPEs and mine tailings

Assessing the design choices made by the applicant and the impacts and hazards relating to an ICPE that is subject to licensing or to a mine-tailing disposal facility must be analysed during the review of the impact assessments and risk study (see § E.1.2. and § H.3.4).

The objective of the operators and agents responsible for the administrative monitoring is to determine proportional constraints to the risks and hazards involved in the long-term site management and monitoring of the sites.

## 6 | OPERATION OF FACILITIES (ARTICLE 16)

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*Each Contracting Party shall take the appropriate steps to ensure that:*

- i) the licence to operate a radioactive waste management facility is based upon appropriate assessments as specified in Article 15 and is conditional on the completion of a commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements;*
  - ii) operational limits and conditions derived from tests, operational experience and the assessments, as specified in Article 15, are defined and revised as necessary;*
  - iii) operation, maintenance, monitoring, inspection and testing of a radioactive waste management facility are conducted in accordance with established procedures. For a disposal facility the results thus obtained shall be used to verify and to review the validity of assumptions made and to update the assessments as specified in Article 15 for the period after closure;*
  - iv) engineering and technical support in all safety-related fields are available throughout the operating lifetime of a radioactive waste management facility;*
  - v) procedures for characterisation and segregation of radioactive waste are applied;*
  - vi) incidents significant to safety are reported in a timely manner by the holder of the licence to the regulatory body;*
  - vii) programmes to collect and analyse relevant operating experience are established and that the results are acted upon, where appropriate;*
  - viii) decommissioning plans for a radioactive waste management facility other than a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility, and are reviewed by the regulatory body;*
  - ix) plans for the closure of a disposal facility are prepared and updated, as necessary, using information obtained during the operating lifetime of that facility and are reviewed by the regulatory body.*
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### 6.1. Regulatory framework and ASN requirements

The requirements referred to in Article 16 of the *Joint Convention* are consolidated in the French regulations.

The licence to operate any disposal facility for radioactive waste may only be granted in accordance with the procedure referred to § E.2.2.4 and reiterated in § H.5.1.

The RGEs established by the operator, in accordance with the *BNi Procedures Decree*, must describe the operating limits and conditions of the facility involved. Those RGEs must be revised periodically in order to take into account the evolution of the facility and of the acquired experience.

Quality-assurance rules determine the quality requirements for the operation, maintenance, monitoring and inspection of the facility (See *BNi Order*). More particularly, the operator must have all necessary skills for carrying out all safety-related activities concerned. However, he may call upon external support with regard to engineering and technology in all safety-related fields.

In accordance with the Environment Code, all significant incidents or accidents for nuclear safety or radiation protection must be declared to ASN and to the State representative in the *département* in which the incident or accident took place (see § E.2.2.4.4 and E.2.2.7.2).

The operator must provide a detailed report, including a technical analysis, a human-factor report and a cause tree. ASN must check the thoroughness of the report and use it for a cross-functional analysis between the various operators.

During every decennial safety reviews, all experience feedback on incidents that occurred over the latest decade in France and abroad must be assessed in order to propose potential safety improvements.

A decommissioning plan must also be submitted by the applicant as early as his licence application to create a BNI other than a disposal facility for radioactive waste (see § H.4.1). In the case of a disposal facility, the decommissioning plan is replaced by a document containing the planned modalities for final shutdown, the transition unto a secure state and subsequent monitoring phase (see § H.4.1).

Waste packaging is an essential aspect of radioactive waste management, because the package is the first of the three containment barriers in a disposal facility and, in the case of storage, plays an important role in both containment and possible retrieval.

In accordance with Article L. 542.12 of the Environment Code, Andra is in charge of drafting specifications for disposal of radioactive waste and for giving the competent administrative authorities an opinion on the waste packaging specifications.

The *BNI Order* specifies the following points:

- Waste intended for facilities with acceptance specifications stipulated in Article L. 542.12 of the Environment Code is packaged in accordance with these specifications;
- The packaging of radioactive waste intended for facilities currently being studied and for which there are no acceptance specifications requires prior approval by ASN.

A draft ASN resolution will be made available to the public on the ASN website in 2014 for observations. The purpose of this draft is to specify the requirements of the *BNI Order*.

For the CSA, ANDRA has set in place a series of procedures (specifications, certification procedure, verification and computerised monitoring, visual control and dose rate upon arrival, handling procedures for non-conformities). As mentioned in § D.3.2.2.2 above, the criteria for package acceptance in the centre are the result of the operating and long-term safety assessments. Each producer designs and develops its processing/packaging projects (per type of final package) and submits them to Andra for a check on conformity with the specifications issued by this organisation and to obtain final approval. It should be remembered that the CSA can only accept approved packages for disposal.

For certain radioactive waste, and notably HL/IL-LL waste, a repository is under review, but its commissioning is not planned before 2025 (industrial-pilot phase), according to the necessary authorisations. Hence, the acceptance specifications for HL/IL-LL will only be developed as studies advance. Preliminary acceptance specifications for HL/IL-LL waste packages will be issued only at the time when the licence application to create a deep geological formation repository to be submitted.

In this framework, AREVA NC has been developing production specifications for its packages at La Hague plant since 1991 and continues to do so for new package types, with a view to ensuring that production is based on a qualified process and quality-assurance procedures. ASN and its technical support organisation review those package-production specifications before any new waste packages will be produced. ANDRA also provides its opinion to ASN.

## 6.2. Steps taken by BNI operators

### 6.2.1. ANDRA operational safety practices

For its facilities, ANDRA follows the procedures described in § E.2.2, especially with regard to commissioning and to the declaration of safety-related events.

RGEs and General Monitoring Rules (*Règles générales de surveillance* – RGS) describe the normal operating mode for disposal facilities. Established by ANDRA, they are consistent with general regulations, each facility's specific regulations (especially the creation-licence decree) and the technical requirements notified by ASN. RGEs and RGSes are subject to the formal approval of ASN.

Environmental-monitoring plans are also drawn up by ANDRA and prescribe the qualitative and quantitative nature, as well as the frequency, of measurements to be taken in or around the disposal facilities in order to meet the objectives of the decree on the transition unto the monitoring phase and to the order for licensing discharges. They are also subject to ASN's critical review prior to their implementation.

Those steps are taken not only at the CSA in service, but also at the CSM, now in its monitoring phase.

In the case of the Cires, ANDRA complies with the requirements of the ICPE regulatory framework, as described in § E.2.3.1.

Generally speaking, all ANDRA activities, especially the operation, maintenance and monitoring of disposal facilities, are carried out in accordance with established procedures that are consistent with ANDRA's quality system (see § F.3.2.1). The structure of the Agency is designed to maintain the necessary scientific and technical skills in all areas relating to the safety of its facilities (see § F.2.2.1).

#### **6.2.2. Operational safety practices of CEA, AREVA and EDF**

Radioactive-waste and spent-fuel management facilities all constitute BNIs. Consequently, the operational-safety practices of the CEA, AREVA and EDF are identical to those applicable to spent-fuel management facilities, as described in § G.6.2.

### **6.3. ASN analysis for BNIs**

As mentioned above, the purpose of the provisions described in § E.2.2 concerning BNI regulations is to comply with the objectives of Article 16 of the *Joint Convention*. Controlling the steps taken by operators, particularly through frequent inspections and periodic safety reviews, ensures that the regulations are applied properly.

In 2011, Andra submitted an application for modification of the facilities, so that in addition to the non-destructive checks already performed (visual, X-ray, sizing, gamma spectrometry) they could carry out X-ray imaging checks, tritium degassing checks and destructive inspections (core sampling of low radioactivity packages). ASN is in favour of Andra having its own advanced inspection resources in order to check the quality of the packages received in its facilities, including by means of spot checks. The construction of this facility was approved by ASN in mid-2013.

In addition, ASN receives every year ANDRA's status reports on the quality of the packages received at the CSA, from every major waste producer. ASN conducts inspections in order to verify the soundness and efficiency of the system set in place by ANDRA.

### **6.4. ICPEs and mine tailings**

In the case of ICPEs, the steps to be taken with regard to the operation, maintenance, monitoring, and ultimately upon termination of activity, are prescribed through technical requirements to be incorporated into the relevant prefectoral order (see § E.1.2), taken in application of the *Environment Code*, notably of its Book V, as described in § Annex. With regard to mine tailings, since all facilities are no longer in operation, practices with regard to closure are described in § H.7.2.

## 7 | INSTITUTIONAL MEASURES AFTER CLOSURE (ARTICLE 17)

*Each Contracting Party shall take the appropriate steps to ensure that after closure of a disposal facility:*

- i) records of the location, design and inventory of that facility required by the regulatory body are preserved;*
- ii) active or passive institutional controls such as monitoring or access restrictions are carried out, if required, and*
- iii) if, during any period of active institutional control, an unplanned release of radioactive materials into the environment is detected, intervention measures are implemented, if necessary.*

### 7.1. Waste generated by BNIs or ICPEs

#### 7.1.1. Legislative framework

The legislative framework applicable to radioactive waste disposal BNIs for the period following their closure is as follows:

- the *Environment Code* requires that the transition of such a BNI to the monitoring phase be subject to authorisation (Article L. 593.25) and that the administrative authority may implement institutional controls applicable to this BNI (Article L. 593.5);
- the *BNI Procedures Decree* specifies the content of the application for authorisation to make the transition to the monitoring phase (this file more specifically contains an impact assessment, a safety report, a risk management assessment, the general monitoring rules and, as necessary, the institutional controls);
- the *BNI Order* more specifically requires that protection of the interests mentioned in Article L. 593.1 of the *Environment Code* (i.e. security, public health and safety, protection of nature and the environment) must be ensured in a passive manner and must not require any intervention after a limited monitoring period, it being understood that the licensee must justify the design adopted and the technical feasibility such as to be able to meet these requirements.

#### 7.1.2. The Centre de stockage de la Manche (CSM)

In France, the CSM is the only facility to have moved unto its monitoring phase (final shutdown according to the definition given by the *Joint Convention*). Waste reception operations stopped on 30 June 1994 but the facility entered into its monitoring phase in January 2003 (See decree for moving in monitoring phase on 10 January 2013).

The different characteristics of the CSN monitoring phase are detailed above in § D.3.3.1. and in § F.4.2.1.3 for liquid discharges.

*The monitoring phase is the period during which the disposal facility must be controlled* (access restriction, with monitoring and repairs, if need be). That phase is due to last for at least 300 years, with due account of the fact that the number of required actions will decrease over time. The said *Decree of 10 January 2003* specifies that the monitoring plan throughout that period is revised every 10 years, at the same time as the safety report, the RGEs and the emergency plan. Those documents are submitted to ASN for review and take experience feedback into account. Similarly to the CSM case, the approach must be gradual and cautious.

During the procedure which authorised the CSM to enter the monitoring phase, a certain number of recommendations were issued, notably by the Manche repository situation review board, known as the “Turpin Commission” (1996), such as:

- to assess the durability of the installed cover and estimate the benefits of replacing it by a new one in order to facilitate the control programme;
- to optimise the control programme, in order for monitoring to become increasingly passive;
- to hand over all required information to future generations (plans, data, summary report and detailed case, transmission support, etc.), and
- to inform and to involve the public throughout the monitoring phase.

The years of CSM operation were marked by tritium contamination of the groundwater, discovered in 1976. The waste which caused this contamination was removed in 1977 and 1978 but contamination of the groundwater remains significant. At the request of the CLI, four tritium measurement campaigns were performed via boreholes. The tritium concentration varies according to the depth. These measurements were supplemented by Andra. On the basis of the measurements taken and the interpretation of the results by Andra, ASN will check whether the centre's monitoring plan is sufficient or whether additional studies and measures are necessary in order to fine-tune the hydrogeological model.

*As already mentioned in § D.3.2.2.1, the safety reassessments are carried out every ten years.* The last safety assessment was carried out on the centre by ASN in December 2009. ASN made its conclusions known concerning the files in a letter sent out on 15 February 2010. Following isolated problems with the cover embankment, Andra established a programme to consolidate these embankments that the Agency is gradually implementing. An interim report on the repository cover modifications will be presented to ASN by 2015, as requested by ASN in 2009. ASN also asked that a monitoring effort be maintained and that a clearer understanding of the long-term behaviour of the repository be obtained.

### Long-term archival and conservation of memory

#### Archival

*Long-term archiving also constitutes a significant component.* The technical prescriptions set by ASN for the monitoring phase require that the following information be archived over the long term.

In order to retain the memory of the Centre and encourage its transmission over several centuries, Andra has taken a number of steps, which were mentioned in § D.3.2.2.1 and which are specified below.

Andra has created a “passive” memory consisting of detailed memory records and summary memory records. All of the documents constituting the detailed record are printed on permanent paper and kept in duplicate, in two different locations. In accordance with the recommendations of the “Turpin Commission”, Andra produced an interim version of the “summary record” in 2008, with the aim of preserving essential information about the CSM for future generations. Following the assessments carried out in 2012 to examine the pertinence of the data contained in the detailed record, Andra is required to carry out an exercise to prioritise the data it contains, by the end of 2016. A new version of the summary record should also be produced by the same date. The existence of the repository is also recorded in the land registry.

Andra also utilises an “active” record based on communication with the public and regular contacts with the Local Information Committee.

#### The memory project

The solution adopted by Andra to conserve a memory of the CSM focuses on documentary conservation and does not consider other media. Moreover, conservation of this memory for “only” a few centuries after closure of the repository is felt to be too short by several of the stakeholders in the future Cigéo project. Andra therefore decided in 2010 to launch a memory project with a two-fold aim: increase the robustness of the reference solution and give consideration to a memory lasting several millennia.

Scientific studies on materials ageing consisted in testing the ink/paper pair using standardised tests. This needs to be further consolidated by an international laboratory. Long-term durability studies on other media are currently being defined. They will concern media other than paper for writing and etching, more specifically studies of surface markers to be installed on the cover of the centres and the production of sapphire disks as demonstrators of a memory medium lasting up to a million years.

Studies of a completely different nature have also been initiated on the following subject.

#### Permanence:

- of languages and symbols, in order to determine the reasonable period for which current or dead languages can be known, and what the communication solutions might be once these languages are no longer known,
- of institutional conservation of writing, audio, objects, etc., by the specialised French but also international organisations, to analyse the preventive measures taken to limit deterioration over time and encourage assimilation and transmission by future generations,

- of long-duration digital archival, notably by organising an intelligence watch in this field which is beginning to develop and which, within the time frame of a few decades, could open up new prospects for the long term,

#### Temporality and vestiges:

- archaeology of techniques and landscapes, incorporating man-made and geodynamic changes and the possibility of memory within human creations (use of the infill of surface-ground connections as a memorisation tool),
- memory of “legacy” disposal sites not managed by Andra, which exist at various locations in France (uranium mines, nuclear test sites, etc.),

#### The societal aspect of the problem:

- perception of long time scales (several millennia and more) by the public, within a grouping of human and social sciences laboratories,
- three main orientations (regression, stagnation, progress) for the possible societal changes in science, technology, humanity, etc.,
- integration of the preservation of the memory of disposal facilities into nuclear, heritage and memory teaching programmes,
- transmission of memory between generations via the social networks on the web, to provide worldwide information about the memory of the disposal centres.

## 7.2. Mine tailings

After shutdown, mining sites must undergo work in accordance with the Prefect’s decisions in order to control long-term hazards by selecting robust and durable structures.

First of all, the Prefect requires the implementation of a reliable active monitoring system guaranteeing that any impact remains acceptable.

On the basis of experience feedback from that control, active monitoring may be scaled down to passive monitoring. Long-term acceptability is examined in the light of realistic scenarios of degraded situations (loss of embankment impermeability, cover degradation, mining works, residential homes, etc.).

One major aspect of the monitoring system is institutional control, the aim of which is to ensure that any changes brought to the land will not affect risk control. The institutional control of lands and waters consists of the following:

- restrictions on the occupation or use of the site (irrigation, agriculture, breeding, home building, swimming, etc.);
- mandatory actions (monitoring, maintenance, etc.);
- required precautions (excavation work, pipe laying, etc.), and
- access restrictions.

Information must be accessible to the public and certified by a notary (contract lawyer). In the event of a major hazard, the Prefect may decide to implement a mining risk prevention plan.

Mining site rehabilitation has been designed and then carried out with a view to scaling down the monitoring of those sites to a very slight level, once an active monitoring phase of a few years is set in place. The objective of operators and agents responsible for administrative monitoring was to avoid excessive site-monitoring or maintenance constraints over the long term.

However, checks and even modifications proved to be necessary for the disposal sites used for treatment residues from uranium-bearing ore and mining waste rock, and measures scheduled to last a certain time are currently ongoing (see § B.6.3).



# SECTION I | TRANSBOUNDARY MOVEMENTS

## (ART. 27)

### Article 27

1. *Each Contracting Party involved in transboundary movement shall take the appropriate steps to ensure that such movement is undertaken in a manner consistent with the provisions of this Convention and relevant binding international instruments. In so doing:*
  - i. *a Contracting Party which is a State of origin shall take the appropriate steps to ensure that transboundary movement is authorised and takes place only with the prior notification and consent of the State of destination;*
  - ii. *a transboundary movement through States of transit shall be subject to those international obligations, which are relevant to the particular modes of transport utilised;*
  - iii. *a Contracting Party which is a State of destination shall consent to a transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or the radioactive waste in a manner consistent with this Convention;*
  - iv. *a Contracting Party which is a State of origin shall authorise a transboundary movement only if it can satisfy itself in accordance with the consent of the State of destination that the requirements of subparagraph (iii) are met prior to transboundary movement, and*
  - v. *a Contracting Party which is a State of origin shall take the appropriate steps to permit re-entry into its territory, if a transboundary movement is not or cannot be completed in conformity with this Article, unless an alternative safe arrangement can be made.*
2. *A Contracting Party shall not license the shipment of its spent fuel or radioactive waste to a destination south of latitude 60 degrees South for storage or disposal.*
3. *Nothing in this Convention prejudices or affects:*
  - vi. *the exercise, by ships and aircraft of all States, of maritime, river and air navigation rights and freedoms, as provided for in international law;*
  - vii. *rights of a Contracting Party to which radioactive waste is exported for processing to return, or provide for the return of, the radioactive waste and other products after treatment to the State of origin;*
  - viii. *the right of a Contracting Party to export its spent fuel for processing, and*
  - ix. *the rights of a Contracting Party to which spent fuel is exported for processing to return, or provide for the return of, radioactive waste and other products resulting from processing operations to the State of origin.*

## 1 | LICENSING OF TRANSBOUNDARY TRANSPORT

France advocates the principle whereby every NPP operator is liable for the waste he generates. That principle is integrated in the Environment Code which prohibits the disposal of any radioactive waste in France that originates from abroad or results from the processing of spent fuel and radioactive waste produced abroad. The same Article specifies that the introduction of any radioactive substance or equipment on French soil for treatment purposes is conditional upon intergovernmental agreements, setting a mandatory date for the return of the ultimate treatment waste to the country of origin (see § B.1.4).

Radioactive waste is conditioned in a form that guarantees their most secure transport and storage possible for the environment and public health. France ensures that the countries of destination of that waste comply with the obligations set by § 1 of Article 27 of the *Joint Convention*.

With regard to the organisation of transboundary movements, France applies all international, European and national safety, transport, security, physical-protection and public-order regulations, including the prescriptions of *2006/117/EURATOM Council directive of 20 November 2006 concerning the monitoring and control of radioactive-waste and spent-fuel transfers*, as transposed in internal law by *Decree No. 2008-1380 of 19 December 2008* and codified in Articles R. 542-34 to 66 of the *Environment Code*.

Transboundary movements of spent fuel and radioactive waste between France and third-party countries involve mainly spent-fuel processing operations, that are performed at the La Hague Plant on behalf of Belgian, Dutch, German, Italian, Japanese and Swiss customers.

Most transboundary movements between European countries are made by rail. Sea routes are used for Japan-bound shipments, since suitable port infrastructures meeting the required nuclear-safety level have been built at both ends of the itinerary. No significant incident compromising safety, security or radiation protection has been notified in recent years during those shipments.

In accordance with § 2 of Article 27 of the *Joint Convention*, France has never authorised any spent-fuel or radioactive-waste movement towards a destination located south of 60° latitude South.

Since French authorities are truly committed to fulfilling the transport provisions of Article 27 of the *Joint Convention*, they readily supplement them through a transparency policy, based on information exchange and dialogue, particularly with the public at large and civil society. More specifically, they apply those sea-transport provisions to coastal States along the sea routes and conduct diplomatic information campaigns.

## 2 | CONTROL OF TRANSPORT SAFETY

### 2.1. Organisation of safety control for the transport of radioactive substances

Since 12 June 1997, ASN has been responsible for regulating and controlling the safe transport of radioactive and fissile materials for civilian uses. Its powers in that field are mentioned in the *Environment Code*.

It should be noted that transport regulations for radioactive substances have two separate objectives, as follows:

- security, or physical protection, consists in preventing any loss, disappearance, theft and fraudulent use of nuclear materials (usable for nuclear weapons production), for which the High Civil Servant for Defence and Security (*Haut fonctionnaire de défense et de Sécurité* – HFDS) reporting to the Minister of Ecology, is, per delegation of the Ministry of Defence and Energy, the competent authority, and
- safety consists in controlling the irradiation, contamination and criticality risks relating to the transport of radioactive and fissile materials, in order to protect human beings and the environment against their ill effects. Safety control is the responsibility of ASN.

In accordance with *Decree No. 2001-592 of 5 July 2001 Relating to the Safety and Radiation Protection of National Defence Activities and Facilities*, the transport of radioactive and fissile substances for defence purposes is the responsibility of the Managing Director for the Nuclear Safety and Radiation Protection of National Defence Activities and Facilities (*Délégué à la sûreté nucléaire et à la radioprotection pour les activités et installations intéressant la défense* – DSND).

With regard to controlling the safe transport of radioactive and fissile substances, ASN is responsible for the following aspects:

- defining technical regulations and monitoring their application;
- accomplishing licensing procedures (certification of packages and organisations);
- organising and implementing inspection procedures;
- take all enforcement measures (formal notice, consignment, ex officio execution of work, shipment suspension, etc.) and impose all necessary sanctions; and
- proposing and organising public information.

In addition, ASN may also intervene in the framework of emergency plans developed by public authorities in case of accident.

### 2.2. Regulations for the Transport of Radioactive Material

Unlike technical safety regulations for facilities, which are specific to each State, an international basis for transport safety has been defined by the International Atomic Energy Agency (IAEA) and constitutes its *Regulations for the Safe Transport of Radioactive Materials* (TS-R-1).

That basis has been used in order to define the following modal safety regulations currently in force:

- the *European Agreement Concerning the International Carriage of Dangerous Goods by Road* (ADR Agreement) for road transport;
- the *Regulations Concerning the International Transport of Dangerous Goods by Rail* (RID Regulations) for rail transport;
- the *Regulation for the Carriage of Dangerous Substances on the Rhine* (ADN Regulations) for inland waterway transport;
- the *International Maritime Dangerous Goods Code* (IMDG Code) for sea transport, and
- the technical instructions of the International Civil Aviation Organisation (ICAO) for air transport.

These modal regulations have been fully transposed into French law and are enforced by orders. In that context, ASN has frequent contacts with public administrative services, such as the General Directorate for Infrastructures, Transport and the Sea (*Direction générale des infrastructures, des transports et de la mer* – DGMT) and the Directorate General for Civil Aviation (*Direction générale de l'aviation civile* – DGAC); it also has a representative on the Interministerial Committee on the Transport of Dangerous Goods (*Commission interministérielle du transport des matières dangereuses* – CITMD).

Transport safety is based on three main factors:

- the robustness of the packages;
- the reliability of transport means and of the special equipment of certain vehicles, and
- the efficiency of the emergency preparedness plan in case of accident.

Regulations are based on the IAEA recommendations, which specify performance criteria for packages. The safety functions to be achieved include containment, radiation protection, thermal-risk control and criticality.

The safety level of the packages is adapted to the potential harmfulness of the transported material. For each type of package (excepted packages, industrial-type packages, Type-A packages, Type-B packages, Type-C packages), the regulations define the relevant safety requirements, together with test standards to be met.

In order to ensure compliance with specifications and operators' awareness of their obligations, the responsibility for safety lies with the operator requesting transport, thus barring any other duly formalised arrangement.

ASN is the competent authority for the safe transport of radioactive materials. It supervises the drafting and enforcement of technical regulations. Two other public organisations are also involved as follows:

- IRSN, as technical support for certain governmental authorities, by reviewing application and reports, and
- the Ministry of the Interior, whose responsibility is to prepare the site-emergency plans to be implemented by the Prefects (*Plans d'Organisation des SECours* – ORSEC).

In consultation with the IRSN, ASN strives to intervene as early as possible in the development of regulations by participating notably in different existing international or multinational working groups on the transport of hazardous or radioactive materials.

In such framework, ASN is a member of the IAEA Transport Safety Standards Committee (TRANSSC) and sits as expert on many task forces on transport. It also participates in European Competent Authorities Association (EACA).

With regard to spent fuel, France is not bound by the obligations referred to in Article 27.1.IV, since it imports mainly spent fuel in order to process it on its territory, at La Hague. Nevertheless, relevant contracts are covered by intergovernmental agreements between the French government and the other foreign governments involved, in accordance with the *Environment Code*.

With regard to the transport of radioactive waste, the obligations must comply with regulations concerning safety, transport, security, physical protection and maintenance of law and order. Those regulations are derived from national and international laws and from the requirements defined by the IAEA after

consultation with various international bodies in charge of transport safety issues. In particular, Articles 13, 15 and 25 of the *Decree of 22 September 1994 Relating to the Import, Export, Transit and Exchange of Waste between the Member States of the European Community via France*, which transposes *EURATOM directive No. 92/3*, specifies that before authorising any transboundary movement of radioactive waste, the competent French authority must ensure that the State authorities of the country of destination have approved such shipment.

*Law No. 80-572 of 25 July 1980 Concerning the Protection and Control of Nuclear Materials* and its various implementation *instruments*, including *Decree No. 81-512 of 12 May 1981 Relating to the Protection and Control of Radioactive Materials* and the *Ministerial Order of 26 March 1982*, are designed to prevent any theft or misappropriation by malice of nuclear materials contained in a facility or in a shipment. That provision applies to fuel transport.

In order to achieve that goal, the above-mentioned texts require that owners and conveyors obtain a general licence beforehand. More particularly, they are required to take appropriate steps to protect the material they collect or transport and to comply with inspection requirements.

In order to achieve that task, the CMN relies on the assistance and technical expertise of the IRSN. In the field of transport, the IRSN is responsible for organising and monitoring nuclear shipments under its own authority.

In that context, a duly licensed conveyor must submit to the IRSN a notice describing the conditions of each operation: nature and quantity of transported materials, places of departure and arrival, itinerary and schedule, border-crossing points. After examination, the notice is referred to the CMN for the final decision of the HFD.

The conveyance operation itself is supervised by the IRSN. In that context, the conveyor must ensure contact between the convoy and the IRSN in order to keep the latter informed at all times of any event likely to delay or to compromise the operation, and hence to inform the HFD.

If necessary, the Minister of the Interior may decide whether transport may take place or not according to the specified conditions. The decision implies close co-operation between the CMN and police authorities.

For some radioactive substances not constituting nuclear materials, the general safety provisions apply.

### 2.3. Inspections relating to the transport of radioactive materials

ASN has implemented an inspection structure involving its local divisions and is working in a similar way with existing procedures for BNIs.

A sound organisation is sought from the regulatory and practical standpoints with the other regulatory authorities responsible notably for transport means, labour inspection in the transport sector or the protection of nuclear materials. Those regulatory authorities may prohibit a shipment after detecting non-conformities with regulations. In addition, the *TSN Act* reinforces the powers of ASN inspectors, especially in relation to violations and penalties.

Since 1998, more than 1,300 inspections have been carried out in that field, including 131 in 2013.

### 2.4. Incidents relating to the transport of radioactive materials

ASN has sent out a guide, dated 21 October 2005, to all shippers and conveyors. The guide, which may also be consulted on ASN's website ([www.asn.fr](http://www.asn.fr)), redefines the criteria for the incident and accident declaration that were described initially in the circular of 28 August 2003. It also relies on the model of incident report proposed in the *ADR* and *RID Orders*.

All transport discrepancies must be declared to ASN. Apart from that declaration, a detailed incident report must be sent to ASN within two months after the event. This report does not concern events whose immediate significance does not necessitate an individual analysis but which can present an interest in that their repetitive nature could indicate a problem requiring an in-depth analysis. In case of contamination, an analytical report must be sent to ASN within two months after the event.

## SECTION J | DISUSED SEALED SOURCES (ART. 28)

### Article 28

*1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, remanufacturing or disposal of disused sealed sources takes place in a safe manner...*

*2. A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed source.*

### 1 | REGULATORY FRAMEWORK

The general regulatory framework for sources is described in § F.4.1.2.4. Any user to whom a sealed source has been delivered must have them collected by the supplier as soon as it is out of use and no later than 10 years after the initial approval appearing on the corresponding supply form. Those provisions relating to the recovery of sources and to financial responsibilities apply in France since the early 90s.

Studies on suitable solutions for eliminating disused sources are also under way in the framework of the PNGMDR.

ASN has authorised that sealed radioactive sources with a shorter half-life than caesium-137 (i.e., about 30 years) be disposed of at the CSA, in accordance with activity limits per source and per source package. Since that management system concerns only about 10% of disused sources, it will not allow for the overall long-term management of all sources.

In order to control and to limit the number of radioactive sources to be recovered, the extension of the operating lifetime of some sources is contemplated. A technical Resolution by ASN specifying the conditions under which such extension may be granted was ratified by the *Order of 23 October 2009 (ASN Resolution No. 2009-DC-0150)*. Such extension needs to be assessed particularly on the basis of the construction process of the source, the quality of its fabrication, its past operating conditions and the extent to which its state and impermeability may be controlled. The results of periodical technical controls throughout the operating lifetime of the source are also examined.

In addition, within the framework of the elimination or recycling process of certain sealed radioactive sources, the creation of an administrative decommissioning process is being investigated. Such process would exempt relevant sources from individual controls applicable to sealed sources. However, they will have to be eliminated through licensed activities or facilities. In order to facilitate recycling, the selected criteria for decommissioning sources will vary depending on the type of applicant (user, distributor or manufacturer) and will address especially the residual activity of the source and of its exposure risks on contact.

### 2 | CEA'S ROLE

Given its past role as one of the main French suppliers of sealed sources, the CEA now has to manage all disused sources that are being returned by the industry, hospitals, research organisations or found in its own facilities. Furthermore, the CEA created in 2009, together with its former subsidiary, CIS bio international, a public interest group on cobalt-60 and caesium-137 HL sources in order to collect not only all HL sources of cobalt-60 and caesium-137 distributed in France by the CEA or CIS bio, but also all orphan sources of the same type. In addition, the CEA stores a large number of sources in its facilities, including radium sources, without any practical use that public authorities have entrusted upon ANDRA.

Since those residues involve a wide variety of items, some of which have to be recovered from distant countries and often require to be characterised due to the lack of supporting documentation, or insufficiency

thereof, which is normally attached to such items, an agreement was notably signed in 2011 at the IAEA's request, between France and the IAEA in order to secure all sealed sources of French origin.

The radioactive-source inventory of sources used by the CEA in its own facilities is maintained on a database via the input from waste-holding units. The database indicates the status of the source (whether in use or disused) and its planned recovery system.

Disused radioactive sources are treated through appropriate disposal processes, which are currently being drafted within a specific procedure to declassify the sources into waste.

Used sealed sources (whether obsolete or with no practical use) are collected and handled by suitable recovery systems for their nature. The three major systems set in place by the CEA include the following:

- HL sources of cobalt-60 and caesium-137;
- HL alpha or neutron sources, and
- other sources (slightly irradiating).

It should be noted that any source for which the supplier or the manufacturer is not the CEA is nominally recovered, with the option that the CEA may act as substitute supplier and use its own systems.

Pursuant to the PNGMDR, the CEA has started to implement elimination systems for used sealed sources, as follows:

- the recycling of sources batches, in co-operation with source manufacturers (thus requiring their export most of the time;
- the conditioning packages of waste sources, derived from existing models of radioactive-waste packages, and
- the transfer to ANDRA's disposal facility (Cires or CSA) or to a storage facility pending the creation of disposal facilities for HL-LL, IL-LL and LL-LL waste.

The CEA has set forth as its strategic objective to ensure, within a ten year timeframe, the recovery and elimination of all sealed sources it supplied or manufactured in the past.

### 3 | STORAGE OF DISUSED SEALED SOURCES

#### 3.1. Stock of disused sealed sources

In late 2011, Andra updated an inventory of the stocks of disused sealed sources considered as waste, together with the entities in possession of them, pursuant to *decree 2012-542 of 23 April 2012 setting out the requirements of the PNGMDR 2010-2012*. 3.5 million disused sealed sources have been declared to Andra. The companies in the French grouping of electronic fire safety industries (GESI) hold about 74% of all disused sealed sources (smoke detectors), the French armed forces hold about 23% (scrapped military equipment such as compasses, instrument dials, etc.) and industrial and medical sources represent about 3% (including the sources at CEA, the *Compagnie pour l'Etude et la Réalisation de Combustibles Atomiques* - CERCA, EDF, etc.).

#### 3.2. Overview of the conditions of storage of sealed sources

Pursuant to *the Waste Act* and to 2007-2009 PNGMDR prescriptions, Andra submitted a study on the disposal of disused sealed sources.

Andra's study is based on a disposal facility for disused sealed sources according to existing or future management systems for radioactive waste (Cires, CSA, future disposal facilities for LL-LL and HL/IL-LL waste). In 2001, Andra established acceptance limits for sealed-source packages at the CSA, together with an activity criterion on packages and structures, called "specific-activity limit" (*limite d'activité massique* – LAM), and, a criterion for the activity per radionuclide of each source, called "source activity limit" (*limite d'activité des sources* – LAS). The latter was estimated in such in order to limit exposures, notably in the case of drop scenarios during the operating lifetime or of human intrusions with recovery of a disused sealed source beyond the monitoring period (scenarios taking into account the potential attractive character).

Only the CSA (Centre de Stockage de l'Aube - Aube waste repository) can accept sources, and only those whose radioactive half-life is less than or equal to that of caesium 137, that is to say 30 years, with activity levels below certain thresholds defined according to the radionuclide concerned. Thus, for the VLL waste repository (Cires), the specifications currently prohibit the disposal of sources, but the regulatory framework of the Cires repository could allow acceptance criteria to be defined.

For the sources that cannot be accepted in the CSA, Andra has examined the possibility of disposal in the LLW-LL route. These acceptance criteria are yet to be defined for a future LLW-LL type waste repository.

Disused sealed sources not acceptable in surface or sub-surface repositories have been allocated to deep geological disposal, along with ILW-LL waste for disused sources having low exothermic properties and with HLW waste for the most exothermic disused sources.

The method of identifying disposal routes that could accept each type of source can be summarised through a decision tree, applying to each disused sealed source the following successive criteria: the form of the radioactive substance, solid, liquid or gaseous, the half-life, short or long, the activity of the disposal package and its compatibility with other repository parameters, primarily the thermal power and chemical nature. This tree structure figures in § 3.1.3.2 of the PNGMDR 2013-2015 which is available on the ASN website.

In February 2013 ANDRA submitted a report containing the recommendations for optimising the planning of the retrieval and collection of disused sealed sources considered as waste, but this document does not provide all the information necessary to set up disposal routes for these sealed sources.

### 3.3. The provisions of Article 15 of the Decree of 27 December 2013

A working group, jointly chaired by the Director General for Energy and Climate and the Director General for the Prevention of Risks, or their representatives, is set up in order to continue to define the procedures for the management of disused sealed sources, if they are intended for recycling, or are considered as waste.

The main lines of work are:

- continuation of Andra's study of the conditions of acceptability in disposal facilities (including at the Cires repository);
- defining the batches of disused sealed sources according to their characteristics, enabling each one to be assigned to a disposal route;
- a study of the requirements in terms of treatment and packaging facilities;
- a study of the requirements in terms of interim storage facilities;
- optimised technical and economic planning considering the availability of processing, storage and disposal facilities and transport constraints.

CEA, which is a stakeholder in the management of disused sealed sources and ensures the secretariat of the working group, must send a synthesis of the group's work to the Ministers responsible for energy and nuclear safety by the end of 2014. ASN and ASND will be consulted to obtain their opinion on this report.



# SECTION K | GENERAL EFFORTS TO IMPROVE SAFETY

## 1 | NATIONAL MEASURES

In order to guarantee and maintain a high level of nuclear safety for the nuclear installations in France, the French authorities carry out their duties on the basis of various principles.

Among these principles, a priority is the continuous improvement of nuclear safety, using the best available techniques.

### 1.1. ASN Objectives

The duties of ASN are essentially to regulate, authorise (license) and oversee existing and projected basic nuclear installations (BNI), in both normal operation and emergency situations. One of the duties is also to inform the general public and the stakeholders.

ASN is involved in all aspects of radioactive waste management, fuel management and decommissioning, either directly as the installation oversight authority or within the framework of the PNGMDR.

ASN aims to provide effective, impartial, legitimate and credible oversight of nuclear activities, recognised as such by the citizens and constituting an international reference.

#### 1.1.1. Objectives concerning radioactive materials and waste

##### The findings

- Long-term management routes exist for nearly 90% of radioactive waste by volume, and the remaining waste is stored pending the deployment of long-term management solutions. The majority of the waste is packaged in packages. Only a small proportion of the radioactive waste is still in bulk or packaged in ways that are incompatible with their acceptance in their intended management routes. This essentially concerns legacy waste.
- The established management framework is sound. Ongoing complements (see § K.1.1.4 below).
- Further progress is still required, in particular so that all types of radioactive waste have their own long-term management route. This is the objective of the National radioactive materials and waste management plan (PNGMDR), which is now at its third edition. Each edition of the PNGMDR is transmitted to Parliament and evaluated by the OPECST (Parliamentary Office for the Evaluation of Scientific and Technological Choices). The instructions for formulating the demands that result from this plan are set by a decree. ASN gives the government opinions on the studies and research carried out to meet these demands.

##### The issues

##### Deep geological disposal of High and Intermediate Level, Long-Lived waste (HLW/ILW-LL);

ASN has issued three main opinions on the project developed by Andra in 2011 and 2013, in which it indicates the principles to be adhered to and the aspects of the project to be studied in greater depth, while at the same time emphasising the quality of Andra's studies and research. It has highlighted the difficulties involved in drawing up the inventory of waste to be placed in disposal, the need to produce demonstrators, the

caution to exercise for the build-up, the need for a clear explanation of the principle of reversibility understood by all the stakeholders, the significance of the risks in operation, etc.

ASN's objective will be to check that the stated principles and the recommendations are properly taken into consideration. It will also be to examine the files presenting the adopted safety options that Andra could transmit to ASN in the years to come and the subsequent creation authorisation application.

ASN will take account of the conclusions of the public debate held in 2013 on the project and the proposals made by Andra on 6 May 2014 for the continuation of the project.

It shall ensure that any modifications made to the project reinforce the safety of the installation and the transparency and dialogue, and that the considerable efforts made to achieve commissioning of the waste management route continue.

ASN will examine the files provided by Andra with the aim of giving the government the necessary opinions of the requisite quality as quickly as possible, and of informing the public and the stakeholders on the subject.

Lastly, ASN identifies the need to clarify as soon as possible the procedural adaptations necessary to authorise and oversee an installation presenting particularities with respect to the other BNIs (need for reversibility, underground installation, importance of the acquisition of data on the behaviour of the geological environment, duration of operation, etc.).

#### **Disposal of low level, long-lived waste (LLW-LL):**

ASN considers that it is necessary for France to have a disposal facility for low-level, long-lived waste (LLW-LL). It will have to give its opinion on the studies prescribed by the *Decree of 27 December 2013* following on from the PNGMDR 2013-2015 and will closely follow the process to find a suitable site. Studies must focus on the characterisation of graphite waste and bituminized waste, on the management scenarios for these two types of waste (in particular with respect to the type of disposal) and on the feasibility of reworked cover disposal for this waste and for radiferous waste. ASN will examine these studies and give the government its options at the appropriate times.

ASN may also adopt a position on whether or not it is necessary to create an interim storage solution for graphite waste, given that decommissioning of the gas-cooled reactors is dependent on the availability of a disposal route for this type of waste.

#### **The packaging of the waste, and legacy waste in particular.**

ASN considers that research must be continued and intensified in the coming years in order to define and implement appropriate packaging methods for irradiating LLW-LL waste containing organic matter and for legacy waste.

As the level of safety of certain legacy waste storage facilities is unsatisfactory, ASN asks the licensees concerned to rapidly retrieve and package this waste with a view to storing it in safe facilities. An ASN resolution concerning the retrieval and packaging of the legacy waste at the La Hague site is currently being prepared on this account. ASN aims to issue this resolution in the course of 2014.

ASN will also give an opinion on the studies and the strategy that the *Decree of 27 December 2013* requires of AREVA, CEA and EDF concerning the retrieval and packaging of waste produced before 2015 to be packaged before 2030.

#### **The overall coherence of radioactive waste management**

ASN considers it necessary to optimise the distribution of waste streams between the existing or planned management routes, taking account of the risks involved with each type of waste and the following requirements set by the *Decree of 27 December 2013*:

Every effort shall be made to ensure the coherence and the technical and economic optimisation of the radioactive waste management system;

- The radioactive waste disposal facilities are few in number and of limited capacity, therefore their use must be optimised by the various players;
- The radioactive waste management routes take account of the volumes of waste transported and the distances to be covered.

Furthermore, the said decree requires an evaluation of the methods of creating routes for recycling metallic materials and rubble (for reuse in the nuclear field). ASN is particularly attached to the recycling of these materials in the nuclear sector to reduce waste production and to avoid overloading the Cires facility. It will provide its opinion on the study and the methods.

ASN will also be attentive to the remaining waste-acceptance capacity of the Cires facility, which is dropping faster than planned.

Lastly, studies must be conducted on the management of waste for which disposal routes either do not exist at present or are at the project stage (asbestos, mercury, non-incinerable organic oils and liquids, etc.).

### **The objectives of ASN**

The *Decree of 27 December 2013* stipulates that a number of studies must be continued in the following areas:

- sealed sources
- mining waste and waste rock
- technologically enhanced natural radioactivity
- tritiated waste from small producers
- radioactive materials
- etc.

ASN will have to issue an opinion on each of these studies.

#### **1.1.2. Objectives pertaining to decommissioning**

Apart from finalising a number of regulatory or guidance texts (see § K.1.1.4 below), ASN will continue its oversight of installations undergoing decommissioning.

It will among other things endeavour to:

- get the licensees to devote the necessary means to ensure immediate and rapid dismantling and achieve a final state in which the maximum possible amount of hazardous substances, radioactive substances included, has been removed;
- examine the decommissioning strategy proposed by EDF for all its facilities, take a stance regarding the time frame for decommissioning the gas-cooled reactors, and examine how to capitalise on the experience feedback from CHOOZ for the decommissioning of the PWRs;
- verify that the decommissioning strategy proposed by EURODIF corresponds to the volume reduction objectives, the harmfulness of the waste and the recommendations of the PNGMDR;
- continue examining the final shutdown and decommissioning applications, particularly for the Phénix reactor;
- check the safety and radiation protection associated with the decommissioning operations, particularly for UP2 400 - a plant that involves potentially high risks.

#### **1.1.3. Objectives pertaining to the fuel management**

The safety management review already in progress must continue with examination of the measures taken by AREVA to ensure the operational safety of the installations (detailed exercise on the function of head of installation, first-level "safety" inspection, monitoring of subcontracted work, etc.). These various points should be examined by the competent Advisory Committee of Experts by 2016.

### **Tricastin site**

In 2014, the platform will continue its reorganisation, with the aim of having the licensee AREVA NC take over operation of all the facilities. ASN will examine the modification declarations associated with this project and will remain vigilant as regards maintaining of the technical and financial capacities of the future licensee and provisioning for the long-term expenses on account of the Environment Code. Furthermore, ASN will take a stance on the internal authorisation process that the licensee has asked to implement.

### MELOX plant

ASN will be vigilant with regard to the means adopted to assist with the changes in materials used, given the anticipated requirements in terms of safety and radiation protection such as they were examined as part of the periodic safety review in 2013. In this context, control of dosimetry, consideration of social, organisational and human factors, monitoring of subcontracted operations and the prevention of criticality risks will remain the oversight priorities.

### La Hague site.

As part of the periodic safety review of plant UP3-A, a number of points receive particular attention, such as the verification of regulatory conformity of the UP3 plant (which led to the development of the "elements important for protection" required by the recent regulations), the effects of ageing on structures and equipment (an examination and justification methodology still remains to be developed), and the elements of the baseline requirements (safety analysis report (RDS), general operating rules (RGE), on-site emergency plan (PUI), waste study). The Advisory Committee of Experts has already had three meetings and the last two will be held in 2014 and early 2015. ASN will make known its conclusions at the end of this procedure.

### Romans site

ASN has noted numerous deviations during its various oversight actions in the last years, particularly with regard to the management of operational safety and in the renovation and bringing the site facilities and equipment into compliance with safety standards. ASN will be particularly attentive to the remediation of the situation by the licensee. The site shall undergo a large-scale inspection in these areas at the end of 2014.

### Stress tests

ASN will issue resolutions, as it has done for the EDF power plants, concerning the "hardened safety core" imposed by the stress tests for MELOX and La Hague and will monitor the implementation of the measures adopted further to post-Fukushima experience feedback.

#### 1.1.4. Objectives pertaining to the regulatory framework

The regulatory framework was considered by ASN to be on the whole satisfactory.. Nevertheless, ASN has proposed that the conditions of supervision of nuclear installation decommissioning be modified to guarantee application of the immediate dismantling strategy by the nuclear licensees. Several complementary texts are moreover currently being drafted. This concerns in particular the transposition of the European directive on radioactive waste and the draft resolutions concerning the conditions of application of the *BNi Order*, the BNi safety reports, the BNi periodic safety reviews, the packaging of radioactive waste, the waste studies, etc.

The regulatory framework for decommissioning must be supplemented by an ASN resolution specifying the requirements indicated in the *BNi Order*. ASN also intends revising the complete clean-out methodologies guide for BNIs undergoing decommissioning and producing a guide to the remediation of polluted soils on sites undergoing decommissioning.

Council Directive 2011/70/Euratom of 19th July 2011 aims to establish a Community framework for the safe and responsible management of spent fuels and radioactive waste. To date, the provisions of the directive are extensively enshrined in national legislation. The French Government proposed that additional transposition measures be postponed to the end of 2014, as part of the Act on energy transition for green growth.

Lastly, ASN will remain strongly involved in international work, maintaining its active participation in the working groups, particularly within the framework of the IAEA Waste Safety Standards Committee (WASSC) and the International Decommissioning Network (IDN) and in the Working Group on Waste and Decommissioning (WGWD) of WENRA (see § K.2.1.1). ASN will also participate in the reflections of the various international authorities on radioactive waste disposal, particularly concerning reversibility.

## 1.2. Operators' objectives

### 1.2.1. ANDRA objectives

The Waste Act and the putting in place of the PNGMR have extended and reinforced the remit of Andra, which acts as a State operator. A new contract defining Andra's objectives for the period from 2013 to 2016 was signed with the Government in 2013. These objectives set out three broad strategic paths:

- in consultation with all the stakeholders, prepare the resolutions and the construction for disposal facilities for HLW and ILW-LL and LLW-LL waste. This concerns in particular:
  - the production of the necessary files,
  - the development of the consultation with all the stakeholders in order to prepare the public decision,
  - the integration of the projects in the regional schemes favouring local socio-economic dynamics;
  - the cooperation with the other nuclear licensees to respond optimally to their needs and benefit from their own experience feedback, in compliance with the responsibilities of each party;
- while guaranteeing a high level of safety, improving customer satisfaction with respect to the disposal of their VLLW and LILW-SL ultimate radioactive waste. This objective can be broken down as follows:
  - service proposals adapted to the needs of Andra's customers;
  - minimisation of the environmental impact around the Andra centres;
  - optimisation of the consumption and the cost of the disposal facilities;
- provide and valorise innovative solutions for optimised radioactive waste management. This strategic path results in Andra adopting a position not only on the disposal of waste but also on the provision of integrated management solutions and/or participation in the optimisation of waste management prior to disposal.

### 1.2.2. CEA Objectives

Maintaining its BNIs at the optimum level of safety remains a major priority for CEA.

On this account, CEA performs periodic safety reviews of its installations every ten years. The lessons drawn from the accident that hit the Fukushima-Daichii nuclear power plant in Japan in 2011 have also given rise to a plan of actions to reinforce the protection of the installations against natural phenomena of high intensity, not taken into consideration in the installation design basis due to their very low probability of occurrence.

CEA is also conducting a major programme to renovate its transport packages to meet its needs and changes in regulations.

Training and awareness-raising actions continue to be implemented to reinforce the security, radiation protection and nuclear safety culture of the personnel. Likewise, the entire chain of command is mobilised in the progress approach on which the safety policy of the installations is founded, and which implies its commitment and accountability as regards defining objectives and allocating resources.

In the area of radiation protection, CEA, which considers the health of its personnel and outside contractors a priority, is stepping up its action for exposure reduction and forward-looking management, in which the employees concerned are fully involved.

CEA is implementing a major radioactive clean-out and decommissioning programme on those of its installations whose maintained operation is no longer justified, whether this is because they no longer meet CEA's R&D requirements or because they do not meet current safety standards. In this programme, CEA is endeavouring to minimise the resulting waste production and ensure that the waste is correctly categorised to avoid overloading existing management routes as a result of systematic conservative classification.

CEA also contributes to the studies called out in the PNGMDR, particularly in the areas of waste disposal, storage and packaging, the management of disused sealed sources and the recycling of radioactive waste.

### 1.2.3. EDF Objectives

EDF aims at having optimised management routes for all its waste and is working, within the framework of the PNGMDR and in collaboration with Andra and the other waste producers, on the development of these routes through its technical and financial participation.

EDF's other objective is to make the best use possible of current disposal facilities in service in order to extend their operating lifetime by limiting the volumes intended for disposal.

With regard to disposal-facility projects, EDF and the other waste producers are financing ANDRA's overall actions concerning HL-LL and IL-LL waste within the revamped framework of the *Waste Act*.

#### 1.2.4. AREVA Objectives

Each year, lines of improvement in the various areas of safety and waste management are identified for each installation and action plans are established.

These actions can concern:

- physical modifications of the installations by applying techniques identified within the framework of the period safety reviews,
- taking into account an event and the lessons learned from it, which can result in modifications to the installations or equipment or changes in work methods and procedures,
- reducing worker dosimetry by optimising or reorganising the working environments,
- integrating regulatory changes,
- improving prevention of the criticality risk by checking the effectiveness of the measures taken, by upgrading the computerised management systems and by improving the ergonomics of the human/machine interfaces,
- the actors, taking into account, for example, the analysis of risks associated with the organisational and human factors in the safety-related activities and the decommissioning activities.
- the collective work approach by developing or simplifying the organisational structures,
- training and skills development, notably to fulfil a work function,
- dissemination of the safety culture with collective self-assessment tools,
- reductions in consumption and the production of waste, such as studying the implementation of additional management routes or treatment methods that reduce the environmental and radiological impacts of radioactive waste management, reductions in energy consumption and the production of conventional waste and the optimisation of valorisation by material recycling,
- measures to enhance transparency and communication of information, particularly with local authorities and the local actors.

The AREVA group moreover continues to invest in:

- the creation of new units such as the centrifuge enrichment plant, conversion plants and waste treatment units,
- the renovation and compliance upgrading of installations and equipment,
- the retrieval and packaging of waste, and in decommissioning and the management of waste from shut down installations,
- the implementation of emergency situation management and mitigation measures defined within the framework of the post-Fukushima stress tests
- and lastly in the R&D actions to develop new processes and more resistant materials, to use less polluting reagents and acquire a better understanding of certain risks and phenomena.

## 2 | INTERNATIONAL CO-OPERATION MEASURES

### 2.1. Institutional co-operation

#### 2.1.1. ASN co-operation measures

ASN's international activities are carried out within the legislative framework defined by Article L. 592-28 of the Environment Code.

ASN also aims to promote a high level of safety and the reinforcement of the nuclear safety and radiation protection culture across the world.

Lastly, ASN considers that international relations should enable it to consolidate its skills in its areas of activity.

#### 2.1.1.1. ASN'S EUROPEAN ACTIVITIES

Europe constitutes a priority field of international action for ASN, which thereby intends contributing to the construction of a European hub on the subjects of nuclear safety, safety of spent fuel and radioactive waste management, and radiation protection. ASN is heavily involved in the work of the associations WENRA and HERCA, which work respectively on nuclear safety - including waste management, and radiation protection.

ASN has invested itself in the work of WENRA, whose missions include developing reference safety levels in order to harmonise nuclear safety practices in Europe. Working groups were set up in 2002 to develop these reference levels. One of these groups, the WGWD (*Working Group on Waste and Decommissioning*) was tasked with developing reference levels relative to the safety of radioactive waste and spent fuel storage facilities, of radioactive waste disposal facilities and of decommissioning operations. The WENRA member countries must produce national action plans for the transposition of these reference levels. ASN is thus drafting an action plan to meet WENRA's requirements. These reference levels will be valuable input data for drafting the ASN resolutions detailing the provisions of the *BNi Order*.

In the area of radiation protection, ASN is a member of the association HERCA; four working groups are currently addressing the following themes: workers and dosimetric passport, justification and optimisation of the use of radioactive sources in the non-medical sector, medical applications, and emergency situation preparedness and management.

ASN is also participating in projects under the 7th Euratom R&D Framework Programme, such as the SITEX project (dedicated to the technical support anticipations and needs of a nuclear safety authority in the examination of a file concerning a deep geological disposal facility) and PREPARE project (concerning emergency situations and post-accident management in the field of radioactive substance transport).

#### 2.1.1.2. RELATIONS WITH THE IAEA

ASN actively participates in the work of the IAEA Commission of Safety Standards (CSS) which draws up international standards for the safety of nuclear installations, waste management, radioactive substance transport and radiation protection. It is a member of the four safety standards Committees (NUSSC for the safety of nuclear installations, RASSC for radiation protection, TRANSSC for the safety of radioactive material transport and WASSC for the safety of radioactive waste).

It also participates in GEOSAF (IAEA project on the safety of a deep geological repository during the operating phase) and HIDRA (IAEA project on the unintentional impacts of human activities on deep geological repositories once the memory of the repository has been lost. The discussions on this theme, which explores time scales of up to a million years, go beyond the bounds of conventional technical subjects and address issues such as the societal impacts).

ASN is also a member of the International Decommissioning Network (IDN) coordinated by the IAEA and as such keeps itself informed of the international projects. It contributed in particular to the CIDER (*constraints to implementing decommissioning and environmental remediation programmes*) project, which aims to identify and develop aids to overcome the difficulties that member countries can encounter in site decommissioning and rehabilitation projects, and which held its first plenary meeting in March 2013.

#### 2.1.1.3. RELATIONS WITH THE NEA

Within the NEA (Nuclear Energy Agency), ASN participates in the work of the CNRA (Committee on Nuclear Regulatory Activities) which is chaired by the ASN Director-General. ASN also participates in the work of the Committee on Radiation Protection and Public Health (CRPPH), the Radioactive Waste Management Committee (RWMC) and a few working groups of the Committee on the Safety of Nuclear Installations (CSNI).

#### 2.1.1.4. BILATERAL RELATIONS

Bilateral relations between ASN and its foreign counterparts represent an essential vector for international actions. They allow interactions on topical subjects and the rapid implementation of cooperation measures,

and they can prove useful for informing the countries concerned if events occur on nuclear installations situated close to national borders.

#### 2.1.1.5. PEER REVIEWS

##### IRRS

ASN is also preparing for the *Integrated Regulatory Review Service* - IRRS, a peer review of the organisation of the regulation and oversight of safety in France, organised under the aegis of IAEA, which it requested for November 2014. To prepare for this, ASN in 2013 initiated a self-assessment, the conclusions of which will be transmitted to the auditors ahead of the mission.

ASN was peer-reviewed for the first time in 2006, at the time of its creation as an independent authority. In 2009, the obligation to undergo such an audit at least once every ten years was instituted by the European directive on nuclear safety.

An IRRS follow up mission was organised in 2009. The participating international experts considered that ASN had responded satisfactorily to 90% of the recommendations and suggestions made in 2006. In a number of areas such as inspection, emergency preparedness, public information or ASN's international role, they were once again of the opinion that ASN's actions ranked amongst the best international practices. They also identified some areas for improvement, notably in terms of skills management. ASN took advantage of the conclusions of this mission to reinforce the conformity of its practices and its organization with the best international standards.

The reports for these two IRRS missions are available for consultation on [www.asn.fr](http://www.asn.fr).

##### Accreditation NF EN ISO/CEI 17020

Since 1 July 2013, the ASN Nuclear Pressure Equipment Department has been accredited in compliance with standard NF EN ISO/CEI 17020 as a type A organisation for manufacturing inspection and in-service monitoring of nuclear pressure equipment (No. 3-1018 available from the COFRAC site). This is not the result of a regulatory requirement but of a recommendation from an IAEA experts group, during an Integrated Regulatory Review Service (IRRS) audit of ASN performed in late 2006.

#### 2.1.2. IRSN's co-operation programmes

With regard to the safe management of radioactive waste and to the safe management of spent fuel, the IRSN's international relations revolve mainly around the following development areas:

- the understanding of the processes regulating the transfers of radioactive materials in geological media and the development of states of art and elements of doctrine on scientific and technical issues;
- research on deep earthquakes and their impact on rock fracturing and groundwater circulations and studies on seismic forecasts;
- studies on the applicability of instrumentation means, notably on investigation techniques for disposal sites and auscultation of underground work behaviour;
- modelling of overall significant phenomena for the safety of disposal facilities, and of the potential dosimetric consequences of those facilities;
- specific risk studies associated with the operation of deep geological disposal facilities for HL/IL-LL waste;
- safety studies on fuel treatment and waste management in the framework of the development scenarios for a nuclear fleet of Generation-IV reactors;
- assistance to safety authorities of Eastern European and former Soviet Union countries (Armenia, Bulgaria, Georgia, Lithuania, Russia and Ukraine) through various European projects, such as the International Nuclear Society Council (INSC) and Instrument for Pre-accession Assistance (IPA) together with the projects of the European Bank for Reconstruction and Development (EBRD) concerning the safe decommissioning of nuclear facilities and the safety of storage and disposal facilities for radioactive waste, and

- safety-training actions for waste management actions (decommissioning, waste treatment facilities, disposal) for the representatives of the civil society, experts or foreign safety authorities, through programmes managed by ENSTTI (training and tutorials modules).

The IRSN's major partners include the following:

- GRS from Germany and Bel V from Belgium, for safety analyses of disposal facilities and the modelling of their behaviour over the long term;
- JNES and JAEA from Japan and SwRI from the USA, for safety interventions in waste disposal facilities;
- SSTC from Ukraine and both SEC-NRS and IBRAE from Russia for improving waste and spent-fuel management and corresponding safety assessments, and
- CNSC from Canada and FANC from Belgium for the study of key mechanisms for the safety of deep geological repositories.

Work on furthering knowledge and improving assessment tools is also conducted within the international organisations. In that context, the IRSN has participated or is participating in the following EC programmes:

- FORGE (European Commission) regarding the study of the impact of gas formations within deep geological repositories, and
- SITEX (European Commission) regarding the governance of research and expertise for geological disposal.

In addition, the IRSN partakes in the studies being conducted at the Mont Terri Laboratory, Switzerland, on the safety of deep geological repositories for HL-LL waste.

IRSN is also a member of various international working groups involved in the drafting of technical recommendations, guides and standards on decommissioning radioactive waste and spent fuel, and notably in the preparation of IAEA's safety documents.

The Institute also leads or participates, under the aegis of the IAEA, in projects aiming at harmonizing practices for the safety of geological repositories (GEOSAF2, PRISM2, HIDRA), facility decommissioning (FASA, DRIMA) and the management of the resulting waste (SADRWMS and SAFRAN). Furthermore, it is also involved in the activities of the NEA expert groups on radioactive-waste management and deep geological repositories (RWMC).

Lastly, IRSN has helped to create a working group within the ETSO association which is intended to enhance the interactions and the networking of the TSOs (Technical Safety Organisations) in the research into and appraisal of the safety of waste.

### 2.1.3. Participation of France in ENSREG

The European Nuclear Safety Regulators Group (ENSREG) was created by decision of the European Commission on 17 July 2007 (2007/530/Euratom) in order to advise and to assist the Commission in the progressive development of a common vision and, ultimately,, of new European rules with regard to the safety of nuclear facilities and the safe management of spent fuel and radioactive waste. The Group constitutes an exchange platform between national regulatory authorities.

France is represented through ASN and the DGEC. More particularly, ASN participates in ENSREG's Working Group on the Safety of Nuclear Facilities; the DGEC and ASN are also involved in the Working Group on Spent Fuel and Radioactive Waste Management.

On 19 July 2011, the Council of the European Union adopted the *directive 2011/70/Euratom* for the management of spent fuel and radioactive waste (see § A.2.1.1 above).

### 2.1.4. ANDRA's international co-operation

The international aspect is an important part of ANDRA's activities. The *Waste Act* entrusted the Agency with an outreach mission of its know-how abroad. Its other mission is to make available to the public useful information relating to radioactive-waste management and to participate in the dissemination of the scientific and technological culture in that field, which should not be limited to a strictly domestic context.

It is also essential to compare ANDRA's approaches with foreign ones and, hence, to benefit from the experience feedback of foreign partners, which naturally leads to international co-operation initiatives, especially with its counterparts, and to mobilise a scientific expertise about the Agency's programmes and projects. In that respect, ANDRA has set the following goals:

- to promote contacts and co-operation projects with its foreign partners. ANDRA seeks to present its projects and approaches at the international scale in order to compare them with those in other countries concerned by the topic. In that context, ANDRA has played a significant role in the preparation and implementation of the Implementing Geological Disposal Technology Platform (IGD-TP) and took an active part in the development of the Strategic Agenda for Research (*Agenda stratégique des recherches*) and its Deployment Plan (*Plan de déploiement*). It opens up to its foreign partners its programmes and facilities, such as the Meuse/Haute-Marne URL for studies on the deep geological disposal of HL-LL waste ;
- to sit on leading international bodies, such as European co-ordinating bodies, the OECD/NEA and the IAEA. From 2007 to 2013, the Director-General of Andra was Chairwoman of the NEA Radioactive Waste Management Committee. At present, several directors of Andra participate in the work of the offices of various NEA bodies. Andra is also represented on WATEC (International Radioactive Waste Technical Committee) which meets annually to determine the orientation of IAEA's work in the technical side of radioactive waste management;
- to conduct a scientific, technical and economic watch, which forms a structured activity within ANDRA;
- to organise occasional outreach missions with a view to participating in foreign studies and the development of radioactive-waste disposal projects abroad, and
- to distribute free of charge paper copies of the English version of its publications and documents and to make them available on its website ([www.andra.fr](http://www.andra.fr)).

As part of the European Commission's Framework Programme for Research and Development (FPRD), ANDRA participates actively in projects devoted to the management of HL radioactive waste, and more particularly, to the issues involving deep geological disposal. ANDRA has lead the project of Monitoring Developments for Safe Repository Operation and Staged Closure (MoDeRn) devoted to studies and research into the surveillance and monitoring of geological disposal facilities and of the environment, and handed over the final report to the Commission in February 2014. In the follow-up, and as a complement to this work, Andra has proposed work on preservation of the memory. This has been structured within the NEA and an international conference will be held on the subject in Verdun (France) in September 2014.

## 2.2. Co-operation programmes of waste and spent-fuel producers

### 2.2.1. CEA's international co-operation programmes

As a scientific and technical research organisation specialising in nuclear technology, the CEA extends its activities to all related fields, especially, the field of safety. Those activities entail many international co-operation programmes.

Regarding safety at its own facilities, the CEA is involved in the EC Research Programme and in projects co-ordinated by the OECD/NEA and the IAEA on spent-fuel and radioactive-waste management. It has also developed regular exchanges with several foreign counterpart organisations, namely on the operating experience with British and Belgian facilities, the lessons to be learnt from incidents that occurred in Belgium, Japan, the United Kingdom and the USA, together with research on the long-term conditioning and behaviour of waste packages.

### 2.2.2. AREVA's international co-operation programmes

With regard to facilities dealing with the fuel cycle and radioactive waste management, international exchanges on co-operation programmes in which AREVA is involved may be divided into three main areas, as follows:

- relations with international institutions participating in the development of safety and radiation protection standards.

- relations with countries in which AREVA is operating one or several facilities or is performing transport activities, and
- international projects.

In the framework of the activities conducted in Europe regarding safety and radiation protection, AREVA participates in the European Nuclear Installations Safety Standards (ENISS), an association of European operators that has been created with a view to establishing a dialogue with the WENRA in the context of the harmonisation approaches within the European Union and particularly on topics, not only like the storage of waste and spent fuel, but also as the decommissioning of BNIs. AREVA participates also in the work of the European Nuclear Energy Forum (ENEF), which groups stakeholders in the nuclear sector and whose work seals also with safety and waste.

AREVA also provides its expertise by taking part in assessments of strategies, nuclear sites and installations at the request of and to assist IAEA, as well as in the regular technical meetings to prepare or revise the IAEA technical documents, guides and safety standards, or via various inter-professional associations, such as the World Association of Nuclear Operators (WANO), of which it became a full member in 2012 as licensee of the nuclear fuel recycling plant in La Hague.

AREVA carries out a significant part of its activities outside France by operating fuel-cycle facilities and by providing transport or storage services to foreign customers, thus leading to a large number of exchanges with the relevant entities. Those exchanges exist also about the knowledge of the waste packages that are produced by AREVA and shipped back to original customers. Hence, such packages constitute international “standards” in the sense they are given as basic data in the numerous concepts of deep geological repositories, notably in Belgium, Germany, Japan, Switzerland, etc.

Over and above those co-operation efforts, AREVA partakes in international actions and projects with a view to improving not only the management of waste and spent fuel, but also the safety of storage facilities.

Together with the Shaw Company, AREVA is involved in the construction of MOX-fuel fabrication plant in South Carolina (USA) in order to reduce the inventory of military plutonium by recycling it in the form of MOX fuel to be used American NPPs. That reduction of inventories is carried out in the framework of the Russian-American disarmament agreements and according to the technologies of the AREVA Group.

In addition, AREVA is at the stage of advanced discussions for a recycling plant project in China, in combination with an ambitious national nuclear-energy development programme that will ensure the responsible management of spent fuel at the end of the cycle, according to the nuclear development of China.

### **2.2.3. EDF's international co-operation programmes**

EDF's international activities concern a number of key areas, in all activity domains of EDF:

- international activities within the EDF Group and foreign nuclear development projects (United-Kingdom with EDF Energy, China, Poland, South Africa, United States of America, etc.); exchanges of knowledge are conducted with EDF Energy ;
- bilateral exchanges of experience, mainly via twinning agreements and co-operation agreements;
- participation in international organisations which enhances experience feedback exchanges, including secondment of experts from the World Association of Nuclear Operators (WANO) and peer reviews, IAEA and Operational Safety Review Team (OSART), Institute of Nuclear Power Operations (INPO), Electric Power Research Institute (EPRI), ENISS within the European Atomic Forum (FORATOM), World Nuclear Association (WNA) etc.;
- contract-based advice and service activities (Daya Bay, Koeberg, etc.);
- preparation and planning for future reactors, and technology-watch activities (EUR, etc.), and
- decommissioning and environment.

The first area for EDF's international co-operation is exchange of experience. Twinning operations between French and foreign NPPs and co-operation agreements with operators having NPPs under decommissioning

constitute the main framework for those exchanges and allow direct information exchanges between operators of different cultures working in different environments.

A second area concerns collaboration with international institutions. At the IAEA, EDF takes part in the work performed on safety standards and guides and on incident analysis (IRS); it also participates in OSART delegations to assess the safety of nuclear facilities, both in France and abroad. With WANO, EDF is involved in a number of programmes and peer reviews (both in France and abroad) as well as in other programmes, particularly those concerning assistance visits, experience feedback, technical meetings and performance indicators, which includes sharing databases. EDF also follows the work of the OECD/NEA, EPRI, INPO, NRC, and WNA, in particular through its participation in the working groups on spent fuel management, waste management and decommissioning.

A third area concerns consulting and service activities to other operators, co-operation agreements (China, South Africa), assistance in various technical fields (training, engineering, chemistry, etc.,) and partnerships (Eastern Europe, Russia, etc.).

Of the facilities concerned by radioactive-waste management for spent-fuel management, as presented in Section D, the more important ones belong to the BNL category, as defined in § E.1.1, and are scattered throughout France, as shown in the following figure:

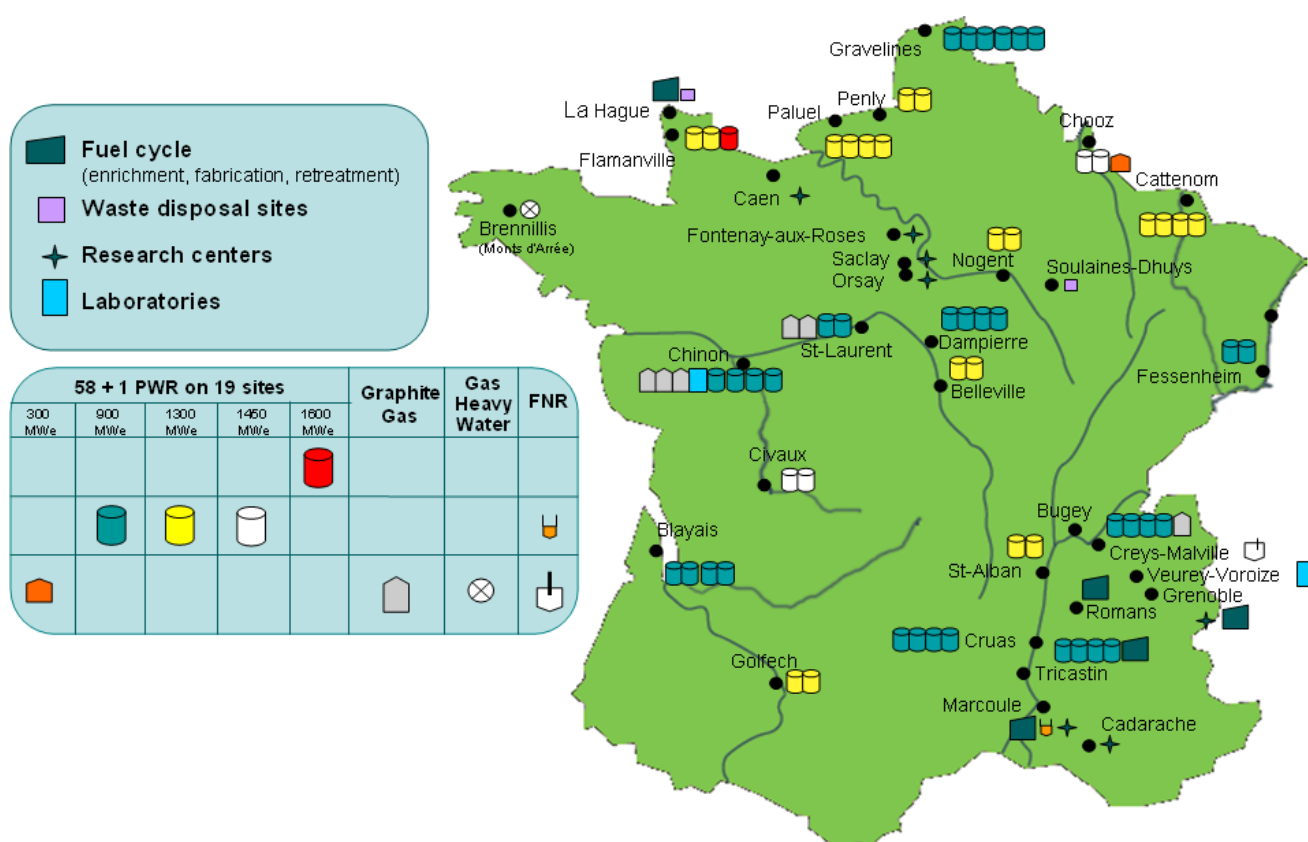


FIGURE 15 : LOCALISATION OF FUEL CYCLE FACILITIES IN FRANCE ON 31 DECEMBER 2013

# 1 | SPENT FUEL GENERATING OR MANAGEMENT FACILITIES ON 31 DECEMBER 2013

## 1.1. Spent fuel generating facilities

Spent fuel is generated or likely to be generated in the BNIs shown below.

N° BNI	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
24	CABRI and SCARABÉE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactors	27.05.64			Modification decree
39	MASURCA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		14.12.66	15.12.66	
40	OSIRIS - ISIS (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactors		08.06.65	12.06.65	
42	EOLE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		23.06.65	28 and 29.06.65	
67	HIGH FLUX REACTOR (RHF) 38041 Grenoble Cedex	Institut Max von Laue Paul Langevin	Reactor		19.06.69 05.12.94	22.06.69 06.12.94	Modification decree
75	FESSENHEIM NUCLEAR POWER PLANT (reactors 1 et 2) 68740 Fessenheim	EDF	Reactors		03.02.72	10.02.72	Modification decree
78	BUGEY NUCLEAR POWER PLANT (reactors 2 et 3) 01980 Loyettes	EDF	Reactors		20.11.72	26.11.72	Modification decree
84	DAMPIERRE NUCLEAR POWER PLANT (reactors 1 et 2) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
85	DAMPIERRE NUCLEAR POWER PLANT (reactors 3 et 4) 45570 Ouzouer-sur-Loire	EDF	Reactors		14.06.76	19.06.76	
86	BLAYAIS NUCLEAR POWER PLANT (reactors 1 et 2) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		14.06.76	19.06.76	
87	TRICASTIN NUCLEAR POWER PLANT (reactors 1 et 2) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Modification decree
88	TRICASTIN NUCLEAR POWER PLANT (reactors 3 et 4) 26130 Saint-Paul-Trois-Châteaux	EDF	Reactors		02.07.76	04.07.76	Modification decree
89	BUGEY NUCLEAR POWER PLANT (reactors 4 et 5) 01980 Loyettes	EDF	Reactors		27.07.76	17.08.76	Modification decree
92	PHÉBUS (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		05.07.77	19.07.77	Modification decree
95	MINERVE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Reactor		21.09.77	27.09.77	Modification decree
96	GRAVELINES NUCLEAR POWER PLANT (reactors 1 et 2) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Modification decree
97	GRAVELINES NUCLEAR POWER PLANT (reactors 3 et 4) 59820 Gravelines	EDF	Reactors		24.10.77	26.10.77	Modification decree
100	SAINT-LAURENT DES EAUX NUCLEAR POWER PLANT (reactors B1 et B2) 41220 La Ferté-St-Cyr	EDF	Reactors		08.03.78	21.03.78	
101	ORPHÉE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor		08.03.78	21.03.78	
103	PALUEL NUCLEAR POWER PLANT (reactor 1) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
104	PALUEL NUCLEAR POWER PLANT (reactor 2) 76450 Cany-Barville	EDF	Reactor		10.11.78	14.11.78	
107	CHINON NUCLEAR POWER	EDF	Reactors		04.12.79	08.12.79	Modification decree

N° BNI	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
	PLANT (reactors B1 et B2) 37420 Avoine						
108	FLAMANVILLE NUCLEAR POWER PLANT (reactor 1) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
109	FLAMANVILLE NUCLEAR POWER PLANT (reactor 2) 50830 Flamanville	EDF	Reactor		21.12.79	26.12.79	
110	BLAYAIS NUCLEAR POWER PLANT (reactors 3 et 4) 33820 Saint-Ciers-sur-Gironde	EDF	Reactors		05.02.80	14.02.80	Modification decree
111	CRUAS NUCLEAR POWER PLANT (reactors 1 et 2) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Two Modification decrees
112	CRUAS NUCLEAR POWER PLANT (reactors 3 et 4) 07350 Cruas	EDF	Reactors		08.12.80	31.12.80	Modification decree
114	PALUEL NUCLEAR POWER PLANT (reactor 3) 76450 Cany – Barville	EDF	Reactor		03.04.81	05.04.81	
115	PALUEL NUCLEAR POWER PLANT reactor 4) 76450 Cany – Barville	EDF	Reactor		03.04.81	05.04.81	
119	SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 1) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
120	SAINT-ALBAN - SAINT-MAURICE NUCLEAR POWER PLANT (reactor 2) 38550 Le Péage-de-Roussillon	EDF	Reactor		12.11.81	15.11.81	
122	GRAVELINES NUCLEAR POWER PLANT (reactors 5 et 6) 59820 Gravelines	EDF	Reactors		18.12.81	20.12.81	Two Modification decrees
124	CATTENOM NUCLEAR POWER PLANT (reactor 1) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
125	CATTENOM NUCLEAR POWER PLANT (reactor 2) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
126	CATTENOM NUCLEAR POWER PLANT (reactor 3) 57570 Cattenom	EDF	Reactor		24.06.82	26.06.82	
127	BELLEVILLE NUCLEAR POWER PLANT (reactor 1) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	
128	BELLEVILLE NUCLEAR POWER PLANT (reactor 2) 18240 Léré	EDF	Reactor		15.09.82	16.09.82	Modification decree
129	NOGENT SUR SEINE NUCLEAR POWER PLANT (reactor 1) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification decree
130	NOGENT SUR SEINE NUCLEAR POWER PLANT (reactor 2) 10400 Nogent-sur-Seine	EDF	Reactor		28.09.82	30.09.82	Modification decree
132	CHINON NUCLEAR POWER PLANT (reactors B3 et B4) 37420 Avoine	EDF	Reactors		07.10.82	10.10.82	Modification decree
135	GOLFECH NUCLEAR POWER PLANT (reactor 1) 82400 Golfech	EDF	Reactor		03.03.83	06.03.83	Modification decree
136	PENLY NUCLEAR POWER PLANT (reactor 1) 76370 Neuville-lès-Dieppe	EDF	Reactor		23.02.83	26.02.83	
137	CATTENOM NUCLEAR POWER PLANT (reactor 4) 57570 Cattenom	EDF	Reactor		29.02.84	03.03.84	
139	CHOOZ B NUCLEAR POWER PLANT (reactor 1) 08600 Givet	EDF	Reactor		09.10.84	13.10.84	Deferment of commissioning: Decrees of 18.10.1993, J.O. of 23.10.93 and of

N° BNI	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
							<b>11.06.99, J.O. of 18.06.99</b>
<b>140</b>	PENLY NUCLEAR POWER PLANT (Reactor 2) 76370 Neuville-lès-Dieppe	EDF	Reactor		09.10.84	13.10.84	
<b>142</b>	GOLFECH NUCLEAR POWER PLANT (reactor 2) 82400 Golfech	EDF	Reactor		31.07.85	07.08.85	
<b>144</b>	CHOOZ B NUCLEAR POWER PLANT (reactor 2) 08600 Givet	EDF	Reactor		18.02.86	25.02.86	<b>Deferment of commissioning: Decrees of 18.10.93, J.O. du 23.10.93 and of 11.06.99, J.O. of 18.06.99</b>
<b>158</b>	CIVAUX NUCLEAR POWER PLANT (reactor 1) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	<b>Deferment of commissioning: Decrees of 11.06.99, J.O. of 18.06.99</b>
<b>159</b>	CIVAUX NUCLEAR POWER PLANT (reactor 2) BP 1 86320 Civaux	EDF	Reactor		06.12.93	12.12.93	<b>Deferment of commissioning: Decrees of 11.06.99, J.O. of 18.06.99</b>

TABLE 24 : SPENT FUEL GENERATING FACILITIES ON 31 DECEMBER 2013

## 1.2. Spent fuel storage or processing facilities

Spent fuel is stored or processed in the BNIs as shown below (it should be noted that spent fuel is also stored on the nuclear power plant (NPP) sites).

N° BNI	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
<b>22</b>	TEMPORARY DISPOSAL FACILITY (PEGASE) AND SPENT NUCLEAR FUEL DRY STORAGE INSTALLATION (CASCAD) (Cadarshe) 13115 Saint-Paul-lez-Durance	CEA	Disposal of radioactive substances	27.05.64	17.04.80	27.04.80	<b>Shutdown of ex-reactor on 19.12.75. Modification decree of 04.09.89, J.O. of 08.09.89</b>
<b>33</b>	SPENT FUEL REPROCESSING PLANT (UP2 and AT1) (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances	27.05.64			<b>Final shutdown and decommissioning Decree of 08.11.13 J.O. of 10.11.13</b>
<b>47</b>	ELAN IIB FACILITY (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		03.11.67	09.11.67	<b>Final shutdown and decommissioning Decree of 08.11.13, J.O. of 10.11.13</b>
<b>50</b>	SPENT FUEL TEST LABORATORY (LECI) (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances	08.01.68			<b>One modification decree</b>
<b>55</b>	ACTIVE FUEL EXAMINATION LABORATORY (LECA) AND SPENT FUEL REPROCESSING, CLEAN-OUT AND REPACKAGING STATION (STAR) (Cadarshe) 13115 Saint-Paul-lez-Durance	CEA	Use of radioactive substances	08.01.68			<b>Extension (Star creation) decree of 04.09.89, J.O. of 08.09.89</b>
<b>72</b>	SOLID RADIOACTIVE WASTE MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Storage or disposal of radioactive substances		14.06.71	22.06.71	
<b>80</b>	HAO (HIGH LEVEL OXIDE) FACILITY (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		17.01.74	05.02.74	<b>Final shutdown and decommissioning Decree of 31.07.09, J.O. of 04.08.09 :</b>
<b>94</b>	IRRADIATED MATERIALS FACILITY (Chinon) 37420 Avoine	EDF	Use of radioactive substances	29.01.64			<b>One modification decree</b>
<b>116</b>	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP3 A" (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12.05.81	16.05.81	<b>Several modification decrees</b>

N° BNI	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
117	REPROCESSING PLANT FOR SPENT FUEL ELEMENTS FROM LIGHT WATER REACTORS "UP2 800" (La Hague) 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12.05.81	16.05.81	Several modification decrees
141	FUEL STORAGE FACILITY (Creys-Malville) 38510 Morestel	EDF	Storage or disposal of radioactive substances		24.07.85	31.07.85	Several modification decrees
148	ATALANTE CEN VALRHO (Chusclan) 30205 Bagnols-sur-Cèze	CEA	R&D Laboratory and study on actinide production		19.07.89	25.07.89	Deferment of commissioning: Decree of 22.07.99 J.O. du 23.07.99

TABLE 25 : SPENT FUEL PROCESSING OR STORAGE FACILITIES ON 31 DECEMBER 2013

## 2 | RADIOACTIVE WASTE GENERATING OR MANAGEMENT FACILITIES ON 31 DECEMBER 2013

### 2.1. BNIs generating radioactive waste different from those listed in L1, L.2.2 and L.3

The following BNIs produce radioactive waste, as do the BNIs that manage spent fuel (see L1), the radioactive waste storage and treatment BNIs (see L.2.2) and the BNIs undergoing decommissioning (see L.3.).

BNI n°	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
18	ULYSSE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Reactor	27.05.64			Operation stopped, fuel evacuated
29	ARTIFICIAL RADIONUCLIDES PRODUCTION FACILITY (Saclay) 91191 Gif-sur-Yvette Cedex	Cis Bio International	Transformation or production of radioactive substances	27.05.64			One modification decree (operator change)
53	ENRICHED URANIUM AND PLUTONIUM WAREHOUSE (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Storage of radioactive substances	08.01.68			
63	FUEL ELEMENTS FABRICATION PLANT 26104 Romans-sur-Isère	FBFC	Production of radioactive substances	09.05.67			Two modification decrees
68	DAGNEUX IONISATION PLANT Z.I. Les Chartinières 01120 Dagneux	IONISOS	Use of radioactive substances		20.07.71	25.07.71	Two modification decrees
71	PHENIX NUCLEAR POWER PLANT (Marcoule) 30205 Bagnols-sur-Cèze	CEA	Reactor		31.12.69	09.01.70	Preparation to final shutdown
77	POSEIDON – CAPRI IRRADIATION FACILITIES (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Use of radioactive substances		07.08.72	15.08.72	
93	GEORGES BESSE PLANT FOR URANIUM ISOTOPE SEPARATION BY GASEOUS DIFFUSION (Eurodif) 26702 Pierrelatte Cedex	EURODIF PRODUCTION	Transformation of radioactive substances		08.09.77	10.09.77	Several modification decrees
98	NUCLEAR FUELS FABRICATION UNIT 26104 Romans-sur-Isère	FBFC	Production of radioactive substances		02.03.78	10.03.78	One modification decree
99	CHINON INTER-REGIONAL WAREHOUSE 37420 Avoine	EDF	Fuel storage		02.03.78	11.03.78	One modification decree
102	BUGEY INTER-REGIONAL WAREHOUSE 01980 Loyettes	EDF	Fuel storage		15.06.78	27.06.78	One modification decree
113	LARGE NATIONAL HEAVY ION ACCELERATOR (GANIL) 14021 Caen Cedex	G.I.E GANIL	Particle accelerator		29.12.80	10.01.81	One modification decree One creation authorisation decree for Spiral 2 extension/phase 1
123	LABORATORY FOR THE EXPERIMENTAL DESIGN AND FABRICATION OF ADVANCED	CEA	Production of radioactive substances		23.12.81	26.12.81	

BNI n°	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
	NUCLEAR FUELS (LEFCA) (Cadarache) 13115 Saint-Paul-lez-Durance						
138	URANIUM CLEAN-UP AND RECOVERY FACILITY (Tricastin) 26130 Saint-Paul-Trois-Châteaux	Socatri	Plant		22.06.84	30.06.84	Two modification decrees
143	NUCLEAR MAINTENANCE FACILITY (SOMANU) 59600 Maubeuge	SOMANU	Nuclear maintenance		18.10.85	22.10.85	
146	POUZAUGES IONISATION PLANT Z.I. de Monlifiant 85700 Pouzauges	IONISOS	Ionising facility		30.01.89	31.01.89	One modification decree (operator change)
147	GAMMASTER IONISATION PLANT – M.I.N. 712 13323 Marseille Cedex 14	ISOTRON FRANCE	Ionising facility		30.01.89	31.01.89	
151	NUCLEAR FUELS FABRICATION PLANT (MELOX) BP 2 - 30200 Chusclan	AREVA NC	Production of radioactive substances		21.05.90	22.05.90	Several modification decrees
154	SABLÉ-SUR-SARTHE IONISATION PLANT Z.I. de l'Aubrée 72300 Sablé-sur-Sarthe	IONISOS	Ionising facility		01.04.92	04.04.92	One modification decree (operator change)
155	INSTALLATION TU 5 BP 16 26701 Pierrelatte	AREVA NC	Transformation of radioactive substances		07.07.92	11.07.92	One modification decree
156	CHICADE (Cadarache) BP 1 13108 Saint-Paul-lez-Durance Cedex	CEA	Research and development laboratory		29.03.93	30.03.93	
157	TRICASTIN OPERATIONAL HOT UNIT (BCOT) BP 127 84504 Bollène Cedex	EDF	Nuclear maintenance		29.11.93	07.12.93	One modification decree
169	MAGENTA 13115 Saint-Paul-lez Durance Cedex (Bouches-du-Rhône)	CEA	Receipt and shipping of radioactive substances		25.09.08	27.09.08	Decree in J.O. on 27.09.08 ASN resolution for commissioning on 27.01.11

**TABLE 26 : BNIS PRODUCING RADIOACTIVE WASTE DIFFERENT FROM BNIS LISTED IN L.1 AND L.2.2 AND THE BNIS UNDERGOING DECOMMISSIONING LISTED IN L.3. ON 31 DECEMBER 2013**

## 2.2. BNIs managing radioactive waste

The main BNIs managing radioactive waste (processing, storage, and disposal) are listed in the table below. It should nevertheless be noted that the BNIs listed in L.1 and L.2.1 and the BNIs undergoing decommissioning figuring in L.3 also include radioactive waste processing and storage facilities. More particularly, BNIs 116 and 117 (La Hague plants) which figure in section L.1.2 have extensive facilities for processing and storing waste, particularly HLW and ILW-LL waste.

BNI n°	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
35	LIQUID EFFLUENT MANAGEMENT ZONE (Saclay) 91191 Gif-sur-Yvette Cedex	CEA	Transformation of radioactive substances	27.05.64			One modification decree
37	EFFLUENT AND SOLID WASTE TREATMENT STATION (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Transformation of radioactive substances	27.05.64			
56	RADIOACTIVE WASTE INTERIM STORAGE AREA (Cadarache) 13115 Saint-Paul-lez-Durance	CEA	Storage of radioactive substances	08.01.68			
66	MANCHE WASTE REPOSITORY (CSM) 50448 Beaumont-Hague	Andra	Radioactive waste disposal facility		19.06.69	22.06.69	Entry in monitoring phase : decree of 10.01.2003, J.O. of 11.01.2003
72	SOLID RADIOACTIVE WASTE MANAGEMENT ZONE (Saclay)	CEA	Storage or deposit of radioactive		14.06.71	22.06.71	

BNI n°	Name and location of facility	Operator	Type of facility	Declaration date	Licensing date	Publication date in JO	Remarks
	91191 Gif-sur-Yvette Cedex		substances				
74	INTERIM STORAGE OF IRRADIATED GRAPHITE SLEEVES (SAINT LAURENT DES EAUX) 41220 La Ferté-St-Cyr	EDF	Storage or deposit of radioactive substances		14.06.71	22.06.71	<b>One modification decree (operator change)</b>
118	LIQUID EFFLUENT AND SOLID WASTE TREATMENT STATION "STE3" La Hague 50107 Cherbourg	AREVA NC	Transformation of radioactive substances		12.05.81	16.05.81	<b>Several modification decrees</b>
149	AUBE WASTE REPOSITORY (CSA) Soulaines-Dhuys 10200 Bar-sur-Aube	Andra	Disposal facility of radioactive waste		04.09.89	06.09.89	<b>Two modification decrees</b>
160	Centraco Codolet 30200 Bagnols-sur-Cèze	Socodei	Treatment of radioactive waste and liquid discharges		27.08.96	31.08.96	<b>Two modification decrees</b>
164	Cedra (Cadarache) 13113 St Paul lez Durance	CEA	Packaging and storage of radioactive substances		04.10.04	05.10.04	
–	Bassins B1 et B2 (Malvési) 11100 Narbonne (Aude)	AREVA NC	Packaging and storage of radioactive substances				<b>ASN resolutions of 22.12.09 and 18.06.13</b>

TABLE 27 : MAJOR BNIS MANAGING RADIOACTIVE WASTE ON 31 DECEMBER 2013

*Note: Cires (very low level waste repository) is classified as an ICPE (installation classified on environmental protection grounds) and therefore does not figure in this list.*

### 3 | FACILITIES DECOMMISSIONED OR UNDERGOING DECOMMISSIONING ON 31 DECEMBER 2013.

#### 3.1. Decommissioned reactors or in the process of being decommissioned

Facility name and location	BNI No.	Commissioning year	Final production shutdown year	Thermal power (MW)	Last regulatory actions	Current status
NEREIDE Fontenay-aux-Roses	(ex BNI n°10)	1960	1981	0,5	1987 : cancelled from BNI List	Decommissioned, delicensed
TRITON Fontenay-aux-Roses	(ex BNI n°10)	1959	1982	6,5	1987 : cancelled from BNI list and classified as IC	Delicensed, classified as ICPE
ZOÉ Fontenay-aux-Roses	(ex BNI n°11)	1948	1975	0,25	1978 : cancelled from BNI list and classified as IC	Contained (Museum), delicensed, classified as ICPE
MINERVE Fontenay-aux-Roses	(ex BNI n°12)	1959	1976	0,0001	1977 : cancelled from BNI list	Dismantled at FAR and rebuilt at Cadarache site.
EL2Saclay	(ex BNI n°13)	1952	1965	2,8	cancelled from BNI list	Partially dismantled, remaining parts contained.
EL 3Saclay	(ex BNI n°14)	1957	1979	18	1988 : cancelled from BNI list and classified as IC	Partially dismantled, remaining parts contained.
MELUSINE Grenoble	(ex BNI 19)	1958	1988	8	2011 : cancelled from BNI list	Cleaned-out
SILOETTE Grenoble	(ex BNI 21)	1964	2002	0,100	2007 : cancelled from BNI list	Cleaned-out
PEGGY Cadarache	(ex BNI n°23)	1961	1975	0,001	1976 : cancelled from BNI list	Decommissioned, delicensed
CESAR Cadarache	(ex BNI n°26)	1964	1974	0,01	1978 : cancelled from BNI list	Decommissioned, delicensed
MARIUS Cadarache	(ex BNI n°27)	1960 in Marcoule, 1964 in Cadarache	1983	0,0004	1987 : cancelled from BNI list	Decommissioned, delicensed
HARMONIE Cadarache	(ex BNI 41)	1965	1996	0,001	1987 : cancelled from BNI list	Building demolished
University reactor of Strasbourg (RUS) Strasbourg	(ex BNI 44)	1967	1997	0,100	1987 : cancelled from BNI list	Cleaned-out, delicensed
SILOE Grenoble	20	1963	1997	35	2005 : Decree for final	Undergoing

Facility name and location	BNI No.	Commissioning year	Final production shutdown year	Thermal power (MW)	Last regulatory actions	Current status
					shutdown and decommissioning (MAD-DEM) 2013 : modification of the decree	decommissioning
RAPSODIE Cadarache	25	1967	1983	20 then 40	2011 : cancelled from BNI list	Preparation to final shutdown
BUGEY 1 Lagneu	45	1972	1994	1920	1996 : Decree for final shutdown 2008 : Decree for complete decommissioning	Undergoing decommissioning
SAINT-LAURENT DES EAUX A1 La Ferté-Saint-Cyr	46	1969	1990	1662	1994 : Decree for final shutdown 2010 : Decree for complete decommissioning	Undergoing decommissioning
SAINT-LAURENT A2 La Ferté-Saint-Cyr	46	1971	1992	1801	1994 : Decree for final shutdown 2010 : Decree for complete decommissioning	Undergoing decommissioning
SUPERPHENIX Creys-Malville	91	1985	1997	3000	1998 : Decree for final shutdown 2006 : Decree for final shutdown (last step) and complete decommissioning	Undergoing decommissioning
Chinon A1D (ex-Chinon A1) Avoine	133 (ex BNI n°5)	1963	1973	300	1982 : Decree for Chinon A1 containment and creation of the storage BNI Chinon A1D	Partially decommissioned, modified as storage BNI for waste let on site (museum)
CHINON A2D (ex-Chinon A2) Avoine	153 (ex BNI n°6)	1965	1985	865	1991 : Decree for partial decommissioning of Chinon A2 and creation of the storage BNI Chinon A2D	Partially decommissioned, modified as storage BNI for waste let on site
CHINON A3D (ex-Chinon A3) Avoine	161 (ex BNI n°7)	1966	1990	1360	1996 : Decree for partial decommissioning of Chinon A3 and creation of the storage BNI Chinon A3D	Partially decommissioned, modified as storage BNI for waste let on site
EL-4D (ex-EL4) Brennilis Huelgoat	162 (ex BNI n°28)	1966	1985	250	1996 : Decree for decommissioning and creation of the storage BNI EL-4D Various decrees including the decree for final shutdown and complete decommissioning cancelled by State Council decision on 06.06.07 decree for final shutdown and complete decommissioning of 27.07.11	Undergoing decommissioning
CHOOZ AD (ex-Chooz A) Givet	163 (ex BNI n°A1, 2, 3)	1967	1991	1040	1999 : Decree of partial decommissioning of Chooz A and creation of the storage BNI Chooz AD Decree of final shutdown and decommissioning of 27.09.07, J.O. of 29.09.07	Partially decommissioned, modified as storage BNI for waste let on site

TABLE 28 : DECOMMISSIONED REACTORS OR IN THE PROCESS OF BEING DECOMMISSIONED ON 31 DECEMBER 2013

### 3.2. Other decommissioned facilities or in the process of being decommissioned

Facility name and location	BNI n°	Facility type	Commissioning year	Final production shutdown year	Last regulatory actions	Current status
LE BOUCHET	(ex BNI n°30)	Ore processing	1953	1970	cancelled from BNI list	Decommissioned
GUEUGNON	(ex BNI n°31)	Ore processing	1965	1980	cancelled from BNI list	Decommissioned
STED Fontenay-aux-Roses	BNI 34	EFFLUENT AND SOLID WASTE TREATMENT STATION	Avant 1964	2006	2006 : cancelled from BNI list	Integrated to BNI 166
ALS Saclay	(ex BNI 43)	Accelerator	1965	1996	2006 : cancelled from BNI list	Cleaned-out

Facility name and location	BNI n°	Facility type	Commissioning year	Final production shutdown year	Last regulatory actions	Current status
SATURNE Saclay	(ex BNI 48)	Accelerator	1958	1997	2005 : cancelled from BNI list	Cleaned-out
ATTILA Fontenay-aux-Roses	(ex BNI 57)	Processing pilot	1966	1975	2006 : cancelled from BNI list	Integrated to BNI 165 and 166
LCPu Fontenay-aux-Roses	(ex BNI 57)	Plutonium chemistry laboratory	1966	1995	2006 : cancelled from BNI list	Integrated to BNI 165 et 166
BAT. 19 Fontenay-aux-Roses	(ex BNI n 58)	Plutonium metallurgy	1968	1984	1984 : cancelled from BNI list	Decommissioned
RM2 Fontenay-aux-Roses	(ex BNI 59)	Radio-metallurgy	1968	1982	2006 : cancelled from BNI list	Integrated to BNI 165 and 166
LCAC Grenoble	(ex BNI n°60)	Fuel analysis	1968	1984	1997 : cancelled from BNI list	Decommissioned
STEDS Fontenay-aux-Roses	(ex BNI 73)	Radioactive waste decay storage	1989		2006 : cancelled from BNI list	Integrated to BNI 166
ARAC Saclay	(ex BNI n°81)	Fabrication of fuel assemblies	1975	1995	1999 : cancelled from BNI list	Cleaned-out
IRCA Cadarache	(ex BNI 121)	Irradiator	1983	1996	2006 : cancelled from BNI list	Cleaned-out
FBFC Pierrelatte	(ex BNI 131)	Fuel fabrication	1983	1998	2003 : cancelled from BNI list	Cleaned-out
MIRAMAS URANIUM Warehouse Istres	(ex BNI134)	Uranium bearing materials warehouse	1964	2004	2007 : cancelled from BNI list	Cleaned-out
SNCS Osmanville	(ex BNI 152)	Ioniser	1983	1995	2002 : cancelled from BNI list	Cleaned-out
ATPu Cadarache	32	Fabrication or transformation of radioactive substances	1962	2003	2009 : Modification of the decree for final shutdown and decommissioning	Decommissioning in progress
SPENT FUEL REPROCESSING PLANT (UP2) (La Hague) 50107 Cherbourg	33	Transformation of radioactive substances	1964	2004	2013 : Decree for final shutdown and decommissioning	Decommissioning in progress
STED et Storage facility of high activity waste Grenoble	36 et 79	Facility for waste processing and storage	1964/1972	2008	2008 : Decree for final shutdown and decommissioning	Decommissioning in progress
STE2 La Hague	38	Effluent and solid waste treatment station	1964	2004	2013 : Decree for final shutdown and partial decommissioning	Decommissioning in progress
ELAN II B La Hague	47	Cs 137 source manufacturing	1970	1973	2013 : Decree for final shutdown and decommissioning	Decommissioning in progress
LHA (High activity laboratory) Saclay	49	Laboratory	1960	1996	2008 : Decree for final shutdown and decommissioning	Decommissioning in progress
ATUE Cadarache	52	Uranium processing	1963	1997	2006 : Decree for final shutdown and decommissioning	Decommissioning in progress
LPC Cadarache	54	Laboratory	1966	2003	2009 : Decree for final shutdown and decommissioning	Decommissioning in progress
LAMA Grenoble	61	Laboratory	1968	2002	2008 : Decree for final shutdown and decommissioning	Decommissioning in progress
SICN Veurey-Voroize	65 et 90	Fuel production plant	1963	2000	2006 : Decree for final shutdown and decommissioning	Decommissioning in progress
HAO Facility La Hague	80	Transformation of radioactive substances	1974	2004	2009 : Decree for final shutdown and decommissioning	Decommissioning in progress
COMURHEX Pierrelatte	105	Plant for uranium chemical transformation	1979	2008		Decommissioning in progress

Facility name and location	BNI n°	Facility type	Commissioning year	Final production shutdown year	Last regulatory actions	Current status
LURE Orsay	106	Particle accelerator	from 1956 to 1987	2008	2009 : Decree for final shutdown and decommissioning	Decommissioning in progress
PROCEDE Fontenay-aux-Roses	165	Grouping of former process installations	2006		2006 : Decree for final shutdown and decommissioning	Decommissioning in progress
SUPPORT Fontenay-aux-Roses	166	Waste packaging and processing	2006		2006 : Decree for final shutdown and decommissioning	Decommissioning in progress

TABLE 29 : OTHER DECOMMISSIONED FACILITIES OR IN THE PROCESS OF BEING DECOMMISSIONED ON 31 DECEMBER 2013

## 4 | COMPLEMENTARY SAFETY ASSESSMENTS OF NUCLEAR INSTALLATIONS IN THE LIGHT OF FUKUSHIMA ACCIDENT « STRESS TESTS » – LIST OF INSTALLATIONS AND SITES CONCERNED

The Fukushima accident in Japan has led the French safety authorities, in response to the Prime Minister's referral, to ask the licensees to carry out stress tests on their installations and their support functions.

Based on the specifications drawn up by the French safety authorities, the stress tests consist in analysing the beyond-design-basis safety margins of nuclear installations with respect to extreme natural phenomena (earthquakes, floods, etc.). They involve a deterministic approach that consists in increasing the level of aggression in question to assess the resistance of the installation to extreme situations and the current measures to counter them. The postulated successive losses of safety functions (electrical power supplies, cooling systems, etc.), and the management of accidents resulting from these situations are examined.

The aim is to identify any situations that could lead to a sudden deterioration of the accident sequences ("cliff-edge effect") and propose additional measures to prevent such situations and to increase the robustness of the installation with regard to defence in depth.

After a first series of stress tests carried out in 2011 on those installations considered as priorities by the safety authorities (batch 1), a second series of stress tests was carried out in 2012 on other CEA installations and on the resources shared by the Cadarache and Marcoule centres (batch 2). These stress tests were supplemented in 2013 by stress tests on the shared resources of the Saclay centre and on other CEA installations for which stress tests results are to be transmitted to the authorities when the periodic safety review of the installation becomes due (batch 3).

See chapter A.3 for the stress test follow-ups.

### 4.1. Installations and sites identified as priority to be assessed in 2011

#### 4.1.1. Installations operated by Electricité de France – NPPs

- Belleville NPP (BNI 127 et 128)
- Blayais NPP (BNI 86 et 110)
- Bugey NPP (BNI 78 et 89)
- Cattenom NPP (BNI 124, 125, 126 et 137)
- Chinon B NPP (BNI 107 et 132)
- Chooz B NPP (BNI 139 et 144)
- Civaux NPP (BNI 158 et 159)
- Cruas NPP (BNI 111 et 112)
- Dampierre NPP (BNI 84 et 85)
- Fessenheim NPP (BNI 75)
- Flamanville NPP, including Flamanville 3 (BNI 108, 109 et 167)

- Golfech NPP (BNI 135 et 142)
- Gravelines NPP (BNI 96, 97 et 122)
- Nogent NPP (BNI 129 et 130)
- Paluel NPP (BNI 103, 104, 114 et 115)
- Penly NPP (BNI 136 et 140)
- Saint-Alban-Saint-Maurice NPP (BNI 119 et 120)
- Saint Laurent B NPP (BNI 100)
- Tricastin NPP (BNI 87 et 88)

#### 4.1.2. Installations operated by CEA

Cadarache site	<ul style="list-style-type: none"> <li>• Jules Horowitz Reactor (BNI 172)</li> <li>• Masurca (BNI 39)</li> <li>• ATPu (BNI 32)</li> </ul>
Saclay site	<ul style="list-style-type: none"> <li>• OSIRIS (BNI 40)</li> </ul>
Marcoule site	<ul style="list-style-type: none"> <li>• Phénix (BNI 71)</li> </ul>

#### 4.1.3. Installations operated by AREVA

La Hague site AREVA NC	<ul style="list-style-type: none"> <li>• UP3 (BNI 116)</li> <li>• UP2 800 (BNI 117)</li> <li>• UP2 400 (BNI 33)</li> <li>• STE2 A (BNI 38)</li> </ul>	<ul style="list-style-type: none"> <li>• HAO (BNI 80)</li> <li>• Elan 2B (BNI 47)</li> <li>• STE3 (BNI 118)</li> <li>• Site support functions</li> </ul>
Marcoule site	<ul style="list-style-type: none"> <li>• MELOX SA : Melox facility (BNI 151)</li> </ul>	
Tricastin site EURODIF SA	<ul style="list-style-type: none"> <li>• George Besse I facility (BNI 93)</li> <li>• SET : George Besse II and RECII (BNI 168)</li> <li>• AREVA NC : TU5 W facility (BNI 155)</li> <li>• Comurhex – Tricastin facility (BNI 105)</li> <li>• SOCATRI (BNI 138)</li> <li>• Site support functions</li> </ul>	
Romans site	<ul style="list-style-type: none"> <li>• FBFC : FBFC facility (BNI 98)</li> </ul>	

#### 4.1.4. Installations operated by l'Institut Laue Langevin

Grenoble site	<ul style="list-style-type: none"> <li>• High Flux Reactor (RHF) (BNI 67)</li> </ul>
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### 4.2. Installations and sites assessed in 2012

#### 4.2.1. Installations operated by CEA

Cadarache site	<ul style="list-style-type: none"> <li>• Rapsodie (BNI 25)</li> <li>• MCMF (BNI 53)</li> <li>• LECA (BNI 55)</li> <li>• CHICADE (BNI 148)</li> </ul>	<ul style="list-style-type: none"> <li>• Cabri (BNI 24)</li> <li>• PEGASE (BNI 22)</li> <li>• Storage facility (BNI 56)</li> <li>• Site support functions</li> </ul>
Saclay site	<ul style="list-style-type: none"> <li>• Orphée (BNI 101)</li> </ul>	
Marcoule site	<ul style="list-style-type: none"> <li>• Atalante (BNI 156)</li> <li>• Site support functions</li> </ul>	

**4.2.2. Installations operated by AREVA**

<b>Romans site</b>	<ul style="list-style-type: none"> <li>• FBFC – CERCA facility (BNI 63)</li> </ul>
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**4.2.3. Installations operated by Cisbio International**

<b>Saclay site</b>	<ul style="list-style-type: none"> <li>• Cisbio facility (BNI 29)</li> </ul>
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**4.2.4. EDF installations being decommissioned**

<b>Creys Malville site</b>	<ul style="list-style-type: none"> <li>• Superphénix including TNA (BNI 91)</li> <li>• APEC (BNI 141)</li> </ul>
<b>Bugey site</b>	<ul style="list-style-type: none"> <li>• Bugey 1 (BNI 45)</li> </ul>
<b>Chinon site</b>	<ul style="list-style-type: none"> <li>• Chinon A1 (BNI 133)</li> <li>• Chinon A2 (BNI 153)</li> <li>• Chinon A3 (BNI 161)</li> </ul>
<b>Saint-Laurent site</b>	<ul style="list-style-type: none"> <li>• Saint-Laurent A1 (BNI 46)</li> <li>• Saint-Laurent A2 (BNI 46)</li> </ul>
<b>Chooz site</b>	<ul style="list-style-type: none"> <li>• Chooz A (BNI 163)</li> </ul>
<b>Brennilis site</b>	<ul style="list-style-type: none"> <li>• Monts d'Arrée - EL4-D (BNI 162)</li> </ul>

**4.2.5. Installation under construction ITER ORGANIZATION**

<b>Cadarache site</b>	<ul style="list-style-type: none"> <li>• ITER</li> </ul>
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**4.3. Other installations of lower priority to be assessed according to specific ASN requests, including by anticipated periodic safety reviews****4.3.1. Installations operated by CEA**

<b>Cadarache site</b>	<ul style="list-style-type: none"> <li>• Phébus (BNI 92)</li> <li>• EOLE (BNI 42)</li> <li>• MINERVE (BNI 95)</li> <li>• STAR (BNI 55)</li> <li>• Magenta (BNI 169)</li> <li>• CEDRA (BNI 164)</li> </ul>	<ul style="list-style-type: none"> <li>• LPC (BNI 54)</li> <li>• LEFCA (BNI 123)</li> <li>• CASCAD (BNI 22)</li> <li>• AGATE (BNI 171)</li> <li>• STEDS Traitement (BNI 37)</li> </ul>
<b>Saclay site</b>	<ul style="list-style-type: none"> <li>• LECI (BNI 50)</li> <li>• Poséidon (BNI 77)</li> </ul>	<ul style="list-style-type: none"> <li>• ZGDS Storage facility (BNI 72)</li> <li>• ZGEL Liquid Effluent Management Zone (BNI 35)</li> </ul>
<b>Fontenay-aux-Roses site</b>	<ul style="list-style-type: none"> <li>• BNI Process (BNI 165)</li> <li>• BNI Support (BNI 166)</li> </ul>	

The following BNIs are not concerned by the stress tests: ATUe (BNI 52) on the Cadarache site, Ulysse (BNI 18) and LHA (BNI 49) on the Saclay site, STED (BNI 36), LAMA (BNI 61), STED (BNI 79) and Siloé (BNI 20) on the Grenoble site.

**4.3.2. Installations operated by IONISOS**

- Dagneux site (BNI 68)
- Pouzauges site (BNI 146)
- Sablé sur Sarthe site (BNI 154)

**4.3.3. Installations operated by Andra**

- CSM (BNI 66)

- CSA (BNI 149)

#### 4.3.4. Installations operated by EdF

Tricastin site	<ul style="list-style-type: none"> <li>• Tricastin operational hot unit (BCOT) (BNI 157)</li> </ul>
Chinon site	<ul style="list-style-type: none"> <li>• Irradiated materials facility (AMI) (BNI 94)</li> <li>• Chinon inter-regional warehouse (MIR) (BNI 99)</li> </ul>
Bugey site	<ul style="list-style-type: none"> <li>• Bugey Inter-regional warehouse (MIR) (BNI 102)</li> <li>• ICEDA (BNI 173)</li> </ul>
Saint- Laurent site	<ul style="list-style-type: none"> <li>• Interim storage facility of irradiated graphite sleeves (BNI 74)</li> </ul>

#### 4.3.5. Installations operated by AREVA group

Narbonne site	<ul style="list-style-type: none"> <li>• Comurhex Malvézi (ECRIN) (Licensing in progress)</li> </ul>
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#### 4.3.6. Other operators

SOCODEI	Marcoule site	<ul style="list-style-type: none"> <li>• Centraco (BNI 160)</li> </ul>
SOMANU	Maubeuge site	<ul style="list-style-type: none"> <li>• Nuclear maintenance facility (BNI 143)</li> </ul>
GIE GANIL	Caen site	<ul style="list-style-type: none"> <li>• GANIL (BNI 113)</li> </ul>
ISOTRON		<ul style="list-style-type: none"> <li>• GAMMASTER - Marseille (BNI 147)</li> <li>• GAMMATEC – Chuslan (BNI170)</li> </ul>

The following BNIs are not concerned by the stress tests: the Strasbourg university reactor (BNI 44) – Louis Pasteur University, the LURE (BNI 106), SICN (BNI65 and BNI90).

## 5 | MAJOR LEGISLATIVE AND REGULATORY TEXTS

### 5.1. Laws and regulations in force

#### **Planning Act No. 2006-739 of 28 June 2006 (“Waste Act”)**

On the Sustainable Management of Radioactive Materials and Waste.

→ codified in the Environment Code

#### **Act No. 2006-686 of 13 June 2006 (« TSN Act »)**

Concerning Transparency and Security in the Nuclear Field (TSN Act).

→ codified in the Environment Code

#### **Decree No.2013-1304 of 27 December 2013**

Setting out the prescriptions of the National Plan for the Management of radioactive materials and waste (PNGMDR)

#### **Decree No. 2008-875 of 29 August 2008**

Concerning the Nature of the Information to be transmitted for the National Inventory and the PNGMDR

#### **Decree No. 2008-357 of 16 April 2008**

Concerning the Definition of a National Management Plan for Radioactive Materials and Waste

#### **Decree No. 2008-209 of 3 March 2008**

Concerning the Management of Foreign Waste and Processing Contracts

#### **Decree No. 2007-1582 of 7 November 2007**

Concerning the Protection of Persons against the Hazards of Ionising Radiation and Modifying the Public Health Code, Extensively Revised Part III of Book III of the First Part of the Public Health Code.

#### **Decree No. 2007-1572 of 6 November**

Concerning Technical Inquiries on Accidents or Incidents Induced by Nuclear Activities.

#### **Decree No. 2007-1570 of 5 November 2007**

Concerning Occupational Protection against Ionising Radiation and Modifying the Labour Code.

#### **Decree No. 2007-1557 of 2 November 2007 (“BNI Procedures Decree”)**

Concerning Basic Nuclear Facilities and the Regulation of Nuclear Safety Aspects Involved in the Transport of Radioactive Material.

#### **Decree No. 2007-831 of 11 May 2007**

Concerning the Appointment and Empowerment Procedures for Nuclear Safety Inspectors.

#### **Decree No. 2007-830 of 11 May 2007**

Concerning the BNI Nomenclature.

#### **Decree No. 2007-721 of 7 May 2007**

Determining the Fraction of the Support Tax Paid Back to the Communes any part of which is Less Than 10 km From the Main Access to the Underground Installations of the Bure (Meuse) Research Laboratory pursuant to V of Article 43 of Act No. 99-1172 of 30 December 1999, as amended, constituting the 2000 Finance Act.

#### **Decree No. 2007-720 of 7 May 2007**

Concerning the Membership and Operating Procedures of the Local Information and Oversight Committees Created by Article L542-13 of the *Environment Code* for Underground Laboratories Conducting Research Into the Radioactive Waste Management and Modifying *Decree No. 99-686 of 3 August 1999*.

#### **Decree of 5 April 2007**

Constituting nomination to the National Commission for the Assessment of Research and Studies Concerning the Management of Radioactive Materials and Waste.

**Decree No. 2007-243 of 23 February 2007**

Concerning the Secure Financing of Nuclear Costs.

**Decree No. 2007-150 of 5 February 2007**

Defining the Perimeter of the Proximity area described in Article L542-11 of the *Environment Code*, Concerning the Meuse and Haute-Marne Underground Laboratory Designed to Study the Suitability of Deep Geological Formations for Disposing of Which Radioactive Waste.

**Decree No. 2006-1606 of 14 December 2006**

Concerning Public Interest Groups Regulated by Article L542-11 of the *Environment Code*.

**Decree No. 2003-296 of 31 March 2003**

Concerning Occupational Protection against the Hazards of Ionising Radiation.

**Decree No. 2002-460 of 04 April 2002**

On the General Protection of Persons Against the Hazards of Ionising Radiation.

**Order of 7 February 2012**

Setting the general rules relative to basic nuclear installations.

**Order 2001-270 of 28 March 2001**

On the Transposition of EU Directives Concerning the Protection Against Ionising Radiation.

**5.2. Basic safety rules subject to the Convention on 30 June 2014**

**5.2.1. Basic safety rules**

**RFS-I.1.a** Inclusion of Hazards Relating to Aircraft Crashes (7 October 1992).

**RFS-I.1.b** Inclusion of Hazards Linked to the Industrial Environment and Communication Routes (7 October 1992).

**RFS 2001-01** Determination of Seismic Movements to Be Considered for Installation Safety (revision of RFS-I.1.c – 16 May 2001).

**RFS-I.2** Safety Objectives and Design Bases for Surface Facilities Intended for Long-term Disposal of Solid Short or medium-lived Radioactive Waste with Low or Intermediate Specific Activity (8 November 1982 – revision of 19 June 1984).

**RFS-I.3.c** Criticality Hazards (18 October 1984).

**RFS-I.4.a** Fire Protection (28 February 1985).

**RFS-II.2** Design and Operation of Ventilation Systems in Other Basic Nuclear Facilities than Nuclear Reactors (20 December 1991).

**RFS-III.2.a** General Provisions Applicable to the Production, Monitoring, Treatment, Packaging and Interim Storage of Various Waste Categories Resulting from Processing of Fuel Irradiated in Pressurised-water Reactors (24 September 1982).

**RFS-III.2.b** Special Provisions Applicable to the Production, Monitoring, Treatment, Packaging and Interim Storage of High-level Waste Packaged in Glass and Resulting from Processing of Fuel Irradiated in Pressurised-water Reactors (12 December 1982).

**RFS-III.2.c** Special Provisions Applicable to the Production, Monitoring, Treatment, Packaging and Interim Storage of Low or Intermediate-level Waste Encapsulated in Bitumen and Resulting from Processing of Fuel Irradiated in Pressurised-water Reactors (5 April 1984).

**RFS-III.2.d** Special Provisions Applicable to the Production, Monitoring, Treatment, Packaging and Interim Storage of Waste Encapsulated in Cement and Resulting from Processing of Fuel Irradiated in Pressurised-water Reactors (1 February 1985).

**RFS-III.2.e** Prerequisites for the Approval of Packages of Encapsulated Solid Waste Intended for Surface Disposal (31 October 1986 – revision of 29 May 1995).

### 5.2.2. Guides

**Guide** to notification procedures for significant events concerning nuclear installations and radioactive material transport

**ASN Guide n°3:** Recommendations for writing annual public information reports concerning basic nuclear installations (20 October 2010)

**ASN Guide n°6:** Final shutdown, decommissioning and delicensing of basic nuclear installations in France (18 June 2013)

**ASN Guide n°7:** Transport of radioactive packages or substances on the public highway for civil purposes (28 February 2013)

**ASN Guide n°8:** Assessing the conformity of nuclear pressure equipment (4 September 2012)

**ASN Guide n°9:** Determining the perimeter of a BNI (31 October 2013)

**ASN Guide n°10:** Guide to the local involvement of Local Information Committees (CLIs) in the third 10-year outages of 900-MWe reactors (1 June 2010).

**ASN Guide n°13:** Protection of basic nuclear installations against external flooding (8 January 2013)

**Draft ASN Guide n°14:** Acceptable complete clean-out methodologies in basic nuclear installations in France (21 June 2010)

**ASN Guide n°18:** Disposal of effluents and waste contaminated by radionuclides, produced in facilities licensed under the Public Health Code (26 January 2008)

**ASN Guide n°19:** Application of Order of 12/12/2005 relative to nuclear pressure equipment (21 February 2013)

**Methodological guide:** Management of sites potentially polluted by radioactive substances (December 2011)

**Guide** indicating the conditions of application of the fire provisions of the Order of 31/12/1999 amended (1 April 2006)

**Guide** to the regulatory requirements applicable to the transport of radioactive materials in airports (February 2006)

**Safety Guide** on the final disposal of radioactive waste in deep geological formations (February 2008)

**General safety orientations notice** in view of the search for a site for disposal of low specific activity, long-lived waste (June 2008)

## 6 | STRUCTURE OF MAJOR NUCLEAR OPERATORS

### 6.1. ANDRA

ANDRA was created in 1979 as part of the CEA. In 1992, it became an independent establishment run by a chief executive officer who supervises the Agency's functional and operational divisions.

#### 6.1.1. Functional divisions

- the General Secretariat, in charge of purchasing, management, accounts, legal matters and information systems;
- the Human Resources Division, and
- the Communications, and
- the International Affairs Division.

#### 6.1.2. Operational divisions

- the Risk Management Division, whose mission is first and foremost to propose and to implement the Agency's policy with regard to safety, radiation protection, quality, occupational health and safety, environmental protection and sustainable development, and also to support the top management in the implementation of the strategic leadership ; that division is also responsible for drawing the inventory of all radioactive waste present on French soil and for disseminating the national inventory ;
- the Programme Division is in charge of leading specific studies to determine and to implement management solutions for long-lived radioactive waste for which a perennial solution is still pending ; in that capacity, it orients the strategic leadership of the CIGÉO Project, co-ordinates LL-LL Waste Project and carries out prospective studies concerning new systems, notably those involving Generation-IV reactors;
- the Engineering and CIGÉO Project Division, whose mission is to represent ANDRA, as client for the design and execution of nuclear and non-nuclear infrastructures for both surface and underground facilities that are necessary for an overall view of the deep geological repository (CIGÉO) and to the construction of its first unit, in accordance with the prescriptions specified by the Programme Division;
- the Research and Development Division, whose mission is to draft and to implement the scientific programmes in response to the objectives set by the other Agency divisions; in order to achieve that goal, the Division proposes and implements the Agency's scientific policy, after validation by the Chief Executive Officer. It carries out corresponding investigations or have them carried out, ensures their follow-up, summary and delivery; it warrants the quality of scientific data ; it also provides scientific and technical assistance and expert advice to the Agency's various entities in support of ANDRA's activities with regard to geology, hydrogeology, materials science, radionuclide transfers towards the biosphere and human beings, as well as mathematical modelling;
- the Meuse/Haute-Marne Underground Research Laboratory Division, consisting of a scientific tool to study the geological environment and to characterise the clay host formation where the facility is implemented ; the activity of the URL covers the construction and implementation of the installations and of the scientific experimentations; the Division also ensures the surveys over the zone of the future HL-waste repository, and
- the Industrial Division, which is in charge of operating ANDRA's disposal facilities and implementing industrial solutions for taking over radioactive waste; in that context, it serves as the Agency's official contact with waste producers and holders for industrial activities.

### 6.2. CEA

The CEA is a public research organisation founded in 1945.

With the publication of the legislative section of the Research Code (Ordinance n° 2004-545 of 11 June 2004), the CEA (formerly the *Commissariat à l'Energie Atomique* - Atomic Energy Commission), which became the Alternative Energies and Atomic Energy Commission on 10 March 2010 (Supplementary Budget

Act 2010-237 of 9 March 2010) now lies within the category of Industrial and Commercial Public Establishments (EPIC), in the research EPIC category.

Its status and its missions are defined in Articles L. 332-1 to L. 332-7 of the Research Code.

A major actor in the world of research, development and innovation, the CEA works in four broad areas: low-carbon energies (nuclear and renewables), information technologies, technologies for health, defence and global security. In each of these four broad areas, CEA has first-class fundamental research resources and plays a role in dynamic development through innovation in relation with industry. It coordinates and takes part in the research work conducted in the TGIRs (*Très grandes infrastructures de recherche* - Very large research infrastructures).

## GOVERNANCE D'ENTREPRISE

(au 31 décembre 2012)

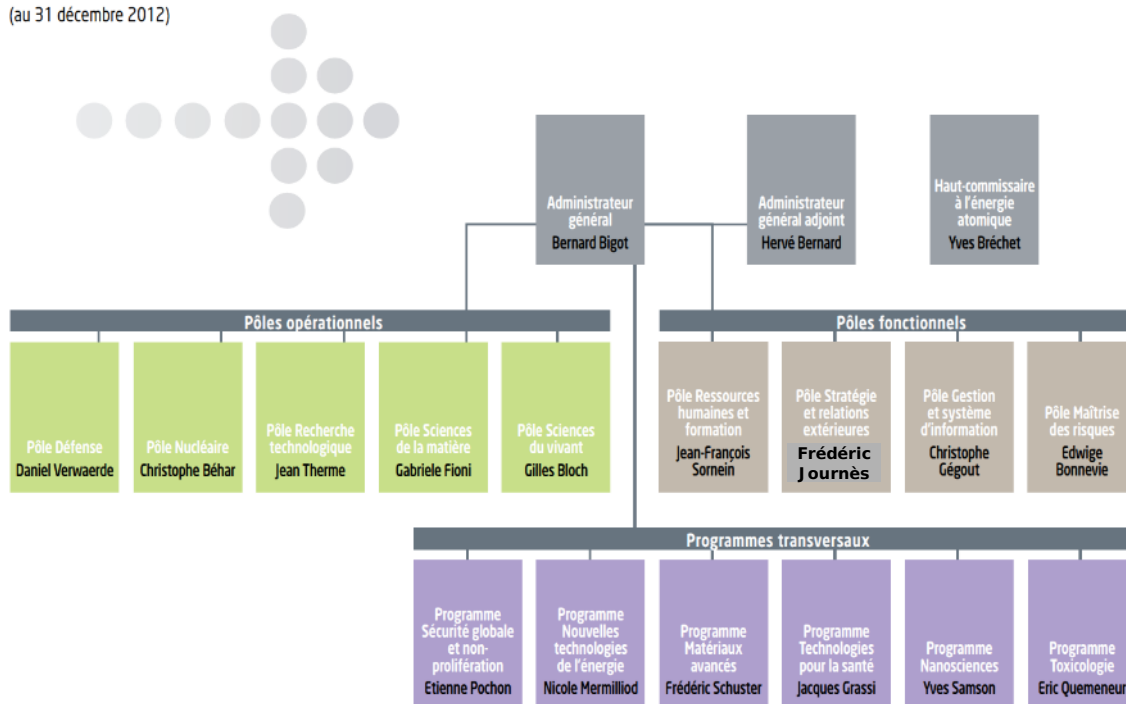


FIGURE 16 : ORGANISATION CHART OF CEA

### 6.3. AREVA

AREVA continues to develop its key historical topics that is the nuclear fuel cycle (Mining, Front-end, Reactors and Services, Back-end) and renewable energies (Offshore Wind Turbines, Concentrated Solar Energy, Biomass, Hydrogen and Energy Storage).

The AREVA Group is one of the world's leaders for finding solutions to generate energy with less CO<sub>2</sub>.

AREVA's activities are reflected in the organisation chart shown below.

The general nuclear-safety-inspection function pertains to the Corporate Safety, Security, Health and Environment Department (*Direction Corporate sûreté-sécurité-santé-environnement – D3SE*).

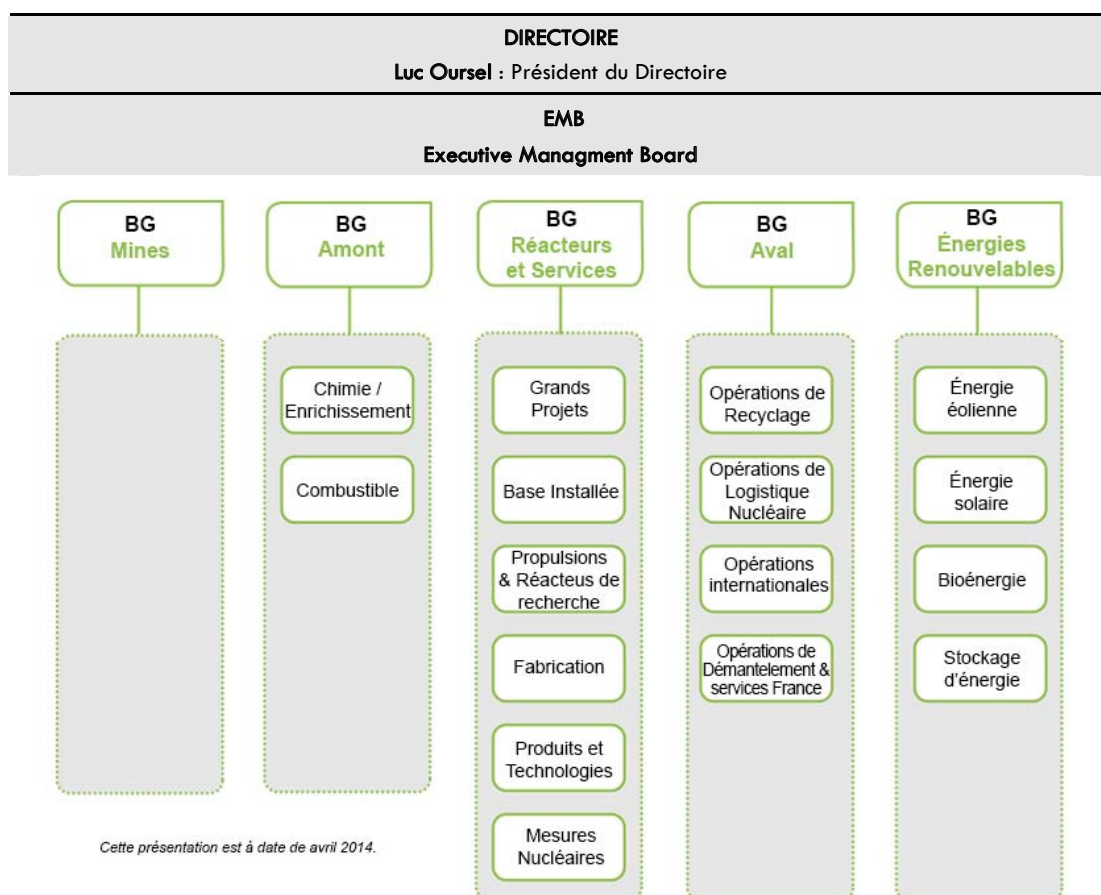


FIGURE 17 : ORGANISATION CHART OF AREVA

### 6.4. EDF

EDF is the leading electricity-generating company in France and the only one to operate NPPs. Within the various divisions and units of its Production and Engineering Branch (*Direction Production Ingénierie – DPI*), EDF is directly responsible for managing process waste and spent fuel. The main components of the DPI associated with the nuclear sector are described below.

#### 6.4.1. Nuclear Production Division

As nuclear operator, the DPN is in charge of operational sites until their final shutdown. The DPN holds the main responsibility for all generic actions. In that respect, it bears the waste-related costs, which include especially the fixed costs for “pre-processing” (mobile packaging units and CENTRACO) and disposal (CSA and Cires). The Director of the DPN is the main contact with the ASN Director-General, particularly in the field of radioactive waste management in operating NPPs

##### 6.4.1.1. POWER AND NUCLEAR POWER GENERATING STATIONS

In accordance with regulations, NPP managers are responsible for their waste (from the production site up to their final destination) and for the conformity of the packages they produce. They are required to

implement the doctrine drawn up for the entire nuclear fleet and to use generic agreements of waste packages, whenever available. They ensure that the agreements are consistent with existing national provisions. They rely essentially on the support of the Corporate Technical Support Unit (*Unité technique opérationnelle* – UTO).

#### 6.4.1.2. NATIONAL ENGINEERING UNITS

The UTO is only national engineering unit supporting NPPs for operational waste-management issues. It is responsible for:

- The development of the doctrine regarding operating waste (basic requirements, internal guidelines, etc.);
- the methodological support necessary for the implementation of the doctrine;
- the review of package agreements;
- proposing products to NPPs (packages, hulls, drums) and materials (dry loads) for waste conditioning and managing common conditioning resources (mobile units, etc.), and

The Operational Engineering Unit (*Unité d'ingénierie d'exploitation* – UNIE), is also involved in waste management and specifically for the definition of “zoning” (classification of buildings and rooms according to their radiological content) and for the definition and leadership of the professional workforce and skills in charge of managing waste on nuclear sites.

#### 6.4.2. Nuclear Engineering Division

The DIN of EDF is responsible for the design, construction, implementation and operating support engineering of EDF's NPPs in France, as well as for the deconstruction and development operations of the international nuclear projects of the EDF Group.

As owner of the nuclear facilities it operates, EDF is responsible for the project management of their deconstruction.

The CIDEN is the DIN unit responsible for the deconstruction and clean-out of nuclear facilities.

The CIDEN has special teams that are responsible for operations on the sites being deconstructed. It defines the treatment strategy for waste present in the facilities being dismantled and is responsible for their operational management. It designs and ensures responsibility for the provision of specific waste-treatment, conditioning and storage facilities.

#### 6.4.3. Nuclear Fuel Division

By delegation from DPI, DCN is responsible, for EDF SA, for the activities associated with the fuel cycle and therefore in particular for defining the management strategy for spent fuel and for radioactive waste: working in particular on the basis of the needs expressed by the sites in operation or undergoing decommissioning via the national engineering units (UTO, Ciden) and its own needs, DCN coordinates the development of the processes necessary for implementation of the radioactive waste management policies within the Group.

It manages the contracts for uranium procurement and enrichment, manufacture of UO<sub>2</sub> and MOX fuel, and the transport, reception, storage and processing contracts for spent fuel and induced waste.

## 7 | MESUREMENTS TAKEN IN THE ENVIRONMENT

### 7.1. Monitoring stations

#### 7.1.1. Radioactivity telemetry network

##### 7.1.1.1. TELERAY (AMBIENT GAMMA DOSE RATE)

IRSN's TELERAY alert network is the French national network dedicated to the permanent watch of ambient gamma radiation levels. With a 24h/24h alert function in the event of an abnormal rise in the level of radioactivity, the network's probes are distributed over the entire French territory (mainland France and the French overseas departments, regions and *collectivités*, known by their acronym "DROM/COM") and take an equivalent dose rate measurement (in nSv/h) every ten minutes. The purpose of the network is to provide the public and the decision-makers with real-time information enabling the taking of pertinent decisions to protect and inform the populations.

Network renewal began in 2010 with the gradual replacement of the entire acquisition chain (up to 450 probes on completion of redeployment, transmission network, supervision system) and reinforcing of the cover of the probes over the entire territory and in particular in a radius of 10 to 30 km around nuclear sites.

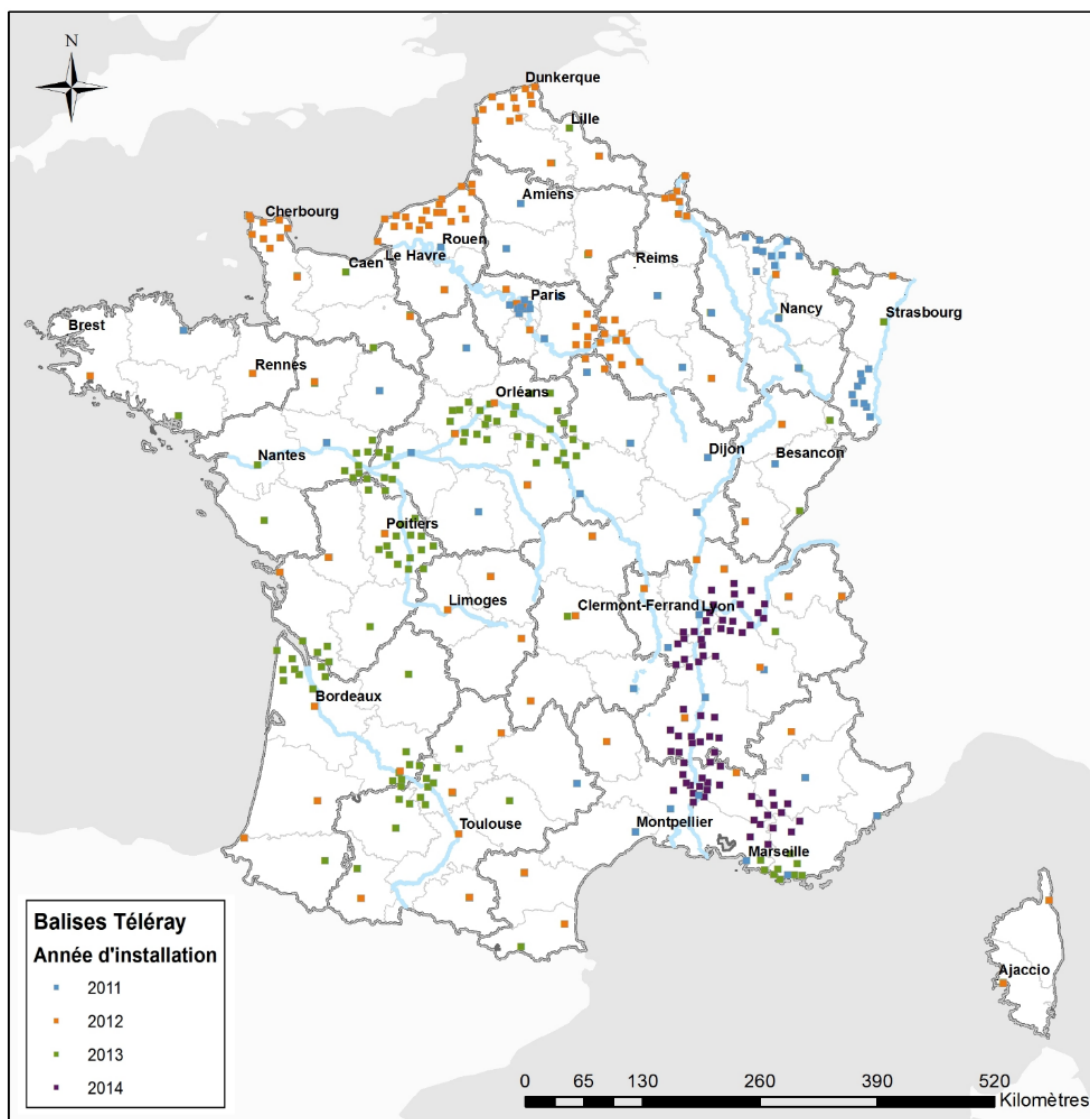


FIGURE 18 : LOCALISATION OF THE TELERAY NETWORK'S PROBES IN FRANCE ON 31 DECEMBER 2013

### 7.1.1.2. HYDROTELÉRAY NETWORK (RADIOACTIVITY OF MAJOR RIVERS)

The Hydrotéléray network is an automated network dedicated to the real-time monitoring of the radioactivity of the major rivers downstream from all nuclear facilities and before their discharge in the open throughout the country. It includes seven telemetry stations (Seine, Loire, Rhône, Rhine, Meuse, Moselle and Garonne). The system is equipped with a sodium-iodide (NaI) detector and is able to measure by gamma-spectrometry in situ radioactivity in water channelled from rivers in 25L leaded tanks. The network carries out more than 30,000 measurements each year, with special focus on <sup>131</sup>Iodine and <sup>137</sup>Caesium.

### 7.1.2. Monitoring of the atmospheric compartment

#### 7.1.2.1. AMBIENT GAMMA DOSIMETRY

Besides the monitoring in real-time of the ambient gamma exposure by the probes of the Téléray Network, the external dose is monitored by a network of more than 100 radiophotoluminescent dosimeters (RPL Network), which is integrated over periods of three months.

#### 7.1.2.2. ATMOSPHERIC AEROSOLS

The radioactivity of atmospheric aerosols is monitored throughout the country by two types of complementary stations forming the Permanent Radioactivity Observatory (*Observatoire permanent de la radioactivité dans l'air* – réseau OPERA-Air), as follows:

- a total of 39 (36 after replacement campaign) “low and intermediate-level” air (23 old stations to be replaced at a rate of 10 m<sup>3</sup>/h and 16 new stations at a rate of 80 m<sup>3</sup>/h), which are spread throughout the country, with 31 of them being located in accordance with the potential influence of a nuclear facility. They provide weekly data on the radioactivity of aerosols based on gamma-spectrometry measurements. An alpha measurement is carried out on certain potential alpha emitter sites, and
- a total of eight very-high-rate (*très grand débit* – TGD) stations at a rate of 300 to 700 m<sup>3</sup>/h are scattered throughout the country. The gamma-spectrometry aerosol recordings are collected over a period of 7 to 10 days and measure radionuclide traces in the order of 10<sup>-7</sup> Bq/m<sup>3</sup>.

#### 7.1.2.3. RAINWATERS

The nuclear installations (29 stations) are monitored through collectors positioned downwind of the prevailing winds, where the rainwater is collected weekly. Apart from monitoring nuclear facilities, the rainwater-monitoring system includes 12 stations disseminated throughout the country. A total of 28 nuclear facilities are monitored through a collector network installed under prevailing winds at locations where water is collected on a weekly basis.

#### 7.1.2.4. GASES

Atmospheric compartment monitoring is sometimes supplemented by sampling tritium in the air, which is achieved in particular by means of bubblers installed near a few nuclear installations.

Environment	Sample	Analysis
Atmosphere	450 Teleray recorders (continuous) > 100 integrating dosimeters (quarterly)	Ambient $\gamma$ radiation
Aerosols	Filter / 44 stations (weekly)	$\gamma$ Spectrometry (weekly)
Rainwaters	29 collectors nearby nuclear sites (weekly) + 14 other collectors	<sup>3</sup> H (monthly) + $\gamma$ , $\alpha$ , Spectrometry and global (according to stations)
Gases	3 bubblers (weekly)	<sup>3</sup> H (HTO form and other forms)

TABLE 30 : MEASUREMENT PROGRAMME IMPLEMENTED BY IRSN FOR THE RADIOLOGIC MONITORING OF ATMOSPHERIC COMPARTMENT

### 7.1.3. Monitoring of the water compartment

#### 7.1.3.1. CONTINENTAL STREAM

In addition to the Hydrotéléray continuous monitoring network, French rivers are monitored by a system of 27 stations comprising semi-automated water collectors, with devices for trapping suspended matter in 25

stations, the majority of which are located immediately downstream of the nuclear installations. The taking of samples of surface water, water from resurgences, sediments, aquatic plants and fish supplement the inland water monitoring system.

#### 7.1.3.2. COASTAL WATERS

The marine environment is monitored from coastal sampling points scattered along all seashores of the country. The number of stations and their location are determined not only by the determination to ensure a sound geographic coverage, but also by the proximity of nuclear facilities and by the application of specific follow-up programmes (e.g., for the Mediterranean Sea). Two types of stations are found, as follows:

- stations submitted to the influence of the discharges made by nuclear facilities with a follow-up of evolution in space and time of the radiological stats, and
- so-called “reference” stations that characterise background noise and potential pollution sources other than the discharges from coastal nuclear facilities and monitor the radionuclide input of large rivers in the sea.

On the coasts of the North Sea and of the English Channel, there are nine stations. On the Atlantic Ocean and on the Mediterranean Sea, seawaters are monitored in four and two points, respectively.

Coastal monitoring includes seawater sampling points but also bio-indicators (seaweed and molluscs) that concentrate radionuclides and account for the status of the environment better than the direct measurements in seawater. Fishes are also sampled on a yearly basis.

Environments	Samplings (frequency)	Analysis plan
Groundwater	14 stations (semi-yearly)	$^3\text{H}$ , $\alpha$ global, $\beta$ global, K, $\gamma$ spectrometry on 3 stations
Drinking waters	3 stations (semi-yearly)	$\alpha$ global, $\beta$ global, K, $^3\text{H}$ , $^{90}\text{Sr}$ , $\gamma$ spectrometry, U
River water	27 water collector (continuous) 45 stations (manual, semi-yearly) 7 stations Hydroteleray	$^3\text{H}$ (monthly) $\alpha$ global, $\beta$ global, K, (semi-monthly) $\alpha$ global, $\beta$ global, U, $\gamma$ spectrometry $\gamma$ spectrometry
Suspended matters	25 stations (monthly)	$\gamma$ spectrometry (monthly) Pu, Am, Sr sur (5 stations, yearly)
Sediments	22 stations (yearly to semi-yearly)	$\gamma$ spectrometry, Pu, Am, U
Aquatic plants	7 stations (yearly to semi-yearly)	$\gamma$ spectrometry + $^3\text{H}$ linked, $^{14}\text{C}$ , Sr, Pu, Am on some stations
Sea water	4 water collector (continuous) 11 manual sampling stations	$^3\text{H}$ (monthly), $\gamma$ spectrometry (quarterly) $^3\text{H}$ (semi-yearly), $\gamma$ spectrometry (yearly)
Sea sediments	20 stations (yearly to semi-yearly)	$\gamma$ spectrometry, + Pu, Am, U on 10 stations
Molluscs	14 stations (yearly to quarterly)	$\gamma$ spectrometry + $^3\text{H}$ linked, $^{14}\text{C}$ , Sr, Pu, Am on some stations
Seaweeds	16 stations (yearly to semi-yearly)	$\gamma$ spectrometry + $^3\text{H}$ linked, $^{14}\text{C}$ , Sr, Pu, Am on some stations

TABLE 31 : MEASUREMENT PROGRAMME IMPLEMENTED BY IRSN FOR THE RADIOLOGIC MONITORING OF WATER COMPARTMENT

#### 7.1.4. Monitoring of terrestrial compartment

A sampling network was deployed throughout the country through the contribution of decentralised State services, such the Directorate-General for Foodstuffs (*Direction générale de l'alimentation* – DGAL) and Directorate-General for Competition, Consumer Affairs and Fraud Prevention (*Direction générale de la concurrence, de la consommation et de la répression des fraudes* – DGCCRF) and provides for permanent watch over the radioactivity levels in the terrestrial flora and the food chain, in both mainland France and the overseas territories.

Monitoring is ensured by taking regular samples of milk, leafy vegetables, and cereal crops in the vicinity of nuclear installations.

In addition, annual monitoring based on taking samples of fruit, vegetables, beverages, ground vegetables and meat from reared livestock or wild game, is ensured over the entire country and managed at departmental level.

The reference levels are acquired during specific studies called "radiological findings".

#### 7.1.5. Regional radiological findings

The purpose of the regional radiological findings is to establish over an extensive area (covering several departments) an updated baseline of the levels of radioactivity in certain environmental compartments that are characteristic of the area in question. This baseline must take into account firstly the "background radiation noise" associated with the natural radioactivity and the persistence of old atmospheric fallout (nuclear weapons tests and the Chernobyl accident) and secondly the influence of current or past discharges from any nuclear installations present in the area. In the event of incidental or accidental discharge, this baseline will serve as a comparison benchmark and help orient the deployment of reinforced monitoring.

Every report, updated approximately every five years, would include several sampling campaigns in the order of 100 to 200 between the terrestrial environment (major agricultural productions), terrestrial and sea water environment and the atmospheric environment (aerosols and gases). Depending on the scale of the findings and the studied environment, the emphasis is placed on typical agricultural crops and livestock production for the area concerned, fishery products or the natural bio-indicators.

Following the prototype radiological finding in the "Val de Loire", two large regions have been investigated since 2009 (the "South-West" and "Rhône Valley"), followed by the "North-East" study. The Paris Basin followed by Brittany will be studied as of 2015. The seaboard will also be investigated with the "Channel - North Sea" and "Mediterranean Sea" findings (adaptation of the methodology to the marine environment) and New-Caledonia. Findings coming under a particular theme are also planned for: study of areas of persistence (current radiological state of areas in which the fallout from atmospheric tests of nuclear weapons and Chernobyl had been the highest), study of mining sites (extension of the former uranium mine monitoring areas to a distance much further downstream).

Element	Sampling (frequency)	Analysis plan
Milk	32 nearby nuclear sites (semi-yearly to quarterly) 10 stations under <i>department</i> monitoring (yearly)	$\gamma$ Spectrometry, free $^3\text{H}$ + $^{14}\text{C}$ , $^3\text{H}$ linked, U on some stations $\gamma$ Spectrometry, + free $^3\text{H}$ , $^{90}\text{Sr}$ on some stations
Wheat	31 nearby nuclear sites (yearly)	$\gamma$ Spectrometry + linked $^3\text{H}$ , $^{14}\text{C}$ , Pu, Am, U on some stations
Vegetables-leaves	23 nearby nuclear sites (yearly) 5 for oversea monitoring	$\gamma$ Spectrometry, $^3\text{H}$ , $^{14}\text{C}$ + linked $^3\text{H}$ on some stations $\gamma$ Spectrometry + U, Th on one station
Fruits and vegetables	14 scheduled in 2014 (yearly)	$\gamma$ Spectrometry + $^3\text{H}$ free-linked, $^{14}\text{C}$ , Pu, Am, U on some stations
Meat	4 scheduled in 2014 (yearly)	$\gamma$ Spectrometry + $^3\text{H}$ linked, $^{14}\text{C}$ , $^{90}\text{Sr}$ on some stations
Drinks	1 scheduled in 2014	$\gamma$ Spectrometry, $^3\text{H}$
Plants	29 stations (yearly to semi-yearly)	$\gamma$ Spectrometry, $^3\text{H}$ free/linked, $^{14}\text{C}$ , U, Sr, Pu, Am on some stations

TABLE 32 : MEASUREMENT PROGRAMME IMPLEMENTED BY IRSN FOR THE RADIOLOGIC MONITORING OF WATER COMPARTMENT (RADIOLOGIC CASES EXCLUDED)

#### 7.1.6. Regulatory environmental monitoring of NPPs

Radioactive discharges around nuclear sites are monitored by the operators themselves according to the regulatory specifications described below. Those provisions represent a general minimum requirement, but, depending on the situation involved, operators are invited to take additional measurements, especially around the AREVA Site at La Hague.

The statutory environmental monitoring of BNIs is adapted for each type of facility, whether a nuclear-power reactor, a plant or a laboratory is involved. The different measurements associated with the monitored environments, are presented hereinafter.

## 7.1.6.1. REGULATORY ENVIRONMENTAL MONITORING OF NPPS

The different measurements associated with the NPP monitoring, are presented in the following table.

Environment	Samplings and measurements to be carried out by the operator
<b>Air at ground level</b>	Four stations for continuous sampling of atmospheric dust on a fixed filter with daily measurement of total $\alpha$ and global $\beta$ if total $\beta$ exceeds 2 mBq/m <sup>3</sup> One continuous sample under the prevailing wind Weekly measurement of atmospheric <sup>3</sup> H
<b>Rainwaters</b>	One station under the prevailing wind (monthly collector) Measurements: total $\beta$ and tritium on monthly mix
<b>Ambient <math>\gamma</math> radiation</b>	Four stations at 1 km with continuous measurement and recording (10 nGy/h to 10 Gy/h) 10 stations around the site perimeter with continuous measurement and recording (10 nGy/h to 10 mGy/h) Four stations with continuous measurements at 5 km (10 nGy/h to 0.5 Gy/h)
<b>Plants</b>	Two grass-sampling points (monthly check) with measurements: total $\beta$ , $\gamma$ spectrometry (+ <sup>14</sup> C and C, quarterly) Main agricultural crops (annual check) with measurements: total $\beta$ , $\gamma$ spectrometry
<b>Milk</b>	Two sampling points (monthly check) with yearly measurements: $\beta$ ( <sup>40</sup> K excluded), K (+ <sup>14</sup> C),
<b>Environment receiving liquid discharges</b>	Samples at mid-discharge into the river or after dilution in cooling water (case of coastal NPPs), with measurement of total $\beta$ , K and <sup>3</sup> H Continuous sampling from the river or after dilution in the cooling water (case of coastal power plants) with daily tritium measurements Seawater samples (coastal NPPs only) twice a month with measurement of total $\beta$ , K and <sup>3</sup> H Annual samples of sediments, aquatic fauna and flora with measurement of total $\beta$ , $\gamma$ spectrometry
<b>Groundwater</b>	Five sampling points (monthly check) with measurement of total $\beta$ , K and <sup>3</sup> H
<b>Soils</b>	Regulatory samplings and checks to be performed by the operator

TABLE 33 : REGULATORY ENVIRONMENTAL MONITORING OF NPPS

## 7.1.6.2. REGULATORY ENVIRONMENTAL MONITORING OF CEA OR AREVA FACILITIES

The principles behind regulatory environmental monitoring in the area surrounding a laboratory or plant are summed hereinafter.

Environment	Samplings and measurements to be carried out by the operator
<b>Air at ground level</b>	Four continuous sampling stations for sampling dust particles in the air, with fixed filters and daily measurements of overall $\beta$ -emitting and $\alpha$ -emitting radionuclides One continuous sampling station providing weekly measurements of <sup>3</sup> H in the air
<b>Rainwaters</b>	Two continuous sampling stations, one of which is exposed to the prevailing winds, with weekly measurements of overall $\beta$ -emitting radionuclides and tritium
<b>Gamma-emitting background radiation</b>	Four beacons recording measurements on a continuous basis 10 integrator dosimeters at the site boundaries (monthly readings)
<b>Plants</b>	Four grass-sampling points (monthly monitoring) Major farms in the area (annual monitoring) with measurements: overall $\beta$ , $\gamma$ spectrometry (+ <sup>3</sup> H and <sup>14</sup> C, at regular intervals)
<b>Milk</b>	One sampling point (monthly monitoring) Measurements taken: overall $\beta$ , $\gamma$ spectrometry (+ <sup>3</sup> H and <sup>14</sup> C, at regular intervals)
<b>Soil</b>	One annual sample Annual measurements: <sup>14</sup> C and $\gamma$ spectrometry
<b>Environment receiving liquid discharges</b>	At the least, weekly sampling of water in the receiving environment, measuring overall $\alpha$ , overall $\beta$ , potassium and tritium Annual sampling of sediment and aquatic flora and fauna using $\gamma$ spectrometry
<b>Groundwater</b>	Five sampling points (monthly monitoring) measuring overall $\alpha$ , overall $\beta$ , potassium and tritium

TABLE 34 : REGULATORY ENVIRONMENTAL MONITORING AT CEA OR AREVA FACILITIES

## 7.2. Measurements in the environment and around nuclear sites

### 7.2.1. Gaseous discharges from nuclear sites

Gaseous discharges from the major BNIs and the corresponding authorised limits are presented in the following tables, according to the categories of grouped radioactive products used in valid licences on 1 January 2007.

#### 7.2.1.1. LIMITS AND VALUES OF GASEOUS DISCHARGES FROM EDF SITES

	Tritium		Carbon 14		Rare gases		Iodine		PF / PA	
	Limit TBq	2013 Discharges TBq	Limit TBq	2013 Discharges TBq	Limit TBq	2013 Discharges TBq	Limit GBq	2013 Discharges GBq	Limit GBq	2013 Discharges GBq
<b>900 MWe Reactors</b>										
Le Blayais	8	1,2	2,2	0,57	72	0,55	1,6	0,031	1,6	0,0056
Le Bugey	2 590 <sup>(1)</sup>	0,7	-	0,51	-	0,68	111 <sup>(2)</sup>	0,042	-	0,0026
Chinon	8	1,6	2,2	0,51	72	0,83	1,6	0,023	1,6	0,0032
Cruas-Meyssse	8	1,0	2,2	0,62	72	1,05	1,6	0,042	1,6	0,0160
Dampierre	10	1,6	2,2	0,56	72	2,84	1,6	0,380	0,8	0,0060
Fessenheim	1 480 <sup>(1)</sup>	1,0	-	0,22	-	0,15	111 <sup>(2)</sup>	0,015	-	0,0021
Gravelines	12	3,0	3,3	0,84	108	2,56	2,4	0,069	2,4	0,0270
St Laurent	4	0,5	1,1	0,20	36	0,86	0,8	0,014	0,8	0,0024
Le Tricastin	8	1,8	2,2	0,59	72	2,04	1,6	0,033	1,6	0,0046
<b>1 300 MWe Reactors</b>										
Belleville	5	2,3	1,4	0,38	25	0,87	0,8	0,470	0,1	0,0075
Cattenom	10	3,2	2,8	0,72	50	1,21	1,6	0,090	0,2	0,0081
Flamanville	8	1,4	1,4	0,43	25	0,70	0,8	0,035	0,1	0,0032
Golfech	8	1,1	1,4	0,46	45	0,82	0,8	0,026	0,8	0,0050
Nogent	8	1,3	1,4	0,44	45	0,24	0,8	0,100	0,8	0,0028
Paluel	10	2,0	2,8	0,83	90	0,85	1,6	0,043	1,6	0,0081
Penly	8	1,2	1,4	0,46	45	0,71	0,8	0,027	0,8	0,0052
St Alban	5	1,1	1,4	0,41	45	0,66	0,8	0,023	0,8	0,0055
<b>1 450 MWe Reactors</b>										
Chooz	5	1,0	1,4	0,49	25	6,86	0,8	0,059	0,1	0,0038
Civaux	5	1,7	1,4	0,43	25	0,91	0,8	0,025	0,1	0,0016

TABLE 35 : LIMITS AND VALUES OF GASEOUS DISCHARGES FROM EDF SITES

<sup>(1)</sup> Limits for tritium, 14 Carbon and rare gases discharges

<sup>(2)</sup> Limits for iodine, fission and activation products discharges (different from iodine, tritium, 14 Carbon and rare gases)

#### 7.2.1.2. LIMITS AND VALUES OF GASEOUS DISCHARGES FROM AREVA'S LA HAGUE SITE

The current licence (*Order of 8 January 2007*) subdivided the previous discharge categories and reduced authorised limits, as shown in the following table.

Site	Tritium		Alpha emitters		Radioiodine		Rare gases	
	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)
La Hague	150	61,9	0,01	0,0018	0,02	0,0060	470 000	289 000

Site	Carbon 14		Other artificial beta and gamma emitters	
	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)
La Hague	28	21	1	0,10

TABLE 36 : LIMITS AND VALUE OF GASEOUS DISCHARGES FROM AREVA'S LA HAGUE SITE

## 7.2.1.3. LIMITS AND VALUES OF GASEOUS DISCHARGES FROM CEA

Current licences cover two or four gas categories depending on the site, as shown in the following table.

Site	Rare gases		Tritium		Halogens		Aerosols	
	Limit (TBq)	2013 discharges (TBq)	Limit (TBq)	2013 discharges (TBq)	Limit (GBq)	2013 discharges (GBq)	Limit (GBq)	2013 discharges (GBq)
<b>Grenoble</b>	0,4	0	8,39	0,0362			0,08	0,0001
<b>Saclay</b>	740	36,56	555	20,13	18,5	0,173	37	0,034

	Rare gases and tritium		Halogens and aerosols	
	Limit (TBq)	2013 discharges (TBq)	Limit (GBq)	2013 discharges (GBq)
<b>Cadarache</b>	555	< 33,8	18,5	< 0,0093

TABLE 37 : LIMITS AND VALUES OF GASEOUS DISCHARGES FROM CEA SITES

## 7.2.2. Liquid discharges from nuclear sites

Liquid discharges from major BNIs are presented in the following tables with their corresponding limits per category of radioactive product specified in current licences.

## 7.2.2.1. LIMITS AND VALUES OF LIQUID DISCHARGES FROM EDF SITES

	Tritium		Carbon 14		Iodines		PF / PA	
	Limits TBq	2013 discharges TBq	Limits GBq	2013 discharges GBq	Limits GBq	2013 discharges GBq	Limits GBq	2013 discharges GBq
<b>900 MWe reactors</b>								
Le Blayais	80	44,7	400	42,6	0,1	0,0122	25	0,556
Le Bugey	185	44,3	2 035 <sup>(1)</sup>	38,1	2035 <sup>(1)</sup>	0,0159	2035 <sup>(1)</sup>	1,35
Chinon	80	44,9	600	38,3	0,6	0,0194	60	0,652
Cruas-Meyssse	80	58,3	600	46,1	0,6	0,0298	60	0,908
Dampierre	100	50,0	260	42,1	0,6	0,0181	36	0,819
Fessenheim	74	14,2	925 <sup>(1)</sup>	16,5	925 <sup>(1)</sup>	0,0051	925 <sup>(1)</sup>	0,371
Gravelines	120	60,8	900	63,0	0,9	0,0330	90	5,00
St Laurent	45	14,7	300	14,7	0,3	0,0061	30	0,144
Le Tricastin	90	51,3	260	44,5	0,6	0,0311	60	0,614
<b>1 300 MWe reactors</b>								
Bellevalle	60	59,1	190	28,8	0,1	0,0146	10	0,569
Cattenom	140	110,0	380	54,2	0,2	0,0188	20	1,05
Flamanville	80	49,1	190	32,1	0,1	0,0096	10	0,652
Golfech	80	69,3	190	34,1	0,1	0,0102	25	0,157
Nogent	80	59,0	190	33,3	0,1	0,0172	25	0,619
Paluel	120	104,0	800	62,1	0,2	0,0125	50	1,61
Penly	80	59,0	190	34,3	0,1	0,0071	25	1,114
St Alban	60	55,6	400	30,9	0,1	0,0119	25	0,346
<b>1 450 MWe reactors</b>								
Chooz	80	63,8	190	36,7	0,1	0,0106	5	0,383
Civaux	80	53,4	190	32,5	0,1	0,0043	5	0,154

TABLE 38 : LIMITS AND VALUES OF LIQUID DISCHARGES IN 2013 FROM EDF SITES

<sup>(1)</sup> Limits for Carbon 14, iodines, and activation and fission products discharges.

## 7.2.2.2. LIMITS AND VALUES OF LIQUID DISCHARGES FROM AREVA'S LA HAGUE SITE

The current licence (*Order of 8 January 2007*) subdivides the previous discharge categories and reduces authorised limits, as shown in the following table.

Tritium		Alpha emitters		Strontium 90		Caesium 137		Caesium 134	
Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)
18 500	13400	0.14	0,021	11	0,29	8	0,58	0,5	0,026

Carbon 14		Ruthenium 106		Cobalt 60		Radioiodines		Other beta and gamma emitters	
Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)	Limit (TBq/an)	2013 discharges (TBq)
42	8,58	15	1,22	1,4	0,08	2,6	1,58	60	2,91

TABLE 39 : LIMITS AND VALUES OF LIQUID DISCHARGES FROM AREVA'S LA HAGUE SITE

## 7.2.2.3. LIMITS AND VALUES OF LIQUID DISCHARGES FROM CEA SITES

Current licences concern four sites and cover three categories of liquid discharges, as shown in the following table.

Site	Tritium		Alpha emitters		Others	
	Limits	2013 discharges	Limits	2013 discharges	Limits	2013 discharges
	(TBq)	(TBq)	(GBq)	(GBq)	(GBq)	(GBq)
<b>Cadarache</b>	1	0.053	0.13	0.00027	1.5	0.326
<b>Fontenay-aux-Roses</b>	0.2	0.000005	1	0.001	40	0.006
<b>Grenoble</b>	0.097	0.00068	0.022	0.0001	0.22	0.0076
<b>Saclay</b>	0.246	0.0147	0.01	0.044	0.54	0.024

TABLE 40 : LIMITS AND VALUES OF LIQUID DISCHARGES FROM CEA SITES

Those results confirm ASN's policy to downgrade discharge licences by adapting them more strictly to the operating requirements of the facilities.

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- 6 | Environment Code - *Code de l'environnement – Journal officiel de la République française*.
- 7 | Nuclear Safety and radiation protection in France in 2013. ASN annual report, March 2014.

### 8.2. Internet Sites

All above-mentioned documents or at least a summary of their content, as well as other relevant information on the theme of this report, may be consulted on Internet, especially on the following websites:

Legifrance	<a href="http://www.legifrance.fr">www.legifrance.fr</a>
ASN	<a href="http://www.asn.fr">www.asn.fr</a>
Andra	<a href="http://www.andra.fr">www.andra.fr</a>
CEA	<a href="http://www.cea.fr">www.cea.fr</a>
AREVA	<a href="http://www.areva.fr">www.areva.fr</a>
EDF	<a href="http://www.edf.fr">www.edf.fr</a>
MEDDE:	<a href="http://www.developpement-durable.gouv.fr/">www.developpement-durable.gouv.fr/</a>
AIEA	<a href="http://www.iaea.org">www.iaea.org</a>

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<sup>20</sup> Legislative and regulatory texts are also available in French on: [www.legifrance.fr](http://www.legifrance.fr)

## 9 | LIST OF THE MAINS ABBREVIATIONS AND ACCRONYMS

<b>AGATE</b>	<i>Atelier de gestion avancée et de traitement des effluents</i> – Advanced Effluent Management and Treatment Workshop
<b>ANDRA</b>	<i>Agence nationale pour la gestion des déchets radioactifs</i> – French National Radioactive Waste Management Agency
<b>AREVA</b>	Corporate holding company
<b>ASN</b>	<i>Autorité de sûreté nucléaire</i> – Nuclear Safety Authority
<b>BNI</b>	<i>Installation nucléaire de base</i> – basic nuclear facility)
<b>CEA</b>	<i>Commissariat à l'énergie atomique</i> – French Atomic Energy Commission
<b>CEDRA</b>	<i>Conditionnement et entreposage de déchets radioactifs</i> – Radioactive Waste Conditioning and Storage Project
<b>CENTRACO</b>	<i>Centre de traitement et de conditionnement de déchets de faible activité</i> – Low-level Waste Processing and Conditioning Facility
<b>CICNR</b>	<i>Comité interministériel aux crises nucléaires ou radiologique</i> - Interministerial Committee for Nuclear and Radiological Emergencies
<b>CIDEN</b>	<i>Centre d'ingénierie de la déconstruction et de l'environnement</i> – Technical Centre for Deconstruction and the Environment
<b>CIINB</b>	<i>Commission interministérielle des installations nucléaires de base</i> – Interministerial Committee for Basic Nuclear Facilities
<b>CMN</b>	<i>Centre de médecine nucléaire</i> – nuclear medicine centre
<b>CNE</b>	<i>Commission nationale d'évaluation</i> – National Review Board
<b>CODERST</b>	<i>Conseil départemental de l'environnement et des risques sanitaires et technologiques</i> – Departmental Council on the Environment and Health and Technological Risks
<b>COFRAC</b>	<i>Comité français d'accréditation</i> – French Accreditation Committee
<b>COGEMA</b>	<i>Compagnie générale des matières nucléaires</i>
<b>CSFMA</b>	<i>Centre de stockage de l'Aube pour déchets de faible et moyenne activité</i> – <i>Centre de l'Aube</i> Disposal Facility for LIL Waste)
<b>CSM</b>	<i>Centre de stockage de la Manche</i> – <i>Centre de la Manche</i> Disposal Facility
<b>CSTFA</b>	<i>Centre de stockage de l'Aube pour déchets de très faible activité</i> – <i>Centre de Morvilliers</i> Disposal Facility for VLL Waste
<b>DARQSI</b>	<i>Direction de l'action régionale, de la qualité et de la sécurité industrielle</i> – Directorate of Regional Action, Quality and Industrial Security
<b>DDSC</b>	<i>Direction de la Défense et de la sécurité civiles</i> - Directorate for Civil Security and Defence
<b>DGEC</b>	<i>Direction générale de l'énergie et du climat</i> – General Directorate for Energy and climate
<b>DGEMP</b>	<i>Direction générale de l'énergie et des matières premières</i> – General Directorate for Energy and Raw Materials
<b>DGS</b>	<i>Direction générale de la santé</i> – General directorate for Health
<b>DGSNR</b>	<i>Direction générale de la sûreté nucléaire et de la radioprotection</i> – General Directorate for Nuclear Safety and Radiation Protection
<b>DHOS</b>	<i>Direction de l'hospitalisation et de l'organisation des soins</i> – Directorate for Hospitalisation and Care Organisation
<b>DPN</b>	<i>Division production nucléaire d'EDF</i> – EDF Nuclear Production Division
<b>DGPR</b>	<i>Direction générale de la prévention des risques</i> - Risk Control Branch
<b>DPPR</b>	<i>Direction de la prévention de la pollution et des risques</i> – Pollution Control and Risk Branch
<b>DRASS</b>	<i>Direction régionale des affaires sociales et de la santé</i> – Regional Directorates for Health and Social Affairs
<b>DREAL</b>	<i>Direction régionale de l'environnement, de l'aménagement et du logement</i> – Regional Directorate for Environment, Planning and Housing
<b>DRIRE</b>	<i>Direction régionale de l'industrie, la recherche et l'environnement</i> (Regional Directorate for Industry, Research and the Environment)

<b>ECC</b>	<i>Atelier d'entreposage des coques et embouts compactés</i> – Compacted Waste Storage Building
<b>EDF</b>	<i>Électricité de France</i>
<b>EIP</b>	<i>Entreposage intermédiaire polyvalent</i> – Multipurpose Interim Storage Facility
<b>ENISS</b>	European Nuclear Installations Safety Standards
<b>EPIC</b>	<i>Etablissement public à caractère industriel et commercial</i> – public industrial and commercial establishment
<b>EPRI</b>	Electric Power Research Institute
<b>EU</b>	European Union
<b>FORATOM</b>	European Atomic Forum
<b>GCR</b>	Gas-cooled reactor
<b>GGR</b>	Graphite-moderated gas-cooled reactor
<b>GPE</b>	<i>Groupe permanent d'experts</i> – Expert Advisory Group
<b>GPD</b>	<i>Groupe permanent pour les déchets</i> – Expert Advisory Group on Waste
<b>HFDSN</b>	Haut fonctionnaire de défense et de sécurité nucléaire – High Civil Servant for Defence and nuclear safety
<b>HL</b>	High-level (waste)
<b>HL-LL</b>	High-level long-lived (waste)
<b>HWR</b>	Heavy-water reactor
<b>IAEA</b>	International Atomic Energy Agency
<b>ICEDA</b>	<i>Installation de conditionnement et d'entreposage des déchets d'activation</i> – Conditioning and storage facility for activation waste
<b>ICPE</b>	<i>Installation classée pour la protection de l'environnement</i> – classified facility on environmental-protection grounds
<b>ICRP</b>	International Commission on Radiation Protection
<b>IL</b>	Intermediate-level
<b>ILL</b>	<i>Institut Laue-Langevin</i> – Laue-Langevin Institute
<b>IL-LL</b>	intermediate-level long-lived
<b>INES</b>	International Nuclear Event Scale
<b>INPO</b>	Institute of Nuclear Power Operations
<b>IPSN</b>	<i>Institut de protection et de sûreté nucléaire</i> – Institute for Nuclear Protection and Safety
<b>IRSN</b>	<i>Institut de radioprotection et de sûreté nucléaire</i> – Institute for Radiological Protection and Nuclear Safety
<b>LIL</b>	Low- and intermediate-level (waste)
<b>LIL-SL</b>	Low-level <i>or</i> long-lived (waste)
<b>LL-LL</b>	Low-level long-lived (waste)
<b>LL-SL</b>	Low-level short-lived (waste)
<b>LWR</b>	Light-water reactor
<b>MEDDE</b>	<i>Ministère de l'écologie, du développement durable et de l'énergie</i> –Ministry of Ecology, Sustainable development and Energy (since May 2012)
<b>MEDDTL</b>	<i>Ministère de l'écologie, du développement durable, des transports et du logement</i> – Ministry of Ecology, Sustainable Development, Transport and Housing (Nov. 2010 and May 2012)
<b>MEEDDM</b>	<i>Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer</i> – Ministry of Ecology, Energy, Sustainable Development and the SEA (until November 2010)
<b>MEIE</b>	<i>Ministère de l'Économie, des Finances et de l'Industrie</i> – Ministry of Economy, Finance and Industry (also responsible for Energy till May 2012)
<b>MHM</b>	Meuse/Haute-Marne Underground Research Laboratory
<b>MOX</b>	Fuel made of mixed uranium and plutonium oxides
<b>NPP</b>	Nuclear power plant
<b>OECD/NEA</b>	OECD Nuclear Energy Agency of the Organisation for Economic Co-operation and

	Development
<b>OPECST</b>	<i>Office parlementaire d'évaluation des choix scientifiques et techniques</i> – Parliamentary Office for the Assessment of Scientific and Technological Options
<b>OSART</b>	Operational Safety Review Team
<b>PNGMDR</b>	<i>Plan national de gestion des matières et des déchets radioactifs</i> – Plan for Radioactive Materials and Waste
<b>PPI</b>	<i>Plan particulier d'intervention</i> – Off-site Emergency Plan
<b>PUI</b>	<i>Plan d'urgence interne</i> – On-site Emergency Plan
<b>PWR</b>	Pressurised-water reactor
<b>RFS</b>	<i>Règle fondamentale de sûreté</i> – Basic Safety Rule
<b>RGE</b>	<i>Règles générales d'exploitation</i> – General Operational Rules
<b>SBNI</b>	<i>Installation nucléaire de base secrète [défense]</i> – secret basic nuclear facility [defence]
<b>SGDN</b>	<i>Secrétariat général de la défense nationale</i> - General Secretariat for National Defence
<b>SICN</b>	<i>Société industrielle de combustible nucléaire</i>
<b>SL</b>	Short-lived (waste)
<b>SOCODEI</b>	<i>Société pour le conditionnement des déchets et effluents industriels</i> – Conditioning Company for Industrial Waste and Effluents
<b>STE</b>	<i>Spécifications techniques d'exploitation</i> – technical operational specifications
<b>TranSAS</b>	Transport Safety Appraisal Service
<b>VLL</b>	Very-low-level (waste)
<b><i>TSN Act</i></b>	<i>Act of 13 June 2006 on Transparency and Security in the Nuclear Field</i> – Loi du 13 juin 2006 sur la transparence et la sécurité dans le domaine nucléaire
<b>UOx</b>	Uranium-based oxides
<b>WANO</b>	World Association of Nuclear Operators
<b>WENRA</b>	Western European Nuclear Regulators' Association

## FIFTH NATIONAL REPORT ON COMPLIANCE WITH THE JOINT CONVENTION OBLIGATIONS